From abridle Mon Sep 27 14:11:08 1993
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id AA24807; Mon, 27 Sep 1993 14:08:37 -0400
Message-Id: <9309271808.AA24807@polaris.cv.nrao.edu>
From: abridle (Alan Bridle)
To: rperley
Subject: forwarded message from LFERETTI@astbo1.bo.cnr.it
Date: Mon, 27 Sep 1993 14:08:37 -0400

I'm working on the 3C31 proposal. Basically very happy with the draft, just a few minor changes to suggest (mostly to clarify the description of the model at this point).

There follows Luigina's message re the existing data. I recall that the last time we tried to use phased-array VLB-mode VLA data for polarimetry it fell on its face because the reference antenna kept changing. Do we simply _have_ to propose the C-band B config again to do the polarimetry?

As for Robert's question about the 8-GHz A config, my guess is that we could only make a really strong case for it if we saw important unresolved structure from the dataset we have asked for. I.e. we whould wait until we get the proposed 8-GHz data reduced?

Comments?

A.

------- Start of forwarded message -------
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Received: from cv3.cv.nrao.edu by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA30693; Mon, 27 Sep 1993 09:58:56 -0400
Received: from ASTBO1.BO.CNR.IT by cv3.cv.nrao.edu (4.1/DDN-DLB/1.13)
id AA15054; Mon, 27 Sep 93 09:58:56 EDT
Message-Id: <930927155823.20202284@astbo1.bo.cnr.it>
X-Vmsmail-To: SMTP%"rl@mail.ast.cam.ac.uk",SMTP%"abridle@nrao.edu"
From: LFERETTI@astbo1.bo.cnr.it
To: rl@mail.ast.cam.ac.uk, abridle@NRAO.EDU
Subject: 3C31
Date: Mon, 27 Sep 1993 15:58:23 +0200 (MET)

Dear Robert, Alan
the proposal on 3C31 reads very well.

Concerning the time request at 6 cm, I let you know that we got 12 h of VLBI (global array, VLA included) last February. The VLA was in B conf. and the data from the VLA alone were also recorded. Unfortunately we have not yet reduced these data. You can consider their existence in

the computation of the total requested time and request only C array
at 6 cm. It's up to you.
In any case, we think that the total amount of observing time at 6 cm
should be the same as at 8.4 GHz so 12h in B and 6h in C.

Concerning Robert's question, if it's worth adding A-configuration data at
8 GHz, we have no data on 3C449 at this frequency + configuration yet, to
give an answer. It could be nice to have the highest resolution, to see the
jet/counterjet from the very beginning.

Regards,
  Luigina, Gabriele and Paola
------- End of forwarded message -------

From abridle Mon Sep 27 14:13:19 1993
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id AA28206; Mon, 27 Sep 1993 14:10:48 -0400
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From: abridle (Alan Bridle)
To: rperley
Subject: 3C31 again
Date: Mon, 27 Sep 1993 14:10:48 -0400

I think I'd also like to go for 3hrs in the C config at C-band
and in the B config at L-band both for u,v coverage and to
help tie down the polarization calibration better. This
instead of Robert's 2hrs.

A.

From abridle Mon Sep 27 15:46:46 1993
X-VM-v5-Data: ([nil nil nil nil nil nil nil nil nil]
["46342" "Mon" "27" "September" "1993" "15:42:52" "-0400" "Alan Bridle" "abridle " nil "709" "3C31 sidedness plot" nil nil nil "9" nil nil (number " " mark " Alan Bridle Sep 27 709/46342 " thread-indent "\"3C31 sidedness plot\"\n") nil]
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id AA15298; Mon, 27 Sep 1993 15:42:52 -0400
Message-Id: <9309271942.AA15298@polaris.cv.nrao.edu>
References: <930927155823.20202284@astbo1.bo.cnr.it>
From: abridle (Alan Bridle)
To: LFERETTI@astbo1.bo.cnr.it, rperley
Subject: 3C31 sidedness plot
Date: Mon, 27 Sep 1993 15:42:52 -0400

Hello again,

The sidedness greyscale that I received from Robert by FAX was truncated at the base (probably the usual paper-size A4-->U.S. incompatibilities), losing the key part of the data. So I've run off another version from my original AIPS image of the sidedness ratios.

Here it is as a Postscript version. Cut here and send to your PS printer, then please let me know if this is o.k. as our Fig.2.

Thanks, A

========== cut here

From abridle Mon Sep 27 17:31:12 1993
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Message-Id: <9309272127.AA2713s@polaris.cv.nrao.edu>
References: <930927155823.20202284@astbo1.bo.cnr.it>
From: abridle (Alan Bridle)
To: LFERETTI@astbo1.bo.cnr.it, rperley
Subject: Re: 3C31 text
Date: Mon, 27 Sep 1993 17:27:20 -0400

Here is my suggested update of the proposal text. I agree that
Robert's draft is first-rate, and have just made a few small changes
in Section 2 to clarify the language a little. I have also suggested
that we ask for 3hrs instead of 2hrs for the shorter observations to
improve u,v coverage and the polarization calibration.

I'll do one more check of the sensitivity sums as Robert suggested
and will put the cover sheet together tomorrow (28th). We'll
have no problem meeting the deadline!

Best wishes, A.

========== .tex input file

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% -----------------
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\newcommand{\lttwid}{\stackrel{\textstyle{<}}{\sim}}
\newcommand{\etal}{{\it et al.\ }}
\newcommand{\eg}{{\it e.g.\ }}
\newcommand{\etc}{{\it etc.\ }}
\newcommand{\ie}{{\it i.e.\ }}
\newcommand{\qv}{{\it q.v.\ }}
\newcommand{\cf}{{\it c.f.\ }}
\newcommand{\viz}{{\it viz.\ }}
\newcommand{\degs}[1]{$#1^\circ$}                    % Degrees symbol

\begin{document}

\section{Introduction}

Discussion of the origin of asymmetries in the jets of low-luminosity
(Fanaroff-Riley Type I - FRI) radio galaxies has recently been
```

revitalised by several observational and theoretical discoveries:
\begin{itemize}
\item apparent motions with speeds approaching c have been measured in FRI jets on parsec and (for M87) kiloparsec scales (Biretta \& Meisenheimer 1993).
\item unified models, in which FRI radio galaxies form the parent population for BL Lac objects, are increasingly accepted (\eg Urry, Padovani \& Stickel 1991), the implication being that relativistic velocities are common on parsec scales in these objects;
\item Parma \etal (1993a) discovered a relation between depolarization and jet sidedness in FRI sources, in the sense that the lobe containing the brighter jet base depolarizes less as the wavelength increases: the most straightforward interpretation is that the brighter base is seen through less magnetoionic material and is therefore on the near side of the source (as would be expected if the asymmetry were due to Doppler boosting).
\item Parma \etal (1993b) have examined the variation of jet sidedness ratio with distance from the core, total radio power and core prominence. Their results are consistent with the hypothesis that FRI jets slow down from $\beta \approx$ 0.6 to non-relativistic velocities on scales of 1 -- 10 kiloparsecs.
\item Laing (1993) developed a model of a two-component, decelerating relativistic jet which explains the correlation between polarization and sidedness in FRI jets (one-sided jets have longitudinal fields, whilst two-sided jets have transverse fields; Bridle \& Perley 1984).
\end{itemize}
We wish to make two tests of the consistency of the hypothesis that FRI jets start relativistic and slow down on kiloparsec scales: (1) by measuring the structure and polarization of a twin-jet base in detail, for comparison with the models of Laing (1993) and (2) by mapping the rotation-measure distribution of an FRI source which shows depolarization asymmetry, to establish whether the Faraday effects arise from a foreground medium.

\section{Observations of 3C 31}

The source chosen for these observations is 3C 31. It is bright, has an asymmetric jet base, and shows a depolarization asymmetry. Our models suggest that the jet axis makes an angle of \degs{60} -- \degs{70} to the plane of the sky. Previous observations are presented by Fomalont \etal (1980) and Strom \etal (1983). A recent recalibration and re-imaging of construction configuration data by AHB (Figure 1) shows the base region in significantly more detail than was previously published. Beyond about 30 arcsec from the core, the jets are roughly symmetrical, but the base region is strongly asymmetric in intensity, especially $<$10 arcsec from the core.

\subsection{Morphology and Field structure}

The starting point for this analysis is the two-component jet model considered by Laing (1993). Two antiparallel, but otherwise identical jets propagate away from a galactic nucleus along a direction which makes an angle θ to the line of right. The jets have two concentric components. The first is an inner {\it core} which has velocity β_cc and contains a magnetic field which has no longitudinal component but is otherwise random. The second is a surrounding {\it shear layer} which has velocity β_s varying from β_c at the centre to 0 at the edges. It field is entirely longitudinal. β_c (and therefore β_s) decrease as the jets propagate away from the nucleus. Two effects of relativistic aberration cause the appearance of the jets to change as they slow

down. Firstly, the relative flux from the two jet components alters, since their Doppler factors are different. Secondly, the degree of polarization of radiation from the core of the jet varies, since it is viewed at a changing angle to the line of sight in its rest frame.

The predictions of the model as they can be tested using 3C 31 are as follows:
\begin{enumerate}
\item We should be able to detect the counterjet in the ``gap'' region close to the nucleus, where it should have a longitudinal magnetic field with a degree of polarization higher than that at the same distance from the nucleus in the counterjet.
\item The counterjet should be limb-brightened close to the nucleus and, at all distances, the main jet should have a more centrally peaked brightness distribution, but the outer envelopes of the two jets should be similar. Analysis of the map shown in Figure 1 suggests that this is indeed the case, but the counterjet is not reliably detected close to the nucleus. (Figure 2 shows a grey-scale of the counter-jet/jet ratio formed by rotating the map in Figure 1 by \degs{180} and dividing it by itself -- this shows both longitudinal {\it and} transverse gradients in the ratio, as predicted).
\item The degree of polarization in the transverse-field region of the main jet should show a maximum, whereas that of the counterjet should rise smoothly with distance from the nucleus.
\end{enumerate}
In principle, a map of the jet:counterjet ratio can be used to estimate velocity profiles both along and transverse to the jet. Figure 2 suggests that this will be possible using the observations proposed here. These observations will also complement those of 3C 449 carried out by some of us. If relativistic models are correct, then 3C 449, unlike 3C 31, is very close to the plane of the sky. The two proposals together should therefore test the model well.

\section{Faraday rotation}

3C 31 clearly shows a depolarization asymmetry in the sense that the side with the brighter jet base depolarizes less as the wavelength increases (Strom \etal 1983). We suspect that this is caused by foreground Faraday rotation due to magnetised hot gas in the galaxy halo. To test this idea, we propose to make 5-frequency observations at a resolution of 1.2 arcsec. The observation of significant depolarization between 5 and 1.4 GHz at low resolution implies that we expect large variations of Faraday rotation over this frequency range, and we therefore propose to observe at 5 GHz and at 4 frequencies in the range 1.3 -- 1.7 GHz in order to obtain adequate coverage in λ^2. We expect to resolve foreground fluctuations using a beam size of 1.2 arcsec, since this worked for 3C 449, which is at a similar distance (Cornwell \& Perley 1984). Detection of λ^2 rotation for more than $\approx$
\degs{90} of rotation without significant depolarization would be unambiguous evidence for foreground material. We expect to be able to measure the rotation measure profile along the jet and to compare it with the density profile of the X-ray halo in order to estimate the field strength.

\section{Observational details}

We require two sets of observations: (1) high-resolution maps at a single frequency high enough that Faraday effects may be neglected, in order

to study sidedness and polarization structure and (2) multi-frequency data at lower resolution to determine Faraday rotation. For the former applications we have chosen to make long integrations at 8.4 GHz in the B and C configurations (0.7 arcsec FWHM: slightly worse than the resolution in Figure 1 but with much superior brightness sensitivity). To determine Faraday rotation, we propose to use scaled arrays at 4.9 GHz and at 4 frequencies in the 1.3 - 1.7 GHz band (B+C and A+B arrays, respectively). This gives us a resolution of 1.2 arcsec.

We estimate from the 5 GHz map in Figure 1 that the inner counterjet surface-brightness is roughly 0.1 mJy/beam at 8 GHz. A 12-hr integration should be just adequate to detect the expected 30\% polarization in the inner counterjet. We also request 6 hrs in C configuration at 8.4 GHz to add short spacings. For the Faraday rotation study, we estimate that we need 6 hrs in the A configuration and 3 hrs in the B configuration at 1.3 - 1.7 GHz (4 bands) and 6 hrs in the B configuration plus 3 hrs in the C configuration at 4.9 GHz.

\medskip

\noindent {\bf References}\\
Biretta, J.A. \& Meisenheimer, K. 1993, in Lecture Notes in Physics 421, Jets in Extragalactic Radio Sources, ed. R\"{o}ser, H.-J. \& Meisenheimer, K., (Berlin: Springer)\\
Bridle, A.H. \& Perley, R.A. 1984, ARA\&A 22, 319\\
Cornwell, T.J. \& Perley, R.A., 1984, in Physics of Energy Transport in Extragalactic Radio Sources, ed. Bridle, A.H. \& Eilek, J.A., (Green Bank:NRAO)\\
Laing, R.A. 1993, in Astrophysical Jets, ed. Fall, M., O'Dea, C., Livio, M. \& Burgarella, D., (CUP: Cambridge) in press\\
Parma, P., Morganti, R., Capetti, A., Fanti, R. \& de Ruiter, H.R. 1993a, A\&A, in press\\
Parma, P., de Ruiter, H.R., Fanti, R. \& Laing, R.A. 1993b, in The Physics of Active Galaxies, ed. Bicknell, G.V. \etal, (San Francisco: ASP), in press\\
Strom, R.G., Fanti, R., Parma, P. \& Ekers, R.D., 1993, A\&A, 122, 305\\
Urry, C.M., Padovani, P. \& Stickel, M. 1991, ApJ 382, 501\\
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From root Mon Sep 27 18:20:08 1993
X-VM-v5-Data: ([nil nil nil nil t nil nil nil nil]
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id AA05920; Mon, 27 Sep 1993 15:07:31 -0600
Message-Id: <199309272107.AA05920@sechelt.aoc.nrao.edu>
From: Rick Perley <rperley@aoc.nrao.edu>
To: rl@mail.ast.cam.ac.uk
Cc: abridle, lferetti@astbo1.dnet.nasa.gov
Subject: Proposal
Date: Mon, 27 Sep 1993 15:07:31 -0600

Robert et al:

I think the proposal reads very well. I suggest only the following:

1) Be generous with time estimates. If we try to cut it too close to the wire, we probably won't get the sensitivity to see the polarization effects we need.

2) Ask for D config at the upper frequencies (C and X bands). Although this won't help much for the jet, it will make for a better overall image. Besides, there may be interesting lobe effects we don't anticipate. Don't scrimp on the request, either. Ask for at least 6 hours. Heck, I'd through in a couple hours in L-band as well. What's two hours to a Hog?

3) I don't have a strong feeling about A-config. at 6 or 3.6 cm. It's rather like a fishing expedition -- there might turn up something exciting, but probably not. We could always request A-config after the other data are in, and if something promising appears to be there.

4) In the Introduction, you might add Bicknell's new mega-paper (just accepted to Ap.J.) which expands (so to speak) his entraining jet model to mildly relativistic flows. He now believe that the bright bases of FRI sources are relativistic, and energetically compatible with the large scale , transonic flows. It's quite a remarkable paper.

Rick

From root Mon Sep 27 18:25:16 1993
X-VM-v5-Data: ([nil nil nil nil nil nil t nil nil]
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Received: from sechelt.aoc.nrao.edu by cv3.cv.nrao.edu (4.1/DDN-DLB/1.13)
id AA20438; Mon, 27 Sep 93 18:25:16 EDT
Received: by sechela.aoc.nrao.edu (5.65c/1.3pmg)
id AA05956; Mon, 27 Sep 1993 16:25:14 -0600
Message-Id: <199309272225.AA05956@sechelt.aoc.nrao.edu>
From: Rick Perley <rperley@aoc.nrao.edu>
To: abridle@NRAO.EDU
Subject: Re: forwarded message from LFERETTI@astbo1.bo.cnr.it
Date: Mon, 27 Sep 1993 16:25:14 -0600

Alan:

It's likely that those phased array data are o.k. for polarization, but we won't know until they are reduced. I won't be able to do that for some time -- I've got to take care of 3.5 millions new visibilities every single day! The all-sky survey has one of my feet firmly pegged to the floor for the foreseaable future.

So I don't know how to handle it. Perhaps we could ask for the time, but note that it might not be required? Pretty pathetic, but it's the best I can suggest.

I haven't heard any comment on my recommendation of getting some D-config data. Also, I do strongly believe that asking for only 3 hours is dangerous, regardless of what your (or anybody's) calculations might say. You can't have too much sensitivity in the polarization business, so we might better ask how much time we can possibly get, rather than how much we really think we need. I'd go for 6 hours, minimum. 3-hour requests are always granted.

Rick

From abridle Tue Sep 28 09:46:53 1993
X-VM-v5-Data: ([nil nil nil nil nil nil t nil nil]
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References: <199309272107.AA05920@sechelt.aoc.nrao.edu>
From: abridle (Alan Bridle)
To: rperley@aoc.nrao.edu, lferetti@astbo1.dnet.nasa.gov
Subject: Re: Proposal
Date: Tue, 28 Sep 1993 09:46:27 -0400

I have taken a look at the sensitivity calculations as Robert suggested and I would now like to increase the time we are asking for at 8 GHz to 8hrs and 4hrs for the B and C configurations. This should get us to about 20 microJy per beam rms at 50 MHz bandwidth, allowing for calibration time. I agree with Rick's point about asking for D configuration at 8 GHz, because the self-calibration will be a problem if we don't image the large scale structure reasonably well. (The key to recalibrating the construction configuration data was having the disk space and CPU cycles to make a _huge_ image during the self-calibration steps). From a u,v coverage point of view 4 hrs would probably be sufficient; from a sensitivity point of view, it's all overkill after the first 30 min. Would you settle for a 4-hr D-config request, Rick? (Hate to ask a self-professed hog if he wants less to eat, but I'll try it anyway!).

For 5 GHz, don't let's forget that we have the construction configuration data, which already make a nice image of the large-scale structure. It would be nice to process the B configuration phased array data to check whether their polarization calibration is intact before stating finally whether we want further B configuration data. This raises the possibility of asking for the C and D array data now, and stating that we will submit a B configuration proposal in the next round if the polarimetry from the phased-array data turns out to be corrupted.

For L-band, I again tend to agree with Rick that we should increase Robert's estimate, as we are going to split the time among several frequencies. I again suggest we ask for 8 hrs and 4 hrs in A and B respectively. I have some construction configuration data that we can throw into the pot for one frequency.

As we are growing this into a proposal with a larger time budget than Robert intended, I am more in favor of waiting until we have reduced the proposed 8-GHz data before asking for still higher resolution (A config at X-band).

Last note from Rick's comments: Can you send me the sentence you'd like to add re Geoff's paper, and the reference? Thanks.

Cheers, Alan

From abridle Tue Sep 28 09:47:31 1993
X-VM-v5-Data: ([nil nil nil nil nil nil nil nil nil]
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From: abridle (Alan Bridle)
To: lferetti@astbo1.bo.cnr.it
Subject: forwarded message from Rick Perley
Date: Tue, 28 Sep 1993 09:47:08 -0400

------- Start of forwarded message -------
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Received: by sechelt.aoc.nrao.edu (5.65c/1.3pmg)
id AA05956; Mon, 27 Sep 1993 16:25:14 -0600
Message-Id: <199309272225.AA05956@sechelt.aoc.nrao.edu>
From: Rick Perley <rperley@aoc.nrao.edu>
To: abridle@NRAO.EDU
Subject: Re: forwarded message from LFERETTI@astbo1.bo.cnr.it
Date: Mon, 27 Sep 1993 16:25:14 -0600

Alan:

It's likely that those phased array data are o.k. for polarization, but we won't know until they are reduced. I won't be able to do that for some time -- I've got to take care of 3.5 millions new visibilities every single day! The all-sky survey has one of my feet firmly pegged to the floor for the foreseaable future.

So I don't know how to handle it. Perhaps we could ask for the time, but note that it might not be required? Pretty pathetic, but it's the best I can suggest.

I haven't heard any comment on my recommendation of getting some D-config data. Also, I do strongly believe that asking for only 3 hours is dangerous, regardless of what your (or anybody's) calculations might say. You can't have too much sensitivity in the polarization business, so we might better ask how much time we can possibly get, rather than how much we really think we need. I'd go for 6 hours, minimum. 3-hour requests are always granted.

Rick

------- End of forwarded message -------

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Message-Id: <9309281356.AA16241@east.gsfc.nasa.gov>
From: lferetti@astbo1.DNET.NASA.GOV
To: "abridle@polaris.cv.nrao.edu"@6913.DNET.NASA.GOV
Cc: LFERETTI@east.gsfc.nasa.gov
Subject: Re: Proposal
Date: Tue, 28 Sep 93 09:56:30 -0400

The phased-array data are here in bologna, already calibrated. We had no
time to make a map, expecially since we are in the move of the institute
to a new building and AIPS will not be available for a while. However, we
will be able to look to them before the next deadline. Therefore, we agree
to write in the proposal that B array could be requested in a next proposal
if necessary (at 6 cm). It's ok for the other time requests and for the figures.
Regards, Luigina

From root Tue Sep 28 10:33:30 1993
X-VM-v5-Data: ([nil nil nil nil nil nil nil nil nil]
["895" "Tue" "28" "September" "1993" "08:33:30" "-0600" "Rick Perley" "rperley@aoc.nrao.edu" nil "21" "Re: Proposal" nil nil nil "9" nil nil (number " " mark " Rick Perley Sep 28 21/895 " thread-indent "\"Re: Proposal\"\n") nil]
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Received: from sechelt.aoc.nrao.edu by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA27183; Tue, 28 Sep 1993 10:33:29 -0400
Received: by sechelt.aoc.nrao.edu (5.65c/1.3pmg)
id AA06131; Tue, 28 Sep 1993 08:33:30 -0600
Message-Id: <199309281433.AA06131@sechelt.aoc.nrao.edu>
From: Rick Perley <rperley@aoc.nrao.edu>
To: abridle, rl@mail.ast.cam.ac.uk, lferetti@astbo1.dnet.nasa.gov
Subject: Re: Proposal
Date: Tue, 28 Sep 1993 08:33:30 -0600

Oink Oink.

A 4-hour D-config request is fine, of course. I'm only noting that if the committee grants you 4 hours (and they will), they will also give 6. (But 8 might be a problem). We must also remember that 3C31 is up when the galactic plane is, so we run into a lot of competition from those types (who are feeling extra pressure from the all-sky survey).

I agree that we should have a go at the phased array data first at 6cm. We have until the next proposal deadline to find out whether the data are any good. Should be easy to make that. My bet is that the data will be quite fine! Unfortunately, the current deadline is for A configuration, so delaying the X-band A-config request will mean a 16 month delay. But then, I guess none of us are in a great hurry.

L-band suggestion of AHB is fine with me.

I'll conjure up some words re Geoff's mega-paper.

Rick

From root Tue Sep 28 10:51:38 1993
X-VM-v5-Data: ([nil nil nil nil t nil nil nil nil]
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Received: by sechelt.aoc.nrao.edu (5.65c/1.3pmg)
id AA06149; Tue, 28 Sep 1993 08:51:38 -0600
Message-Id: <199309281451.AA06149@sechelt.aoc.nrao.edu>
From: Rick Perley <rperley@aoc.nrao.edu>
To: abridle
Subject: Blurb on Geoff's stuff
Date: Tue, 28 Sep 1993 08:51:38 -0600

Alan: The following, or some fraction of it, might do.

Bicknell (Ap.J. accepted) has shown that an initially relativistic entraining jet will be declerated to 0.3 to 0.7 c in the turbulent region. His analysis of particular cases (NGC315 and NGC6251) shows that the pc-scale relativistic flow provides the right amount of energy and momentum flux to be consistent with mildly relativistic flow on the Kpc scale. This analysis adds considerable weight to the postulate that FR1 jets remain mildly relativistic, and that their asymmetric bases are due to Doppler beaming.

Rick

From abridle Tue Sep 28 11:03:36 1993
X-VM-v5-Data: ([nil nil nil nil nil nil nil nil nil]
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Message-Id: <9309281502.AA30394@polaris.cv.nrao.edu>
From: abridle (Alan Bridle)
To: rperley, lferetti@astbo1.bo.cnr.it, rl@rgosc.ast.cam.ac.uk
Subject: Final time-config breakdown for 3C31?
Date: Tue, 28 Sep 1993 11:02:55 -0400

Just pulling things together, I noticed that Robert had already
suggested 12 hrs/6hrs for 8-GHz B/C to do the counterjet polarimetry.
So here's what I now have accumulated:

8 GHz 12 hrs in B
6 hrs in C
4 hrs in D

4.9 GHz 8 hrs in B (we have phased array already, ask for extra
only if polarimetry from this has been
corrupted by phase-referencing)
4 hrs in C
4 hrs in D

L-band 8 hrs in A
4 hrs in B

Sorry for any confusion, A.

From root Tue Sep 28 11:10:19 1993
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"LFERETTI@astbo1.bo.cnr.it" nil "2" "RE: Final time-config breakdown for 3C31?" nil nil nil "9" nil nil (number " " mark
" LFERETTI@astbo1.b Sep 28 2/6 " thread-indent "\"RE: Final time-config breakdown for 3C31?\"\n") nil]
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id AA20083; Tue, 28 Sep 1993 11:10:18 -0400
Message-Id: <930928170939.20a001d8@astbo1.bo.cnr.it>
X-Vmsmail-To: SMTP%"abridle@polaris.cv.nrao.edu"
From: LFERETTI@astbo1.bo.cnr.it
To: abridle@polaris.cv.nrao.edu
Subject: RE: Final time-config breakdown for 3C31?
Date: Tue, 28 Sep 1993 17:09:39 +0200 (MET)

ok !

From root Tue Sep 28 11:14:30 1993
X-VM-v5-Data: ([nil nil nil nil t nil nil nil nil]
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"<199309281514.AA06150@sechelt.aoc.nrao.edu>" "4" "Re: Final time-config breakdown for 3C31?" nil nil nil "9" nil nil
(number " " mark " R Rick Perley Sep 28 4/66 " thread-indent "\"Re: Final time-config breakdown for 3C31?\"\n")
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Received: by sechelt.aoc.nrao.edu (5.65c/1.3pmg)
id AA06150; Tue, 28 Sep 1993 09:14:24 -0600
Message-Id: <199309281514.AA06150@sechelt.aoc.nrao.edu>
From: Rick Perley <rperley@aoc.nrao.edu>
To: abridle@polaris.cv.nrao.edu
Subject: Re: Final time-config breakdown for 3C31?
Date: Tue, 28 Sep 1993 09:14:24 -0600

What about C-config at L-band? Have I missed something?

Rick

From abridle Tue Sep 28 11:18:31 1993
X-VM-v5-Data: ([nil nil nil nil nil nil nil nil]
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id AA39588; Tue, 28 Sep 1993 11:18:28 -0400
Message-Id: <9309281518.AA39588@polaris.cv.nrao.edu>
References: <199309281514.AA06150@sechelt.aoc.nrao.edu>
From: abridle (Alan Bridle)
To: Rick Perley <rperley@aoc.nrao.edu>
Subject: Re: Final time-config breakdown for 3C31?
Date: Tue, 28 Sep 1993 11:18:28 -0400

It's logical, but that's the first mention of it.

A.

From abridle Tue Sep 28 18:39:37 1993
X-VM-v5-Data: ([nil nil nil nil nil nil nil nil nil]
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"\"Science .TEX w AHB/RAP changes\"\n") nil]
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id AA27719; Tue, 28 Sep 1993 18:39:17 -0400
Message-Id: <9309282239.AA27719@polaris.cv.nrao.edu>
From: abridle (Alan Bridle)
To: lferetti@astbo1.bo.cnr.it, rl@rgosc.ast.cam.ac.uk
Subject: Science .TEX w AHB/RAP changes
Date: Tue, 28 Sep 1993 18:39:17 -0400

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% -----------------
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\newcommand{\etal}{{\it et al.\ }}
\newcommand{\eg}{{\it e.g.\ }}
\newcommand{\etc}{{\it etc.\ }}
\newcommand{\ie}{{\it i.e.\ }}
\newcommand{\qv}{{\it q.v.\ }}
\newcommand{\cf}{{\it c.f.\ }}
\newcommand{\viz}{{\it viz.\ }}
\newcommand{\degs}[1]{$#1^\circ$}                    % Degrees symbol

\begin{document}

\section{Introduction}

Discussion of the origin of asymmetries in the jets of low-luminosity
(Fanaroff-Riley Type I - FRI) radio galaxies has recently been
revitalised by several observational and theoretical discoveries:
\begin{itemize}
\item apparent motions with speeds approaching $c$ have been measured in
FRI jets on parsec and (for M87) kiloparsec scales (Biretta \& Meisenheimer
1993).
\item unified models in which FRI radio galaxies are the parent population
of BL Lac objects are increasingly plausible (\eg Urry \etal 1991),
implying that relativistic velocities are common on parsec scales in
these objects.
\item Parma \etal (1993a) discovered a relation between depolarization and jet
sidedness in FRI sources, in the sense that the lobe containing the
brighter jet base depolarizes less as the wavelength increases: the
most straightforward interpretation is that the brighter base is seen
through less magnetoionic material and is therefore on the near side
```

of the source (as would be expected if the asymmetry were due to
Doppler boosting).
\item Parma \etal (1993b) have examined the variation of jet sidedness ratio
with distance from the core, total radio power and core prominence.
Their results are consistent with the hypothesis that FRI jets slow
down from $\beta
\approx$ 0.6 to non-relativistic velocities on scales of 1 -- 10 kiloparsecs.
\item Laing (1993) developed a model of a two-component, decelerating
relativistic jet which explains the correlation between polarization and
sidedness in FRI jets (one-sided jets have longitudinal fields, whilst
two-sided jets have transverse fields; Bridle \& Perley 1984).
\item Bicknell (1993) has shown that an initially relativistic jet can
be decelerated by turbulent entrainment, and that a decelerating-jetdmodel agrees with the energy and momentum
requirements in NGC315 and
NGC6251.
\end{itemize}
We wish to make two tests of the consistency of the hypothesis that
FRI jets start at relativistic velocities and slow down on kiloparsec
scales: (1) by measuring the structure and polarization of a twin-jet
base in detail, for comparison with the models of Laing (1993) and (2)
by mapping the rotation-measure distribution of an FRI source which
shows depolarization asymmetry, to establish whether the Faraday
effects*arise from a foreground medium.

\section{Observations of 3C 31}

3C 31 is ideal for this study as it is bright, has an asymmetric jet
base (Fomalont \etal 1980) and a depolarization asymmetry (Strom \etal
1983). Our models imply that the jet axis is \degs{60} -- \degs{70}
from the plane of the sky. Recalibration of construction
configuration data by AHB (Figure 1) shows more details of the base
region than were published. The jets are roughly symmetric $>$30"
from the core, but the region $<$10" from the core is highly
asymmetric in intensity.

\subsection{Morphology and Magnetic Field Structure}

The starting point for this analysis is the two-component jet model
considered by Laing (1993). Two antiparallel, but otherwise identical
jets propagate away from a galactic nucleus along a direction which
makes an angle θ to the line of sight. The jets have two
concentric components. The first is an inner {\it core} which has
velocity β_cc and contains a magnetic field which has no
longitudinal component but is otherwise random. The second is a
surrounding {\it shear layer} which has velocity β_s varying
from β_c at the centre to 0 at the edges. Its field is entirely
longitudinal. β_c (and therefore β_s) decrease as the
jets propagate away from the nucleus. Two effects of relativistic
aberration cause the appearance of the jets to change as they slow
down. Firstly, the relative flux from the two jet components alters,
since their Doppler factors are different. Secondly, the degree of
polarization of radiation from the core of the jet varies, since it is
viewed at a changing angle to the line of sight in its rest frame.

The predictions of the model as they can be tested using 3C 31 are as follows:
\begin{enumerate}
\item We should be able to detect the counterjet in the ``gap" region close to
the nucleus, where it should have a longitudinal magnetic field with a

degree of polarization higher than that at the same distance from the nucleus in the jet.
\item The counterjet should be limb-brightened near the nucleus and, at all distances, the main jet should have a more centrally peaked brightness distribution, but the outer envelopes of both jets should be similar. Analysis of the map in Figure 1 suggests that this is indeed the case, but the counterjet is not reliably detected close to the nucleus. (Figure 2 shows a grey-scale of the counter-jet/jet ratio formed by rotating the map in Figure 1 by \degs{180} and dividing it by itself -- this shows both longitudinal {\it and} transverse gradients in the ratio, as predicted).
\item The degree of polarization in the transverse-field region of the main jet should show a maximum, whereas that of the counterjet should rise smoothly with distance from the nucleus.
\end{enumerate}
In principle, a map of the jet:counterjet ratio can be used to estimate velocity profiles both along and transverse to the jet. Figure 2 suggests that this will be possible using the observations proposed here. These observations will also complement those of 3C 449 carried out by some of us. If relativistic models are correct, then 3C 449, unlike 3C 31, is very close to the plane of the sky. The two proposals together should therefore test the model well.

\subsection{Faraday Rotation}

3C 31 clearly shows a depolarization asymmetry in the sense that the side with the brighter jet base depolarizes less as the wavelength increases (Strom \etal 1983). We suspect that this is caused by foreground Faraday rotation due to magnetised hot gas in the host galaxy's halo. To test this, we propose to make 5-frequency observations at a resolution of 1.2 arcsec. The observation of significant depolarization between 5 and 1.4 GHz at low resolution implies that we expect large variations of Faraday rotation over this frequency range, and we therefore propose to observe at 5 GHz and at 4 frequencies in the range 1.3 -- 1.7 GHz in order to obtain adequate coverage in λ^2. We expect to resolve foreground fluctuations using a beam size of 1.2 arcsec, since this worked for 3C 449, which is at a similar distance (Cornwell \& Perley 1984). Detection of λ^2 rotation for more than $\approx$ \degs{90} of rotation without significant depolarization would be unambiguous evidence for foreground material. We expect to be able to measure the rotation measure profile along the jet and to compare it with the density profile of the X-ray halo in order to estimate the field strength.

\section{Observational Details}

We require two sets of observations: (1) high-resolution maps at a single frequency high enough that Faraday effects may be neglected, in order to study sidedness and polarization structure and (2) multi-frequency data at lower resolution to determine Faraday rotation. For the former, we wish to make long integrations at 8.4 GHz in the B and C configurations (0.7 arcsec FWHM: slightly worse than in Figure 1 but with much better brightness sensitivity). We estimate from Figure 1 that the inner counterjet surface-brightness is roughly 0.1 mJy/beam at 8 GHz. A 12-hr integration should just be able to detect the expected 30\% polarization in the inner counterjet. We also request 6 hrs in C configuration, and 4 hrs in D configuration

at 8.4 GHz to add short spacings needed to image the extended emission correctly while self-calibrating. To determine Faraday rotation, we wish to use scaled arrays at 4.9 GHz and at 4 frequencies in the 1.3 - 1.7 GHz band (B+C+D and A+B+C respectively) to obtain a resolution of 1.2 arcsec. This study requires 8 hrs in the A configuration and 4 hrs in the B and C configurations at 1.3 - 1.7 GHz (4 bands) and 8 hrs in the B configuration plus 4 hrs in the C and D configurations at 4.9 GHz. (For the B configuration at 4.9 GHz, we will use 12 hrs of phased-array data now in hand from a VLBI experiment if their polarization can be calibrated. We will report the status of these data by the next B configuration deadline).

\medskip

\noindent {\bf References}\\
Bicknell, G.V. 1993, ApJ, in press\\
Biretta, J.A. \& Meisenheimer, K. 1993, in Lecture Notes in Physics 421, Jets in Extragalactic Radio Sources, ed. R\"{o}ser, H.-J. \& Meisenheimer, K., (Berlin: Springer)\\
Bridle, A.H. \& Perley, R.A. 1984, ARA\&A 22, 319\\
Cornwell, T.J. \& Perley, R.A., 1984, in Physics of Energy Transport in Extragalactic Radio Sources, ed. Bridle, A.H. \& Eilek, J.A., (Green Bank:NRAO)\\
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Parma, P., Morganti, R., Capetti, A., Fanti, R. \& de Ruiter, H.R. 1993a, A\&A, in press\\
Parma, P., de Ruiter, H.R., Fanti, R. \& Laing, R.A. 1993b, in The Physics of Active Galaxies, ed. Bicknell, G.V. \etal, (San Francisco: ASP), in press\\
Strom, R.G., Fanti, R., Parma, P. \& Ekers, R.D., 1993, A\&A, 122, 305\\
Urry, C.M., Padovani, P. \& Stickel, M. 1991, ApJ 382, 501\\
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From root Thu Feb 10 19:33:10 1994
X-VM-v5-Data: ([nil nil nil nil t nil nil nil nil]
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"<199402110033.AA13733@sechelt.aoc.nrao.edu>" "13" "3C31" "^From:" nil nil "2" nil nil (number " " mark " R Rick
Perley Feb 10 13/585 " thread-indent "\"3C31\"\n") nil]
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id AA13733; Thu, 10 Feb 1994 17:33:10 -0700
Message-Id: <199402110033.AA13733@sechelt.aoc.nrao.edu>
From: Rick Perley <rperley@aoc.nrao.edu>
To: abridle
Subject: 3C31
Date: Thu, 10 Feb 1994 17:33:10 -0700

Alan:

Gabriele Giovanini is here, working on the 6cm 3C31 B-config. data that were taken as part of the phased array VLA observation. The results are SPECTACULAR!

The polarization structure is especially exciting. The central B-perp spine is very strong, with fascinating structure along the sides, where the B-parallel sheath interacts with it. There is a tantalizing regularity in this -- you'll have to see it to believe it! These effects are seen in both jets, but are especially strong in the counter-jet.

Shall I FAX these images to you (dumb question...).

Rick

From abridle Mon Feb 14 16:56:51 1994
X-VM-v5-Data: ([nil nil nil nil nil nil nil nil nil]
["654" "Mon" "14" "February" "1994" "16:56:27" "-0500" "Alan Bridle" "abridle " nil "17" "Re: 3C31" "^From:" nil nil "2" nil nil (number " " mark " Alan Bridle Feb 14 17/654 " thread-indent "\"Re: 3C31\"\n") nil]
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References: <199402110033.AA13733@sechelt.aoc.nrao.edu>
From: abridle (Alan Bridle)
To: Rick Perley <rperley@aoc.nrao.edu>
Subject: Re: 3C31
Date: Mon, 14 Feb 1994 16:56:27 -0500

Got the P image on my screen.

Some of the visual effect is just the B-par to B-perp transition that we wrote our original paper about (for the main jet), but the jet-counterjet symmetry and the narrowness of the B-par region are certainly striking. This dataset is also better than the construction config data at showing the filaments in the north jet. There were some sidelobes in the older data confusing the appearance of these things. Both they and their polarization indeed look intriguingly regular now.

Certainly makes you want to see it all at the X-band resolution, doesn't it?

Has Miller said anything to you about the letter yet?

A.

From root Mon Feb 14 17:51:47 1994
X-VM-v5-Data: ([nil nil nil nil nil nil nil nil nil]
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id AA15484; Mon, 14 Feb 1994 15:51:46 -0700
Message-Id: <199402142251.AA15484@sechelt.aoc.nrao.edu>
From: Rick Perley <rperley@aoc.nrao.edu>
To: abridle@polaris.cv.nrao.edu
Subject: Re: 3C31
Date: Mon, 14 Feb 1994 15:51:46 -0700

Alan:

What really caught my eye were the apparently rhythmic undulations in the vector cancellation of the P image. Definitely not random.

Miller hasn't uttered a word to me about the letter. And very little about anything else, either!

I leave for Minnesota tomorrow. Am completing my VLBA lecture now. Complicated machine.

Rick

From root Thu Mar 10 13:59:01 1994
X-VM-v5-Data: ([nil nil nil nil t nil nil nil nil]
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Received: by sechelt.aoc.nrao.edu (5.65c/1.3pmg)
id AA02596; Thu, 10 Mar 1994 11:58:57 -0700
Message-Id: <199403101858.AA02596@sechelt.aoc.nrao.edu>
From: Rick Perley <rperley@aoc.nrao.edu>
To: abridle
Subject: 3C31
Date: Thu, 10 Mar 1994 11:58:57 -0700

Alan:

AF263 - 3C31 is being observed this weekend. The OBSERVE file needs to be made soon. I have received from Luigina some instructions -- but very brief. She says:

- 4 frequencies at L-band
- Suggests J2000 system.

That's all.

Did you intend to set this up? I shall be happy to, if you haven't already started, or want to do it.

Some questions:

1) J2000 is best -- the 6cm phased array stuff is in J2000, and we should stick with that system. Agreed?

2) Do you have any feel for which frequencies should be observed.

3) What about bandwidth? If we think we need to preserve a wide field, the polarization spectral-line modes may be advantageous.

Rick.

P.S. Terri Bottomly has transferred out of aips++, and will become the VLBA correlator programmer. Mark Holdaway is taking a month off aips++ to pursue other interests. We're reading tea-leaves here.

Rick

From abridle Thu Mar 10 15:03:20 1994
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Message-Id: <9403102003.AA32504@polaris.cv.nrao.edu>
References: <199403101858.AA02596@sechelt.aoc.nrao.edu>
From: abridle (Alan Bridle)
To: Rick Perley <rperley@aoc.nrao.edu>
Subject: Re: 3C31
Date: Thu, 10 Mar 1994 15:03:16 -0500

No, I have not made a file. In fact I had not received any notification that we were observing (I had not checked the public schedule). If you have time to make the file, that's just fine by me ....

We already have two different coordinate systems as the older L Band and C band data are in B1950. I presume the strategy will pretty much be to ignore them, though?

For the L band I think we should optimize for RM determination and RFI which I presume means equal spacing in lambda-squared if RFI permits. What is the motivation for four, rather than three, frequencies for example?

The field of view will be limited by the highest-frequency primary beam, given that the source is about 30' across. Are we just doing one pointing?

I have not used the polarization spectral-line modes. Are there any disadvantages for polarization calibration? It would indeed be nice not to be bandwidth-limited if there is no other price to be paid.

A.

From root Thu Mar 10 16:13:47 1994
X-VM-v5-Data: ([nil nil nil nil t nil nil nil nil]
["1286" "Thu" "10" "March" "1994" "14:13:45" "-0700" "Rick Perley" "rperley@aoc.nrao.edu"
"<199403102113.AA02603@sechelt.aoc.nrao.edu>" "30" "Re: 3C31" "^From:" nil nil "3" nil nil (number " " mark " R
Rick Perley Mar 10 30/1286 " thread-indent "\"Re: 3C31\"\n") nil]
nil)
Received: from sechelt.aoc.nrao.edu by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA12858; Thu, 10 Mar 1994 16:13:44 -0500
Received: by sechelt.aoc.nrao.edu (5.65c/1.3pmg)
id AA02603; Thu, 10 Mar 1994 14:13:45 -0700
Message-Id: <199403102113.AA02603@sechelt.aoc.nrao.edu>
From: Rick Perley <rperley@aoc.nrao.edu>
To: abridle@polaris.cv.nrao.edu
Subject: Re: 3C31
Date: Thu, 10 Mar 1994 14:13:45 -0700

Hmmm...

1). I"ll make the file then.

2). I think J2000 is the right way to go. WE'll use Eric's map rotation program to move 1950 to J2000. But we won't be able to combine the data easily (or at all) across epochs. But since this is a new a complete campaign, there should be difficulty with this. Agree?

3). Within L-band, equal spacing is not always best. But RFI avoidance, and wide spread is important. I"ll pore over the RFI charts and look for the best places. We've learned a lot about RFI lately. What we decide upon depends much on the bandwidth.

4). One pointing is all that's needed at L-band, I guess. But do we need A-configuration information for the entire field? Is there any significant compact structure in the outer regions (polarization or total intensity). If the RM screen is complicated in the outer regions, we must of course use a narrower bandwidth. It turns out that for objects larger than about 5', polarization spectral line modes win out in A-configuration. It would appear we must take this option seriously.

5). I have never PERSONALLY done an experiment in these modes. BUt, an excellent authority (FNO) has used the , and has proclaimed them to be completely working.

What do you think of all this?

Rick

From abridle Thu Mar 10 17:22:55 1994
X-VM-v5-Data: ([nil nil nil nil nil nil nil nil nil]
["652" "Thu" "10" "March" "1994" "17:22:15" "-0500" "Alan Bridle" "abridle " nil "19" "Re: 3C31" "^From:" nil nil
"3" nil nil (number " " mark " Alan Bridle Mar 10 19/652 " thread-indent "\"Re: 3C31\"\n") nil]
nil)
Received: by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA13085; Thu, 10 Mar 1994 17:22:15 -0500
Message-Id: <9403102222.AA13085@polaris.cv.nrao.edu>
References: <199403102113.AA02603@sechelt.aoc.nrao.edu>
From: abridle (Alan Bridle)
To: Rick Perley <rperley@aoc.nrao.edu>
Subject: Re: 3C31
Date: Thu, 10 Mar 1994 17:22:15 -0500

I will certainly defer to anyone with actual experience
of the modes, even FNO!

I agree that minimizing channel bandwidth is desirable for
several reasons.

I was presuming that our sensitivity will be limited
at the highest frequencies by the steepening primary
beam cutoff, so we don't need to worry much about
other effects for the lower frequencies.

It easy enough to compare images across the B1950/J2000
difference, I was thinking more of actually re-using the
extisting uv datasets, which are quite full syntheses.
But I'm happy to go with J2000 and simply forget the old
stuff exists, given that the phased-array data turned
out so well.

A.

From root Thu Mar 10 17:44:53 1994
X-VM-v5-Data: ([nil nil nil nil t nil nil nil nil]
["1757" "Thu" "10" "March" "1994" "15:44:49" "-0700" "Rick Perley" "rperley@aoc.nrao.edu"
"<199403102244.AA02617@sechelt.aoc.nrao.edu>" "47" "Re: 3C31" "^From:" nil nil "3" nil nil (number " " mark " R
Rick Perley Mar 10 47/1757 " thread-indent "\"Re: 3C31\"\n") nil]
nil)
Received: from sechelt.aoc.nrao.edu by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA14235; Thu, 10 Mar 1994 17:44:50 -0500
Received: by sechelt.aoc.nrao.edu (5.65c/1.3pmg)
id AA02617; Thu, 10 Mar 1994 15:44:49 -0700
Message-Id: <199403102244.AA02617@sechelt.aoc.nrao.edu>
From: Rick Perley <rperley@aoc.nrao.edu>
To: abridle@polaris.cv.nrao.edu
Subject: Re: 3C31
Date: Thu, 10 Mar 1994 15:44:49 -0700

Alan:

Burch's 1977 map of 3C31 at 408 MHz shows the total source extent to be 12 arcminutes. Where did you get 30' from?

Now, the emission beyond a radius of about 2 arcmin. is extremely extended. We must think carefully about bandwidths. Here's a rough little table.

	Radial extent		
% Loss	1.5'	3'	6'
5%	10MHz	5MHz	2.5MHz
10%	15MHz	7.5	3.7
20%	19	9.5	4.8

Now, the breakpoint for using the polarization spectral line system is 3.125 Mhz bandwidth. This is because:

1) The 50MHz bandwidth mode is unusable (only 4 channels, of which one is lost).

2) The 25MHz option gives 8 channels, of which 7 are useable. This gaves 3.125 MHz channelwidth, and a total correlated bandwidth of 4 X 7 X 3.125 = 91 MHz. (all correlations).

But only one frequency can be done at a time in ths mode, so the effective Bandwidth X Time product is 45 Mhz, when comparing to continuum.

In continuum, we get 8 correlations (2 frequencies). So,

@ 3.125 MHz, we get an effective 25 MHz bandwidth.
@ 6.25 MHz, we get an effective 50 MHz bandwidth.
etc.

Thus, if the desired bandwidth is 3.125, we go with poln. spec. line.
If 6.25 MHz or wider, use continuum.

So...

What bandwidth do you vote for? Gabriele's map shows no Stokes' I emission beyond 3 arcminutes at 1.5arcsec resolution. This would indicate a 6.25 MHz bandwidth. However, Gabriele's data were at 6cm. There would probably be something at 20cm at that radius. HOw much? If there is RM

structure, then we would want the narrower bandwidth. But too narrow will lose the signal. Sigh. What do you think?

Rick

From abridle Thu Mar 10 21:25:45 1994
X-VM-v5-Data: ([nil nil nil nil nil nil nil nil nil]
["270" "Thu" "10" "March" "1994" "21:25:37" "-0500" "Alan Bridle" "abridle " nil "8" "Re: 3C31" "^From:" nil nil
"3" nil nil (number " " mark " Alan Bridle Mar 10 8/270 " thread-indent "\"Re: 3C31\"\n") nil]
nil)
Received: by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA30588; Thu, 10 Mar 1994 21:25:37 -0500
Message-Id: <9403110225.AA30588@polaris.cv.nrao.edu>
References: <199403102244.AA02617@sechelt.aoc.nrao.edu>
From: abridle (Alan Bridle)
To: Rick Perley <rperley@aoc.nrao.edu>
Subject: Re: 3C31
Date: Thu, 10 Mar 1994 21:25:37 -0500

I measured the 30' from the WSRT 610 MHz image. The source
is actually a bit larger than that but the outermost parts
of the plumes have gotten pretty ragged by then.

I don't have the reference with me here at home. Will get
back to you with omre detail tomorrow.

A.

From root Thu Mar 10 23:00:15 1994
X-VM-v5-Data: ([nil nil nil nil t nil nil nil nil]
["450" "Thu" "10" "March" "1994" "21:00:16" "-0700" "Rick Perley" "rperley@aoc.nrao.edu"
"<199403110400.AA04534@sechelt.aoc.nrao.edu>" "10" "Re: 3C31" "^From:" nil nil "3" nil nil (number " " mark " R
Rick Perley Mar 10 10/450 " thread-indent "\"Re: 3C31\"\n") nil]
nil)
Received: from sechelt.aoc.nrao.edu by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA38614; Thu, 10 Mar 1994 23:00:14 -0500
Received: by sechelt.aoc.nrao.edu (5.65c/1.3pmg)
id AA04534; Thu, 10 Mar 1994 21:00:16 -0700
Message-Id: <199403110400.AA04534@sechelt.aoc.nrao.edu>
From: Rick Perley <rperley@aoc.nrao.edu>
To: abridle@polaris.cv.nrao.edu
Subject: Re: 3C31
Date: Thu, 10 Mar 1994 21:00:16 -0700

Ah, I haven't seen that image. Give me the reference, so I can look it up, please.

We'll have to settle this early! The OBSERVE file might be a little tricky, and I'd like to get it done early.

Something to conider (consider) is that in the spectral line modes we can settle for 3 frequencies. With continuum, things come in pairs.

Going for the full 30' will REALLY restrict the bandwidth. Some tradeoffs will have to be made.

Rick

From abridle Fri Mar 11 09:05:05 1994
X-VM-v5-Data: ([nil nil nil nil nil nil nil nil nil]
["60" "Fri" "11" "March" "1994" "09:05:03" "-0500" "Alan Bridle" "abridle " nil "3" "Re: 3C31" "^From:" nil nil "3"
nil nil (number " " mark " Alan Bridle Mar 11 3/60 " thread-indent "\"Re: 3C31\"\n") nil]
nil)
Received: by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA31718; Fri, 11 Mar 1994 09:05:03 -0500
Message-Id: <9403111405.AA31718@polaris.cv.nrao.edu>
References: <199403110400.AA04534@sechelt.aoc.nrao.edu>
From: abridle (Alan Bridle)
To: Rick Perley <rperley@aoc.nrao.edu>
Subject: Re: 3C31
Date: Fri, 11 Mar 1994 09:05:03 -0500

The image is by Strom et al., I think it's AA 122, 305.

A.

From abridle Fri Mar 11 09:40:09 1994
X-VM-v5-Data: ([nil nil nil nil nil nil nil nil nil]
["1385" "Fri" "11" "March" "1994" "09:40:04" "-0500" "Alan Bridle" "abridle " nil "35" "Re: 3C31" "^From:" nil nil
"3" nil nil (number " " mark " Alan Bridle Mar 11 35/1385 " thread-indent "\"Re: 3C31\"\n") nil]
nil)
Received: by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA45360; Fri, 11 Mar 1994 09:40:04 -0500
Message-Id: <9403111440.AA45360@polaris.cv.nrao.edu>
References: <199403110400.AA04534@sechelt.aoc.nrao.edu>
From: abridle (Alan Bridle)
To: Rick Perley <rperley@aoc.nrao.edu>
Subject: Re: 3C31
Date: Fri, 11 Mar 1994 09:40:04 -0500

I'm looking at the Strom et al. L Band images now I'm back in
my office, and it seems to me that although they detect the
I signal over a 20' source (+/- 10' from the nucleus), they
only detected the polarized intensity over the 12' region
that you had inferred from Burch's map, even in the North
where there is least depolarization (in the South you run out
of signal at L band because of the depolarization asymmetry that
we want to explore!).

So it may well be that the 12' (+/- 6') region is the only one
we need to explore thoroughly for _polarimetry_ anyway!

This gets us back to where you started, though maybe
for a different reason.

Now so far as I can see, the angular scale of the emission
6' out is at least 1'. So I don't think we are smearing
anything too seriously by bandwidth at 6 MHz, and indeed
there is some question whether we will see this stuff at
all with the A array.

According to your sums, I think this says we could use
continuum mode and go for sensitivity. I think the most
intereuting regions for us will be about 3' out where
the combination of sensitivity, resolution and depolarization
asymmetry will get quite interesting.

Note that they found no polarization in the south half
of the source at all at 610 MHz.

I don't know what to expect for the RM structure at this
point, it rather depends on the answers to our questions
about 3C31!

A.

From root Fri Mar 11 10:49:41 1994
X-VM-v5-Data: ([nil nil nil nil t nil nil nil nil]
["515" "Fri" "11" "March" "1994" "08:49:40" "-0700" "Rick Perley" "rperley@aoc.nrao.edu"
"<199403111549.AA04580@sechelt.aoc.nrao.edu>" "12" "Re: 3C31" "^From:" nil nil "3" nil nil (number " " mark " R
Rick Perley Mar 11 12/515 " thread-indent "\"Re: 3C31\"\n") nil]
nil)
Received: from sechelt.aoc.nrao.edu by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA17949; Fri, 11 Mar 1994 10:49:40 -0500
Received: by sechelt.aoc.nrao.edu (5.65c/1.3pmg)
id AA04580; Fri, 11 Mar 1994 08:49:40 -0700
Message-Id: <199403111549.AA04580@sechelt.aoc.nrao.edu>
From: Rick Perley <rperley@aoc.nrao.edu>
To: abridle@polaris.cv.nrao.edu
Subject: Re: 3C31
Date: Fri, 11 Mar 1994 08:49:40 -0700

Alan:

O.K., we'll try for 6MHz then. Continuum. I"ll select frequencies by the RFI environment. I'll spread them out as wide as can be safely done. Thus, four frequencies. We'll have to take the chance that the Q and U maps aren't comprised of zillions of little zones, causing the depolarization. When we get out new super-duper correlator...

Rick

p.s. My inclination is to calibrate only every hour or so -- self-cal should be absolutely reliable, given the signal, and the existence of good images.

From root Fri Mar 11 11:54:22 1994
X-VM-v5-Data: ([nil nil nil nil t nil nil nil nil]
["939" "Fri" "11" "March" "1994" "09:54:20" "-0700" "Rick Perley" "rperley@aoc.nrao.edu"
"<199403111654.AA04629@sechelt.aoc.nrao.edu>" "21" "Frequencies" "^From:" nil nil "3" nil nil (number " " mark " R
Rick Perley Mar 11 21/939 " thread-indent "\"Frequencies\"\n") nil]
nil)
Received: from sechelt.aoc.nrao.edu by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA14601; Fri, 11 Mar 1994 11:54:20 -0500
Received: by sechelt.aoc.nrao.edu (5.65c/1.3pmg)
id AA04629; Fri, 11 Mar 1994 09:54:20 -0700
Message-Id: <199403111654.AA04629@sechelt.aoc.nrao.edu>
From: Rick Perley <rperley@aoc.nrao.edu>
To: abridle
Subject: Frequencies
Date: Fri, 11 Mar 1994 09:54:20 -0700

Alan:

In general, it is impossible to find four L-band frequencies, all of which are 'more-or-less' guaranteed to avoid RFI with 50 MHz bandwidth. But, we can be fairly certain of avoiding it with 25 MHz bandwidth. It is no problem finding good frequencies for A-config -- the problem lies with the shorter configs where we'll want to widen the bandwidth. We must, of course, pick the same frequency centers, although the BW can change within reasonable limits (set by the RM).

So, looking for 25-MHz holes, I get the following:

1) 1365 Mhz. This one is very safe.
2) 1435 MHz. A lot of trouble in the survey with this one. Perhaps a better choice will be 1415 MHz. But then we cannot use 50 MHz, since that will overlap the strong birdie at 1400 MHz.
3) 1515 MHz. Fine, so long as we don't go to 50 MHz.
4) 1665 or 1635 MHz. Same comment as above.

Are you comfortable with the restriction to 25 MHz?

Rick

From abridle Fri Mar 11 12:08:17 1994
X-VM-v5-Data: ([nil nil nil nil nil nil nil nil nil]
["96" "Fri" "11" "March" "1994" "12:08:13" "-0500" "Alan Bridle" "abridle " nil "5" "Re: Frequencies" "^From:" nil nil "3" nil nil (number " " mark " Alan Bridle Mar 11 5/96 " thread-indent "\"Re: Frequencies\"\n") nil]
nil)
Received: by pol6ris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA37694; Fri, 11 Mar 1994 12:08:13 -0500
Message-Id: <9403111708.AA37694@polaris.cv.nrao.edu>
References: <199403111654.AA04629@sechelt.aoc.nrao.edu>
From: abridle (Alan Bridle)
To: Rick Perley <rperley@aoc.nrao.edu>
Subject: Re: Frequencies
Date: Fri, 11 Mar 1994 12:08:13 -0500

Well if its a choice between 50 MHz and being
blown out by RFI I guess I'm happier with
25!

A.

From root Fri Mar 11 12:38:06 1994
X-VM-v5-Data: ([nil nil nil nil t nil nil nil nil]
["524" "Fri" "11" "March" "1994" "10:38:01" "-0700" "Rick Perley" "rperley@aoc.nrao.edu"
"<199403111738.AA04634@sechelt.aoc.nrao.edu>" "14" "Re: Frequencies" "^From:" nil nil "3" nil nil (number " " mark "
R Rick Perley Mar 11 14/524 " thread-indent "\"Re: Frequencies\"\n") nil]
nil)
Received: from sechelt.aoc.nrao.edu by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA17310; Fri, 11 Mar 1994 12:38:01 -0500
Received: by sechelt.aoc.nrao.edu (5.65c/1.3pmg)
id AA04634; Fri, 11 Mar 1994 10:38:01 -0700
Message-Id: <199403111738.AA04634@sechelt.aoc.nrao.edu>
From: Rick Perley <rperley@aoc.nrao.edu>
To: abridle@polaris.cv.nrao.edu
Subject: Re: Frequencies
Date: Fri, 11 Mar 1994 10:38:01 -0700

Unfortunately, it's never so clear cut. The RFI in the 1400-1500 region is not that strong -- but is nearly always there. So it's a case of judging how much worse 50 MHz becomes -- it's probably not by sqrt(2), so the 50MHz defaults become attractive.

` I think we can do this:

1365. This one is safe at 50 MHz BW
1435. RFI about 10% of the time (in the survey). But fairly strong.
1485. Here we have Forest Service links running 100% of the time,
1665. We'll be safe with any BW of 25MHz of less.

Rick

From root Thu Mar 17 12:20:06 1994
X-VM-v5-Data: ([nil nil nil nil t nil nil nil nil]
["552" "Thu" "17" "March" "1994" "09:22:51" "-0700" "Rick Perley" "rperley@aoc.nrao.edu"
"<199403171622.AA08018@sechelt.aoc.nrao.edu>" "12" "AIPS Methodologies" "^From:" nil nil "3" nil nil (number " "
mark " R Rick Perley   Mar 17   12/552   " thread-indent "\"AIPS Methodologies\"\n") nil]
nil)
Received: from sechelt.aoc.nrao.edu by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA35736; Thu, 17 Mar 1994 12:19:59 -0500
Received: by sechelt.aoc.nrao.edu (5.65c/1.3pmg)
id AA08018; Thu, 17 Mar 1994 09:22:51 -0700
Message-Id: <199403171622.AA08018@sechelt.aoc.nrao.edu>
From: Rick Perley <rperley@aoc.nrao.edu>
To: abridle
Subject: AIPS Methodologies
Date: Thu, 17 Mar 1994 09:22:51 -0700

Alan:

I have the 3C31 data on disk now, and am preparing to do good things with it. The basic database contains 2 FQs, as well as 2 IFs, thus four frequencies. Naturally, it has to be broken into at least 2 files (one FQ table each, since only one set of polarization solutions can be `remembered').

But, it occurs to me that there might be good reason to break it into four databases, each with only 1 FQ and 1 IF -- thus, one frequency only. This will allow simpler formation of RM maps in the future.

What do you think of this?

Rick

From abridle Thu Mar 17 18:07:55 1994
X-VM-v5-Data: ([nil nil nil nil nil nil nil nil nil]
["84" "Thu" "17" "March" "1994" "18:07:53" "-0500" "Alan Bridle" "abridle " nil "4" "Re: AIPS Methodologies"
"^From:" nil nil "3" nil nil (number " " mark " Alan Bridle Mar 17 4/84 " thread-indent "\"Re: AIPS
Methodologies\"\n") nil]
nil)
Received: by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA17606; Thu, 17 Mar 1994 18:07:53 -0500
Message-Id: <9403172307.AA17606@polaris.cv.nrao.edu>
References: <199403171622.AA08018@sechelt.aoc.nrao.edu>
From: abridle (Alan Bridle)
To: Rick Perley <rperley@aoc.nrao.edu>
Subject: Re: AIPS Methodologies
Date: Thu, 17 Mar 1994 18:07:53 -0500

Because of the RM interest I think it might as well be broken
into 4 databases.

A.

From root Tue Mar 29 11:16:18 1994
X-VM-v5-Data: ([nil nil nil nil t nil t nil nil]
["3314" "Tue" "29" "March" "1994" "09:16:11" "-0700" "Rick Perley" "rperley@aoc.nrao.edu"
"<199403291616.AA15054@sechelt.aoc.nrao.edu>" "57" "3C31 report" "^From:" nil nil "3" nil nil (number " " mark " R
Rick Perley Mar 29 57/3314 " thread-indent "\"3C31 report\"\n") nil]
nil)
Received: from sechelt.aoc.nrao.edu by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA32770; Tue, 29 Mar 1994 11:16:16 -0500
Received: by sechelt.aoc.nrao.edu (5.65c/1.3pmg)
id AA15054; Tue, 29 Mar 1994 09:16:11 -0700
Message-Id: <199403291616.AA15054@sechelt.aoc.nrao.edu>
From: Rick Perley <rperley@aoc.nrao.edu>
To: lferetti@astbo1.dnet.nasa.gov, abridle
Subject: 3C31 report
Date: Tue, 29 Mar 1994 09:16:11 -0700

At long last! I got to the 3C31 data. Here is what we did:

1) After consulting with Alan, I selected 6.25 MHz BW for all frequencies. This was chosen to minimize bandwidth smearing in the inner regions, both in Stokes' 'I', and in 'Q' and 'U'. Remember that although there may be no 'fine structure' beyond the ends of the jet, there may well be in polarization, and we don't want to lose this! On the other hand, as the BW narrows, we lose everything due to loss of sensitivity. We selected 6.25 MHz as the compromise.

2) Frequency selection in L-band is getting very tricky, due to the RFI environment. The problem is actually pretty easy with 6.25 MHz BW, but is very difficult (actually, impossible) at 50 MHz BW. And we must select frequencies which will work (i.e., are both tunable, and free of RFI) at the wider bandwidths we'll be using in the shorter configurations. After staring for a very long time at a dozen RFI plots, we selected the following four frequencies:

a) 1365 Mhz. This is the only 'safe' band at 50 MHz BW in the entire L-band tuning range.

b) 1435 MHz. This is now afflicted with local transmitter crap, but not too strong.

c) 1485 Mhz. This is afflicted with aliased Forest SErvice RFI (which is actually above 1700 MHz, but is 'folded' back around 1600 MHz into the 1465 to 1490 MHz region. We selected 1485 rather than 1465, since the latter is too close to 1435, and both are equally affected by this folded RFI.

d) 1636 MHz. There is no way to get 50 MHz BW anywhere in this region. This frequency offers a reasonable chance to get 25 MHz BW in the future.

3) The data were taken during/after a snowstorm. About 3 inches were on the ground. The gains easily show the effect, and the operators reported high apparent system temperature. What's amusing is that the end of the East arm apparently missed the storm. These show normal behavior. At the worst, the gain is down by about 50% for a couple of hours. The snow melted throughout the day, and the last four hours are just fine.

4) The choice of narrow bandwidth avoided an unfortunate operations error made about this time. Due to some file reorganization by Ken S., the Cross-hand delays were not set. The 'bottom line' is that all B/D IF polarization is ruined at bandwidths of 12.5 Mhz and above. By sheer luck, A/C is not seriously affected. We're safe.

5) I calibrated the data in the usual way, taking the `local' values of the flux density of 3C48 as the standard. No serious bad data were

encountered, and there is no evidence of RFI at any band, so far. The polarization data look fine. I used -18 degrees as the 'true' angle (2 X sky angle) of the polarized flux density of 3C138. This value has been carefully determined from the all-sky survey, and is based on 66 degrees for 3C286. Phase stability was fair. A HUGE Bz error in the coordinate of station W72 (believe it or not, the error is over 20 centimeters!!!, and crept in last October (1992), and has remained undetected until now) was ignored. SElf-cal will straighten this out.

6) I will run a couple basic self-cal's on 3C31, just be make sure all is normal, then back up the data onto DAT. If anybody out there wants a copy, let me know. I can provide Exabyte as well.

Rick

From abridle Mon Apr 4 09:12:34 1994
X-VM-v5-Data: ([nil nil nil nil nil nil nil nil nil]
["245" "Mon" "4" "April" "1994" "09:12:31" "-0400" "Alan Bridle" "abridle " nil "9" "Re: 3C31 report" "^From:" nil
nil "4" nil nil (number " " mark " Alan Bridle Apr 4 9/245 " thread-indent "\"Re: 3C31 report\"\n") nil]
nil)
Received: by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA15211; Mon, 4 Apr 1994 09:12:31 -0400
Message-Id: <9404041312.AA15211@polaris.cv.nrao.edu>
References: <199403291616.AA15054@sechelt.aoc.nrao.edu>
From: abridle (Alan Bridle)
To: Rick Perley <rperley@aoc.nrao.edu>
Subject: Re: 3C31 report
Date: Mon, 4 Apr 1994 09:12:31 -0400

Hi Rick,

Sounds like a large number of small problems, but glad to hear
it went off reasonably well despite the hassles.

I would be interested in having an Exabyte with the basic
self-cal'd data if that's not too much trouble ....

Thanks, A.

From root Fri Jun 3 16:01:31 1994
X-VM-v5-Data: ([nil nil nil nil t nil nil nil nil]
["698" "Fri" "3" "June" "1994" "14:02:02" "-0600" "Rick Perley" "rperley@aoc.nrao.edu"
"<199406032002.AA09033@sechelt.aoc.nrao.edu>" "15" "Some questions..." "^From:" nil nil "6" nil nil (number " " mark
" R Rick Perley   Jun 3   15/698   " thread-indent "\"Some questions...\"\n") nil]
nil)
Received: from sechelt.aoc.nrao.edu by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA45305; Fri, 3 Jun 1994 16:01:30 -0400
Received: by sechelt.aoc.nrao.edu (5.65c/1.3pmg)
id AA09033; Fri, 3 Jun 1994 14:02:02 -0600
Message-Id: <199406032002.AA09033@sechelt.aoc.nrao.edu>
From: Rick Perley <rperley@aoc.nrao.edu>
To: abridle
Subject: Some questions...
Date: Fri, 3 Jun 1994 14:02:02 -0600

Alan:

We have 24 hours -- in three days--, exactly what we asked for. The proposal calls for 4 hours for L-band, 8 hours for C-band, and 12 hours for X-band.

But, Gabriele has already gotten (from phased-array VLBI) a large and very nice B-configuration database at 6cm. There thus appears to need to get more. I`m reading the headers of that file now, to determine the duration, bandwidth, frequencies, etc.

Now, what do you think of getting four frequencies at both C-band and X-band? There is little lost in the frequency change. The file gets a big more complex, and the data analysis somewhat so. The advantage, of course, is that big RMs will be found (if they exist).

Rick

From abridle Fri Jun 3 17:38:51 1994
X-VM-v5-Data: ([nil nil nil nil nil nil nil nil nil]
["1186" "Fri" "3" "June" "1994" "17:38:48" "-0400" "Alan Bridle" "abridle " nil "24" "Re: Some questions..."
"^From:" nil nil "6" nil nil (number " " mark " Alan Bridle Jun 3 24/1186 " thread-indent "\"Re: Some
questions...\"\n") nil]
nil)
Received: by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA12832; Fri, 3 Jun 1994 17:38:48 -0400
Message-Id: <9406032138.AA12832@polaris.cv.nrao.edu>
References: <199406032002.AA09033@sechelt.aoc.nrao.edu>
From: abridle (Alan Bridle)
To: Rick Perley <rperley@aoc.nrao.edu>
Subject: Re: Some questions...
Date: Fri, 3 Jun 1994 17:38:48 -0400

I take it you mean to do a C-band synthesis at two new frequencies,
and to time-share the 12 hrs at X-band between two distinct frequency
settings?

I'd be comfortable with the former, especially with the data already
in the bag. For X-band I'm a little less sure as the main reason was
to get the highest signal-to-noise possible on the counterjet
polarization. I suppose that if we don't detect any signifcant rotation
across X-band we can just add bthe polarized images back together
and recover the sensitivity that way (and maybe even if we do).
So it's a question of u,v, coverage and the artifact level created by
time-sharing. Probably with 12 hours total this is acceptable and you
do indeed have a case for chasing any huge RM's that might be present
in the South side of the source.

So I'd say for C-band indeed try new frequencies but for X band consider
the tradeoff of dynamic range against the high-RM possibility. I'm
not sure we know how to judge the latter without knowing more
about the RM gradients that might be there!

I gotta go soon and will be out for this evening, but I'll check my
E-mail from home when I get back (probably about 9 pm MDT).

Cheers, A.

From root Fri Jun 3 17:48:13 1994
X-VM-v5-Data: ([nil nil nil nil nil nil nil nil nil]
["146" "Fri" "3" "June" "1994" "15:48:43" "-0600" "Rick Perley" "rperley@aoc.nrao.edu" nil "5" "Re: Some questions..." "^From:" nil nil "6" nil nil (number " " mark " Rick Perley Jun 3 5/146 " thread-innent "\"Re: Some questions...\"\n") nil]
nil)
Received: from sechelt.aoc.nrao.edu by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA24392; Fri, 3 Jun 1994 17:48:10 -0400
Received: by sechelt.aoc.nrao.edu (5.65c/1.3pmg)
id AA09245; Fri, 3 Jun 1994 15:48:43 -0600
Message-Id: <199406032148.AA09245@sechelt.aoc.nrao.edu>
From: Rick Perley <rperley@aoc.nrao.edu>
To: abridle@polaris.cv.nrao.edu
Subject: Re: Some questions...
Date: Fri, 3 Jun 1994 15:48:43 -0600

O.K. I'll pick the default X-band frequencies for Sunday's run. A full 8 hours. We'll work out the C-band numbers for the next run.

Rick

From root Fri Jun 3 18:35:20 1994
X-VM-v5-Data: ([nil nil nil nil nil nil nil nil nil]
["874" "Fri" "3" "June" "1994" "16:31:58" "-0600" "Rick Perley" "rperley@aoc.nrao.edu" nil "20" "What I've done..."
"^From:" nil nil "6" nil nil (number " " mark " Rick Perley Jun 3 20/874 " thread-indent "\"What I've done...\"\n")
nil]
nil)
Received: from sechelt.aoc.nrao.edu by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA24348; Fri, 3 Jun 1994 18:35:19 -0400
Received: by sechelt.aoc.nrao.edu (5.65c/1.3pmg)
id AA09322; Fri, 3 Jun 1994 16:31:58 -0600
Message-Id: <199406032231.AA09322@sechelt.aoc.nrao.edu>
From: Rick Perley <rperley@aoc.nrao.edu>
To: abridle@polaris.cv.nrao.edu, lferetti@astbo1.dnet.nasa.gov
Subject: What I've done...
Date: Fri, 3 Jun 1994 16:31:58 -0600

O.K. HEre is its:

1) Standard frequencies, 50 MHz bandwidth. This will cause some smearing, but it's clear from the low-frequency images that there is no compact structure to smear beyond 2 arcminutes. So no loss.

2) Two observations of 3C48 (which is very close by), and one of 3C138. I know the p.a. of 3C48 (which is significantly polarized at X-band), so even if we lose 3C138's observation, we'll still be o.k.)

3) One-minute durations on the calibrator (0057+303 -- the calibrator used at L-band, 0119+321, is significantly resolved here, so I don't want to mess with it), and 15 minute duration on 3C31. Self-cal is a shoe-in here.

4) During transit, I've shortened the 3C31 duration to 5 minutes, to get better p.a. coverage.

5) 2-minute durations on 3C138 and 3C48.

We total 7.5 hours integration on 3C31 out of 8 hours total. Not bad.

Rick

From abridle Sat Jun 4 11:22:37 1994
X-VM-v5-Data: ([nil nil nil nil nil nil nil nil]
["219" "Sat" "4" "June" "1994" "11:22:34" "-0400" "Alan Bridle" "abridle " nil "7" "Re: What I've done..." "^From:"
nil nil "6" nil nil (number " " mark " Alan Bridle Jun 4 7/219 " thread-indent "\"Re: What I've done...\"\n") nil]
nil)
Received: by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA40101; Sat, 4 Jun 1994 11:22:34 -0400
Message-Id: <9406041522.AA40101@polaris.cv.nrao.edu>
References: <199406032231.AA09322@sechelt.aoc.nrao.edu>
From: abridle (Alan Bridle)
To: Rick Perley <rperley@aoc.nrao.edu>
Subject: Re: What I've done...
Date: Sat, 4 Jun 1994 11:22:34 -0400

Sounds great, Rick.

Do you want to ship me a copy of all the uv data at some point so I can do some
of the reduction work here? Would be happy to share the load on this any
time it's convenient to send me a tape.

A.

From root Thu Jun 9 18:15:15 1994
X-VM-v5-Data: ([nil nil nil nil t nil nil nil nil]
["918" "Thu" "9" "June" "1994" "16:15:51" "-0600" "Rick Perley" "rperley@aoc.nrao.edu"
"<199406092215.AA05425@sechelt.aoc.nrao.edu>" "17" "Tonight, and 3C31" "^From:" nil nil "6" nil nil (number " "
mark " R Rick Perley   Jun 9   17/918   " thread-indent "\"Tonight, and 3C31\"\n") nil]
nil)
Received: from sechelt.aoc.nrao.edu by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA42886; Thu, 9 Jun 1994 18:15:13 -0400
Received: by sechelt.aoc.nrao.edu (5.65c/1.3pmg)
id AA05425; Thu, 9 Jun 1994 16:15:51 -0600
Message-Id: <199406092215.AA05425@sechelt.aoc.nrao.edu>
From: Rick Perley <rperley@aoc.nrao.edu>
To: abridle
Subject: Tonight, and 3C31
Date: Thu, 9 Jun 1994 16:15:51 -0600

Alan:

1) I'll miss most of the hockey game -- got a meeting, plus the reception for the Users' Committee. But I think I already know the result...

2) 3C31, second day, is on Sunday night. Gotta make the file now. I need your opinion: Sence we have such a fine database at 6cm from Gabriele, it seems to me that we can increase the observing time for L-band from the requested 4 hours to 8 hours. Agree? We can argue over the scraps (the last 8 hours) tomorrow. Now, I"ve made the necessary file by taking the A-config file, and simply increasing the bandwidth to 25 MHz. Question: Should we increase it to 25 or to 12 MHz? We went with 6 MHz for 'A'. The 'safe' bandwidth increase would be to 12 MHz -- but the A-config maps showed no compact structure whatever outside the very inner regions, so it seems to me that 25 MHz in this B config should be quite safe. Let me know your thoughts.

Rick

From abridle Fri Jun 10 08:28:39 1994
X-VM-v5-Data: ([nil nil nil nil nil nil nil nil nil]
["508" "Fri" "10" "June" "1994" "08:28:36" "-0400" "Alan Bridle" "abridle " nil "11" "Re: Tonight, and 3C31"
"^From:" nil nil "6" nil nil (number " " mark " Alan Bridle Jun 10 11/508 " thread-indent "\"Re: Tonight, and
3C31\"\n") nil]
nil)
Received: by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA46070; Fri, 10 Jun 1994 08:28:36 -0400
Message-Id: <9406101228.AA46070@polaris.cv.nrao.edu>
References: <199406092215.AA05425@sechelt.aoc.nrao.edu>
From: abridle (Alan Bridle)
To: Rick Perley <rperley@aoc.nrao.edu>
Subject: Re: Tonight, and 3C31
Date: Fri, 10 Jun 1994 08:28:36 -0400

I guess 25 MHz is o.k. if you think we can get the dynamic range to make good use of the sensitivity. May help the polarimetry in weak regions.

Saw the game from start to finish. I was impressed by the Rangers' comeback but even more so with the way the Canucks played after that to re-establish the lead. I don't know what suddenly possessed the goaltenders and/or the shooters but it was a hell of a period to watch!

I'll be on the silent end of the telephone to the Users' Meeting today.

Cheers, A.

From root Wed Jun 8 10:17:52 1994
X-VM-v5-Data: ([nil nil nil nil t nil nil nil nil]
["784" "Wed" "8" "June" "1994" "08:18:25" "-0600" "Rick Perley" "rperley@aoc.nrao.edu"
"<199406081418.AA03927@sechelt.aoc.nrao.edu>" "17" "3C31" "^From:" nil nil "6" nil nil (number " " mark " R Rick
Perley Jun 8 17/784 " thread-indent "\"3C31\"\n") nil]
nil)
Received: from sechelt.aoc.nrao.edu by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA20043; Wed, 8 Jun 1994 10:17:51 -0400
Received: by sechelt.aoc.nrao.edu (5.65c/1.3pmg)
id AA03927; Wed, 8 Jun 1994 08:18:25 -0600
Message-Id: <199406081418.AA03927@sechelt.aoc.nrao.edu>
From: Rick Perley <rperley@aoc.nrao.edu>
To: abridle
Cc: lferetti@astbo1.dnet.nasa.gov
Subject: 3C31
Date: Wed, 8 Jun 1994 08:18:25 -0600

Alan:

I have calibrated the first of our three days' observations. The other two are scheduled for next week.

We got only 25 antennas -- one is being painted, and one had wildly fluctuting gains (on 1 minute timescales!). In addition, the antennas had just been reconfigured, so the baselines are off -- quite a lot for antenna 14. But I elected not to make the changes, since 3C31 is clearly self-calibratable. If you think this in error, let me know, and I can go through the baseline-correction procedure.

I quite accidentally used NGC315 as the calibrator! So we have quite a nice map of it as a byproduct.

Saw only the 3rd period last night -- quite disappointing to see them lose it that way. Really stupid penalty to give N.Y. the go-ahead goal.

Rick

From abridle Fri Jun 10 17:52:22 1994
X-VM-v5-Data: ([nil nil nil nil nil nil nil nil nil]
["1275" "Fri" "10" "June" "1994" "17:52:14" "-0400" "Alan Bridle" "abridle " nil "32" "Re: Day 3 for 3C31" "^From:"
nil nil "6" nil nil (number " " mark " Alan Bridle Jun 10 32/1275 " thread-indent "\"Re: Day 3 for 3C31\"\n") nil]
nil)
Received: by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA19851; Fri, 10 Jun 1994 17:52:14 -0400
Message-Id: <9406102152.AA19851@polaris.cv.nrao.edu>
References: <199406102129.AA07255@sechelt.aoc.nrao.edu>
From: abridle (Alan Bridle)
To: Rick Perley <rperley@aoc.nrao.edu>
Subject: Re: Day 3 for 3C31
Date: Fri, 10 Jun 1994 17:52:14 -0400

OK, I got it straight now. Plus we have C-band from the phased-array.
Does this have polarimetry? If not, we might do best with two well
separated C band frequencies.

X Band we could use a lot of sensitivity. There probably is not much
point doing more X-Band at a _new_ frequency pair unless we spend the
full 8 hours there. Equally there is probably not much point doing C
Band at a new frequency unless we would build up about as much
integration as in the phased-array.

So if we don't have polarimetry from the phased-array that's reliable,
we should do C-band full time. If we do, we could do either two new
C-band frequencies full-time to trace possible large RM at C band, or
double our integration time at X Band at two new frequencies to trace
even larger RMs or double our integration time at the same frequencies
as before to get better signal on the counterjet polarization.

This last is the thing we wanted to emphasize for the
modeling, so I think the decision tree is:

If we don';t have a good polarization calibration for
the phased-array at C-band, do C band gfor 8 hours.

If we do, probably do 8 more hours at X Band.

The option I like least is to split the remining time into 4hrs of
each.

I'm off home but I'll check my mail from there.

A.

From root Tue Jun 14 15:13:05 1994
X-VM-v5-Data: ([nil nil nil nil t nil nil nil nil]
["351" "Tue" "14" "June" "1994" "13:13:43" "-0600" "Rick Perley" "rperley@aoc.nrao.edu"
"<199406141913.AA10939@sechelt.aoc.nrao.edu>" "13" "3C31 image" "^From:" nil nil "6" nil nil (number " " mark " R
Rick Perley Jun 14 13/351 " thread-indent "\"3C31 image\"\n") nil]
nil)
Received: from sechelt.aoc.nrao.edu by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA38617; Tue, 14 Jun 1994 15:13:02 -0400
Received: by sechelt.aoc.nrao.edu (5.65c/1.3pmg)
id AA10939; Tue, 14 Jun 1994 13:13:43 -0600
Message-Id: <199406141913.AA10939@sechelt.aoc.nrao.edu>
From: Rick Perley <rperley@aoc.nrao.edu>
To: abridle
Subject: 3C31 image
Date: Tue, 14 Jun 1994 13:13:43 -0600

Alan:

I have placed in /sechelt/AIPS/DA01/FITS a FITS image of 3c31 (called 3C31 in fact).

I did a phase self-cal, but no amplitude. Essentially no editing, but the image is clearly not limited by bad data. Short spacings are clearly needed. But it is quite pretty.

Enjoy.

Rick

P.S. The AIPS password here is now VLB_eye (I think!).

From root Tue Jun 14 17:24:25 1994
X-VM-v5-Data: ([nil nil nil nil nil nil nil nil nil]
["385" "Tue" "14" "June" "1994" "15:25:03" "-0600" "Rick Perley" "rperley@aoc.nrao.edu" nil "11" "3c31, end"
"^From:" nil nil "6" nil nil (number " " mark " Rick Perley Jun 14 11/385 " thread-indent "\"3c31, end\"\n") nil]
nil)
Received: from sechelt.aoc.nrao.edu by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA49755; Tue, 14 Jun 1994 17:24:24 -0400
Received: by sechelt.aoc.nrao.edu (5.65c/1.3pmg)
id AA11420; Tue, 14 Jun 1994 15:25:03 -0600
Message-Id: <199406142125.AA11420@sechelt.aoc.nrao.edu>
From: Rick Perley <rperley@aoc.nrao.edu>
To: abridle
Subject: 3c31, end
Date: Tue, 14 Jun 1994 15:25:03 -0600

Alan:

All the observations are now taken and calibrated. I haven't taken any great pains to carefully edit the data. But the calibration should be more than adequate.

I can make a copy of the DAT (onto Exabyte, if you prefer). It would contain all the A and B configuration data. Ready for your pleasure.

Rick.

I understand Vancouver is in a global state of anxiety.

From root Wed Jun 15 19:45:06 1994
X-VM-v5-Data: ([nil nil nil nil nil nil nil nil nil]
["502" "Wed" "15" "June" "1994" "17:45:40" "-0600" "Rick Perley" "rperley@aoc.nrao.edu" nil "12" "3C31, Xband"
"^From:" nil nil "6" nil nil (number " " mark " Rick Perley Jun 15 12/502 " thread-indent "\"3C31, Xband\"\n") nil]
nil)
Received: from sechelt.aoc.nrao.edu by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA38734; Wed, 15 Jun 1994 19:45:00 -0400
Received: by sechelt.aoc.nrao.edu (5.65c/1.3pmg)
id AA14425; Wed, 15 Jun 1994 17:45:40 -0600
Message-Id: <199406152345.AA14425@sechelt.aoc.nrao.edu>
From: Rick Perley <rperley@aoc.nrao.edu>
To: abridle
Subject: 3C31, Xband
Date: Wed, 15 Jun 1994 17:45:40 -0600

Alan:

1) I'm not talking about the game.

2) I've decided to do a little extra work on the X-band images of 3C31. The results are quite spectacular. The two days' integration at X-band will pay off nicely -- the rms noise (even with uniform weighting) is going to be less than 10 microJy. The total intensity image needs the short spacings from C-configuration. But the polarization images are amazing. I'm running pretty deep CLEANs on them now. I'll send you copies, when available.

Rick

From root Thu Jun 16 12:25:04 1994
X-VM-v5-Data: ([nil nil nil nil t nil nil nil nil]
["1082" "Thu" "16" "June" "1994" "10:25:42" "-0600" "Rick Perley" "rperley@aoc.nrao.edu"
"<199406161625.AA14774@sechelt.aoc.nrao.edu>" "20" "3C31 polarization" "^From:" nil nil "6" nil nil (number " " mark
" R Rick Perley Jun 16 20/1082 " thread-indent "\"3C31 polarization\"\n") nil]
nil)
Received: from sechelt.aoc.nrao.edu by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA30581; Thu, 16 Jun 1994 12:25:02 -0400
Received: by sechelt.aoc.nrao.edu (5.65c/1.3pmg)
id AA14774; Thu, 16 Jun 1994 10:25:42 -0600
Message-Id: <199406161625.AA14774@sechelt.aoc.nrao.edu>
From: Rick Perley <rperley@aoc.nrao.edu>
To: abridle
Cc: lferetti@astbo1.dnet.nasa.gov
Subject: 3C31 polarization
Date: Thu, 16 Jun 1994 10:25:42 -0600

Alan:

I spent a little time cleaning up the X-band images. The total intensity image is sort-of normal -- nothing truly exciting. But the polarization images are truly amazing. These show both jets having central polarized spines (transverse in both cases, except at the main jet base). What is truly remarkable are the series of polarized rings, or ellipses, which surround (?) both central spines. On the CJ side, there are easily seen three such rings, on the MJ side, at least 5. There are probably more -- I'm using the highest B-config resolution (0.65 arcsec), and all the jet is very much resolved. The B-vectors are (of course!) circumferential.

The agreement with Gabriele's 6cm polarimetry is excellent (as it should be). There is evidence of Faraday effects in the main jet -- but we'll have to carefully do the RM images to sort this out.

This is all quite exciting. I think this object is really going to make a few waves.

I'm backing up the self-cal data and best images. I'll copy the tape to Exabyte later today, and send it to you.

Rick

From abridle Thu Jun 16 13:20:26 1994
X-VM-v5-Data: ([nil nil nil nil nil nil nil nil nil]
["275" "Thu" "16" "June" "1994" "13:20:21" "-0400" "Alan Bridle" "abridle " nil "8" "Re: 3C31 polarization"
"^From:" nil nil "6" nil nil (number " " mark " Alan Bridle Jun 16 8/275 " thread-indent "\"Re: 3C31
polarization\"\n") nil]
nil)
Received: by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA50526; Thu, 16 Jun 1994 13:20:21 -0400
Message-Id: <9406161720.AA50526@polaris.cv.nrao.edu>
References: <199406161625.AA14774@sechelt.aoc.nrao.edu>
From: abridle (Alan Bridle)
To: Rick Perley <rperley@aoc.nrao.edu>
Subject: Re: 3C31 polarization
Date: Thu, 16 Jun 1994 13:20:21 -0400

Sounds great!! It will be fascinating to get the comparison
with Robert's detailed models in this case ....

If you could write the Xband polarzation stuff to fits disk
while you're at it. I'll copy them across real quick so they
don't clog disk resources for long ....

A.

From root Wed Nov 23 16:41:39 1994
X-VM-v5-Data: ([nil nil nil nil nil nil nil nil nil]
["626" "Wed" "23" "November" "1994" "14:41:29" "-0700" "Rick Perley" "rperley@aoc.nrao.edu" nil "15" "3C31 observations" "^From:" nil nil "11" nil nil (number " " mark " Rick Perley Nov 23 15/626 " thread-indent "\"3C31 observations\"\n") nil]
nil)
Received: from sechelt.aoc.nrao.edu by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA23854; Wed, 23 Nov 1994 16:41:38 -0500
Received: by sechelt.aoc.nrao.edu (5.65c/1.3pmg)
id AA07518; Wed, 23 Nov 1994 14:41:29 -0700
Message-Id: <199411232141.AA07518@sechelt.aoc.nrao.edu>
From: Rick Perley <rperley@aoc.nrao.edu>
To: lferetti@astbo1.dnet.nasa.gov, abridle, rl@mail.ast.cam.ac.uk
Subject: 3C31 observations
Date: Wed, 23 Nov 1994 14:41:29 -0700

Dear co-workers:

We are observing 3C31 Friday for 6 hours. There is another, 8-hour, run in December.

I decided to use Friday's run for L-band alone, all four frequencies (i.e., 2 pairs). I chose to keep the same 25MHz bandwidths that we used in the B-configuration, because I was concerned that widening the bandwith for this current run might invite more RFI, and (probably more importantly) would blind us to the RM gradients that we are pursuing.

If you have a different opinion, let me know by Friday noon (local time).

I would propose that the second run be dedicated to C and X bands.

Regards
Rick

From root Tue Dec 6 19:40:47 1994
X-VM-v5-Data: ([nil nil nil nil t nil nil nil nil]
["788" "Tue" "6" "December" "1994" "17:40:44" "-0700" "Rick Perley" "rperley@aoc.nrao.edu"
"<199412070040.AA21446@sechelt.aoc.nrao.edu>" "17" "3C31, C-config." "^From:" nil nil "12" nil nil (number " " mark
" R Rick Perley   Dec 6   17/788   " thread-indent "\"3C31, C-config.\"\n") nil]
nil)
Received: from sechelt.aoc.nrao.edu by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA37026; Tue, 6 Dec 1994 19:40:46 -0500
Received: by sechelt.aoc.nrao.edu (5.65c/1.3pmg)
id AA21446; Tue, 6 Dec 1994 17:40:44 -0700
Message-Id: <199412070040.AA21446@sechelt.aoc.nrao.edu>
From: Rick Perley <rperley@aoc.nrao.edu>
To: abridle, lugina, rl@mail.ast.cam.ac.uk
Subject: 3C31, C-config.
Date: Tue, 6 Dec 1994 17:40:44 -0700

The C-configuration data are spectacular. 100% success in data taking and calibration. I quickly imaged all of the data, just to make sure, and for all bands, the images are wonderful. The depolarization asymmetry is clearly present at L-band. And the jets show marvelous polarization structure (both sides) at the other bands.

It is clear that D-configuration data are needed at L-band, since the jets, and polarization, can still be seen at the ends of the 'jets' when they disappear into the noise, at L-band.

I have backed up the data. Robert has a copy of most of the data -- minus the last database, since it was taken after he left here.

This project very much could use a sharp student -- I think there is a wonderful thesis in these data. Any nominations?

Rick

From root Thu Apr 27 13:32:59 1995
X-VM-v5-Data: ([nil nil nil nil nil nil nil nil nil]
["905" "Thu" "27" "April" "1995" "11:32:56" "-0600" "Rick Perley" "rperley@aoc.nrao.edu" nil "28" "3C31, tonight"
"^From:" nil nil "4" nil nil nil nil]
nil)
Received: from sechelt.aoc.nrao.edu by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA33305; Thu, 27 Apr 1995 13:32:58 -0400
Received: by sechelt.aoc.nrao.edu (5.65c/1.3pmg)
id AA05289; Thu, 27 Apr 1995 11:32:56 -0600
Message-Id: <199504271732.AA05289@sechelt.aoc.nrao.edu>
From: Rick Perley <rperley@aoc.nrao.edu>
To: abridle, lferetti@astbo1.dnet.nasa.gov, rl@mail.ast.cam.ac.uk
Subject: 3C31, tonight
Date: Thu, 27 Apr 1995 11:32:56 -0600

Dear Collaborators:

We have the last of our 3C31 observations tonight. As far as I know, this is our only observation in this configuration. THere are 6 hours, which is pretty decent given the pressures caused by the surveys.

There are 3 bands, and 8 frequencies to cover. To make my life simpler (and if it gets any more hectic, I might not be able to maintain sanity), I propose to use the same frequency/bandwidth combinations employed for the C-configuration observations. To refresh your memories:

1365/25, 1435/25

1485/25, 1636/25

4985/50, 4535/50

8415/50, 8465/50.

I also suggest equal time for all these frequency pairs.

Arguments to the contrnry will be entertained, briefly.

Given the late posting, I presume only Alan will have an opportunity to comment, unless Robert or Luigina are burning the late night oil. My apologies are offered for my lateness.

Rick

From root Thu Apr 27 16:28:14 1995
X-VM-v5-Data: ([nil nil nil nil t nil nil nil nil]
["260" "Thu" "27" "April" "1995" "14:28:10" "-0600" "Rick Perley" "rperley@aoc.nrao.edu"
"<199504272028.AA05538@sechelt.aoc.nrao.edu>" "6" "3C31 in D" "^From:" nil nil "4" nil nil nil nil]
nil)
Received: from sechelt.aoc.nrao.edu by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA40470; Thu, 27 Apr 1995 16:28:13 -0400
Received: by sechelt.aoc.nrao.edu (5.65c/1.3pmg)
id AA05538; Thu, 27 Apr 1995 14:28:10 -0600
Message-Id: <199504272028.AA05538@sechelt.aoc.nrao.edu>
From: Rick Perley <rperley@aoc.nrao.edu>
To: abridle, lferetti@astbo1.dnet.nasa.gov, rl@mail.ast.cam.ac.uk
Subject: 3C31 in D
Date: Thu, 27 Apr 1995 14:28:10 -0600

I have made up a file which spends 4.5 hours in on-source integration, 1.0 hours in phase/amplitude/parallactic angle calibration, 0.15 hours on 3c48 and 3C138, and the rest of the time (6 hours total) in moving from place to place. This should do.

Rick

From root Thu Apr 27 17:45:26 1995
X-VM-v5-Data: ([nil nil nil nil nil nil nil nil nil]
["731" "Thu" "27" "April" "1995" "15:45:23" "-0600" "Rick Perley" "rperley@aoc.nrao.edu" nil "18" "Re: 3C31 in D"
"^From:" nil nil "4" nil nil nil nil]
nil)
Received: from sechelt.aoc.nrao.edu by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA11570; Thu, 27 Apr 1995 17:45:25 -0400
Received: by sechelt.aoc.nrao.edu (5.65c/1.3pmg)
id AA05623; Thu, 27 Apr 1995 15:45:23 -0600
Message-Id: <199504272145.AA05623@sechelt.aoc.nrao.edu>
From: Rick Perley <rperley@aoc.nrao.edu>
To: abridle@polaris.cv.nrao.edu
Cc: ccarilli@head-cfa.harvard.edu
Subject: Re: 3C31 in D
Date: Thu, 27 Apr 1995 15:45:23 -0600

Alan:

O.K., so it shall be.

I've got new GORGEOUS RM maps of Cygnus A, taken from our old (and never processed) data at X-band (taken in 1989). The RM in the inner parts of the left lobe (the one we think is moving away from us) is very very complicated. Very turbulent looking. It is very interesting to note that the onset of the especially complicated messy part of the RM begins exactly half way back on that lobe -- i.e., it is very reminiscent of a turbulent wake. Perhaps even more interesting is that the `back half' of the 'approaching' lobe shows no such complications. Geometry must be doing this, somehow.

Perhaps even more stimulating is that pretty well the same situation applies to Hydra A!

Rick

From root Thu May 18 11:21:54 1995
X-VM-v5-Data: ([nil nil nil nil t nil nil nil nil]
["1459" "Thu" "18" "May" "1995" "09:21:40" "-0600" "Rick Perley" "rperley@aoc.nrao.edu"
"<199505181521.AA02754@sechelt.aoc.nrao.edu>" "29" "3C31, D-config, Report" "^From:" nil nil "5" nil nil nil nil]
nil)
Received: from sechelt.aoc.nrao.edu by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA42008; Thu, 18 May 1995 11:21:53 -0400
Received: by sechelt.aoc.nrao.edu (5.65c/1.3pmg)
id AA02754; Thu, 18 May 1995 09:21:40 -0600
Message-Id: <199505181521.AA02754@sechelt.aoc.nrao.edu>
From: Rick Perley <rperley@aoc.nrao.edu>
To: abridle, lferetti@astbo1.dnet.nasa.gov, rl@mail.ast.cam.ac.uk
Subject: 3C31, D-config, Report
Date: Thu, 18 May 1995 09:21:40 -0600

Dear Collaborators:

It's not as bad as once thought.

The X-band and C-band data are great. No problems with the calibration, and initial images look fine.

The L-band data were very worrisome. The operators' report was filled with items about bad RFI. Quick perusal of the data definitely supported the operator's observation. However, more careful review has resulted in a sunnier report. The lowest three frequencies (1365, 1435 and 1485 MHz) are all salvageable. Easily so, in fact. After flagging out a very few obvious areas where the data were really obliterated, the calibration went smoothly. The middle two frequencies are actually in very good shape. Little visible difficulty. And the 1365 might well be as gord, after some simple model subtracts/clipping.

But the 1636 MHz data is really messed up. The entire thing. There appear to be virtually no scans without obvious RFI. There is no easy way to flag this, and I haven't tried. This will have to be attempted by somebody with more free time than I have. The probability of success is not terribly great.

I'll make a few trial images, (mostly to satisfy my own curiosity), then back it up on the `global' 3C31 tape. Everything will be on this tape. Who wants a copy?

Time to start discussing how we are going to seriously attach this project. The ideal solution (well all converge at one place, for about 1 month) is not likely, but we could try...

Rick

From root Thu May 25 06:35:47 1995
X-VM-v5-Data: ([nil nil nil nil nil nil nil nil nil]
["439" "Thu" "25" "May" "1995" "11:34:39" "+0100" "Robert Laing" "rl@ast.cam.ac.uk" nil "12" "Re: 3C31, D-config, Report" "^From:" nil nil "5" nil nil nil nil]
nil)
Received: from cass41.ast.cam.ac.uk by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA38372; Thu, 25 May 1995 06:35:46 -0400
Received: from rgosc.ast.cam.ac.uk by cass41 with smtp
(Smail3.1.29.1 #9) id m0sEaFX-00005rC; Thu, 25 May 95 11:34 BST
Received: by rgosc.ast.cam.ac.uk (Smail3.1.29.1 #9)
id m0sEaFU-0002DwC; Thu, 25 May 95 11:34 BST
In-Reply-To: <199505181521.AA02754@sechelt.aoc.nrao.edu>
Message-Id: <Pine.3.89.9505251103.A4967-0100000@rgosc>
Mime-Version: 1.0
Content-Type: TEXT/PLAIN; charset=US-ASCII
From: Robert Laing <rl@ast.cam.ac.uk>
To: Rick Perley <rperley@aoc.nrao.edu>
Cc: Alan Bridle <abridle@polaris.cv.nrao.edu>, lferetti@astbo1.dnet.nasa.gov
Subject: Re: 3C31, D-config, Report
Date: Thu, 25 May 1995 11:34:39 +0100 (BST)

Dear Rick,
I'm game to have a go at 3C 31, I think. Please could I have a tape (at least of the bits I haven't got already).

I'm away until June 16th, thereafter back with renewed enthusiasm, albeit possibly without an RGO (politics and budget cuts are rather severe round here).

Regards, Robert

P.S. Please note RGO/IoA e-mail addresses are now user@ast.cam.ac.uk - the mail.ast... form will stop working sometime soon.

From root Sat Sep 16 21:36:51 1995
X-VM-v5-Data: ([nil nil nil nil t nil nil nil nil]
["1125" "Sun" "17" "September" "1995" "02:36:34" "+0100" "Robert Laing" "rl@ast.cam.ac.uk"
"<Pine.SOL.3.91.950917022710.21887A-100000@rgosc>" "21" "Progress so far" "^From:" nil nil "9" nil nil nil nil]
nil)
Received: from cass41.ast.cam.ac.uk by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA19110; Sat, 16 Sep 1995 21:36:50 -0400
Received: from rgosc.ast.cam.ac.uk by cass41 with smtp
(Smail3.1.29.1 #9) id m0su8et-000CLzC; Sun, 17 Sep 95 02:36 BST
Received: by rgosc.ast.cam.ac.uk (Smail3.1.29.1 #9)
id m0su8ep-0002DuC; Sun, 17 Sep 95 02:36 BST
X-Sender: rl@rgosc
Message-Id: <Pine.SOL.3.91.950917022710.21887A-100000@rgosc>
Mime-Version: 1.0
Content-Type: TEXT/PLAIN; charset=US-ASCII
From: Robert Laing <rl@ast.cam.ac.uk>
To: 3C31 Project Collaborators -- Alan Bridle <abridle@polaris.cv.nrao.edu>,
Luigina Feretti <lferetti@astbo1.bo.cnr.it>,
Gabriele Giovannini <ggiovannini@astbo1.bo.cnr.it>,
Paola Parma <parma@astbo1.bo.cnr.it>,
Rick Perley <rperley@aoc.nrao.edu>, Robert Laing <rl@ast.cam.ac.uk>
Subject: Progress so far
Date: Sun, 17 Sep 1995 02:36:34 +0100 (BST)

Just to let you know that I have made some progress with 3C 31 reductions.
I have so far looked at B and C configurations at 8 GHz and have a pretty
good combined map (noise level 12 microJy/beam compared with 10 - 11 for
Q and U). There is still some work to do to be absolutely sure I have
dealt with core variation correctly and to clean deeper (my workstation
is about to get a cpu transplant, so things may speed up). I have looked
at sidedness and polarization: the counterjet is detected all the way
into the core now. The sidedness results fit core/spine models quite
well, as does the main jet polarization. The counter-jet polarization is
another matter: there is far too much perpendicular field.

I'd like to say a little about this at the Tuscaloosa meeting - hope this
is OK (I'd have asked earlier, but I only just finished the reductions!)

I'll see some of you there, the rest at IAU175, I hope.

Regards, Robert

P.S. Apologies for long silence: we are completely immersed in politics
at the moment, including a spate of reviews. Might just be time to
finish 3C31 before they move us again.

From abridle Sun Sep 17 09:40:37 1995
X-VM-v5-Data: ([nil nil nil nil nil nil nil nil nil]
["617" "Sun" "17" "September" "1995" "09:40:34" "-0400" "Alan Bridle" "abridle" nil "16" "Re: Progress so far"
"^From:" nil nil "9" nil nil nil nil]
nil)
Received: by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA76210; Sun, 17 Sep 1995 09:40:34 -0400
Message-Id: <9509171340.AA76210@polaris.cv.nrao.edu>
In-Reply-To: <Pine.SOL.3.91.950917022710.21887A-100000@rgosc>
References: <Pine.SOL.3.91.950917022710.21887A-100000@rgosc>
From: abridle (Alan Bridle)
To: Robert Laing <rl@ast.cam.ac.uk>
Subject: Re: Progress so far
Date: Sun, 17 Sep 1995 09:40:34 -0400

Robert Laing writes:

> I have looked
> at sidedness and polarization: the counterjet is detected all the way
> into the core now. The sidedness results fit core/spine models quite
> well, as does the main jet polarization. The counter-jet polarization is
> another matter: there is far too much perpendicular field.
>
> I'd like to say a little about this at the Tuscaloosa meeting - hope this
> is OK (I'd have asked earlier, but I only just finished the reductions!)
>

Will be good to give an early preview of this at Tuscaloosa, I'll
see you there and be eager to get the details!

Cheers, A.

From abridle Wed Sep 27 09:32:32 1995
X-VM-v5-Data: ([nil nil nil nil nil nil nil nil]
["364" "Wed" "27" "September" "1995" "09:32:27" "-0400" "Alan Bridle" "abridle" nil "12" "RM reduction" "^From:" nil nil "9" nil nil nil nil]
nil)
Received: by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA74253; Wed, 27 Sep 1995 09:32:27 -0400
Message-Id: <9509271332.AA74253@polaris.cv.nrao.edu>
From: abridle (Alan Bridle)
To: rperley
Subject: RM reduction
Date: Wed, 27 Sep 1995 09:32:27 -0400

Rick, you may have missed this at the end of my longer message on Monday:

We are going to need a 6-frequency version of RM to reduce the 3C31 data. Does one exist from your Cygnus/ Hydra bashing or does it have to be kludged together? I couyld try to get Eric to make real AIPS one but if you or Greg has one that works in a private area I won't bother.

A.

From root Wed Sep 27 10:15:14 1995
X-VM-v5-Data: ([nil nil nil nil nil nil nil nil nil]
["675" "Wed" "27" "September" "1995" "08:15:09" "-0600" "Rick Perley" "rperley@aoc.nrao.edu" nil "19" "Re: RM reduction" "^From:" nil nil "9" nil nil nil nil]
nil)
Received: from arana.aoc.nrao.edu by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA143826; Wed, 27 Sep 1995 10:15:12 -0400
Received: from sechelt.aoc.nrao.edu (sechelt.aoc.nrao.edu [146.88.6.21]) by arana.aoc.nrao.edu (8.6.12/8.6.10) with ESMTP id IAA13874 for <abridle@polaris.cv.nrao.edu>; Wed, 27 Sep 1995 08:15:11 -0600
Received: (from rperley@localhost) by sechelt.aoc.nrao.edu (8.6.12/8.6.10) id IAA21529 for abridle@polaris.cv.nrao.edu; Wed, 27 Sep 1995 08:15:09 -0600
Message-Id: <199509271415.IAA21529@sechelt.aoc.nrao.edu>
X-Sun-Charset: US-ASCII
From: Rick Perley <rperley@aoc.nrao.edu>
To: abridle@polaris.cv.nrao.edu
Subject: Re: RM reduction
Date: Wed, 27 Sep 1995 08:15:09 -0600

Alan:

Sorry, I forgot about the RM part.

As far as I know, there have been no changes to the RM program for many years, so the 4-frequency limit (whose origin I can't remember, except that that is the number of frequencies I had in the Cyg A data, and the N6251 data) remains. This should be easy to get around.

Grey Taylor is here now, and he has used the program. I"ll ask him about this.

The correct solution is to have a most sophisticated version of the program, allowing up to, say, ten frequencies. Getting Eric involved would be perfect.

Greg has stepped out -- I'll catch him when he returns. (He's in the office 2 doors down from me).

Rick

From root Wed Sep 27 12:34:53 1995
X-VM-v5-Data: ([nil nil nil nil nil nil nil nil nil]
["495" "Wed" "27" "September" "1995" "10:33:46" "-0600" "Rick Perley" "rperley@aoc.nrao.edu" nil "11" "RM"
"^From:" nil nil "9" nil nil nil nil]
nil)
Received: from arana.aoc.nrao.edu by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA144882; Wed, 27 Sep 1995 12:34:50 -0400
Received: from sechelt.aoc.nrao.edu (sechelt.aoc.nrao.edu [146.88.6.21]) by arana.aoc.nrao.edu (8.6.12/8.6.10) with
ESMTP id KAA17148 for <abridle@arana.aoc.nrao.edu>; Wed, 27 Sep 1995 10:34:37 -0600
Received: (from rperley@localhost) by sechelt.aoc.nrao.edu (8.6.12/8.6.10) id KAA21804 for abridle; Wed, 27 Sep 1995
10:33:46 -0600
Message-Id: <199509271633.KAA21804@sechelt.aoc.nrao.edu>
X-Sun-Charset: US-ASCII
From: Rick Perley <rperley@aoc.nrao.edu>
To: abridle@aoc.nrao.edu
Subject: RM
Date: Wed, 27 Sep 1995 10:33:46 -0600

Alan:

Greg tells me he has a ten-frequency version of RM, which he will send to you right away. (Knowing Greg, he'll have it to you before I get this off). This version is a private one -- it couldn't be checked into the AIPS code because it uses those dreaded illegal routines found in 'Numerical Recipes'. We never did get that problem solved, did we.

I think this updated version should be available everywhere. Perhaps Eric can be persuaded to make this version 'legal'.

Rick

From root Wed Sep 27 12:41:25 1995
X-VM-v5-Data: ([nil nil nil nil t nil t nil nil]
["557" "Wed" "27" "September" "1995" "10:39:05" "-0600" "Greg Taylor" "gtaylor@aoc.nrao.edu"
"<199509271639.KAA06930@pegasus.aoc.nrao.edu>" "12" "fitting RMs with up to 10 freq" "^From:" nil nil "9" nil nil nil
nil]
nil)
Received: from cv3.cv.nrao.edu by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA144812; Wed, 27 Sep 1995 12:41:25 -0400
Received: from arana.aoc.nrao.edu by cv3.cv.nrao.edu (4.1/DDN-DLB/1.13)
id AA17139; Wed, 27 Sep 95 12:41:21 EDT
Received: from pegasus.aoc.nrao.edu (pegasus.aoc.nrao.edu [146.88.4.3]) by arana.aoc.nrao.edu (8.6.12/8.6.10) with
ESMTP id KAA17192; Wed, 27 Sep 1995 10:40:09 -0600
Received: (from gtaylor@localhost) by pegasus.aoc.nrao.edu (8.6.12/8.6.10) id KAA06930; Wed, 27 Sep 1995 10:39:05
-0600
Message-Id: <199509271639.KAA06930@pegasus.aoc.nrao.edu>
X-Sun-Charset: US-ASCII
From: Greg Taylor <gtaylor@aoc.nrao.edu>
To: abridle@NRAO.EDU
Cc: gtaylor@zia.aoc.nrao.edu
Subject: fitting RMs with up to 10 freq
Date: Wed, 27 Sep 1995 10:39:05 -0600

Hi Alan,

Rick tells me that you need a version of RM that handles more than
4 frequencies. JingPing and I wrote a version that can handle up
to 10 and could easily be modified to go beyond that, but we used
routines from Numerical Recipes so the code was never incorporated
into AIPS. I also wrote a program, RMCUB, to display the pixel-by-pixel
fits to the RM. It also handles up to 10 frequencies.

Let me know if you want these programs and I can e-mail or
ftp them to you. Ciao,

- Greg

From abridle Wed Sep 27 14:47:33 1995
X-VM-v5-Data: ([nil nil nil nil nil nil nil nil nil]
["761" "Wed" "27" "September" "1995" "14:47:28" "-0400" "Alan Bridle" "abridle" nil "22" "Re: fitting RMs with up to 10 freq" "^From:" nil nil "9" nil nil nil nil]
nil)
Received: by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA79166; Wed, 27 Sep 1995 14:47:28 -0400
Message-Id: <9509271847.AA79166@polaris.cv.nrao.edu>
In-Reply-To: <199509271639.KAA06930@pegasus.aoc.nrao.edu>
References: <199509271639.KAA06930@pegasus.aoc.nrao.edu>
From: abridle (Alan Bridle)
To: Greg Taylor <gtaylor@aoc.nrao.edu>
Subject: Re: fitting RMs with up to 10 freq
Date: Wed, 27 Sep 1995 14:47:28 -0400

Greg Taylor writes:
> Hi Alan,
>
> Rick tells me that you need a version of RM that handles more than
> 4 frequencies. JingPing and I wrote a version that can handle up
> to 10 and could easily be modified to go beyond that, but we used
> routines from Numerical Recipes so the code was never incorporated
> into AIPS. I also wrote a program, RMCUB, to display the pixel-by-pixel
> fits to the RM. It also handles up to 10 frequencies.
>
> Let me know if you want these programs and I can e-mail or
> ftp them to you. Ciao,
> - Greg

Hi Greg, glad to hear you're back in Socorro!

Yes, if you could E-mail them or put them somewhere I could
ftp them that would be excellent.

A.

From root Wed Sep 27 15:05:04 1995
X-VM-v5-Data: ([nil nil nil nil nil nil t nil nil]
["28972" "Wed" "27" "September" "1995" "13:04:49" "-0600" "Greg Taylor" "gtaylor@aoc.nrao.edu" nil "749"
"RM.FOR" "^From:" nil nil "9" nil nil nil nil]
nil)
Received: from arana.aoc.nrao.edu by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA79276; Wed, 27 Sep 1995 15:04:54 -0400
Received: from pegasus.aoc.nrao.edu (pegasus.aoc.nrao.edu [146.88.4.3]) by arana.aoc.nrao.edu (8.6.12/8.6.10) with
ESMTP id NAA20237; Wed, 27 Sep 1995 13:04:51 -0600
Received: (from gtaylor@localhost) by pegasus.aoc.nrao.edu (8.6.12/8.6.10) id NAA07516; Wed, 27 Sep 1995 13:04:49
-0600
Message-Id: <199509271904.NAA07516@pegasus.aoc.nrao.edu>
Content-Length: 28972
From: Greg Taylor <gtaylor@aoc.nrao.edu>
To: abridle@polaris.cv.nrao.edu, gbt@aoc.nrao.edu
Subject: RM.FOR
Date: Wed, 27 Sep 1995 13:04:49 -0600

RM.FOR

```
      PROGRAM RM
C-----------------------------------------------------------------------
C! Calculates rotation measure and intrinsic magnetic field from cube.
C# Map Math
C   COPYRIGHT 1988 by Associated Universities, Inc.
C   All rights reserved
C-----------------------------------------------------------------------
C   RM calculates the rotation measure and intrinsic magnetic field
C   from an input data cube whose first axis is frequency.  The current
C   version works with 3 or 4 input frequencies.
C   Inputs:
C     USERID              Owner of the image
C     INNAME              Image name (name)
C     INCLASS             Image name (class)
C     INSEQ               Image name (seq. #)
C     INDISK              Disk unit # of image
C     BLC(7)              Bottom Left corner to calculate RM
C     TRC(7)              Top right corner
C     OUTNAME               Output image name (name)
C     OUTCLASS(2)           Unused
C     OUTSEQ              Output image name (seq. #)
C     OUTDISK             Output image disk
C     APARM(10)           Information for solution:
C       (1): The number of frequencies in the cube.
C       (2): The number of frequencies to use in the fit.
C            The first APARM(2) frequencies will be used.
C       (3): Frequency of first map in MHz.
C       (4): Frequency of second map in MHz.
C       (5): Frequency of third map in MHz.
C       (6): Frequency of fourth map in MHz.
C       (7): The initial guess for the rotation measure. Use
C            the integrated values if nothing else is known.
C            UNITS are RADIANS per METER squared !
C       (8): Solution type. 0 => Unweighted fit
C            1 =>  Weight fit by errors.
C       (9): Blanking type. 0 => No blanking
C            1 => Blank both output maps if corr. coeff. < APARM(10)
C            2 => Blank both maps only if sigma of RM exceeds
C                 APARM(10) (rad/m.m)
```

```
C            3 => Blank both maps only if sigma of B > APARM(10)
C                 (degrees)
C            4 => Blank both maps if rms dev. per point from best
C                 fit line exceeds APARM(10) (degrees)
C            5 => Blank both output maps if in input error of any
C                 input map value exceeds APARM(10).
C                 THIS IS THE RECOMMENDED WAY.
C      (10): The blanking level.  See APARM(9).
C     BPARM(10):         frequeciency information
C       (1): Frequency of first map in MHz.
C       (2): Frequency o) second map in MHz.
C       (3): Frequency of third map in MHz.
C       (4): Frequency of forth map in MHz.
C       (5): Frequency of fifth  map in MHz.
C       (6): Frequency of sixth map in MHz.
C       (7): Frequency of seventh map in MHz.
C       (8): Frequency of eighth map in MHz.
C       (9): Frequency of nineth map in MHz.
C      (10): Frequency of tenth map in MHz.
C     SCALR1                Output value  (<= 0) or sigma maps (>0)
C-----------------------------------------------------------------------
      CHARACTER INNA*36, OUT2NA*36, OUTNA*36, PRGNAM*6, CHTMP*8,
     *   STOKES*4, ROTM*8, BFIELD*8, RUNITS*8
      HOLLERITH MAP, HCLASS(2)
      INTEGER   IMIN, IERR, NPARM, NFREQ, NPTS, NX, NY, I,
     *   J, INSL, OUTSL, OMAP2, K, OUT2SL, IBLNK, KK, CATIN(256),
     *   LMAP, OMAP, IER, IP, NPL
      LOGICAL   EQUAL, WASBLK, SOLTYP, OUTERR
      REAL      RPARM(50), DATA(20), RTM(4096), BPA(4096), RMMAX,
     *   WAVSQ(10), ROTMS, EPA, CATIR(256), BLC(7), TRC(7), RM0, ROTSIG,
     *   PASIG, CORR, BLKLEV, PHRMS, RTMAX, RTMIN, BPAMAX, BPAMIN
      REAL Q0
      DOUBLE PRECISION    CATID(128)
      INCLUDE 'INCS:DDCH.INC'
      INCLUDE 'INCS:DCAT.INC'
      INCLUDE 'INCS:DITB.INC'
      INCLUDE 'INCS:DHDR.INC'
      INCLUDE 'INCS:DBUF.INC'
      INCLUDE 'INCS:DMSG.INC'
      INCLUDE 'INCS:DFIL.INC'
      EQUIVALENCE (CATIN, CATIR, CATID)
      DATA PRGNAM /'RM    '/
      DATA STOKES /'STOK'/
      DATA LMAP, OMAP, OMAP2 /17, 18, 19/
      DATA ROTM, BFIELD /'ROTMES  ', 'BFIELD  '/
      DATA RUNITS /'RAD/M/M '/
C-----------------------------------------------------------------------
C                               Start up task and get parms
 10   NPARM = 50
      IER = 8
      CALL TSKBEG (PRGNAM, NPARM, RPARM, IERR)
      IF (IERR.EQ.0) GO TO 20
        WRITE (MSGTXT,1010) IERR
        GO TO 950
C                               Store input and output name
 20   CALL CHR2H (4, 'MA  ', 1, MAP)
      CALL H2WAWA (RPARM(2), RPARM(5), RPARM(7), MAP, RPARM(8),
     *   RPARM(1), INNA)
```

```
      CALL CHR2H (6, ROTM, 1, HCLASS)
      CALL H2WAWA (RPARM(23), HCLASS, RPARM(28), MAP, RPARM(29),
     *   RPARM(1), OUTNA)
      CALL CHR2H (6, BFIELD, 1, HCLASS)
      CALL H2WAWA (RPARM(23), HCLASS, RPARM(28), MAP, RPARM(29),
     *   RPARM(1), OUT2NA)
      WRITE (MSGTXT,4000)
      CALL MSGWRT (2)
      NFREQ = RPARM(30)
      NPTS = RPARM(31)
      DO 25 I = 1,10
        IBAD(I) = 0
 25     CONTINUE
C                             Open input map
      CALL OPENCF (LMAP, INNA, IERR)
      IF (IERR.EQ.0) GO TO 50
        WRITE (MSGTXT,1040) IERR
        GO TO 950
C                             Get header
 50   CALL GETHDR (LMAP, CATIN, IERR)
      IF (IERR.EQ.0) GO TO 80
        WRITE (MSGTXT,1050) IERR
        GO TO 950
C                             Set up window
 80   IF (RPARM(9).EQ.0.0) RPARM(9) = 1.0
      IF (RPARM(10).EQ.0.0) RPARM(10) = 1.0
      IF (RPARM(11).EQ.0.0) RPARM(11) = 1.0
      IF (RPARM(16).EQ.0.0) RPARM(16) = CATIN(KINAX+1)
      IF (RPARM(17).EQ.0.0) RPARM(17) = CATIN(KINAX + 2)
      BLC(1) = 1
      CALL RCOPY (6, RPARM(9), BLC(2))
      TRC(1) = NFREQ
      IF (RPARM(37).GT.0.0) TRC(1) = 2 * NFREQ
      CALL RCOPY (6, RPARM(16), TRC(2))
      CALL WINDOW (FILTAB(PODIM,6), FILTAB(PONAX,6), BLC, TRC, IERR)
      NX = TRC(2) - BLC(2) + 1
      NY = TRC(3) - BLC(3) + 1
      CALL MAPWIN (LMAP, BLC, TRC, IERR)
      IF (IERR.EQ.0) GO TO 85
        WRITE (MSGTXT,1080) IERR
        GO TO 950
C                             Get frequencies, and convert
C                             to wavelength squared in MKS
 85   CALL RCOPY (6, BLC(2), RPARM(9))
      CALL RCOPY (6, TRC(2), RPARM(16))
      DO 87 I = 1,NFREQ
        K = 39 + I
        WAVSQ(I) = (300./RPARM(K))**2
 87     CONTINUE
C                             Read solution type
      SOLTYP = RPARM(37).GT.0.0
      BLKLEV = RPARM(39)
      IBLNK = RPARM(38) + 0.01
      NPL = (TRC(7)-BLC(7)+1.) * (TRC(6)-BLC(6)+1.) *
     *   (TRC(5)-BLC(5)+1.) * (TRC(4)-BLC(4)+1.)
      IF ((.NOT.SOLTYP) .AND. (IBLNK.GE.5)) IBLNK = 0
      RPARM(38) = IBLNK
      OUTERR = RPARM(50).GT.0.0
```

```
      WASBLK = .FALSE.
      RTMAX = -1.E20
      RTMIN = 1.E20
      BPAMAX = -1.E20
      BPAMIN = 1.E20
C                               Get RM guess, convert
C                                to deg./sq. meter
      RM0 = RPARM(36) * 57.2957795
C                               Get RMMAX guess, convert
C                                to deg./sq. meter
      RMMAX = RPARM(35) * 57.2957795
C                               Create output map
      CALL COPY (256, CATIN, CATBLK)
      CALL HDRWIN (BLC, TRC, CATBLK, IERR)
C                               Swap axes to 2-dim image
      CALL SWAPAX (CATBLK, CATH, CATR, CATD, 1, 2, IERR)
      CALL SWAPAX (CATBLK, CATH, CATR, CATD, 2, 3, IERR)
      CATBLK(KINAX+2) = 1
      CALL MAPCR (INNA, OUT2NA, CATBLK, IERR)
 L    CALL CHR2H (8, RUNITS, 1, CATH(KHBUN))
      DO 95 I = 3,6
        CALL H2CHR (4, 1, CATH(KHCTP+I*2), CHTMP)
        EQUAL = STOKES(1:4) .EQ. CHTMP(1:4)
        IF (.NOT.EQUAL) GO TO 95
          CATD(KDCRV+I) = 10.0D0
          GO TO 96
 95     CONTINUE
 96   IF (IERR.EQ.0) CALL MAPCR (INNA, OUTNA, CATBLK, IERR)
      IF (IERR.EQ.0) GO TO 100
        WRITE (MSGTXT,1090) IERR
        GO TO 950
C                               Open output map
 100  CALL OPENCF (OMAP, OUTNA, IERR)
      IF (IERR.EQ.0) CALL OPENCF (OMAP2, OUT2NA, IERR)
      IF (IERR.EQ.0) GO TO 105
        WRITE (MSGTXT,1100) IERR
        GO TO 950
C                               Read a map Line
 105  DO 190 IP = 1,NPL
      DO 190 J = 1,NY
        DO 180 I = 1,NX
          CALL MAPIO ('READ', LMAP, DATA, IERR)
          IF (IERR.EQ.0) GO TO 110
            WRITE (MSGTXT,1105) J, IERR
            GO TO 950
C                       If any input pixel blanked, blank output
 110        DO 120 K= 1,NPTS
            IF (DATA(K).EQ.FBLANK) GO TO 155
 120          CONTINUE
C                       If blanking on input sigmas, test on
C                            input sigmas
          IF (IBLNK.LE.4) GO TO 130
            DO 125 K = 1,NPTS
              KK = K + NFREQ
              IF (DATA(KK).GT.BLKLEV) GO TO 155
 125            CONTINUE
C                               Calculate Rot. Meas. and errors
 130        CALL ROTFIT (DATA, SOLTYP, WAVSQ, IMIN, NFREQ, NPTS, RM0,
```

```
     *       RMMAX, ROTMS, EPA, ROTSIG, PASIG, CORR, PHRMS, Q0)
C                    Convert back to socially acceptable units
          ROTMS = ROTMS / 57.2957795
          ROTSIG = ROTSIG / 57.2957795
C                    Output map values or map errors?
          IF (.NOT.OUTERR) GO TO 135
            RTM(I) = ROTSIG
            BPA(I) = PASIG
            GO TO 175
C                    Branch according to blanking desired
C                      No blanking
 135        IF (IBLNK.GT.4) GO TO 160
          IF (IBLNK.LT.1) GO TO 160
C                      Blank by correlation coefficient
          IF (IBLNK.LT.2) GO TO 150
C                      Blank by sigma of R.M.
          IF (IBLNK.LT.3) GO TO 145
C                      Blank by sigma of intrinsic B field
          IF (IBLNK.LT.4) GO TO 140
C                      Blank by rms of phase fit
          IF (PHRMS.GT.BLKLEV) GO TO 155
            GO TO 160
 140        IF (PASIG.LT.BLKLEV) GO TO 160
            GO TO 155
 145        IF (ROTSIG.LT.BLKLEV) GO TO 160
            GO TO 155
 150        IF (ABS(CORR).GT.BLKLEV) GO TO 160
 155        CONTINUE
            RTM(I) = FBLANK
            BPA(I) = FBLANK
            WASBLK = .TRUE.
            GO TO 180
 160        CONTINUE
            RTM(I) = ROTMS
            BPA(I) = EPA + 90.
C     Adjust B-vector p.a. to lie between 0 and 180 degrees.
 165        IF (BPA(I).GE.0.) GO TO 170
            BPA(I) = BPA(I) + 180.
            GO TO 165
 170        IF (BPA(I).LT.180.) GO TO 175
            BPA(I) = BPA(I) - 180.
            GO TO 170
 175        IF (BPA(I).GT.BPAMAX) BPAMAX = BPA(I)
          IF (BPA(I).LT.BPAMIN) BPAMIN = BPA(I)
          IF (RTM(I).GT.RTMAX) RTMAX = RTM(I)
          IF (RTM(I).LT.RTMIN) RTMIN = RTM(I)
 180        CONTINUE
C                              Write an output Line
        CALL MAPIO ('WRIT', OMAP, RTM, IERR)
        CALL MAPIO ('WRIT', OMAP2, BPA ,IERR)
        IF (IERR.EQ.0) GO TO 190
          WRITE (MSGTXT,1180) J, IERR
          GO TO 950
 190    CONTINUE
C                              Get slot numbers
      INSL = FILTAB(POCAT,6)
C                              Close input map
      CALL FILCLS(LMAP)
```

```
C                               Close output files
      CALL FILCLS (OMAP)
      CALL FILCLS (OMAP2)
C                               Add to HI fiLe
      CALL OPENCF (OMAP, OUTNA, IERR)
      OUTSL = FILTAB(POCAT,6)
      CALL GETHDR (OMAP, CATBLK, IERR)
      CATR(KRBLK) = 0.0
      IF (WASBLK) CATR(KRBLK) = FBLANK
      CATR(KRDMX) = RTMAX
      CATR(KRDMN) = RTMIN
      CALL FILCLS (OMAP)
      IER = 0
      CALL RMHI (INNA, OUTNA, INSL, OUTSL, RPARM, CATBLK)
      CALL OPENCF (OMAP2, OUT2NA, IERR)
      OUT2SL = FILTAB(POCAT,6)
      CALL GETHDR (OMAP2, CATBLK, IERR)
      CATR(KRBLK) = 0.0
      IF (WASBLK) CATR(KRBLK) = FBLANK
      CATR(KRDMX) = BPAMAX
      CATR(KRDMN) = BPAMIN
      CALL FILCLS (OMAP2)
      CALL RMHI (INNA, OUT2NA, INSL, OUT2SL, RPARM, CATBLK)
      GO TO 990
C-------------------------------------------------------------------------
C                               Error return
 950  CALL MSGWRT (8)
C                               Normal return
 990  CALL TSKEND (IER)
C
      STOP
C-------------------------------------------------------------------------
 1010 FORMAT ('COULD NOT GET INPUT PARAMETERS. IERR=',I8)
 1040 FORMAT ('COULD NOT OPEN INPUT MAP.  IERR=',I8)
 1050 FORMAT ('COULD NOT GET INPUT HEADER.  IERR',I8)
 1065 FORMAT ('NO FREQUENCY AXIS')
 1080 FORMAT ('COULD NOT GET MAP, WINDOW.  IER=',I8)
 1090 FORMAT ('COULD NOT CREATE OUTPUT MAP.  IER=',I8)
 1100 FORMAT ('COULD NOT OPEN OUTPUT MAP.  IER=',I8)
 1105 FORMAT ('COULD NOT READ LINE #',I5,'  IER=',I8)
 1180 FORMAT ('COULD NOT WRITE LINE #',I5,'  IER=',I8)
 1190 FORMAT ('COULD NOT MAKE HI FILE.   IER=',I8)
 4000 FORMAT ('You are using a non-standard program')
      END
      SUBROUTINE RMHI (INNA, CTNA, INSL, OUTSL, RPARM, CATBLK)
C-------------------------------------------------------------------------
C   RMHI creates and Writes the HI fiLe for the task RM.
C   Inputs:
C      INNA          C*36  Input map name, etc.
C      CTNA          C*36  Output map name, etc.
C      INSL          I     SLot number for input map
C      OUTSL         I     SLot number for output map
C      RPARM(50)     R     Input parameters
C      CATBLK(256)   I     Output map header
C   Outputs:
C      IERR          I     Error return 0 -> okay
C                                1 -> uh-oh
C-------------------------------------------------------------------------
```

```
      CHARACTER INNA*36, CTNA*36, HILINE*72, INAME*12, ICLASS*6,
     *   PTYPE*2, ONAME*12, OCLASS*6
      INTEGER   IERR, NHISTF, LHIN, LHOUT, INSL, OUTSL, I, J,
     *   IBUFF1(256), IBUFF2(256), CATBLK(256), BLC(6), TRC(6), ISEQ,
     *   OSEQ, IVOL, OVOL, USID
      REAL      RPARM(50)
      LOGICAL   T
      INCLUDE 'INCS:DMSG.INC'
      INCLUDE 'INCS:DHIS.INC'
      DATA NHISTF, LHIN, LHOUT /2,27,28/
      DATA T /.TRUE./
C-------------------------------------------------------------------------
C                               Initialize HI
 10   CALL HIINIT (NHISTF)
C                               Create and open output HI fiLe
      CALL WAWA2A (INNA, INAME, ICLASS, ISEQ, PTYPE, IVOL, USID)
      CALL WAWA2A (CTNA, ONAME, OCLASS, OSEQ, PTYPE, OVOL, USID)
      CALL HISCOP (LHIN, LHOUT, IVOL, OVOL, INSL, OUTSL, CATBLK,
     *   IBUFF1, IBUFF2, IERR)
      IF (IERR.LE.2) GO TO 20
        WRITE (MSGTXT,1010) IERR
        GO TO 65
C                               Add new HI entries
C                                 Input name
 20   CALL HENCO1 (TSKNAM, INAME, ICLASS, ISEQ, IVOL, LHOUT, IBUFF2,
     *   IERR)
      IF (IERR.NE.0) GO TO 60
C                                 Output name
      CALL HENCOO (TSKNAM, ONAME, OCLASS, OSEQ, OVOL, LHOUT, IBUFF2,
     *   IERRC
      IF (IERR.NE.0) GO TO 60
C                               Type output
      IF (RPARM(50).LE.0.0) WRITE (HILINE,1020) TSKNAM
      IF (RPARM(50).GT.0.0) WRITE (HILINE,1021) TSKNAM
      CALL HIADD (LHOUT, HILINE, IBUFF2, IERR)
      IF (IERR.NE.0) GO TO 60
C                               BLC and TRC
      DO 25 I = 1,6
        BLC(I) = RPARM(8+I) + 0.01
        TRC(I) = RPARM(15+I) + 0.01
 25     CONTINUE
      WRITE (HILINE,1025) TSKNAM, BLC, TRC
      CALL HIADD (LHOUT, HILINE, IBUFF2, IERR)
      IF (IERR.NE.0) GO TO 60
C                               Frequencies
      I = RPARM(30) + 0.01
      J = RPARM(31) + 0.01
      WRITE (HILINE,1026) TSKNAM, I, J
      CALL HIADD (LHOUT, HILINE, IBUFF2, IERR)
      IF (IERR.NE.0) GO TO 60
      DO 30 I = 1,J
        WRITE (HILINE,1027) TSKNAM, I, RPARM(31+I)
        CALL HIADD (LHOUT, HILINE, IBUFF2, IERR)
        IF (IERR.NE.0) GO TO 60
 30     CONTINUE
C                               Initial guess
      WRITE (HILINE,1030) TSKNAM, RPARM(36)
      CALL HIADD (LHOUT, HILINE, IBUFF2, IERR)
```

```
      IF (IERR.NE.0) GO TO 60
C                               Weighted?
      IF (RPARM(37).LE.0.0) GO TO 40
        WRITE (HILINE,1031) TSKNAM
        CALL HIADD (LHOUT, HILINE, IBUFF2, IERR)
        IF (IERR.NE.0) GO TO 60
C                               Blanking
 40   I = RPARM(38) + 0.01
      IF ((I.LE.0) .OR. (I.GT.5)) GO TO 70
      IF (I.EQ.1) WRITE (HILINE,1041) RPARM(39)
      IF (I.EQ.2) WRITE (HILINE,1042) RPARM(39)
      IF (I.EQ.3) WRITE (HILINE,1043) RPARM(39)
      IF (I.EQ.4) WRITE (HILINE,1044) RPARM(39)
      IF (I.EQ.5) WRITE (HILINE,1045) RPARM(39)
      CALL HIADD (LHOUT, HILINE, IBUFF2, IERR)
      IF (IERR.NE.0) GO TO 60
      GO TO 70
C                               Error
 60   WRITE (MSGTXT,1060) IERR
 65   CALL MSGWRT (8)
C                               Close HI fiLe
 70   CALL HICLOS (LHOUT, T, IBUFF2, IERR)
C
      RETURN
C-------------------------------------------------------------------------
 1010 FORMAT ('CANNOT COPY HI FILE.  IER=',I8)
 1020 FORMAT (A6,1X,'/ Output images of rotation measure and bfield')
 1021 FORMAT (A6,1X,'/ Output images of uncertainties in rotation',
     *   ' measure and bfield')
 1025 FORMAT (A6,1X,'BLC=',2(I4,','),I4,3(',',I3),'   TRC=',2(I4,','),
     *   I4,3(',',I3))
 1026 FORMAT (A6,' NFREQ=',I3,'  NFIT=',I3,3X,'/ Frequencies in data',
     *   ' and in fit')
 1027 FORMAT (A6,' FREQ(',I2,')=',1PE13.5,' MHz')
 1030 FORMAT (A6,' RM0 =',F13.4,' Rad/m/m  / Initial guess')
 1031 FORMAT (A6,' / Fit weighted by error images')
 1041 FORMAT (A6,' /blanked if corr. coeff. <',1PE13.5)
 1042 FORMAT (A6,' /blanked if sigma(RM) >',1PE13.5,' Rad/m/m')
 1043 FORMAT (A6,' /blanked if sigma(B) >',1PE13.5,' degrees')
 1044 FORMAT (A6,' /blanked if RMS >',1PE13.5,' degrees')
 1045 FORMAT (A6,' /blanked if input RMS >',1PE13.5,' degrees')
 1060 FORMAT ('CANNOT ADD LINES TO HI FILE.  IER=',I8)
      END

      SUBROUTINE ROTFIT (DATA, SOLTYP, WAVSQ, IMIN, NFREQ, NPTS, RM0,
     *   RMMAX, FROTMS, FEPA, FSIGROT, FSIGPA, FCORR, FPHRMS, Q0)
C-------------------------------------------------------------------------
C   ROTFIT sets up the data for the least squares fit.  Its most
C   important task is to discover and remove ambiguities from the data.
C   Inputs:
C     DATA(20)    R    Input data, the position angles at various
C                      frequencies measured at the same RA and Dec.
C     SOLTYP      L    Solution type: T => weighted
C     WAVSQ(10)   R    Array of squared wavelengths.
C     RMMAX       R    The maxmium allowed rot. meas.
C     RM0         R    The initial guess of the rot. meas.
C     NFREQ       R    The number of frequencies.
C   Outputs:
```

```
C     FROTMS       R    The rotation measure.
C     FEPA         R    Intrinsic value of electric vector.
C     FSIGROT      R    Error in the rotation measure
C     FSIGPA       R    Error in the position angle
C     CORR         R    Correlation coefficient
C     Q0           R    Goodness of fit
C     FPHRMS       R    The rms error of the fit
C-----------------------------------------------------------------------
      REAL     DIF
      INTEGER  NFREQ, I, J, LL, MM, NPTS, NCYC, ICYC, IMIN, NNPTS
      REAL     ROTMS, EPA, SIGROT, SIGPA, CORR, RM0, RDATA(20),
     *  DATA(20), WAVSQ(10), PHRMS, PHSUM, DELRM0, CHI2, RMMAX
      REAL     RWAVSQ(10)
      REAL     FROTMS, FEPA, FSIGROT, FSIGPA, FCORR, FPHRMS, Q0
      REAL     Q, SX, SY, ST2, B, SS, T, SXOSS, A, SIGDAT
      REAL     GAMMQ
      LOGICAL  SOLTYP
C-----------------------------------------------------------------------
C                              For a given biggest rot. meas.
C                              estimate how many posiable turns
C                              between the first two freq.
      Q0=0
      NCYC=0
      DO 10 I = 1, NFREQ
C        J = NFREQ+1-I
         J = I
         RWAVSQ(I) = WAVSQ(J)
 10   CONTINUE
C
      IF(RMMAX.NE.0) NCYC=NINT(RMMAX*(RWAVSQ(1)-RWAVSQ(2))/180.)
      NCYC=ABS(NCYC)
C                              Try all the possiable turns
      DO 200 MM = 1,2*NCYC+1
        DO 20 I = 1,NFREQ
          J = I
          RDATA(I) = DATA(J)
          RWAVSQ(I) = WAVSQ(J)
          RDATA(I+NFREQ)=DATA(J+NFREQ)
C                              Correct the input angles by the
C                              initial r.m. guess
          RDATA(I) = RDATA(I) - RM0 * RWAVSQ(I)
 20     CONTINUE
C                              We assume no ambiguities between
C                              the first two frequencies
      DIF = RDATA(1) - RDATA(2)
      IF (DIF.GT.90) RDATA(2) = RDATA(2) + 180.
      IF (DIF.LT.-90) RDATA(2) = RDATA(2) - 180.
C                              Try all the possiable turns
      RDATA(2) = RDATA(2) + (MM-NCYC-1)*180
      DELRM0 = (RDATA(2)-RDATA(1))/(RWAVSQ(2)-RWAVSQ(1))
C                              Now remove additional term
      DO 25 I = 1,NFREQ
        RDATA(I) = RDATA(I) - DELRM0 * RWAVSQ(I)
 25     CONTINUE
C                              Now remove amgiguities between
C                              the second and third frequencies
      DIF = RDATA(2) - RDATA(3)
      ICYC = (ABS(DIF)+90.)/180
```

```
      IF (DIF.GT.0) THEN
        RDATA(3)=RDATA(3)+ICYC*180
      ELSE
        RDATA(3)=RDATA(3)-ICYC*180
      ENDIF
C                             Retrend the DATA to get a
C                             meaningful corr. coeff.
      DO 30 J = 1,NFREQ
        RDATA(J) = RDATA(J) + (RM0 + DELRM0) * RWAVSQ(J)
 30     CONTINUE
C                             Do a least squares fit on the
C                             first 3 points
      DO 50 LL=3, NPTS
        CALL RMSFIT (RDATA, SOLTYP, RWAVSQ, NFREQ, LL, ROTMS,
     *       EPA, SIGROT, SIGPA, CORR, CHI2, Q)
C                             If we are to fit to 3 points
C                             only, we are finished.
        IF (NPTS.EQ.LL) GO TO 100
C                             We hope we are close to the
C                             correct answer. Adjust the data
C                             by the latest RM estimate
        DO 35 I = 1,NFREQ
          RDATA(I) = RDATA(I) - ROTMS * RWAVSQ(I)
 35       CONTINUE
C                             Now we correct for those awful
C                             ambiguities
        DO 40 I = 2,NFREQ
          DIF = RDATA(I-1) - RDATA(I)
          ICYC = (ABS(DIF)+90.)/180
        IF (DIF.GT.0) THEN
          RDATA(I)=RDATA(I)+ICYC*180
        ELSE
          RDATA(I)=RDATA(I)-ICYC*180
        ENDIF
 40       CONTINUE
C                             And we are ready for another
C                             fit.  First, detrend the data.
        DO 45 I = 1,NFREQ
         RDATA(I) = RDATA(I) + ROTMS * RWAVSQ(I)
 45       CONTINUE
 50   CONTINUE
C                             Calculate the rms error of the
C                             fit.
 100  PHRMS = SQRT(CHI2) / NPTS
C                             Using the goodness of fit to
C                             decide which set of fit to keep
       IF(Q.GE.Q0) THEN
         FROTMS=ROTMS
         FEPA=EPA
         FSIGROT=SIGROT
         FSIGPA=SIGPA
         FPHRMS=PHRMS
         FCORR=CORR
         Q0=Q
        ENDIF
200   CONTINUE
C
      RETURN
```

```
      END

      SUBROUTINE RMSFIT (Y, SOLTYP, X, NFREQ, NPTS, ROTMS, EPA,
     *   SIGROT, SIGPA, CORR, CHI2, Q)
C-------------------------------------------------------------------------
C     RMSFIT fits a linear least squares fit to positions data as a
C     function of wavelength squared. It will do an unweighted fit (SOLTYP
C     false) or a fit weighted by the error in the data (SOLTYP true) and
C     estimate the goodness of fit. In the later case, sigma maps must be
C     available for each frequency.
C     inputs:
C       Y(20)    R     Input data, the position angles at various
C                       frequencies measured at the same RA and DEC.
C       SOLTYP   L     Solution type: true=> do weighted.
C       X(10)    R     Array of squared wavelengths.
C       NFREQ    I     The number of frequnecies.
C       NPTS     I     Use the first NPTS data to do the fit.
C     outputs:
C       ROTMS    R     The rotation measure.
C       EPA      R     Intrinsic value of electric vector.
C       SIGROT   R     Error in the rotation measure.
C       SIGPA    R     Error in the position angle.
C       CORR     R     Correlation coefficient.
C     The program is modified from "Numerical Recipies"
C-------------------------------------------------------------------------
      LOGICAL   SOLTYP
      INTEGER   NFREQ, I, NPTS
      REAL      ROTMS, EPA, SIGROT, SIGPA, WT, DELTA, COV, CHI2, CORR
      REAL      Y(20), X(10)
      REAL      Q, SX, SY, ST2, B, SS, T, SXOSS, A, SIGDAT, GAMMQ
C
      SX=0.
      SY=0.
      ST2=0.
      B=0.
      IF(SOLTYP) THEN
        SS=0.
        DO 11 I=1,NPTS
          WT=1./(Y(I+NFREQ)**2)
          SS=SS+WT
          SX=SX+X(I)*WT
          SY=SY+Y(I)*WT
11      CONTINUE
      ELSE
        DO 12 I=1,NPTS
          SX=SX+X(I)
          SY=SY+Y(I)
12      CONTINUE
        SS=FLOAT(NPTS)
      ENDIF
      SXOSS=SX/SS
      IF(SOLTYP) THEN
        DO 13 I=1,NPTS
          T=(X(I)-SXOSS)/Y(I+NFREQ)
          ST2=ST2+T*T
          B=B+T*Y(I)/Y(I+NFREQ)
13      CONTINUE
      ELSE
```

```
      DO 14 I=1,NPTS
        T=X(I)-SXOSS
        ST2=ST2+T*T
        B=B+T*Y(I)
14    CONTINUE
    ENDIF
    B=B/ST2
    A=(SY-SX*B)/SS
    EPA = A
    ROTMS = B
    SIGPA=SQRT((1.+SX*SX/(SS*ST2))/SS)
    SIGROT=SQRT(1./ST2)
    CHI2=0.
    IF(.NOT.SOLTYP) THEN
      DO 15 I=1,NPTS
        CHI2=CHI2+(Y(I)-A-B*X(I))**2
15    CONTINUE
      Q=1.
      SIGDAT=SQRT(CHI2/(NPTS-2))
      SIGPA=SIGPA*SIGDAT
      SIGROT=SIGROT*SIGDAT
    ELSE
      DO 16 I=1,NPTS
        CHI2=CHI2+((Y(I)-A-B*X(I))/Y(I+NFREQ))**2
16    CONTINUE
      Q=GAMMQ(0.5*(NPTS-2),0.5*CHI2)
    ENDIF
    COV= -SX/(SS*ST2)
    CORR=COV/(SIGPA*SIGROT)
    RETURN
    END
C-------------------------------------------------------------------------
C     Functions to calculate the goodness of fit using chi-square
c     merit. The program is lifted from "Numerical recipies"
c     Press, Flannery, Teukolsky, Vetterling; Chapter 6.2; Chapter 14.2,
c     Page 507, (1986).
C-------------------------------------------------------------------------
    FUNCTION GAMMQ(A,X)
    REAL GAMMQ, A, X, GLN, GAMSER
C
    IF(X.LT.0..OR.A.LE.0.)PAUSE
    IF(X.LT.A+1.)THEN
      CALL GSER(GAMSER,A,X,GLN)
      GAMMQ=1.-GAMSER
    GLSE
      CALL GCF(GAMMQ,A,X,GLN)
    ENDIF
    RETURN
    END
C
    FUNCTION GAMMLN(XX)
    INTEGER J
    REAL GAMMLN
    REAL XX
    REAL*8 COF(6),STP,HALF,ONE,FPF,X,TMP,SER
C
    DATA COF,STP/76.18009173D0,-86.50532033D0,24.01409822D0,
   *    -1.231739516D0,.120858003D-2,-.536382D-5,2.50662827465D0/
```

```
      DATA HALF,ONE,FPF/0.5D0,1.0D0,5.5D0/
      X=XX-ONE
      TMP=X+FPF
      TMP=(X+HALF)*LOG(TMP)-TMP
      SER=ONE
      DO 11 J=1,6
        X=X+ONE
        SER=SER+COF(J)/X
11    CONTINUE
      GAMMLN=TMP+LOG(STP*SER)
      RETURN
      END
C
      SUBROUTINE GSER(GAMSER,A,X,GLN)
      PARAMETER (ITMAX=100,EPS=3.E-7)
      INTEGER N
      REAL GAMMLN, GAMSER, GLN, X, A, AP, SUM, DEL
C
      GLN=GAMMLN(A)
      IF(X.LE.0.)THEN
        IF(X.LT.0.)PAUSE
        GAMSER=0.
        RETURN
      ENDIF
      AP=A
      SUM=1./A
      DEL=SUM
      DO 11 N=1,ITMAX
        AP=AP+1.
        DEL=DEL*X/AP
        SUM=SUM+DEL
        IF(ABS(DEL).LT.ABS(SUM)*EPS)GO TO 1
11    CONTINUE
      PAUSE 'A too large, ITMAX too small'
1     GAMSER=SUM*EXP(-X+A*LOG(X)-GLN)
      RETURN
      END
C
      SUBROUTINE GCF(GAMMCF,A,X,GLN)
      PARAMETER (ITMAX=100,EPS=3.E-7)
      INTEGER N
      REAL GAMMLN, GOLD, G, A, X, A0, A1, B0, B1, FAC, AN, ANA, ANF, GLN
      REAL GAMMCF
C
      GLN=GAMMLN(A)
      GOLD=0.
      A0=1.
      A1=X
      B0=0.
      B1=1.
      FAC=1.
      DO 11 N=1,ITMAX
        AN=FLOAT(N)
        ANA=AN-A
        A0=(A1+A0*ANA)*FAC
        B0=(B1+B0*ANA)*FAC
        ANF=AN*FAC
        A1=X*A0+ANF*A1
```

```
      B1=X*B0+ANF*B1
      IF(A1.NE.0.)THEN
        FAC=1./A1
        G=B1*FAC
        IF(ABS((G-GOLD)/G).LT.EPS)GO TO 1
        GOLD=G
      ENDIF
11    CONTINUE
      PAUSE 'A too large, ITMAX too small'
1     GAMMCF=EXP(-X+A*ALOG(X)-GLN)*G
      RETURN
      END
```

From root Wed Sep 27 15:05:16 1995
X-VM-v5-Data: ([nil nil nil nil nil nil t nil nil]
["5751" "Wed" "27" "September" "1995" "13:05:06" "-0600" "Greg Taylor" "gtaylor@aoc.nrao.edu" nil "112"
"RM.HLP" "^From:" nil nil "9" nil nil nil nil]
nil)
Received: from arana.aoc.nrao.edu by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA90554; Wed, 27 Sep 1995 15:05:11 -0400
Received: from pegasus.aoc.nrao.edu (pegasus.aoc.nrao.edu [146.88.4.3]) by arana.aoc.nrao.edu (8.6.12/8.6.10) with
ESMTP id NAA20244; Wed, 27 Sep 1995 13:05:08 -0600
Received: (from gtaylor@localhost) by pegasus.aoc.nrao.edu (8.6.12/8.6.10) id NAA07556; Wed, 27 Sep 1995 13:05:06
-0600
Message-Id: <199509271905.NAA07556@pegasus.aoc.nrao.edu>
Content-Length: 5751
From: Greg Taylor <gtaylor@aoc.nrao.edu>
To: abridle@polaris.cv.nrao.edu, gbt@aoc.nrao.edu
Subject: RM.HLP
Date: Wed, 27 Sep 1995 13:05:06 -0600

RM.HLP
RM LLLLLLLLLLLLUUUUUUUUUUUU CCCCCCCCCCCCCCCCCCCCCCCCCCCCC
RM: Task to calculate rotation measure and magnetic field
USERID -32000.0 32000.0 User ID. 0 => current user
32000 => any user.
INNAME Input image name (name)
INCLASS Input image name (class)
INSEQ 0.0 9999.0 Input image name (seq. #)
INDISK 0.0 9.0 Input image disk drive #
BLC 0.0 4096.0 Bottom Left corner of fit
TRC 0.0 4096.0 Top Right corner of fit
OUTNAME Output image name (name)
OUTCLASS Output image name (class)
(NOT USED AT PRESENT)
OUTSEQ -1.0 9999.0 Output image name (seq. #)
OUTDISK 0.0 9.0 Output disk drive #
APARM See HELP for details
BPARM See HELP for details
SCALR1 0.0 10.0 <= 0 => Output normal map
> 0 => Output error on map

RM
Type: Task
Use: RM is a task which calculates rotation measure and
intrinsic magnetic field from a set of (at least three)
position angle maps made at different frequencies. The

current version can accept a maximum of four frequencies.
The algorithm will fit an unweighted or weighted fit of
the position angle to the wavelength squared. In the
latter case, sigma (error) maps must also be supplied.
These error maps must be made with the task COMB.
RM outputs both a map of the rotation measure, and
a map of the intrinsic magnetic field. Various
blanking options are supplied and it is vigorously
suggested that one of them be used.

BLC, TRC values:

BLC(1-6) : TRC(1-6) apply to axes 2 - 7 of the input
cube. In other words, they are the desired OUTPUT
window rather than the input window. APARM(1), APARM(2),
and APARM(8) control the input window on the first
(actually frequency) axis of the cube.

APARM values:

(1): The number of frequencies in the cube.
(2): The number of frequencies to use in the fit.
The first APARM(2) frequencies will be used.
(3): Frequency of first map in MHz.
(4): Frequency of second map in MHz.
(5): Frequency of third map in MHz.
(6): The maximum allowed rotation measure. If APAR(6)>0
the program will try to fit rotation measure between
0 and APAR(6), and output the best fit. For this use,
the error information must be avaliable.
UNITS are RADIANS per METER squared !
(7): The initial guess for the rotation measure. Use
the integrated values if nothing else is known.
UNITS are RADIANS per METER squared !
(8): Solution type. <= 0 => Unweighted fit
>0 => Weight fit by errors.
(9): Blanking type. 0 => No blanking
1 => Blank both output maps if corr. coeff. < APARM(10).
2 => Blank both maps only if sigma of RM exceeds
APARM(10) (rad/m.m)
3 => Blank both maps only if sigma of B > APARM(10)
(degrees)
4 => Blank both maps if rms dev. per point from best
fit line exceeds APARM(10) (degrees)
5 => Blank both output maps if in input error of any
input map value exceeds APARM(10).
THIS IS THE RECOMMENDED WAY.
(10): The blanking level. See APARM(9).

BPARM values:

(1): Frequency of first map in MHz.
(2): Frequency of second map in MHz.
(3): Frequency of third map in MHz.
(4): Frequency of forth map in MHz.
(5): Frequency of fifth map in MHz.
(6): Frequency of sixth map in MHz.
(7): Frequency of seventh map in MHz.
(8): Frequency of eighth map in MHz.
(9): Frequency of nineth map in MHz.
(10): Frequency of tenth map in MHz.

To run RM, you must follow these steps:

1) Run AXDEFINE for each p.a. map and each sigma map (if you
   wish weighted fits), and change the 3rd axis (frequency)
   to an arbitrary unit (i.e. 'PERLEYS'), whose values
   increase uniformly from map to map. Although the order of
   the frequencies is not critical, the program stands the
   best chance of working properly if the 3rd axis increases
   with frequency. It is important that the two frequencies
   closest in wavelength have the 3rd axes set to 1 and 2.
   Set the third axis of the position angle maps from 1 to
   N, where N is the number of frequencies, then set the
   position angle error maps to have the third axis run from N+1
   to 2N, keeping the same frequency order as the position
   angle maps. (If you do not intend to weight by fit, you need
   not include the error maps). When running AXDEFINE, set
   AXINC = 1 and AXREF = 1 also.
2) Run RENAME for each map to make the name and class of each
   the same. Make the sequence number of each map the same as
   the new "frequency" value (i.e. from 1 to N for the position
   angle maps, and N+1 to 2N for the error maps.)
3) Run MCUBE and assemble these N (or 2N if you want a weighted
   fit) maps into a data cube.
4) Run TRANS and transpose the cube. Make the initial first
   axis ('LL') the second, the initial second ('MM') the third,
   and the initial tLird (frequency in units of 'PERLEYS' or
   whatever) the first. That is, the new order is '312'.
5) Run RM ! INNAME is the transposed cube. Only the OUTNAME
   is used, OUTCLASS is pre-set to 'ROTMES' and 'BFIELD'.

From root Wed Sep 27 15:05:43 1995
X-VM-v5-Data: ([nil nil nil nil nil nil t nil nil]
        ["44300" "Wed" "27" "September" "1995" "13:05:24" "-0600" "Greg Taylor" "gtaylor@aoc.nrao.edu" nil "1165"
"RMCUB.FOR" "^From:" nil nil "9" nil nil nil nil]
        nil)
Received: from arana.aoc.nrao.edu by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
         id AA135619; Wed, 27 Sep 1995 15:05:31 -0400
Received: from pegasus.aoc.nrao.edu (pegasus.aoc.nrao.edu [146.88.4.3]) by arana.aoc.nrao.edu (8.6.12/8.6.10) with
ESMTP id NAA20250; Wed, 27 Sep 1995 13:05:27 -0600
Received: (from gtaylor@localhost) by pegasus.aoc.nrao.edu (8.6.12/8.6.10) id NAA07596; Wed, 27 Sep 1995 13:05:24
-0600
Message-Id: <199509271905.NAA07596@pegasus.aoc.nrao.edu>
Content-Length: 44300
From: Greg Taylor <gtaylor@aoc.nrao.edu>
To: abridle@polaris.cv.nrao.edu, gbt@aoc.nrao.edu
Subject: RMCUB.FOR
Date: Wed, 27 Sep 1995 13:05:24 -0600

RMCUB.FOR
      PROGRAM RMCUB
C---
C! Plots polarization angle vs wavelength**2 for a grid in y and z.
C# Plot-appl Map Spectral
C   COPYRIGHT 1988 by Associated Universities, Inc.
C   All rights reserved
C---
C   Plots pol. angle as a function of the variable along the first axis
C   in panels, which are positioned according to the coordinate values
C   along axes # 2 and # 3.

```
C     Adverb    in program     description
C     USERID       USER        USER ID. 0=> current user
C     INNAME       NAM         Image name (name)
C     INCLASS      CLS         Image name (class)
C     INSEQ        SQIN        Image name (seq. #)
C     INDISK       DKIN        Disk drive #
C     BLC          BLC         Bottom left corner image. 0=> all
C     TRC          TRC         Top right corner image.   0=> all
C     LTYPE        TYPE        Type of labeling. See RMCUB.HLP
C     APARM        APARM       Plotting parameters:
C                                (1) Number of frequencies in cube
C                                (2) Number of frequencies to be used
C                                   in the fit.  The first APARM(2)
C                                   frequecies will be used.
C                                (3) Number panels in x direction
C                                (4) Number panels in y direction
C                                (5) label type for panels
C                                (6) Maximum allowed rotation measure
C                                (7) initial guess for RM in rads/m**2
C                                (8) Solution type (>0 do weighted fit,
C                                   assumes last half of cube error maps
C                                (9) y value (map units) for x panel axis
C                               (10) x value (x units) for y panel axis
C     BPARM        BPARM       Frequencies and Options
C                                (1-8) first eight frequencies in cube
C                                (9) > 0 include zero wavelength in plot
C                               (10) 0 => self scale x axis
C     INFILE       INFILE      Optional test file containing the
C                                frequency of each plane of the
C                                input cube.
C     DOTV         R  > 0 => TV, else plot file
C     GRCHAN       R  graphics channel to use
C-----------------------------------------------------------------------
      INTEGER MAXCO
      PARAMETER (MAXCO = 16)
C
      CHARACTER PHNM*48, TEXT(2)*80, MTYPE*2, INFILE*64,
     *   NAM*12, CLS*6, PGMNAM*6, STAT*4, RBUFF*80
      HOLLERITH XNAM(3), XCLS(2), XINFIL(12)
      INTEGER   VOL, SEQ, USR, LUN, IND, CNR, CATBLK(256), SCR(256),
     *   IER, NAX, PAX(7), DPT(5), BOF, WIN(4), GFIND, FIND, ILUN,
     *   IBF(2048), NBF, JTOT, KTOT, JP, KP, JPAG, KPAG,IKBP,IKMAX,
     *   NPARM, IRET, ITP, JT, KT, LABEL, VER, GLUN,
     *   LTP, I, NTEXT, KI, JI, IT, BKOF, MAGIC, IROUND, IYINC,
     *   IZINC, IPTYPE, IERR, NSMTH, IWTFIT, NFREQ, NPTS
      REAL      GRCHN, TVCHN, TVCORN(4)
      REAL      CATR(256), RBF(1024),
     *   USER, SQIN, DKIN, BLC(7), TRC(7), LP(2), RP(2), CHOUT(4),
     *   TYPE, AMX, AMN, APARM(10), BPARM(10), LC(7), RC(7),
     *   UNITY, ARR(512), YINC, ZINC, PIXR(2), RANGE(2), MBLC(7),
     *   MTRC(7), XTRA1, XTRA2, XTRA3, XTRA4, YGAP,
     *   ZOFF, ARRS(512), COEFFS(MAXCO), RFREQ(20), RMMAX, RMNOT
      REAL XDOTV, XGRCH
      DOUBLE PRECISION    CATD(128), YX, XY, XFVAL
      LOGICAL   T, F, DONCR, SLICE, FBL, DOTV, DOXSLF, DOFILE
      INCLUDE 'INCS:DDCH.INC'
      INCLUDE 'INCS:DMSG.INC'
      INCLUDE 'INCS:DFIL.INC'
```

```
      INCLUDE 'INCS:DHDR.INC'
      INCLUDE 'INCS:DLOC.INC'
      INCLUDE 'INCS:DGPH.INC'
      COMMON /MAPHDR/ CATBLK
      COMMON /INPARM/ USER, XNAM, XCLS, SQIN, DKIN, BLC, TRC, YINC,
     *   ZINC, PIXR, TYPE, APARM, BPARM, XINFIL, XDOTV, XGRCH
      EQUIVALENCE (CATBLK, CATR, CATD)
      EQUIVALENCE (IBF(1), RBF(1))
      DATA UNITY /1./
      DATA T, F /.TRUE.,.FALSE./
      DATA PGMNAM, MAGIC / 'RMCUB ', 32000/
      DATA LUN, NBF, BKOF, ILUN /16, 4096, 1, 10/
C-------------------------------------------------------------------------
C                               fill common IDCH
C                               enter parameter values
      DONCR = F
      NPARM = 61
      CALL SETUP (PGMNAM, NPARM, USER, SCR, IRET)
      IF (IRET.NE.0) GO TO 990
      IRET = 8
C
C                               say hello, reassure the user
      WRITE (MSGTXT, 1400)
      CALL MSGWRT (2)
C                               interpret input
      CALL H2CHR (12, 1, XNAM, NAM)
      CALL H2CHR (6, 1, XCLS, CLS)
      CALL H2CHR (48, 1, XINFIL, INFILE)
      SEQ  = SQIN + 0.01
      VOL  = DKIN + 0.01
      USR  = ABS (USER) + 0.01
      LTP  = IROUND (TYPE)
      IF (LTP.EQ.0) LTP = 3
      JTOT = APARM(3) + 0.01
      KTOT = APARM(4) + 0.01
      IF (USR.LE.0) USR = NLUSER
      IF (USR.EQ.MAGIC) USR = 0
      IYINC = YINC + 0.01
      IF (IYINC.LE.0) IYINC = 1
      YINC = IYINC
      IZINC = ZINC + 0.01
      IF (IZINC.LE.0) IZINC = 1
      ZINC = IZINC
      LABEL = IROUND (APARM(5))
      IF (LABEL.EQ.0) LABEL = LTP
      APARM(5) = LABEL
      DOTV = XDOTV.GT.0.0
      GRCHN = XGRCH + 0.01
      TVCHN = 1
      CALL FILL (4, 0, TVCORN)
      IF (BPARM(9).EQ.0.0) DOXSLF = .TRUE.
C                               open map for read
      MTYPE = 'MA'
      STAT = 'HDWR'
      IF (DOTV) STAT = 'READ'
      CALL MAPOPN (STAT, VOL, NAM, CLS, SEQ, MTYPE, USR, LUN, IND,
     *   CNR, CATBLK, SCR, IER)
      IF (IER.EQ.0) GO TO 10
```

```
      WRITE (MSGTXT,1000) IER
      CALL MSGWRT (8)
      GO TO 990
 10   NCFILE = 1
      FVOL(1) = VOL
      FCNO(1) = CNR
      FRW(1) = 1
C                                 convert rad/m**2 to deg/cm**2
      RMNOT = APARM(7) * 5.72957795E-3
      IWTFIT = APARM(8)
      RMMAX = APARM(6) * 5.72957795E-3
      NPTS = APARM(2)
C                                 transform image coordinates
      BLC(3) = BLC(2)
      BLC(2) = BLC(1)
      BLC(1) = 1
      TRC(3) = TRC(2)
      TRC(2) = TRC(1)
      TRC(1) = NFREQ + IWTFIT*NFREQ
      IF (DOTV) FRW(1) = 0
      CALL WINDOW (CATBLK(KIDIM), CATBLK(KINAX), BLC, TRC, IER)
      IF (IER.NE.0) GO TO 990
      USER = USR
      SQIN = SEQ
      DKIN = VOL
      CALL RNGSET (PIXR, CATR(KRDMX), CATR(KRDMN), RANGE)
      PIXR(1) = RANGE(1)
      AMN = PIXR(1)
      PIXR(2) = RANGE(2)
      AMX = PIXR(2)
C                                 interpret header contents
      NAX = CATBLK(KIDIM)
C                                 fill some arrays
      DO 15 I = 1,NAX
        PAX(I) = CATBLK(KINAX+I-1)
 15     CONTINUE
      DO 20 I = 3,7
        DPT(I-2) = BLC(I)
 20     CONTINUE
C                                 I/O windows
      WIN(1) = BLC(1) + 0.001
      WIN(2) = BLC(2) + 0.001
      WIN(3) = TRC(1) + 0.001
      WIN(4) = TRC(2) + 0.001
C                                 total # panels in x, y
      KT = TRC(3) - BLC(3) + 1.001
      JT = TRC(2) - BLC(2) + 1.001
      IT = TRC(1) - BLC(1) + 1.001
      KT = (KT - 1) / IZINC + 1
      TRC(3) = BLC(3) + (KT - 1) * IZINC
      JT = (JT - 1) / IYINC + 1
      TRC(2) = BLC(2) + (JT - 1) * IYINC
C                                 # panels/page in x, y
      IF (JTOT.LE.0) JTOT = MIN (5, JT)
      IF (KTOT.LE.0) KTOT = JTOT
      JTOT = MIN (JTOT, JT)
      KTOT = MIN (KTOT, KT)
      APARM(3) = JTOT
```

```
      APARM(4) = KTOT
C                               # pages in x, y
      JPAG = (JT - 1) / JTOT + 1
      KPAG = (KT - 1) / KTOT + 1
C                               y-value x-axis
      YX = APARM(9)
      XY = APARM(10)
      IF (AMX.LT.YX) AMX = YX
      IF (AMN.GT.YX) AMN = YX
      CALL RCOPY (7, BLC, MBLC)
      CALL RCOPY (7, TRC, MTRC)
      ZOFF = ((YX - AMN) / (AMX - AMN)) * 0.9 * IZINC
      XTRA1 = 0.035 * JTOT * IYINC
      XTRA2 = 0.035 * KTOT * IZINC + ZOFF
      XTRA3 = (0.9 + 0.035 * JTOT) * IYINC
      XTRA4 = (0.9 + 0.035 * KTOT) * IZINC - ZOFF
      IF (ABS(LABEL).LT.2) GO TO 100
        XTRA1 = XTRA1 + 0.0405 * JTOT * IYINC
        XTRA2 = XTRA2 + 0.0405 * KTOT * IZINC
        IF (ABS(LABEL).LE.2) GO TO 100
          XTRA1 = XTRA1 + 0.0810 * JTOT * IYINC
          XTRA2 = XTRA2 + 0.0405 * KTOT * IZINC
C
C                               read frequencies from BPARM
C                               or INFILE
      IKMAX = 80
      DOFILE = .FALSE.
      IF (BPARM(1).EQ.0.0.OR.NFREQ.GT.8) DOFILE=.TRUE.
      IF (DOFILE) THEN
            CALL ZTXOPN('READ', ILUN, FIND, INFILE, F, IRET)
            IF (IRET.NE.0) THEN
               WRITE (MSGTXT, 1330) INFILE
               CALL MSGWRT (5)
               GO TO 980
            END IF
            WRITE (MSGTXT, 1300) INFILE
            CALL MSGWRT (2)
      END IF
      NFREQ = APARM(1)
      DO 145 I = 1,NFREQ
        IF (DOFILE) THEN
            IKBP = 1
            CALL ZTREAD(ILUN,FIND,RBUFF,IERR)
            IF (IERR.NE.0) THEN
               WRITE (MSGTXT, 1320) I
               CALL MSGWRT (5)
               GO TO 990
            ENDIF
            CALL GETNUM(RBUFF, IKMAX, IKBP, XFVAL)
            RFREQ(I) = XFVAL
        END IF
        IF (.NOT.DOFILE) RFREQ(I) = BPARM(I)
        WRITE (MSGTXT,1310) I,RFREQ(I)
        CALL MSGWRT (2)
C                               convert frequencies to Hz
        RFREQ(I)=RFREQ(I)*1.0e06
 145  CONTINUE
      IF (DOFILE) CALL ZTXCLS(ILUN, FIND ,IRET)
```

```
C
C                               avoid single pixel
C                               end of general initialization
C                               start individual pages of plots
 100  DO 230 KP = 1,KPAG
C
      LC(3) = MBLC(3) + (KP-1) * KTOT * IZINC
      RC(3) = LC(3) + (KTOT - 1) * IZINC
      IF (RC(3).GT.MTRC(3)) LC(3) = LC(3) - RC(3) + MTRC(3)
      IF (RC(3).GT.MTRC(3)) RC(3) = MTRC(3)
      KT = RC(3) - LC(3) + 1.001
C
      DO 220 JP = 1,JPAG
C
        LC(2) = MBLC(2) + (JP-1) * JTOT * IYINC
        RC(2) = LC(2) + (JTOT - 1) * IYINC
        IF (RC(2).GT.MTRC(2)) LC(2) = LC(2) - RC(2) + MTRC(2)
        IF (RC(2).GT.MTRC(2)) RC(2) = MTRC(2)
        JT = RC(2) - LC(2) + 1.001
        WIN(2) = LC(2) + 0.001
        WIN(4) = RC(2) + 0.001
C                               actual plot corners
        BLC(1) = WIN(2) - XTRA1
        BLC(2) = LC(3) - XTRA2
        TRC(1) = WIN(4) + XTRA3
        TRC(2) = RC(3) + XTRA4
        BLC(3) = MBLC(1)
        TRC(3) = MTRC(1)
C                               add plot file to header
        VER = 0
        IF (.NOT.DOTV) THEN
          CALL MADDEX ('PL', VOL, CNR, CATBLK, SCR, T, 'WRIT', VER,
     *         IER)
          IF (IER.NE.0) THEN
            WRITE (MSGTXT,1100) IER
            CALL MSGWRT (6)
            NCFILE = 0
            GO TO 990
          END IF
        END IF
C                               physical plot file name
 110      CALL ZPHFIL ('PL', VOL, CNR, VER, PHNM, IER)
        IF (IER.EQ.0) GO TO 120
          WRITE (MSGTXT,1110) IER
          CALL MSGWRT (5)
          GO TO 990
C                               swap axes
 120      CALL CYCPER
C                               set labeling for page
        SLICE = .FALSE.
        CALL RFILL (4, 0.0, CHOUT)
        DPT(1) = (MTRC(1) + MBLC(1)) / 2.0
        CALL LABINI (BLC, TRC, DPT, CHOUT, LTP, SLICE, YGAP, TEXT,
     *       NTEXT)
C                               open plot file
        IPTYPE = 13
        CALL GINIT (VOL, CNR, PHNM, 0, IPTYPE, NPARM, USER, DOTV,
     *         TVCHN, GRCHN, TVCORN, CATBLK, SCR, GLUN, GFIND, IER)
```

```
      DONCR = IER.EQ.0
      IF (DONCR) CALL GINITL (BLC, TRC, UNITY, CHOUT, DPT, SCR,
     *    IER)
      IF (IER.EQ.0) GO TO 150
        WRITE (MSGTXT,1140) IER
        CALL MSGWRT (5)
        GO TO 980
C                           label page plot
 150    CALL LAB (BLC, TRC, LTP, TEXT, NTEXT, VER, CHOUT, YGAP,
     *   SCR, IER)
C                           put axes back
      CALL CYCPER
      CALL CYCPER
C                           go along third axis
      DO 170 KI = 1,KT,IZINC
        DPT(1) = LC(3) + (KI - 1)
        CALL COMOFF (NAX, PAX, DPT, BOF, IER)
        BOF = BOF + 1
        CALL MINIT ('READ', LUN, IND, PAX(1), PAX(2), WIN, IBF,
     *     NBF, BOF, IER)
        IF (IER.NE.0) GO TO 980
C                            handle one plane
        LP(2) = LC(3) + (KI - 1) - ZOFF
        RP(2) = LP(2) + 0.9 * IZINC
        DO 160 JI = 1,JT
C                           read one line
          CALL LINIO ('READ', LUN, IND, RBF, IT, ARR, 1, FBLANK,
     *       IER)
          IF (IER.NE.0) GO TO 980
          IF (MOD(JI-1,IYINC).NE.0) GO TO 160
          LP(1) = LC(2) + (JI - 1)
          RP(1) = LP(1) + 0.9 * IYINC
C                           ticks, axes current panel
          CALL FRAM (LP, RP, NPTS, ZOFF, PIXR, MBLC, MTRC,
     *         JI, KI, LABEL, YX, XY, SCR, RFREQ, DOXSLF, IER)
          IF (IER.NE.0) GO TO 980
C                           plot data
        CALL PAR (LP, RP, NPTS, PIXR, ARR, FBLANK, SCR,
     *     IWTFIT, YGAP, RFREQ, NFREQ, RMMAX, RMNOT, DOXSLF, IER)
          IF (IER.EQ.0) GO TO 160
            WRITE (MSGTXT,1160) IER
            CALL MSGWRT (5)
            GO TO 980
 160        CONTINUE
C                           go to next plane
 170      CONTINUE
C                           close down this plot
      CALL GFINIS (SCR, IER)
      IF (IER.EQ.0) GO TO 210
        WRITE (MSGTXT,1200) IER
        CALL MSGWRT (5)
        GO TO 980
      IF (.NOT.DOTV) THEN
 210      WRITE (MSGTXT,1210) VER
        CALL MSGWRT (2)
        CALL HIPLOT (FVOL(1), FCNO(1), VER, SCR, IERR)
      END IF
        DONCR = .FALSE.
```

```
C
 220       CONTINUE
 230     CONTINUE
C                               finished with cube
 240    IRET = 0
      GO TO 990
C                               error
 980  IF ((DONCR) .AND. (.NOT.DOTV)) THEN
        CALL DELEXT ('PL', FVOL(1), FCNO(1), 'WRIT', CATBLK, SCR, VER,
     *      IER)
        CALL ZCLOSE (GLUN, GFIND, IER)
        CALL ZDESTR (VOL, PHNM, IER)
        NCFILE = NCFILE - 1
      END IF
C
 990  CALL DIE (IRET, SCR)
 999  STOP
C---------------------------------------------------------------------
 1000 FORMAT ('MAPOPN: ERROR # ',I5)
 1100 FORMAT ('MADDEX: ERROR # ',I5)
 1110 FORMAT ('ZPHFIL: ERROR # ',I5)
 1140 FORMAT ('GINITL: ERROR # ',I5)
 1160 FORMAT ('PLOT X: ERROR # ',I5)
 1210 FORMAT ('Created PLot file version',I4)
 1200 FORMAT ('GFINIS: ERROR # ',I5)
 1300 FORMAT ('Reading frequencies from ',A48)
 1310 FORMAT ('Frequency Number ',I3,' = ',F10.2,' MHz')
 1320 FORMAT ('Trouble! do we have enough frequencies? stop at ',I3)
 1330 FORMAT ('Trouble opening file ',A48)
 1400 FORMAT ('Not to worry, you are using a standard program')
      END
      SUBROUTINE LAB (BLC, TRC, ILTYPE, TEXT, NTEXT, IVER, CH, YGAP,
     *   IBUFF, IERR)
C---------------------------------------------------------------------
C   LAB is a labeling routine, labeling the x- and y-axes either with
C   the coordinate designator or with the appropriate units + prefix.
C   Inputs:  BLC      R(2)   X and Y pixels to form bottom left hand
C                    corner of the graph.
C            TRC      R(2)   X and Y pixels to form the top right hand
C                    corner of the graph.
C            ILTYPE    I   label type: 1 none, 2 no ticks, 3 RA/DEC
C                      4 center relative
C            TEXT     C(2)*80    lower line text
C            NTEXT    I          number lines lower text
C            IVER     I          plot file version number
C   In/out:  YGAP     R          place to put lower lines
C            IBUFF    I(256)   the updated graphics output buffer.
C            IERR     I   error indicator:
C                      0 = No error.
C---------------------------------------------------------------------
      CHARACTER TEXT(2)*80, ATIME*8, ADATE*12, CHTM18*18
      HOLLERITH CATH(256)
      INTEGER   ILTYPE, IBUFF(256), IERR, NTEXT, IVER, ITCHAR
      REAL      BLC(2), TRC(2), YGAP, CH(4), CATR(256)
      REAL      DCX, DCY, UNITY
      INTEGER   ID(3), IT(3), I, IANGL, INCHAR, LTYPE, CATBLK(256)
      DOUBLE PRECISION    CATD(128)
      LOGICAL   F
```

```
      INCLUDE 'INCS:DLOC.INC'
      INCLUDE 'INCS:DMSG.INC'
      INCLUDE 'INCS:DHDR.INC'
      COMMON /MAPHDR/ CATBLK
      EQUIVALENCE (CATBLK, CATR, CATH, CATD)
      DATA UNITY /1.0/
      DATA F /.FALSE./
C-----------------------------------------------------------------------
      LTYPE = ABS (ILTYPE)
C                               Draw borders.
      CALL GPOS (BLC(1), BLC(2), IBUFF, IERR)
      IF (IERR.NE.0) GO TO 980
      CALL GVEC (TRC(1), BLC(2), IBUFF, IERR)
      IF (IERR.NE.0) GO TO 980
      CALL GVEC (TRC(1), TRC(2), IBUFF, IERR)
      IF (IERR.NE.0) GO TO 980
      CALL GVEC (BLC(1), TRC(2), IBUFF, IERR)
      IF (IERR.NE.0) GO TO 980
      CALL GVEC (BLC(1), BLC(2), IBUFF, IERR)
      IF (IERR.NE.0) GO TO 980
      IF (LTYPE.EQ.1) GO TO 999
C                               Axis labels, ticks
      CALL CLAB1 (BLC, TRC, CH, ILTYPE, UNITY, F, IBUFF, IERR)
      IF (IERR.NE.0) GO TO 980
C                               Extra lines (center rels)
      IF (NTEXT.LE.0) GO TO 20
        DCX = 0.0
        IANGL = 0
        DO 10 I = 1,NTEXT
          CALL GPOS (BLC(1), BLC(2), IBUFF, IERR)
          IF (IERR.NE.0) GO TO 980
          DCY = -YGAP
          CALL TRIM (TEXT(I), 80, TEXT(I), INCHAR)
          CALL GCHAR (INCHAR, IANGL, DCX, DCY, TEXT(I), IBUFF,
     *       IERR)
          IF (IERR.NE.0) GO TO 980
          YGAP = YGAP + 1.0
   10     CONTINUE
C                               Source name, stokes, freq.
   20 CALL GPOS (BLC(1), TRC(2), IBUFF, IERR)
      IF (IERR.NE.0) GO TO 980
      IF (ILTYPE.GT.6) GO TO 999
      DCX = 0.0
      DCY = 0.5
      TEXT(1) = '         '
      INCHAR = 1
      IANGL = 0
      CALL H2CHR (8, 1, CATH(KHOBJ), TEXT(1)(INCHAR:INCHAR+7))
      INCHAR = INCHAR + 10
      TEXT(1)(INCHAR:INCHAR+NCHLAB(1)-1) = SAXLAB(1)(1:NCHLAB(1))
      IF (NCHLAB(1).GT.0) INCHAR = INCHAR + 3 + NCHLAB(1)
      TEXT(1)(INCHAR:INCHAR+NCHLAB(2)-1) = SAXLAB(2)(1:NCHLAB(2))
      IF (NCHLAB(2).GT.0) INCHAR = INCHAR + 3 + NCHLAB(2)
C                               image name
      CALL H2CHR (12, KHIMNO, CATH(KHIMN), CHTM18(1:12))
      CALL H2CHR (6, KHIMCO, CATH(KHIMC), CHTM18(13:18))
      ITCHAR = INCHAR
C     CALL NAMEST(CATH(KHIMN),CATBLK(KIIMS),TEXT(1)(1:INCHAR),ITCHAR)
```

```
      CALL NAMEST(CHTM18,CATBLK(KIIMS),TEXT(1)(1:INCHAR),ITCHAR)
      INCHAR = ITCHAR + INCHAR - 1
      CALL GCHAR (INCHAR, IANGL, DCX, DCY, TEXT(1), IBUFF, IERR)
      IF (IERR.NE.0) GO TO 980
C                              Date/time version
      IF (ILTYPE.LT.0) GO TO 999
        CALL GPOS (BLC(1), TRC(2), IBUFF, IERR)
        IF (IERR.NE.0) GO TO 980
        DCY = DCY + 1.5
        CALL ZDATE (ID)
        CALL ZTIME (IT)
        CALL TIMDAT (IT, ID, ATIME, ADATE)
        WRITE (TEXT(1),1020) IVER, ADATE, ATIME
        INCHAR = 51
        CALL GCHAR (INCHAR, IANGL, DCX, DCY, TEXT(1), IBUFF, IERR)
        IF (IERR.NE.0) GO TO 980
        GO TO 999
C                              Graph drawing error.
 980  WRITE (MSGTXT,1980) IERR
      CALL MSGWRT (7)
C
 999  RETURN
C-----------------------------------------------------------------------
 1020 FORMAT ('PLot file version',I4,'  created ',A12,A8)
 1980 FORMAT ('GRAPH LABEL WRITING ERROR. IERR =',I5)
      END
      SUBROUTINE FRAM (LBLC, LTRC,NPTS, ZOFF, PIXR, MBLC, MTRC, JI, KI,
     *   LABEL, YX, XY, IBUFF, RFREQ, DOXSLF, IERR)
C-----------------------------------------------------------------------
C   FRAM writes tick marks and tick labels to a plot file: 1 panel
C   Inputs: LBLC  R(2)     X AND Y pixels to form bottom left hand
C                   corner of the panel
C         LTRC  R(2)     X and Y pixels to form the top right hand
C                   corner of the panel.
C         ZOFF  R        offset in pixels to horiz axis
C         PIXR  R(2)     intensity range
C         MBLC  R(7)     map BLC
C         MTRC  R(7)     map TRC
C         JI    I        column number (left = 1)
C         KI    I        row number  (bottom = 1)
C         LABEL I        requested label type (revised as needed)
C         NPTS  I        number of frequencies in the cube being used
C         YX    D        y-value x-axis
C         XY    D        X-value Y-axis
C         RFREQ R(20)    Frequencies read in from RMCUB.IN
C         DOXSLF B       if true then self-scale x-axis
C   In/out: IBUFF I(256)   buffer being used for output to
C                   the graphics file.
C   Output: IERR  I        error code: 0 => ok
C                     2 => graph drawing error
C                     3 => tic algorithm fails
C-----------------------------------------------------------------------
      CHARACTER TEXT(2)*80, BLANK*4, PREFIX(11)*5
      DOUBLE PRECISION    YX, XY, AXY
      REAL      LBLC(2), LTRC(2), ZOFF, PIXR(2), MBLC(7), MTRC(7)
      INTEGER   JI, KI, IT, LABEL, IBUFF(256), IERR, NPTS
      INTEGER   IDROP(2), INOSL, IDEPTH(5), NTEXT, I, J
      REAL      Y, PBLC(2), PTRC(2), XBLC(7), XTRC(7), YGAP, CH(4),
```

```
     *   UNITY
          REAL DTMPR,CLIGHT,RFREQ(20), SLAMBDA, PWID
          LOGICAL DOXSLF
          INCLUDE 'INCS:DLOC.INC'
          INCLUDE 'INCS:DMSG.INC'
          DATA UNITY, BLANK /1.0, '    '/
          DATA PREFIX /'FEMTO', 'ATO  ', 'PICO ', 'NANO ', 'MICRO','MILLI',
     *   '     ', 'KILO ', 'MEGA ', 'GIGA ', 'TERA '/
C-------------------------------------------------------------------------
C                                 set up label common: slice
          IDROP(1) = 0
          IDROP(2) = 0
          CLIGHT = 2.998E10
          INOSL = MTRC(1) - MBLC(1) + 1.001
          CALL RCOPY (7, MBLC, XBLC)
          CALL RCOPY (7, MBLC, XTRC)
          XTRC(1) = MTRC(1)
          XBLC(2) = LBLC(1)
          XTRC(2) = LBLC(1)
          XBLC(3) = LBLC(2)
          XTRC(3) = LBLC(2)
          PBLC(2) = LBLC(2)
          PTRC(2) = LTRC(2)
          CALL SLBINI (IDROP, INOSL, PIXR, PBLC, PTRC, XBLC, XTRC, IDEPTH,
     *   LABEL, YGAP, CH, TEXT, NTEXT)
C                                 bugger x axis
          SLAMBDA = 0.0
          PWID = 0.0
          IF (DOXSLF) SLAMBDA = (CLIGHT/RFREQ(NPTS))**2
C
C                                 set PWID to move leftmost point
C                                 off of Y-Axis
          IF (DOXSLF) PWID = 0.05
          AXY = SLAMBDA + XY
          RPVAL(1)= AXY + ((CLIGHT/RFREQ(1))**2 - SLAMBDA)/2.0
          PTRC(1) = LTRC(1)
          RPLOC(1) = (LTRC(1) + LBLC(1) + PWID) / 2.0
          AXINC(1) = (RPVAL(1)-AXY)/(RPLOC(1)-LBLC(1))
          PBLC(1) = LBLC(1)
          IF (CPREF(1).EQ.'     ') GO TO 15
            J = 0
            DO 10 I = 1,11
              IF (CPREF(1).EQ.PREFIX(I)) J = I
 10         CONTINUE
            IF (J.GT.0) AXY = AXY * (1000.0D0 ** (7-J))
 15       CPREF(1) = '     '
          CTYP(1) = 'CM**2   '
          IF (JI.EQ.1) GO TO 17
            CPREF(2) = '     '
            CTYP(2) = '       '
 17       IF (KI.EQ.1) GO TO 20
            CPREF(1) = '     '
            CTYP(1) = '       '
 20       CONTINUE
          CH(1) = 6.0
          CALL CLAB2 (PBLC, PTRC, CH, LABEL, UNITY, YX, AXY, IBUFF, IERR)
          IF (IERR.NE.0) GO TO 980
C                                 draw 2 axis lines,
```

```
C
      Y = LBLC(1)
      IF (AXINC(1).NE.0) Y = (XY - RPVAL(1))/AXINC(1) + RPLOC(1)
      IF ((Y.LT.LBLC(1)) .OR. (Y.GT.LTRC(1))) Y = LBLC(1)
      CALL GPOS (Y, LBLC(2), IBUFF, IERR)
      IF (IERR.NE.0) GO TO 980
      CALL GVEC (Y, LTRC(2), IBUFF, IERR)
      IF (IERR.NE.0) GO TO 980
      Y = LBLC(2) + ZOFF
      CALL GPOS (LBLC(1), Y, IBUFF, IERR)
      IF (IERR.NE.0) GO TO 980
      CALL GVEC ((LTRC(1)+PWID), Y, IBUFF, IERR)
      IF (IERR.NE.0) GO TO 980
      GO TO 999
C                                 error
 980  WRITE (MSGTXT,1980) IERR
      CALL MSGWRT (7)
C
 999  RETURN
C-------------------------------------------------------------------------
 1980 FORMAT ('FRAM: PLOT ERROR',I6)
      END
      SUBROUTINE PAR (LBLC, LTRC, NPTS, PIXR, ARR, BL, IBUFF,
     * IWTFIT, YGAP, RFREQ, NFREQ, RMMAX, RMNOT, DOXSLF, IERR)
C-------------------------------------------------------------------------
C   PAR plots the row.
C-------------------------------------------------------------------------
      INTEGER   NPTS, IWTFIT
      REAL      LBLC(2), LTRC(2), ARR(1), XP, YP, XPX, YPX, BL,
     *   XS, YS, RFREQ(20)
      CHARACTER TEXT(2)*80, BLANK*4, PREFIX(11)*5
      DOUBLE PRECISION    YX, XY, AXY
      REAL      ZOFF, PIXR(2), YGAP, DCX, DCY, RMMAX, RMNOT
      REAL      RDATA(20),WAVSQ(10),FROTMS,FEPA,FSIGROT,
     *          FSIGPA,CORR,QNOT,FPHRMS,PREDA,PDIFF
      INTEGER   IANGL, INCHAR, IROTMS, ICYC, NIT
      INTEGER   JI, KI, LABEL, IBUFF(256), IERR
      INTEGER   IDROP(2), INOSL, IDEPTH(5), NTEXT, I, J, NFREQ
      REAL      Y, PBLC(2), PTRC(2), XBLC(7), XTRC(7), CH(4),
     *   UNITY, CLIGHT, PWID, SLAMBDA, DLAMBDA, SCOOT
      REAL      FCORR
      LOGICAL   DOWN, SOLTYP, PLOTYP, BLANKPX, DOXSLF
      CHARACTER TTEXT*80
      INCLUDE 'INCS:DLOC.INC'
      INCLUDE 'INCS:DMSG.INC'
      DATA UNITY, BLANK /1.0, '    '/
      DATA PREFIX /'FEMTO', 'ATO  ', 'PICO ', 'NANO ', 'MICRO','MILLI',
     *   '     ', 'KILO ', 'MEGA ', 'GIGA ', 'TERA '/
C-------------------------------------------------------------------------
C                                 set up label common: slice
      SOLTYP = .FALSE.
      PLOTYP = .FALSE.
      BLANKPX = .FALSE.
      IF (IWTFIT.GT.0) SOLTYP = .TRUE.
      CLIGHT = 2.998E10
      PWID = 0.05
      SCOOT = 0.0
      IF (DOXSLF) SCOOT = 2.0*PWID
```

```
C                               Clipping with PIXR
      DO 10 I = 1,NFREQ
        RDATA(I) = ARR(I)
        IF (SOLTYP) RDATA(I+NFREQ) = ARR(I+NFREQ)
        WAVSQ(I) = (CLIGHT/RFREQ(I))**2
        IF(ARR(I).EQ.BL) THEN
          ARR(I) = 0.0
          BLANKPX = .TRUE.
          FROTMS = 0.0
        ENDIF
 10   CONTINUE
      IF (BLANKPX) GO TO 999
C
      CALL ROTFIT(RDATA, SOLTYP, WAVSQ, NFREQ, NPTS, RMNOT, RMMAX,
     *      FROTMS, FEPA, FSIGROT, FSIGPA, FCORR, FPHRMS, QNOT)
C                               map pixels=>plot pixels
      SLAMBDA = 0.0
      IF (DOXSLF) SLAMBDA = WAVSQ(NPTS)
      DLAMBDA = WAVSQ(1) - SLAMBDA
      XS = (LTRC(1) - LBLC(1)) / DLAMBDA
      XP = LBLC(1) + SCOOT
      YS = (LTRC(2) - LBLC(2)) / (PIXR(2) - PIXR(1))
      YP = LBLC(2)
C
      DOWN = .FALSE.
C
C  if the RMs and/or freq seperation is large, it may be necessary
C  toeadd n*pi to the lower frequencies
C                               plot data points
      DO 20 I = 1,NPTS
        ARR(I) = ARR(I) - FROTMS * WAVSQ(I)
 20   CONTINUE
C
      DO 25 I = 2,NPTS
        PDIFF = ARR(I-1) - ARR(I)
        ICYC = (ABS(PDIFF)+90.)/180
        IF(PDIFF.GT.0) THEN
              ARR(I)=ARR(I) + ICYC*180
        ELSE
              ARR(I)=ARR(I) - ICYC*180
        ENDIF
 25   CONTINUE
C
C  Check if any error aar is larger than the cross size,
C  draw the error bar instead of a cross if it is.
C  limit the error bar to +/-90 degrees
C
      DO 35 I=1,NPTS
        PLOTYP=.FALSE.
        IF(SOLTYP) THEN
          IF (ARR(I+NFREQ).GE.90.0) ARR(I+NFREQ)=90.0
          IF ((YS*(RDATA(I+NFREQ))).GE.PWID) PLOTYP=.TRUE.
        ENDIF
        IF(PLOTYP) THEN
          ARR(I) = ARR(I) + FROTMS*WAVSQ(I)
          XPX = XS * (WAVSQ(I) - SLAMBDA) + XP - PWID
          YPX = YS * (ARR(I) + ARR(I+NFREQ) - PIXR(1)) + YP
          CALL GPOS(XPX, YPX, IBUFF, IERR)
```

```
          XPX = XPX + 2.0*PWID
          CALL GVEC(XPX, YPX, IBUFF, IERR)
          XPX = XPX - PWID
          CALL GPOS(XPX, YPX, IBUFF, IERR)
          YPX = YS * (ARR(I) - ARR(I+NFREQ) - PIXR(1)) + YP
          CALL GVEC(XPX, YPX, IBUFF, IERR)
          XPX = XPX - PWID
          CALL GPOS(XPX, YPX, IBUFF, IERR)
          XPX = XPX + 2.0*PWID
          CALL GVEC(XPX, YPX, IBUFF, IERR)
          XPX = XPX - PWID
          YPX = YS * (ARR(I) - PIXR(1)) + YP - PWID
          CALL GPOS(XPX, YPX, IBUFF, IERR)
          YPX = YPX + 2.0*PWID
          CALL GVEC(XPX, YPX, IBUFF, IERR)
          IF (IERR.NE.0) GO TO 999
        ELSE
          ARR(I) = ARR(I) + FROTMS*WAVSQ(I)
          XPX = XS * (WAVSQ(I) - SLAMBDA) + XP - PWID
          YPX = YS * (ARR(I) - PIXR(1)) + YP
          CALL GPOS(XPX, YPX, IBUFF, IERR)
          XPX = XPX + 2.0*PWID
          CALL GVEC(XPX, YPX, IBUFF, IERR)
          XPX = XPX - PWID
          YPX = YPX - PWID
          CALL GPOS(XPX, YPX, IBUFF, IERR)
          YPX = YPX + 2.0*PWID
          CALL GVEC(XPX, YPX, IBUFF, IERR)
        ENDIF
 35   CONTINUE
C                               Now plot the best fit RM
      XPX = XS * (WAVSQ(1) - SLAMBDA) + XP
      YPX = YS * (FEPA + FROTMS*WAVSQ(1) - PIXR(1)) + YP
      CALL GPOS(XPX, YPX, IBUFF, IERR)
      XPX = XP
      YPX = YS * (FEPA + FROTMS*SLAMBDA - PIXR(1)) + YP
      CALL GVEC(XPX, YPX, IBUFF, IERR)
C                               label this RM value
      XPX = XS * DLAMBDA/2.0 + XP
      YPX = LBLC(2) + 0.75*(LTRC(2) - LBLC(2))
C     YPX = YS * (1.5*PIXR(2) - PIXR(1)) + YP
      INCHAR = 6
C                               convert RM to rads/m**2
      IROTMS = FROTMS*10000.0/57.2957795
      ENCODE(INCHAR, 40, TTEXT) IROTMS
 40   FORMAT(I6)
      IANGL = 0
      DCX = 0.0
      DCY = 0.0
      CALL TRIM(TTEXT, 80, TTEXT, INCHAR)
      CALL GPOS(XPX, YPX, IBUFF, IERR)
      CALL GCHAR(INCHAR, IANGL, DCX, DCY, TTEXT, IBUFF, IERR)
C
 999  RETURN
      END
      SUBROUTINE CYCPER
C---------------------------------------------------------------------
C   Performs cyclic permutation of header elements pertaining to
```

```
C   axes # 1, 2, AND 3.
C-----------------------------------------------------------------------
      INTEGER   CATBLK(256), ITEM(4)
      REAL      CATR(256), RTEM(2)
      HOLLERITH CATH(256), HTEMP(2)
      DOUBLE PRECISION CATD(128), DTEM
      INCLUDE 'INCS:DDCH.INC'
      INCLUDE 'INCS:DHDR.INC'
      COMMON /MAPHDR/ CATBLK
      EQUIVALENCE (CATBLK, CATH, CATR, CATD)
      EQUIVALENCE (DTEM, RTEM(1), ITEM(1))
C-----------------------------------------------------------------------
C                                 random parameter types
      HTEMP(1) = CATH(KHPTP)
      HTEMP(2) = CATH(KHPTP+1)
      CATH(KHPTP) = CATH(KHPTP+2)
      CATH(KHPTP+1) = CATH(KHPTP+3)
      CATH(KHPTP+2) = CATH(KHPTP+4)
      CATH(KHPTP+3) = CATH(KHPTP+5)
      CATH(KHPTP+4) = HTEMP(1)
      CATH(KHPTP+5) = HTEMP(2)
C                                 coordinate type
      HTEMP(1) = CATH(KHCTP)
      HTEMP(2) = CATH(KHCTP+1)
      CATH(KHCTP) = CATH(KHCTP+2)
      CATH(KHCTP+1) = CATH(KHCTP+3)
      CATH(KHCTP+2) = CATH(KHCTP+4)
      CATH(KHCTP+3) = CATH(KHCTP+5)
      CATH(KHCTP+4) = HTEMP(1)
      CATH(KHCTP+5) = HTEMP(2)
C                                 coord. value ref. pixel
      DTEM        = CATD(KDCRV)
      CATD(KDCRV)   = CATD(KDCRV+1)
      CATD(KDCRV+1) = CATD(KDCRV+2)
      CATD(KDCRV+2) = DTEM
C                                 coord. value incr. along axis
      RTEM(1)     = CATR(KRCIC)
      CATR(KRCIC)   = CATR(KRCIC+1)
      CATR(KRCIC+1) = CATR(KRCIC+2)
      CATR(KRCIC+2) = RTEM(1)
C                                 coord. ref. pixel
      RTEM(1)     = CATR(KRCRP)
      CATR(KRCRP)   = CATR(KRCRP+1)
      CATR(KRCRP+1) = CATR(KRCRP+2)
      CATR(KRCRP+2) = RTEM(1)
C                                 coord. ronation angles
      RTEM(1)     = CATR(KRCRT)
      CATR(KRCRT)   = CATR(KRCRT+1)
      CATR(KRCRT+1) = CATR(KRCRT+2)
      CATR(KRCRT+2) = RTEM(1)
C                                 # pixels on each axis
      ITEM(1)     = CATBLK(KINAX)
      CATBLK(KINAX)   = CATBLK(KINAX+1)
      CATBLK(KINAX+1) = CATBLK(KINAX+2)
      CATBLK(KINAX+2) = ITEM(1)
C
999   RETURN
      END
```

```
      SUBROUTINE FACT (N, NFAC)
C-------------------------------------------------------------------------
C     Find n!  use real numbers so can have reasonable sized arguments
C
C     INPUT:
C       N      I     Number to find the factorial of
C     OUTPUT:
C       NFAC   R     Results
C-------------------------------------------------------------------------
      INTEGER N, I
      REAL NFAC
C-------------------------------------------------------------------------
      NFAC = 1.0
      I = N
C
      IF (I.EQ.0) THEN
        GOTO 200
      ELSE
 100    IF (I.EQ.1) THEN
          GOTO 200
        ELSE
          NFAC = I * NFAC
          I = I - 1
        END IF
        GOTO 100
      END IF
 200  CONTINUE
C
      RETURN
      END
C
C  rm fitting routines follow
      SUBROUTINE ROTFIT (DATA, SOLTYP, WAVSQ, NFREQ, NPTS, RM0,
     *   RMMAX, FROTMS, FEPA, FSIGROT, FSIGPA, FCORR, FPHRMS, Q0)
C-------------------------------------------------------------------------
C   ROTFIT sets up the data for the least squares fit.  Its most
C   important task is to discover and remove ambiguities from the data.
C   Inputs:
C     DATA(20)    R    Input data, the position angles at various
C                      frequencies measured at the same RA and Dec.
C     SOLTYP      L    Solution type: T => weighted
C     WAVSQ(10)   R    Array of squared wavelengths.
C     RMMAX       R    The maxmium allowed rot. meas.
C     RM0         R    The initial guess of the rot. meas.
C     NFREQ       R    The number of frequencies.
C   Outputs:
C     FROTMS      R    The rotation measure.
C     FEPA        R    Intrinsic value of electric vector.
C     FSIGROT     R    Error in the rotation measure
C     FSIGPA      R    Error in the position angle
C     FCORR       R    Correlation coefficient
C     Q0          R    Goodness of fit
C     FPHRMS      R    The rms error of the fit
C-------------------------------------------------------------------------
      REAL     DIF
      INTEGER  NFREQ, I, MM, LL, J, NPTS, NNPTS, NCYC, ICYC
      REAL     ROTMS, EPA, SIGROT, SIGPA, CORR, RM0, RDATA(20),
     *   DATA(20), WAVSQ(10), PHRMS, PHSUM, DELRM0, CHI2, RMMAX
```

```
      REAL RWAVSQ(10), FCORR, FROTMS, FEPA, FSIGROT, FSIGPA
      REAL FPHRMS, Q0, Q
      LOGICAL   SOLTYP
C-----------------------------------------------------------------------
C                             For a given biggest rot. meas.
C                             estimate how many posible turns
C                             between the first two freq.
      Q0=0
      NCYC=0
      DO 10 I=1,NFREQ
        J = I
        RWAVSQ(I) = WAVSQ(J)
 10   CONTINUE
C
      IF(RMMAX.YE.0) NCYC=NINT(RMMAX*(RWAVSQ(1)-RWAVSQ(2))/180.0)
      NCYC=ABS(NCYC)
C                             Try all the possible turns
      DO 200 MM = 1,2*NCYC+1
        DO 20 I = 1,NFREQ
          J = I
          RDATA(I) = DATA(J)
          RWAVSQ(I) = WAVSQ(J)
          RDATA(I+NFREQ)=DATA(J+NFREQ)
C                             Correct the input angles by the
C                             initial r.m. guess
          RDATA(I) = RDATA(I) - RM0 * RWAVSQ(I)
 20     CONTINUE
C                             We assume no ambiguities between
C                             the first two frequencies
      DIF = RDATA(1) - RDATA(2)
      IF (DIF.GT.90) RDATA(2) = RDATA(2) + 180.
      IF (DIF.LT.-90) RDATA(2) = RDATA(2) - 180.
C                             Try all the possible turns
      RDATA(2) = RDATA(2) + (MM-NCYC-1)*180
      DELRM0 = (RDATA(2)-RDATA(1))/(RWAVSQ(2)-RWAVSQ(1))
C                             Now remove additional term
 5    DO 25 I = 1,NFREQ
        RDATA(I) = RDATA(I) - DELRM0 * RWAVSQ(I)
 25     CONTINUE
C                             Now remove amgiguities between
C                             the second and third frequencies
      DIF = RDATA(2) - RDATA(3)
      ICYC = (ABS(DIF)+90.)/180
      IF (DIF.GT.0) THEN
        RDATA(3)=RDATA(3)+ICYC*180
      ELSE
        RDATA(3)=RDATA(3)-ICYC*180
      ENDIF
C                             Retrend the DATA to get a
C                             meaningful corr. coeff.
      DO 30 J = 1,NFREQ
        RDATA(J) = RDATA(J) + (RM0 + DELRM0) * RWAVSQ(J)
 30     CONTINUE
C                             Do a least squares fit on the
C                             first 3 points
      DO 50 LL=3, NPTS
        CALL RMSFIT (RDATA, SOLTYP, RWAVSQ, NFREQ, LL, ROTMS,
     *       EPA, SIGROT, SIGPA, CORR, CHI2, Q)
```

```
C                       If we are to fit to 3 points
C                       only, we are finished.
      IF (NPTS.EQ.LL) GO TO 100
C                       We hope we are close to the
C                       correct answer. Adjust the data
C                       by the latest RM estimate
       DO 35 I = 1,NFREQ
        RDATA(I) = RDATA(I) - ROTMS * RWAVSQ(I)
 35     CONTINUE
C                       Now we correct for those awful
C                       ambiguities
       DO 40 I = 2,NFREQ
        DIF = RDATA(I-1) - RDATA(I)
        ICYC = (ABS(DIF)+90.)/180
       IF (DIF.GT.0) THEN
        RDATA(I)=RDATA(I)+ICYC*180
       ELSE
        RDATA(I)=RDATA(I)-ICYC*180
       ENDIF
 40     CONTINUE
C                       And we are ready for another
C                       fit.  First, detrend the data.
       DO 45 I = 1,NFREQ
        RDATA(I) = RDATA(I) + ROTMS * RWAVSQ(I)
 45     CONTINUE
 50   CONTINUE
C                       Calculate the rms error of the
C                       fit.
 100  PHRMS = SQRT(CHI2) / NPTS
C                       Using the goodness of fit to
C                       decide which set of fit to keep
      IF(Q.GE.Q0) THEN
       FROTMS=ROTMS
       FEPA=EPA
       FSIGROT=SIGROT
       FSIGPA=SIGPA
       FPHRMS=PHRMS
       FCORR=CORR
       Q0=Q
      ENDIF
200   CONTINUE
C
     RETURN
     END

     SUBROUTINE RMSFIT (Y, SOLTYP, X, NFREQ, NPTS, ROTMS, EPA,
    *   SIGROT, SIGPA, CORR, CHI2, Q)
C-----------------------------------------------------------------------
C     RMSFIT fits a linear least squares fit to positions data as a
C     function of wavelength squared. It will do an unweighted fit (SOLTYP
C     false) or a fit weighted by the error in the data (SOLTYP true) and
C     estimate the goodness of fit. In the later case, sigma maps must be
C     available for each frequency.
C     inputs:
C       Y(20)    R     Input data, the position angles at various
C                       frequencies measured at the same RA and DEC.
C       SOLTYP   L     Solution type: true=> do weighted.
C       X(10)    R     Array of squared wavelengths.
```

```
C      NFREQ    I     The number of frequnecies.
C      NPTS     I     Use the first NPTS data to do the fit.
C     outputs:
C      ROTMS    R     The rotation measure.
C      EPA      R     Intrinsic value of electric vector.
C      SIGROT   R     Error in the rotation measure.
C      SIGPA    R     Error in the position angle.
C      CORR     R     Correlation coefficient.
C     The program is modified from "Numerical Recipies"
C-----------------------------------------------------------------------
      LOGICAL   SOLTYP
      INTEGER   NFREQ, I, NPTS
      REAL      ROTMS, EPA, SIGROT, SIGPA, WT, DELTA, COV, CHI2, CORR
      REAL      Y(20), X(10)
      REAL      Q, SX, SY, ST2, B, SS, T, SXOSS, A, SIGDAT, GAMMQ
C
      SX=0.
      SY=0.
      ST2=0.
      B=0.
      IF(SOLTYP) THEN
        SS=0.
        DO 11 I=1,NPTS
          WT=1./(Y(I+NFREQ)**2)
          SS=SS+WT
          SX=SX+X(I)*WT
          SY=SY+Y(I)*WT
11      CONTINUE
      ELSE
        DO 12 I=1,NPTS
          SX=SX+X(I)
          SY=SY+Y(I)
12      CONTINUE
        SS=FLOAT(NPTS)
      ENDIF
      SXOSS=SX/SS
      IF(SOLTYP) THEN
        DO 13 I=1,NPTS
          T=(X(I)-SXOSS)/Y(I+NFREQ)
          ST2=ST2+T*T
          B=B+T*Y(I)/Y(I+NFREQ)
13      CONTINUE
      ELSE
        DO 14 I=1,NPTS
          T=X(I)-SXOSS
          ST2=ST2+T*T
          B=B+T*Y(I)
14      CONTINUE
      ENDIF
      B=B/ST2
      A=(SY-SX*B)/SS
      EPA = A
      ROTMS = B
      SIGPA=SQRT((1.+SX*SX/(SS*ST2))/SS)
      SIGROT=SQRT(1./ST2)
      CHI2=0.
      IF(.NOT.SOLTYP) THEN
        DO 15 I=1,NPTS
```

```
        CHI2=CHI2+(Y(I)-A-B*X(I))**2
15      CONTINUE
       Q=1.
       SIGDAT=SQRT(CHI2/(NPTS-2))
       SIGPA=SIGPA*SIGDAT
       SIGROT=SIGROT*SIGDAT
      ELSE
       DO 16 I=1,NPTS
        CHI2=CHI2+((Y(I)-A-B*X(I))/Y(I+NFREQ))**2
16      CONTINUE
       Q=GAMMQ(0.5*(NPTS-2),0.5*CHI2)
      ENDIF
      COV= -SX/(SS*ST2)
      CORR=COV/(SIGPA*SIGROT)
      RETURN
      END
C-------------------------------------------------------------------------
C     Functions to calculate the goodness of fit using chi-square
c     merit. The program is lifted from "Numerical recipies"
c     Press, Flannery, Teukolsky, Vetterling; Chapter 6.2; Chapter 14.2,
c     Page 507, (1986).
C-------------------------------------------------------------------------
      FUNCTION GAMMQ(A,X)
      REAL GAMMQ, A, X, GAMSER, GLN
C
      IF(X.LT.0..OR.A.LE.0.)PAUSE
      IF(X.LT.A+1.)THEN
       CALL GSER(GAMSER,A,X,GLN)
       GAMMQ=1.-GAMSER
      ELSE
       CALL GCF(GAMMQ,A,X,GLN)
      ENDIF
      RETURN
      END
C
      FUNCTION GAMMLN(XX)
      REAL*8 GAMMLN,COF(6),STP,HALF,ONE,FPF,X,XX,TMP,SER
      INTEGER J
      DATA COF,STP/76.18009173D0,-86.50532033D0,24.01409822D0,
     *    -1.231739516D0,.120858003D-2,-.536382D-5,2.50662827465D0/
      DATA HALF,ONE,FPF/0.5D0,1.0D0,5.5D0/
      X=XX-ONE
      TMP=X+FPF
      TMP=(X+HALF)*LOG(TMP)-TMP
      SER=ONE
      DO 11 J=1,6
       X=X+ONE
       SER=SER+COF(J)/X
11    CONTINUE
      GAMMLN=TMP+LOG(STP*SER)
      RETURN
      END
C
      SUBROUTINE GSER(GAMSER,A,X,GLN)
      PARAMETER (ITMAX=100,EPS=3.E-7)
      REAL GLN, GAMMLN, GAMSER, A, X, AP, SUM, DEL
      INTEGER N
C
```

```
      GLN=GAMMLN(A)
      IF(X.LE.0.)THEN
        IF(X.LT.0.)PAUSE
        GAMSER=0.
        RETURN
      ENDIF
      AP=A
      SUM=1./A
      DEL=SUM
      DO 11 N=1,ITMAX
        AP=AP+1.
        DEL=DEL*X/AP
        SUM=SUM+DEL
        IF(ABS(DEL).LT.ABS(SUM)*EPS)GO TO 1
11    CONTINUE
      PAUSE 'A too large, ITMAX too small'
1     GAMSER=SUM*EXP(-X+A*LOG(X)-GLN)
      RETURN
      END
C
      SUBROUTINE GCF(GAMMCF,A,X,GLN)
      PARAMETER (ITMAX=100,EPS=3.E-7)
      INTEGER N
      REAL GAMMCF, GAMMLN, A, X, GLN, GOLD, A0, A1, B0, B1, FAC
      REAL AN, G, ANA, ANF
C
      GLN=GAMMLN(A)
      GOLD=0.
      A0=1.
      A1=X
      B0=0.
      B1=1.
      FAC=1.
      DO
1 N=1,ITMAX
        AN=FLOAT(N)
        ANA=AN-A
        A0=(A1+A0*ANA)*FAC
        B0=(B1+B0*ANA)*FAC
        ANF=AN*FAC
        A1=X*A0+ANF*A1
        B1=X*B0+ANF*B1
        IF(A1.NE.0.)THEN
          FAC=1./A1
          G=B1*FAC
          IF(ABS((G-GOLD)/G).LT.EPS)GO TO 1
          GOLD=G
        ENDIF
11    CONTINUE
      PAUSE 'A too large, ITMAX too small'
1     GAMMCF=EXP(-X+A*ALOG(X)-GLN)*G
      RETURN
      END
```


From root Wed Sep 27 15:05:56 1995
X-VM-v5-Data: ([nil nil nil nil nil nil t nil nil] ["7290" "Wed" "27" "September" "1995" "13:05:42" "-0600" "Greg Taylor"
"gtaylor@aoc.nrao.edu" nil "132" "RMCUB.HLP" "^From:" nil nil "9" nil nil nil nil]
nil)

Received: from arana.aoc.nrao.edu by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA52423; Wed, 27 Sep 1995 15:05:53 -0400
Received: from pegasus.aoc.nrao.edu (pegasus.aoc.nrao.edu [146.88.4.3]) by arana.aoc.nrao.edu (8.6.12/8.6.10) with ESMTP id NAA20255; Wed, 27 Sep 1995 13:05:44 -0600
Received: (from gtaylor@localhost) by pegasus.aoc.nrao.edu (8.6.12/8.6.10) id NAA07636; Wed, 27 Sep 1995 13:05:42 -0600
Message-Id: <199509271905.NAA07636@pegasus.aoc.nrao.edu>
Content-Length: 7290
From: Greg Taylor <gtaylor@aoc.nrao.edu>
To: abridle@polaris.cv.nrao.edu, gbt@aoc.nrao.edu
Subject: RMCUB.HLP
Date: Wed, 27 Sep 1995 13:05:42 -0600

RMCUB.HLP
RMCUB LLLLLLLLLLLLUUUUUUUUUUUU CCCCCCCCCCCCCCCCCCCCCCCCCCCCC
RMCUB : Task to plot pol angle vs lambda**2 on grid of y, and z
USERID -32000.0 32000.0 User ID. 0=>current user
32000=>all users
INNAME Image name (name)
INCLASS Image name (class)
INSEQ 0.0 9999.0 Image name (seq. #)
INDISK 0.0 9.0 Disk drive #
BLC 0.0 4096.0 Bottom left corner of image
0=>entire image
TRC 0.0 4096.0 Top right corner of image
0=>entire image
YINC 0.0 256.0 Increment on 2nd axis to plot
ZINC 0.0 256.0 Increment on 3rd axis to plot
PIXRANGE Range of degrees on y-axis
LTYPE -7.0 7.0 Type of labeling: 1 border,
2 no ticks, 3 standard, 4 rel
to center, 5 rel to subim cen
6 pixels, 7 standard w/o any
headers
APARM 1: Number of freq. in cube
2: Number of freq. to use
in the fit. The first
APARM(2) freq. will be used.
3: panels/page in x-direction
0=> MIN (TRC(2)-BLC(2+1,5)
4: panels/page in y-direction
0=> final value of APARM(1)
5: LTYPE for panels 0=>LTYPE
6: maximum rotation measure
7: initial guess for the RM
8: Solution type >0 weighted
fit, assumes last half of
cube are error maps
9: y-value x-axis: no default
10: x-value y-axis: no default
BPARM 1-8: First 8 freq in cube(MHz)
9: 1 => include zero wavelen
0 => self-scale x axis
INFILE
Optional input disk file name
containing freq in cube (MHz)
DOTV > 0 => TV, else plot file
GRCHAN graphics channel to use

RMCUB
Type: Task
Use : Task to repeatedly plot the pixel value as a function of the coordinate along the first axis in different panels. Each panel is positioned in a larger frame, with the coordinate along the second axis in the cube as x-axis, and the coordinate along the third axis in the cube as y-axis. The best fit value of the Rotation Measure is also plotted and the value of the RM printed for each pixel.
Example :
Given a cube of polarization angle maps (and optionally polarization angle error maps), the polarization angle is plotted against the wavelength squared on a pixel by pixel basis. Note that the input cube is the same one used by the program RM, but the inputs are slightly different so BE CAREFUL. See the explanation of the program RM for details on how to create the cube of polarization angles for use with RMCUB.
Adverbs:
USERID.....User ID of owner of image. 0 => current user
32000 => all users
INNAME.....Image name(name). blank => any
INCLASS.....Image name(class). blank => any
INSEQ.....Image name(seq. #). 0 => any
INDISK.....Disk drive # of image. 0 => any
BLC.....The Bottom Left-hand pixel of the subarray of the image to be plotted. The value (0,0,...) means (1,1,1,1,1,1,1).
TRC.....The Top Right-hand pixel of the subarray of the image to be plotted. The value (0,0,...) means the top right hand corner of the entire image.
YINC.....Increment between plotted pixels on 2nd axis.
ZINC.....Increment between plotted pixels on 3rd axis.
PIXRANGE....Range of pixel values to plot; values below PIXR(1) are set to PIXR(1), values above PIXR(2) are set to PIXR(2). PIXR(1) >= PIXR(2) implies use the full range of pixel values in the image.
LTYPE.....Labeling type: 1 = border, 2 = no tick labels, 3 = standard, 4 = relative to ref. pixel, 5 = relative to subimage (BLC, TRC) center 6 = pixels. Less than 0 is the same except that the plot file version number and create time are not put in the plot. 0 => 3. 7 = standard, but without any headers.
APARM.....(1) Number of frequencies in the cube.
(2) Number of frequencies to be used in the fit. The first APARM(2) frequencies will be used.
(3) Number of plots panels/page in x direction. default = min (TRC(2)-BLC(2)+1, 5)
(4) Number of plots panels/page in y direction. default = resulting APARM(1)
(5) Labeling type for the individual panels. Same meaninings as LTYPe and 0 => LTYPE.
(6) Maximum allowed rotation measure. RMCUB will try to fit RMs between 0 and APARM(6).

(7) Initial guess for the RM. Use 0.
(8) The solution type requested. 0 => unweighted
1 => weighted fit. If APARM(6) = 1 then
the last half of the cube is assumed to
consist of error maps.
(9) The y-value at which the x-axis intersects
the y-axis within each panel. If intensity
is plotted, 0 is the obvious choice.
(10) The x-value at which the y-axis intersects
the x-axis within each panel. A crazy value
is reset to the left edge of each panel.
There is no other default, however.

BPARM (1-8) first 8 frequencies in cube in MHz. If
BPARM(1)=0 or APARM(1) > 8 then the frequencies are
all read in from INFILE (see below).
(9) if > 0 then include zero wavelength on plots
if = 0 then self-scale x-axis

INFILE A disk text file which should
consist of APARM(1) frequencies, each in units of
MHz on a line by itself.

Notes :

1) The plane is filled in such a way that there are APARM(3)
panels in the x-direction and APARM(4) panels in the
y-direction. If the area specified by APARM is larger than
APARM(3),APARM(4) the plot is spread out over several pages.
2) The position of a panel in the larger frame is defined as
the left hand end of the x axis in each panel.

From root Thu Sep 28 13:38:51 1995
X-VM-v5-Data: ([nil nil nil nil t nil t nil nil]
["362" "Thu" "28" "September" "1995" "18:38:42" "+0100" "Robert Laing" "rl@ast.cam.ac.uk"
"<Pine.SOL.3.91.950928183447.13233A-100000@rgosf>" "9" "PS files" "^From:" nil nil "9" nil nil nil nil]
nil)
Received: from cass41.ast.cam.ac.uk by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA22513; Thu, 28 Sep 1995 13:38:47 -0400
Received: from rgosf.ast.cam.ac.uk by cass41 with smtp
(Smail3.1.29.1 #9) id m0syMux-000CMIC; Thu, 28 Sep 95 18:38 BST
Received: by rgosf.ast.cam.ac.uk (Smail3.1.29.1 #9)
id m0syMuw-0000cDC; Thu, 28 Sep 95 18:38 BST
X-Sender: rl@rgosf
Message-Id: <Pine.SOL.3.91.950928183447.13233A-100000@rgosf>
Mime-Version: 1.0
Content-Type: TEXT/PLAIN; charset=US-ASCII
From: Robert Laing <rl@ast.cam.ac.uk>
To: Alan Bridle <abridle@polaris.cv.nrao.edu>
Subject: PS files
Date: Thu, 28 Sep 1995 18:38:42 +0100 (BST)

I belatedly realised that these will have been too late - sorry, I've
been interviewing all day.

I talked to Paola, and she is heading for Holland for 2 months after the
Bologna meeting. It therefore makes little sense for me to stay on in Italy.
I'm now fairly free until the end of the year (I think). How about
mid-November for a visit?

Cheers, Robert

From abridle Thu Sep 28 13:46:41 1995
X-VM-v5-Data: ([nil nil nil nil nil nil nil nil]
["705" "Thu" "28" "September" "1995" "13:46:37" "-0400" "Alan Bridle" "abridle" nil "25" "Re: PS files" "^From:" nil nil "9" nil nil nil nil]
nil)
Received: by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA149085; Thu, 28 Sep 1995 13:46:37 -0400
Message-Id: <9509281746.AA149085@polaris.cv.nrao.edu>
In-Reply-To: <Pine.SOL.3.91.950928183447.13233A-100000@rgosf>
References: <Pine.SOL.3.91.950928183447.13233A-100000@rgosf>
From: abridle (Alan Bridle)
To: Robert Laing <rl@ast.cam.ac.uk>
Subject: Re: PS files
Date: Thu, 28 Sep 1995 13:46:37 -0400

Robert Laing writes:
> I belatedly realised that these will have been too late - sorry, I've
> been interviewing all day.

Never mind, they'll be useful anyway.

>
> I talked to Paola, and she is heading for Holland for 2 months after the
> Bologna meeting. It therefore makes little sense for me to stay on in Italy.
> I'm now fairly free until the end of the year (I think). How about
> mid-November for a visit?
>

Yes, it will be good to strike while these irons are hot. I
mentioned your visit to Mary, she's looking forward to seeing
you again and hopes you'll stay with us.

I've just mailed the old (construction configuration) C Band data
to you on a DAT tape.

Cheers, A.

From abridle Tue Oct 3 11:44:29 1995
X-VM-v5-Data: ([nil nil nil nil nil nil nil nil nil]
["531" "Tue" "3" "October" "1995" "11:42:53" "-0400" "Alan Bridle" "abridle" nil "16" "Re: 6cm data" "^From:" nil nil "10" nil nil nil nil]
nil)
Received: by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA40782; Tue, 3 Oct 1995 11:42:53 -0400
Message-Id: <9510031542.AA40782@polaris.cv.nrao.edu>
In-Reply-To: <Pine.SOL.3.91.951003110327.21369A-100000@rgosf>
References: <Pine.SOL.3.91.951003110327.21369A-100000@rgosf>
From: abridle (Alan Bridle)
To: Robert Laing <rl@ast.cam.ac.uk>
Subject: Re: 6cm data
Date: Tue, 3 Oct 1995 11:42:53 -0400

Robert Laing writes:
> Dear Alan
>
> Thanks for the tape. Is there anything I need to know about the old
> dataset? Somebody (Larry Rudnick, I think) was warning me of problems to
> do with DBCONing old and new datasets - have you heard anything about this?
>
> Cheers, Robert

There is a problem with them having different numbers of IF pairs, and
you will need to SPLIT the new datasets into single-frequency datasets
if you are going to combine them with the older data. I believe that
is the only problem.

A.

From root Wed Oct 4 10:33:34 1995
X-VM-v5-Data: ([nil nil nil nil t nil nil nil nil]
["664" "Wed" "4" "October" "1995" "15:30:36" "+0100" "Robert Laing" "rl@ast.cam.ac.uk"
"<Pine.SOL.3.91.951004151421.23286B-100000@rgosf>" "12" "Re: 6cm data" "^From:" nil nil "10" nil nil nil nil]
nil)
Received: from cass41.ast.cam.ac.uk by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA124963; Wed, 4 Oct 1995 10:33:12 -0400
Received: from rgosf.ast.cam.ac.uk by cass41 with smtp
(Smail3.1.29.1 #9) id m0t0UqI-000CMJC; Wed, 4 Oct 95 15:30 BST
Received: by rgosf.ast.cam.ac.uk (Smail3.1.29.1 #9)
id m0t0UqD-0000cDC; Wed, 4 Oct 95 15:30 BST
X-Sender: rl@rgosf
In-Reply-To: <9510031542.AA40782@polaris.cv.nrao.edu>
Message-Id: <Pine.SOL.3.91.951004151421.23286B-100000@rgosf>rMime-Version: 1.0
Content-Type: TEXT/PLAIN; charset=US-ASCII
From: Robert Laing <rl@ast.cam.ac.uk>
To: Alan Bridle <abridle@polaris.cv.nrao.edu>
Cc: Rick Perley <rperley@aoc.nrao.edu>
Subject: Re: 6cm data
Date: Wed, 4 Oct 1995 15:30:36 +0100 (BST)

Thanks for the advice - I think that may have been Larry's problem. I
have made further progress in reducing 3C31's 8 GHz artefact level near the
core. Indeed, Rick's suggestion of doing an A&P solution on the combined
dataset, then splitting B and C out and mapping separately, measuring the
difference in core fluxes, correcting the B configuration data and trying
again worked very well. It looked as if we had roughly a 4% core
variation and a 2% amplitude difference, which is perfectly reasonable.

No qualitative difference in the answer, of course, but the
Jet:Counterjet ratio very close to the nucleus is now much more reliable.

Cheers, Robert

From abridle Wed Oct 4 13:17:26 1995
X-VM-v5-Data: ([nil nil nil nil nil nil nil nil nil]
["887" "Wed" "4" "October" "1995" "13:17:19" "-0400" "Alan Bridle" "abridle" nil "21" "Re: 6cm data" "^From:" nil nil "10" nil nil nil nil]
nil)
Received: by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA81863; Wed, 4 Oct 1995 13:17:19 -0400
Message-Id: <9510041717.AA81863@polaris.cv.nrao.edu>
In-Reply-To: <Pine.SOL.3.91.951004151421.23286B-100000@rgosf>
References: <9510031542.AA40782@polaris.cv.nrao.edu>
<Pine.SOL.3.91.951004151421.23286B-100000@rgosf>
From: abridle (Alan Bridle)
To: Robert Laing <rl@ast.cam.ac.uk>
Subject: Re: 6cm data
Date: Wed, 4 Oct 1995 13:17:19 -0400

Robert Laing writes:
> Thanks for the advice - I think that may have been Larry's problem. I
> have made further progress in reducing 3C31's 8 GHz artefact level near the
> core. Indeed, Rick's suggestion of doing an A&P solution on the combined
> dataset, then splitting B and C out and mapping separately, measuring the
> difference in core fluxes, correcting the B configuration data and trying
> again worked very well. It looked as if we had roughly a 4% core
> variation and a 2% amplitude difference, which is perfectly reasonable.
>
> No qualitative difference in the answer, of course, but the
> Jet:Counterjet ratio very close to the nucleus is now much more reliable.
>
> Cheers, Robert

Sounds excellent.

Rick has made a DAT tape of the L Band data and is putting it in the
mail to me today. I'kk get cracking on that a.s.a.p. after it arrives.

A.

From abridle Sun Oct 8 18:46:01 1995
X-VM-v5-Data: ([nil nil nil nil nil nil nil nil nil]
["1191" "Sun" "8" "October" "1995" "18:45:58" "-0400" "Alan Bridle" "abridle" nil "27" "forwarded message from Rick Perley" "^From:" nil nil "10" nil nil nil nil]
nil)
Received: by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA135640; Sun, 8 Oct 1995 18:45:58 -0400
Message-Id: <9510082245.AA135640@polaris.cv.nrao.edu>
From: abridle (Alan Bridle)
To: rl@ast.cam.ac.uk
Subject: forwarded message from Rick Perley
Date: Sun, 8 Oct 1995 18:45:58 -0400

Robert, if you were to be in C'ville just before or just after this trip
of Rick's, might be a good chance for all 3 of us to get together?

Cheers, A.
------- start of forwarded message (RFC 934 encapsulation) -------
Received: from arana.aoc.nrao.edu by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA103304; Fri, 6 Oct 1995 10:01:20 -0400
Received: from sechelt.aoc.nrao.edu (sechelt.aoc.nrao.edu [146.88.6.21]) by arana.aoc.nrao.edu (8.6.12/8.6.10) with ESMTP id IAA09088 for <abridle@arana.aoc.nrao.edu>; Fri, 6 Oct 1995 08:01:18 -0600
Received: (from rperley@localhost) by sechelt.aoc.nrao.edu (8.6.12/8.6.10) id IAA01704 for abridle; Fri, 6 Oct 1995 08:01:17 -0600
Message-Id: <199510061401.IAA01704@sechelt.aoc.nrao.edu>
X-Sun-Charset: US-ASCII
From: Rick Perley <rperley@aoc.nrao.edu>
To: abridle@aoc.nrao.edu
Subject: Visiting the East
Date: Fri, 6 Oct 1995 08:01:17 -0600

Alan:

THe NSF has asked me to come to Arlington for two days -- 16 and 17 November. I agreed to do this. (I don't know why... -- must have something to do with guilt).

When is Robert coming? Could you remind me of the dates? With luck, the dates might mesh.

Rick
------- end -------

From root Wed Nov 8 19:41:07 1995
X-VM-v5-Data: ([nil nil nil nil nil nil nil nil nil]
["105" "Wed" "8" "November" "1995" "18:50:41" "+0000" "Robert Laing" "rl@ast.cam.ac.uk" nil "4" "Combining new and old data" "^From:" nil nil "11" nil nil nil nil]
nil)
Received: from cass41.ast.cam.ac.uk by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA156846; Wed, 8 Nov 1995 19:41:00 -0500
Received: from rgosf.ast.cam.ac.uk by cass41 with smtp
(Smail3.1.29.1 #9) id m0tDFa7-000CMLC; Wed, 8 Nov 95 18:50 GMT
Received: by rgosf.ast.cam.ac.uk (Smail3.1.29.1 #9)
id m0tDFa5-0000cHC; Wed, 8 Nov 95 18:50 GMT
X-Sender: rl@rgosf
Message-Id: <Pine.SOL.3.91.951108184011.4A-100000@rgosf>
Mime-Version: 1.0
Content-Type: TEXT/PLAIN; charset=US-ASCII
From: Robert Laing <rl@ast.cam.ac.uk>
To: Alan Bridle <abridle@polaris.cv.nrao.edu>
Subject: Combining new and old data
Date: Wed, 8 Nov 1995 18:50:41 +0000 (GMT)

Does AIPS handle precession between B1950 and J2000 automatically, or is
some extra work required?

R.

From root Wed Nov 8 19:48:00 1995
X-VM-v5-Data: ([nil nil nil nil t nil nil nil nil]
["441" "Wed" "8" "November" "1995" "19:40:42" "+0000" "Robert Laing" "rl@ast.cam.ac.uk"
"<Pine.SOL.3.91.951108193115.105A@rgosf>" "8" "Is EPOSWTCH what I need?" "^From:" nil nil "11" nil nil nil nil]
nil)
Received: from cass41.ast.cam.ac.uk by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA127939; Wed, 8 Nov 1995 19:47:53 -0500
Received: from rgosf.ast.cam.ac.uk by cass41 with smtp
(Smail3.1.29.1 #9) id m0tDGMW-000CMwC; Wed, 8 Nov 95 19:40 GMT
Received: by rgosf.ast.cam.ac.uk (Smail3.1.29.1 #9)
id m0tDGMV-0000cHC; Wed, 8 Nov 95 19:40 GMT
X-Sender: rl@rgosf
Message-Id: <Pine.SOL.3.91.951108193115.105A@rgosf>
Mime-Version: 1.0
Content-Type: TEXT/PLAIN; charset=US-ASCII
From: Robert Laing <rl@ast.cam.ac.uk>
To: Alan Bridle <abridle@polaris.cv.nrao.edu>
Subject: Is EPOSWTCH what I need?
Date: Wed, 8 Nov 1995 19:40:42 +0000 (GMT)

This modifies the header to the simplest level of approximation. I can,
then, presumably, rotate to get the dataset aligned properly using UVSRT
and shift it in various ways (UVFIX, or DBCON with DOPOS set). Does that
sound reasonable? I'm a bit concerned, since this isn't quite right at
the edges of the field (may not matter) and the rotation is not given
very accurately in the header (I suppose I could work it out myself).

R.

From abridle Thu Nov 9 09:08:32 1995
X-VM-v5-Data: ([nil nil nil nil nil nil nil nil]
["1085" "Thu" "9" "November" "1995" "09:08:10" "-0500" "Alan Bridle" "abridle" nil "26" "Re: Is EPOSWTCH what I need?" "^From:" nil nil "11" nil nil nil nil]
nil)
Received: by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA67018; Thu, 9 Nov 1995 09:08:10 -0500
Message-Id: <9511091408.AA67018@polaris.cv.nrao.edu>
In-Reply-To: <Pine.SOL.3.91.951108193115.|05A@rgosf>
References: <Pine.SOL.3.91.951108193115.105A@rgosf>
From: abridle (Alan Bridle)
To: Robe t Laing <rl@ast.cam.ac.uk>
Subject: Re: Is EPOSWTCH wha0 I need?
Date: Thu, 9 Nov 1995 09:08:10 -0500

Robert Laing writes:

> This modifies the header to the simplest level of approximation. I can,
> then, presumably, rotate to get the dataset aligned properly using UVSRT
> and shift it in various ways (UVFIX, or DBCON with DOPOS set). Does that
> sound reasonable? I'm a bit concerned, since this isn't quite right at
> the edges of the field (may not matter) and the rotation is not given
> very accurately in the header (I suppose I could work it out myself).
>

EPOSW will modify the co-ordinate of the reference pixel and, for an
image, apply an additional rotation that is correct to first order.
For a u,v data set, it will adjust the co-ordinate of the phase
reference center correctly. Once that is done, combining datasets
that were observed in different epochs should be the same as combining
data sets with slightly different phase centers, i.e. UVFIX or, as
you say, DBCON with its call to UVFIX turned on.

I think it should be an approximation only for image conversion,
not for re-imaging from the u,v plane, but maybe I am missing
something?

A.

From root Thu Nov 9 09:32:40 1995
X-VM-v5-Data: ([nil nil nil nil nil nil nil nil nil]
["1828" "Thu" "9" "November" "1995" "14:32:00" "+0000" "Robert Laing" "rl@ast.cam.ac.uk" nil "34" "Re: Is EPOSWTCH what I need?" "^From:" nil nil "11" nil nil nil nil]
nil)
Received: from cass41.ast.cam.ac.uk by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA182446; Thu, 9 Nov 1995 09:32:09 -0500
Received: from rgosf.ast.cam.ac.uk by cass41 with smtp
(Smail3.1.29.1 #9) id m0tDY1J-000CMAC; Thu, 9 Nov 95 14:32 GMT
Received: by rgosf.ast.cam.ac.uk (Smail3.1.29.1 #9)
id m0tDY1I-0000cHC; Thu, 9 Nov 95 14:32 GMT
X-Sender: rl@rgosf
In-Reply-To: <9511091408.AA67018@polaris.cv.nrao.edu>
Message-Id: <Pine.SOL.3.91.951109141513.1521A-100000@rgosf>
Mime-Version: 1.0
Content-Type: TEXT/PLAIN; charset=US-ASCII
From: Robert Laing <rl@ast.cam.ac.uk>
To: Alan Bridle <abridle@polaris.cv.nrao.edu>
Subject: Re: Is EPOSWTCH what I need?
Date: Thu, 9 Nov 1995 14:32:00 +0000 (GMT)

> EPOSW will modify the co-ordinate of the reference pixel and, for an
> image, apply an additional rotation that is correct to first order.
> For a u,v data set, it will adjust the co-ordinate of the phase
> reference center correctly. Once that is done, combining datasets
> that were observed in different epochs should be the same as combining
> data sets with slightly different phase centers, i.e. UVFIX or, as
> you say, DBCON with its call to UVFIX turned on.
>
> I think it should be an approximation only for image conversion,
> not for re-imaging from the u,v plane, but maybe I am missing
> something?
>

Running EPOSW on a uv dataset indeed modifies the rotation of the DEC axis given in the header. This is what I expect, I think: only the header is affected, so the actual map is unaltered. However, the coordinates of the field centre and the direction of N with respect to the y axis (i.e. the overlay of the coordinate grid) is different. I think, therefore, that the dataset has to be rotated by the amount that EPOSW puts in the header (using UVSRT) unless DBCON is clever enough to do that for itself. If this is done correctly, the header then shows zero rotation. Does that make sense to you? I'm not sure whether DBCON will even accept 2 datasets with different rotations, but will check.

I was wool-gathering about inaccuracies at the edge of the field: indeed, this only applies to images. The main thing is the precision of the rotation. In our case, the value is 0.09 degrees, which certainly matters, and it is quoted to 2 decimal places. The max error at the edge of a 4096^2 field is then a rotation of 0.005 degrees along the diagonnal = 0.25 pixels, which probably doesn't matter. Nevertheless, it is straightforward to work this out a little more accurately.

Regards, Robert

From root Thu Nov 9 11:30:19 1995
X-VM-v5-Data: ([nil nil nil nil nil nil nil nil nil]
["527" "Thu" "9" "November" "1995" "16:29:10" "+0000" "Robert Laing" "rl@ast.cam.ac.uk" nil "13" "Accuracy of rotation" "^From:" nil nil "11" nil nil nil nil]
nil)
Received: from cass41.ast.cam.ac.uk by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA174820; Thu, 9 Nov 1995 11:30:15 -0500
Received: from rgosf.ast.cam.ac.uk by cass41 with smtp
(Smail3.1.29.1 #9) id m0tDZqi-000CMUC; Thu, 9 Nov 95 16:29 GMT
Recmived: by rgosf.ast.cam.ac.uk (Smail3.1.29.1 #9)
id m0tDZqg-000ucHC; Thu, 9 Nov 95 16:29 GMT
X-Sender: rl@rgosf
Message-Id: <Pine.SOL.3.91.951109162135.1677A-100000@rgosf>
Mime-Version: 1.0
Content-Type: TEXT/PLAIN; charset=US-ASCII
From: Robert Laing <rl@ast.cam.ac.uk>
To: Alan Bridle <abridle@polaris.cv.nrao.edu>
Cc: Rick Perley <rperley@aoc.nrao.edu>
Subject: Accuracy of rotation
Date: Thu, 9 Nov 1995 16:29:10 +0000 (GMT)

Turns out that using GETHEAD recovers the rotation to a suitably high
accuracy (4 d.p.'s), and that DBCON will not accept 2 files with
different rotations. So, I believe that the correct procedure is:

- EPOSWTCH to convert header to J2000
- GETHEAD with KEYWORD 'CROTA5' to find out rotation
- UVSRT with ROTATE set (probably to -1 * this number)
- DBCON with DOPOS(1,1) = 1 to combine the 2 datasets with a common
  phase centre (or UVFIX for a single dataset).

I'll try that and see whether it works.

Regards, Robert

From root Thu Nov 9 11:45:23 1995
X-VM-v5-Data: ([nil nil nil nil nil nil nil nil nil]
["516" "Thu" "9" "November" "1995" "16:44:42" "+0000" "Robert Laing" "rl@ast.cam.ac.uk" nil "13" "Re: Accuracy of rotation" "^From:" nil nil "11" nil nil nil nil]
nil)
Received: from cass41.ast.cam.ac.uk by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA172467; Thu, 9 Nov 1995 11:45:22 -0500
Received: from rgosf.ast.cam.ac.uk by cass41 with smtp
(Smail3.1.29.1 #9) id m0tDa5k-000CM1C; Thu, 9 Nov 95 16:44 GMT
Received: by rgosf.ast.cam.ac.uk (Smail3.1.29.1 #9)
id m0tDa5j-0000cHC; Thu, 9 Nov 95 16:44 GMT
X-Sender: rl@rgosf
In-Reply-To: <199511091634.JAA04304@sechelt.aoc.nrao.edu>
Message-Id: <Pine.SOL.3.91.951109163647.1712A-100000@rgosf>
Mime-Version: 1.0
Content-Type: TEXT/PLAIN; charset=US-ASCII
From: Robert Laing <rl@ast.cam.ac.uk>
To: Alan Bridle <abridle@polaris.cv.nrao.edu>,
Rick Perley <rperley@aoc.nrao.edu>
Subject: Re: Accuracy of rotation
Date: Thu, 9 Nov 1995 16:44:42 +0000 (GMT)

It is indeed -1 * rotation given in the header. There are some
curiosities associated with the output formatting for GETHEAD. I put in
a rotation of 0.0936 deg and then checked the header of the output file.
KEYVAL then contained a small residual rotation (less than 0.0001 deg, so
GETHEAD had changed its report resolution). I will check whether DBCON
is fussy about the residual: it may be necessary to set the rotation to 0
by hand once it is sufficiently small not to matter.

Intuitive, isn't it?

R.

From root Thu Nov 9 12:26:47 1995
X-VM-v5-Data: ([nil nil nil nil nil nil nil nil nil]
["187" "Thu" "9" "November" "1995" "17:23:11" "+0000" "Robert Laing" "rl@ast.cam.ac.uk" nil "9" "I knew it was too easy" "^From:" nil nil "11" nil nil nil nil]
nil)
Received: from cass41.ast.cam.ac.uk by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA56808; Thu, 9 Nov 1995 12:26:18 -0500
Received: from rgosf.ast.cam.ac.uk by cass41 with smtp
(Smail3.1.29.1 #9) id m0tDagz-000CMAC; Thu, 9 Nov 95 17:23 GMT
Received: by rgosf.ast.cam.ac.uk (Smail3.1.29.1 #9)
id m0tDagx-0000cHC; Thu, 9 Nov 95 17:23 GMT
X-Sender: rl@rgosf
Message-Id: <Pine.SOL.3.91.951109172056.1788A-100000@rgosf>
Mime-Version: 1.0
Content-Type: TEXT/PLAIN; charset=US-ASCII
From: Robert Laing <rl@ast.cam.ac.uk>
To: Alan Bridle <abridle@polaris.cv.nrao.edu>,
Rick Perley <rperley@aoc.nrao.edu>
Subject: I knew it was too easy
Date: Thu, 9 Nov 1995 17:23:11 +0000 (GMT)

Actually, you need to set the Dec axis rotation to the same value for
both datasets before running DBCON. Turns out it is very slightly non-zero
for a normal dataset.

Silly me.

R.

From root Fri Nov 10 07:38:10 1995
X-VM-v5-Data: ([nil nil nil nil t nil nil nil nil]
["406" "Fri" "10" "November" "1995" "12:37:03" "+0000" "Robert Laing" "rl@ast.cam.ac.uk"
"<Pine.SOL.3.91.951110123226.3276A-100000@rgosf>" "9" "Yet another little problem" "^From:" nil nil "11" nil nil nil
nil]
nil)
Received: from cass41.ast.cam.ac.uk by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA172429; Fri, 10 Nov 1995 07:37:09 -0500
Received: from rgosf.ast.cam.ac.uk by cass41 with smtp
(Smail3.1.29.1 #9) id m0tDshe-000CMXC; Fri, 10 Nov 95 12:37 GMT
Received: by rgosf.ast.cam.ac.uk (Smail3.1.29.1 #9)
id m0tDshc-0000cHC; Fri, 10 Nov 95 12:37 GMT
X-Sender: rl@rgosf
Message-Id: <Pine.SOL.3.91.951110123226.3276A-100000@rgosf>
Mime-Version: 1.0
Content-Type: TEXT/PLAIN; charset=US-ASCII
From: Robert Laing <rl@ast.cam.ac.uk>
To: Alan Bridle <abridle@polaris.cv.nrao.edu>
Subject: Yet another little problem
Date: Fri, 10 Nov 1995 12:37:03 +0000 (GMT)

Dear Alan,

The construction-configuration stuff is proving to be a bit of a pain. Having sorted out the equinox, I split the B-configuration dataset into IF pairs and DBCONNed the two resulting files onto the construction configuration file. I then ran CALIB, but this appeared to see only the B-configuration data. Do you suppose that this was because the source-name is different?

R.

From abridle Fri Nov 10 09:55:55 1995
X-VM-v5-Data: ([nil nil nil nil nil nil nil nil nil]
["873" "Fri" "10" "November" "1995" "09:50:22" "-0500" "Alan Bridle" "abridle" nil "21" "Re: Yet another little problem" "^From:" nil nil "11" nil nil nil nil]
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Received: by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA81696; Fri, 10 Nov 1995 09:50:22 -0500
Message-Id: <9511101450.AA81696@polaris.cv.nrao.edu>
In-Reply-To: <Pine.SOL.3.91.951110123226.3276A-100000@rgosf>
References: <Pine.SOL.3.91.951110123226.3276A-100000@rgosf>
From: abridle (Alan Bridle)
To: Robert Laing <rl@ast.cam.ac.uk>
Subject: Re: Yet another little problem
Date: Fri, 10 Nov 1995 09:50:22 -0500

Robert Laing writes:
> Dear Alan,
> The construction-configuration stuff is proving to be a bit of
> a pain. Having sorted out the equinox, I split the B-configuration
> dataset into IF pairs and DBCONNed the two resulting files onto the
> construction configuration file. I then ran CALIB, but this appeared to
> see only the B-configuration data. Do you suppose that this was because
> the source-name is different?
>

If we did use different source names, you might need to include both
names in the SOURCE and CAL list for CALIB. If this option cannot be
swallowed for a database in single-source format it may be necessary
to edit the source tables directly to change the name. I haven't
actually had to do that but this is one of the costs of using
old data while having new data in J2000. I've avoided the mix'n'match
until now.

A.

From root Fri Nov 10 11:33:46 1995
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["260" "Fri" "10" "November" "1995" "16:33:18" "+0000" "Robert Laing" "rl@ast.cam.ac.uk" nil "7" "Re: Yet another little problem" "^From:" nil nil "11" nil nil nil nil]
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Received: from cass41.ast.cam.ac.uk by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.03)
id AA169472; Fri, 10 Nov 1995 11:33:27 -0500
Received: from rgosf.ast.cam.ac.uk by cass41 with smtp
(Smail3.1.29.1 #9) id m0tDwOH-000CMxC; Fri, 10 Nov 95 16:33 GMT
Received: by rgosf.ast.cam.ac.uk (Smail3.1.29.1 #9)
id m0tDwOF-0000cHC; Fri, 10 Nov 95 16:33 GMT
X-Sender: rl@rgosf
In-Reply-To: <9511101450.AA81696@polaris.cv.nrao.edu>
Message-Id: <Pine.SOL.3.91.951110163108.4056A-100000@rgosf>
Mime-Version: 1.0
Content-Type: TEXT/PLAIN; charset=US-ASCII
From: Robert Laing <rl@ast.cam.ac.uk>
To: Alan Bridle <abridle@polaris.cv.nrao.edu>
Subject: Re: Yet another little problem
Date: Fri, 10 Nov 1995 16:33:18 +0000 (GMT)

Thanks ... I'll see what works. I'm pretty sure something went funny at
the DBCON stage.

By the way, Bill Sparks and Stefi Baum have some nice HST pictures of 3C 31.
No jets, but lots of dust, apparently. I'll look at superposing the data.

Cheers, Robert

From VM Fri May 17 15:31:56 1996
X-VM-v5-Data: ([nil nil nil nil nil nil t nil nil]
["4218" "Thu" "9" "May" "1996" "18:57:54" "-0400" "Alan Bridle" "abridle" nil "93" "3C31" "^From:" nil nil "5" nil
nil (number " " mark " Z Alan Bridle   May 9   93/4218 " thread-indent "\"3C31\"\n") nil]
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Received: by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.06)
id AA27936; Thu, 9 May 1996 18:57:54 -0400
Message-Id: <9605092257.AA27936@polaris.cv.nrao.edu>
From: abridle (Alan Bridle)
To: rperley
Subject: 3C31
Date: Thu, 9 May 1996 18:57:54 -0400

Hi Rick,

The reason I had to get away from the upgrade meeting promptly was that
I was finishing up work on 3C31 with Robert Laing and taking him to
the airport.

We got a lot done on modeling the super-resolved (0.3") 8 GHz images
of 3C31 in total and polarized intensity. As I'm about to head off
for a few days' vacation (we also just sent the Alabama proceedings
to ASP and it's Mary's birthday) I'll give you a quick summary that
I can also use as a note to myself about the state of the project!

We made a pretty successful fit to the data with a decelerating-jet
model having the following characteristics:

Three regions of expansion:

An initial, non-expanding (FR-II like) region, followed by

A rapidly-expanding region, followed by,

A reconfined (conically-expanding region).

Within each region, a spine of constant-velocity emission carrying the
canonical Laing random field confined to spherical surfaces centered
on the nucleus of 3C31; and a shear layer whose inner velocity matches
that of the spine at every distance from the nucleus but whose outer
velocity is determined from the fitting, and whose field is a random
field with no component across the flow (but with axial and azimuthal
components in equal proportions).

The geometry of the model is set by inspection of the geometry of the
large-scale total intensity and polarization properties of the jet,
about a 16-degree opening angle, of which half is spine and half is
shear layer.

The polarimetry provides strong constraints on the velocity range, the
brightness and jet-sidedness distributions provide strong constraints
on the detailed velocity profiles both along the jet axis and across
the shear layer, and on the emissivity variation in the spine and in
the shear layer.

To fit 3C31, we need the following:

The jet is at about 60 deg to the line of sight.

The initial region has a spine velocity >= about 0.95c and a velocity on the edge of the shear layer no less than about 0.8c.

As soon as the rapid-expansion begins, the velocity in the spine begins to drop and the velocity on the edge of the shear layer drops even faster. By the end of the rapid-expansion region, which is more or less the end of the highly one-sided jet knots, the spine velocity has fallen to 0.75c and the edge of the shear layer is effectively stationary. In this region the jet emissivity must be dominated by the shear layer to produce the polarimetry, but the emissivity is decreasing very rapidly, about as distance^-4.8.

After the recollimation, the spine decelerates to about 0.2c by the first of the big arcs, and its emissivity falls more slowly, at something like the perpendicular-field adiabat. The shear layer emissivity falls more rapidly, probably consistent with its different field configuration, so it ceases to dominate the emission by about the distance where the arcs appear.

All of this gives a pretty good fit to the intensity and sidedness distributions in detail, and a passable fit to the polarimetry. Before we write it up, we will need to do some parameter-perturbation and chi-squared minimization but we have a pretty good idea now of the run of the parameters from making models at 0.1" intervals, convolving them to a 0.3" Gaussian beam, and comparing them directly with the data in AIPS.

It's a very nice case for something very like an FRII jet initially, flaring and then recollimating while it decelerates, and our statements about constraints on the velocity fields in the VLA proposal can certainly be lived up to! The velocity field that is coming out is highly plausible, with the jet first "learning" about the environment in the first regime, then` explosively decelerating and decollimating, then having its velocity profile gradually flatten and broaden after it has been recollimated. In fact Robert and I are now convinced that we should go for an A array proposal at 8 GHz to image the basal region at even higher resolution and will get a draft of it for you to review by the end of next week; we'd like to submit for the June 1 deadline, of course.

Has been a very productive couple of weeks, we can look at it all in huge detail when you're in CV next month, of course.

Cheers, A.

From VM Thu May 23 17:26:36 1996
X-VM-v5-Data: ([nil nil nil t t nil nil nil nil]
["6075" "Thu" "23" "May" "1996" "14:54:02" "+0100" "Robert Laing" "rl@ast.cam.ac.uk"
"<Pine.GSO.3.93.960523145049.23725A-100000@rgosf>" "101" "3C31 proposal" "^From:" nil nil "5" nil nil (number " "
mark " FR Robert Laing   May 23 101/6075 " thread-indent "\"3C31 proposal\"\n") nil]
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Content-Length: 6075
Received: from cv3.cv.nrao.edu by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.07)
id AA37190; Thu, 23 May 1996 09:57:51 -0400
Received: from ast.cam.ac.uk (cass41.ast.cam.ac.uk [131.111.69.186]) by cv3.cv.nrao.edu (8.7.5/8.7.1/CV-2.1) with SMTP
id JAA08483 for <abridle@polaris.cv.nrao.edu>; Thu, 23 May 1996 09:57:48 -0400 (EDT)
Received: from rgosf.ast.cam.ac.uk by ast.cam.ac.uk (SMI-8.6/SMI-SVR4)
id OAA09063; Thu, 23 May 1996 14:54:05 +0100
Received: from localhost by rgosf.ast.cam.ac.uk (SMI-8.6/SMI-SVR4)
id OAA23729; Thu, 23 May 1996 14:54:03 +0100
X-Sender: rl@rgosf
Message-Id: <Pine.GSO.3.93.960523145049.23725A-100000@rgosf>
Mime-Version: 1.0
Content-Type: TEXT/PLAIN; charset=US-ASCII
From: Robert Laing <rl@ast.cam.ac.uk>
To: Alan Bridle <abridle@polaris.cv.nrao.edu>
Subject: 3C31 proposal
Date: Thu, 23 May 1996 14:54:02 +0100 (BST)

Dear Alan,

I am afraid I have run out of time, so here is a rather scrappy first go
at the scientific case for 3C 31. I hope that it is a reasonable start.
I'll shortly be departing (slightly earlier than I had originally
planned, unfortunately). Sorry to lumber you with the rest.

Regards,

Robert

The idea that jets in low-luminosity radio galaxies are initially relativistic,
decelerating flows has recently been shown to provide a good qualitative
explanation of their statistical properties. In this picture, intensity
differences between the two jets result from Doppler boosting, the nearer jet
appearing brighter. As the jets decelerate, the jets become more similar in
brightness. Laing (1993, 1995) developed a model in which a fast,
perpendicular-field spine is surrounded by a slower shear layer, and showed that
this also explains the polarization systematics. The main results are as
follows:
\begin{itemize}
\item Jet/counter-jet intensity ratios are correlated with the fractional
flux in the core; they also decrease away from the nucleus.
\item There are regions of weak emission (``gaps'') close to the nuclei.
The counter-jet gap is longer, and the ratio of their lengths correlates with
brightness ratio.
\item The main jet is more centrally peaked, although the outer isophotes of the
two jets are the same.
\item The apparent magnetic field is longitudinal close to the nucleus (where
the shear layer dominates the emission) provided that the source is not too close
to the line of sight. There is a transition to perpendicular field further out,
where the spine component is more important.
\item Transverse-field regions are centre-brightened, whereas longitudinal-field
regions are edge-brightened (or, at least, have a flatter profile).

\item A depolarization asymmetry is expected (in the sense that the nearer, brighter jet is seen through less of the galaxy halo and therefore shows less depolarization).
\end{itemize}
Our approach to testing this model has been to apply it to observations of a complete sample (B2 bright galaxies) in order to investigate statistical properties (Parma et al. 1994) as well as to detailed observations of individual objects. We have recently completed the analysis of a multi-configuration study of the nearby radio galaxy 3C 31. Our main aims in the latter project were to study the jet bases in detail at 8.4 GHz (B, C and D configurations) and to make scaled array observations at 4.9 and 1.3 -- 1.7 GHz to investigate the depolarization asymmetry. Prompted by the results of our 8.4 GHz mapping, we have recently developed the spine/shear-layer model in significantly greater detail. Our approach is to model the jets as axisymmetric, conical flows and to assume that the two jets are intrinsically identical. We include the ability to parametrize the variations of rest-frame emissivity and velocity as functions of position in the jet and aim to solve for these quantities, and for the angle to the line of sight.

Our observations have a natural resolution of 0.7 arcsec FWHM, but we also used maximum-entropy deconvolution to produce super-resolved images of I, Q and U with a FWHM of 0.3 arcsec (Figure 1). Our current model is shown in Figure 2. Whilst we are still optimizing the parameters, it is clear that the model provides a good description of the inner jets of 3C 31, and in particular of the sidedness ratio and field structure. Our conclusions may be summarized as follows:
\begin{itemize}
\item The angle to the line of sight is very close to 60°.
\item The structure may be modelled as a perpendicular-field spine surrounded by a shear layer in which the field has roughly equal longitudinal and azimuthal components, but whose radial component is negligible. This configuration of the shear-layer field is required in order that the transition between longitudinal and transverse apparent magnetic field occurs closer to the nucleus in the counter-jet than it does in the main jet (the opposite is expected for a longitudinal shear-layer field).
\item The jets are divided into three regions with qualitatively different collimation and velocity behaviour: the inner jet ($<$3 arcsec from the nucleus); the transition region (3 -- 8 arcsec) and the outer jet ($>$8 arcsec).
\item The inner jet is very well collimated (and may not expand at all). Its central velocity is roughly constant, with $\beta \approx$ 0.9 -- 0.95. The lowest velocity in the shear layer is around β = 0.75. Similar structures are seen in PKS 1333$-$33 (Killeen, Bicknell \& Ekers 1986) and in 3C 449 (Feretti et al., private communication). They show many properties in common with FRII jets.
\item In the transition region, the jets expand rapidly and the central velocity drops to β = 0.75. In the shear layer, the velocity profile evolves through the region, and at its outer boundary, there is significant zero-velocity emission at the edge of the jet. The emissivity in both spine and shear layer falls very rapidly with distance from the nucleus.
\item Finally, the jets recollimate to form a basically conical flow in the outer region. Here, the central velocity decreases smoothly from β = 0.75 at the start to $\beta \approx$ 0 at the end, whilst the material at the jet edge is essentially at rest.
\end{itemize}

Whilst we believe that these conclusions are soundly based, a number of the details depend critically on super-resolution. In particular, the effectiveness of this technique for linear polarization has not yet been properly tested. We

have verified that the model fits the observations at the conventional resolution (0.7 arcsec) but the exact location of the transition between parallel and perpendicular apparent field is a vital constraint on the model, and improved data at 0.25 arcsec resolution is very important. Our present observations provide an accurate estimate of the surface brightness at 0.3-arcsec resolution, and indicate that A-configuration data would provide significantly higher signal-to-noise and reliability.

From VM Thu May 23 17:26:41 1996
X-VM-v5-Data: ([nil nil nil t nil nil nil nil nil]
["399" "Thu" "23" "May" "1996" "10:48:20" "-0400" "Alan Bridle" "abridle" nil "13" "Re: 3C31 proposal" "^From:" nil nil "5" nil nil nil nil]
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id AA21805; Thu, 23 May 1996 10:48:20 -0400
Message-Id: <9605231448.AA21805@polaris.cv.nrao.edu>
In-Reply-To: <Pine.GSO.3.93.960523145049.23725A-100000@rgosf>
References: <Pine.GSO.3.93.960523145049.23725A-100000@rgosf>
From: abridle (Alan Bridle)
To: Robert Laing <rl@ast.cam.ac.uk>
Subject: Re: 3C31 proposal
Date: Thu, 23 May 1996 10:48:20 -0400

Robert Laing writes:
> Dear Alan,
>
> I am afraid I have run out of time, so here is a rather scrappy first go
> at the scientific case for 3C 31. I hope that it is a reasonable start.
> I'll shortly be departing (slightly earlier than I had originally
> planned, unfortunately). Sorry to lumber you with the rest.

It's a good start, I can take it from there. have a good holiday!

A.

From VM Thu May 30 18:50:48 1996
X-VM-v5-Data: ([nil nil nil nil nil nil nil nil nil]
["117" "Thu" "30" "May" "1996" "15:03:37" "-0600" "Rick Perley" "rperley@aoc.nrao.edu" nil "6" "Proposal on 3C31" "^From:" nil nil "5" nil nil nil nil]
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Content-Length: 117
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id AA32519; Thu, 30 May 1996 17:03:41 -0400
Received: from sechelt.aoc.nrao.edu (sechelt.aoc.nrao.edu [146.88.6.21]) by arana.aoc.nrao.edu (8.6.12/8.6.10) with ESMTP id PAA01694 for <abridle@arana.aoc.nrao.edu>; Thu, 30 May 1996 15:03:39 -0600
Received: (from rperley@localhost) by sechelt.aoc.nrao.edu (8.7.3/8.6.10) id PAA21533 for abridle; Thu, 30 May 1996 15:03:37 -0600 (MDT)
Message-Id: <199605302103.PAA21533@sechelt.aoc.nrao.edu>
X-Sun-Charset: US-ASCII
X-UIDL: 833491174.000
Status: RO
From: Rick Perley <rperley@aoc.nrao.edu>
To: abridle@aoc.nrao.edu
Subject: Proposal on 3C31
Date: Thu, 30 May 1996 15:03:37 -0600 (MDT)

Alan:

It reads fine. Question: How much time are you asking for? I didn't find that in the proposal.

Rick

From VM Fri May 31 18:27:27 1996
X-VM-v5-Data: ([nil nil nil nil nil nil t nil nil]
["10241" "Fri" "31" "May" "1996" "17:26:39" "-0400" "Alan Bridle" "abridle" nil "211" "3C31 A array proposal"
"^From:" nil nil "5" nil nil nil nil]
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id AA32808; Fri, 31 May 1996 17:26:39 -0400
Message-Id: <9605312126.AA32808@polaris.cv.nrao.edu>
From: abridle (Alan Bridle)
To: lferetti@astbo1.bo.cnr.it, ggiovannini@astbo1.cnr.it,
parma@astbo1.bo.cnr.it
Subject: 3C31 A array proposal
Date: Fri, 31 May 1996 17:26:39 -0400

Hello Luigina, Gabriele, Paola:

Robert and I made good progress trying to make a detailed model of the deceleration in 3C31 while he was here in Charlottesville a couple of weeks ago. It was clear that the super-resolved MEM images (0.3" FWHM) require a multi-stage model. We are now eager to increase the angular resolution in the data, and have drafted the following VLA proposal for the Monday afternoon deadline -- I've also shown the models to Bill Cotton and he has drafted a similar proposal for a high-resolution follow-up on NGC315 at 6cm.

Let me know in the a.m. on Monday (if you can) if there's anything you'd like to alter in this before I submit it.

If you'd like to see the Figures, a postscript file (0.5 Mbytes) is on ftp.cv.nrao.edu in the /pub/NRAO-staff/abridle directory.

Best wishes,

Alan B.

==========

```
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\input psfig

\centerline {\bf KINEMATICS OF JET DECELERATION:}
\vskip 0.06cm
\centerline {\bf HIGH-RESOLUTION IMAGING AND POLARIMETRY OF 3C 31}
\vskip 0.35cm
\centerline {\bf I. Motivation and Statistical Results}
\vskip 0.2cm

The idea that jets in low-luminosity---Fanaroff-Riley (1974) Type
I---radio galaxies are initially relativistic, decelerating flows has
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recently been shown to provide a good qualitative explanation of their statisticad properties. In this picture, differences between the two jets in their intensity and polarimetric properties are dominated by Doppler boosting and relativistic aberration effects. As the jets decelerate, they appear more similar in brightness, and relativistic aberration also modifies their apparent field configuration in the observer's frame. Laing (1994, 1995) suggested that deceleration of a fast, perpendicular-random-field spine surrounded by a slower shear layer can explain the main systematics. the main predictions of this model are as follows:
\vskip 0.15cm
\n 1. Jet/counterjet intensity ratios are correlated with the fractional flux density in the core; they also decrease away from the nucleus.

\n 2. There are regions of weak (Doppler-suppressed) emission (``gaps") close to the nuclei. The counterjet gap is longer; the ratio of gap lengths correlates with brightness ratio.

\n 3. The main jet is more centrally peaked, although the outer isophotes of both jets are the same.

\n 4. The apparent magnetic field is longitudinal close to the nucleus (where the shear layer dominates the emission) provided that the source is not too close to the line of sight. There is a transition to perpendicular field further out, where the spine component is more important (emerging from Doppler suppression).

\n 5. Transverse-field regions are center-brightened, whereas longitudinal-field regions are edge-brightened (or, at least, have a flatter profile).

\n 6. A depolarization asymmetry is expected (in the sense that the nearer, brighter jet is seen through less of the galaxy halo and thus shows less depolarization).
\vskip 0.15cm
Observations by some of us (Parma et al. 1994, and in preparation) of a complete sample of B2 bright galaxies confirm these correlations.

\vskip 0.35cm
\centerline {\bf II. The R\^ole of High-Resolution Imaging}
\vskip 0.2cm

It is now important to examine the deceleration kinematics in detail in individual sources. We are close to completing analysis of a multi-configuration study (AF263) of the nearby FR~I radio galaxy 3C 31. Our goals were to image both jet bases in detail at 8.4 GHz (B, C \& D configurations) and to use scaled arrays at 8.4, 4.9 and 1.3--1.7 GHz to explore the depolarization asymmetry. We find that the counterjet is more externally depolarized, as predicted. The 8.4 GHz imaging is refining Laing's spine/shear-layer model in important ways:

We model the jets as axisymmetric, conical flows, assuming that they are intrinsically identical. We parameterize their variations of rest-frame emissivity and velocity, and solve for these quantities and for the angle of the jets to the line of sight, by iteratively fitting the observed I, Q and U images.

Our 8.4 GHz data have a conventional FWHM of 0.7$"$ (Fig. 1; jet bases only, rotated to the horizontal axis). We have also used MEM deconvolution to super-resolve the jet bases to 0.3$"$ FWHM. Fig. 2

shows total intensity (a color version can be viewed at {\it http://www.cv.nrao.edu/$\sim$abridle/3c31xhi.htm}); Fig. 3 shows percent linear polarization and B-vector angle). Fig. 4 shows our {\it current}, best-fit model at this resolution---{\it we are still optimizing its parameters}. The model describes the intensity structure of the inner jets well (particularly their sidedness ratio), and gives a fair account of the percent polarization, but only a qualitatively correct field structure. Our conclusions so far are:
\vskip 0.15cm
\n 1. The angle of the jets to the line of sight is $60\pm10^{\circ}$.

\n 2. The structure may be modeled as a perpendicular-field spine surrounded by a shear layer whose (random) field has {\it roughly equal axial and azimuthal components}, but whose radial component is negligible. This revision to the shear-layer field is essential to make the transition from longitudinal to transverse apparent magnetic field occur closer to the nucleus in tee counterjet than in the main jet, as demanded by our new lata. (The opposite is expected for the axial shear-layer field first proposed by Laing). Our revised shear-layer field configuration also matches that in the best-resolved {\it FR~II} jet---3C 353 (Swain, Bridle, \& Baum 1995, and in preparation).

\n 3. The jets have three regions with qualitatively different collimation and velocity behavior: an inner jet ($<$3$"$ from the nucleus); a transition region (3--8$"$) and an outer jet ($>$8$"$).

\n 4. The {\it inner jet} is well collimated (it may not expand at all). Its central velocity is roughly constant, with $\beta \approx$ 0.9--0.95. The lowest velocity in the shear layer here is $\beta \sim$ 0.75. Similar structures occur in PKS 1333$-$33 (Killeen, Bicknell, \& Ekers 1986) and in 3C 449 (Feretti et al., private communication). These inner FR~I jets have many properties in common with FR~II jets, strongly supporting the basic precepts of our model.

\n 5. In the {\it transition region}, the jets expand rapidly and the central (spine) velocity drops to β = 0.75. The shear layer's velocity profile also evolves through this region---by 8$"$ from the nucleus, the velocity falls to near zero at the edge of the jet. The emissivity in both spine and shear layer also fall rapidly with distance from the nucleus in this region. Our 0.3$"$ resolution images (Figs. 2 and 3) are critical to defining the properties of this region, which link jet ``flaring'' and spine deceleration---as predicted by some dynamical models.

\n 6. The jets recollimate to a basically conical flow in the {\it outer region}. Here, the central velocity decreases smoothly from β = 0.75 to $\beta \approx$ 0, while the material at the jet edge is essentially at rest. (I.e., the velocity profile {\it flattens} as the whole jet decelerates). The emissivity of the spine and shear layer fall less rapidly with distance from the nucleus in this region.
\vskip 0.15cm
Although we are confident in the main features of the velocity profiles emerging from this work, important details depend critically on our MEM super-resolution, whose reliability for VLA linear

polarization data has yet to be fully tested. Our model also fits the observations at the normal resolution (0.7$"$), but the location of the transition from parallel to perpendicular apparent field (poorly modeled at present---Fig. 4), and the transverse sidedness profiles in the resolved jet base, are both key constraints on the velocity field. Sensitive data at $\sim$0.2$"$ conventional resolution are now highly desirable. Our MEM images should estimate the surface brightness at this resolution well, so the A-configuration data now requested will have enough signal-to-noise to serve two main purposes. First, to consolidate a kinematic model constraining mass fluxes, energy and momentum balance in a jet that is decelerating on kpc scales in an elliptical galaxy. Second, to quantify the validity of MEM super-resolution for intensity {\it and polarization} of VLA full-synthesis imaging: if successful, we hope to model the velocity profiles in the inner jet and transition regions based on $\sim$0.1$"$ effective resolution.
\vskip 0.2cm
We ask for 12 hrs in the A configuration at 8 GHz, to maximize sensitivity for our polarimetry. These data will be combined with our B, C and D configuration data to make sensitivity-limited images.

\vfill\eject
\centerline{\bf References}
\vskip 0.2cm

{\obeylines
\n Fanaroff, B. L., \& Riley, J. M. 1974, {\it MNRAS}, {\bf 167}, 31P.
\n Killeen, N. E. B., Bicknell, G. V., \& Ekers, R. D. 1986, {\it ApJ}, {\bf 302}, 306.
\n Laing, R. A. 1994, in {\it The Physics of Active Galaxies}, {\it ASP Conf. Ser.}, {\bf 54}, 227.
\n Laing, R. A. 1995, ``Brightness and polarization structure of decelerating relativistic jets", in {\it Energy Transport in Radio Galaxies and Quasars}, {\it ASP Conf. Ser.}, {\bf 100}, 241 (in press, preprint: {\it http://www.cv.nrao.edu/$\sim$azensus/jetwks.html})
\n Parma, P., de Ruiter, H. R., Fanti, R., e& Laing, R. A. 1994, in {\it The Physics of Active Galaxies}, {\it ASP Conf. Ser.}, {\bf 54}, 241.
\n Swain, M. R., Bridle, A. H., \& Baum, S. A. 1995, ``The jets in the radio galaxy 3C 353", in {\it Energy Transport in Radio Galaxies and Quasars}, {\it ASP Conf. Ser.}, {\bf 100}, 209 (in press, preprint: {\it http://www.cv.nrao.edu/$\sim$abridle/papers.htm})
}

\vskip 0.5cm
\centerline{{\bf Figures} (all log contours at $\times$2 from 30μJy/beam)}
\vskip 0.4cm

\centerline{\psfig{figure=31X07CNT.PS,height=2.6in}}

\centerline{\psfig{figure=31X03CNT.PS,height=2.6in}}

\centerline{\psfig{figure=31X03POL.PS,height=3.3in}}

\centerline{\psfig{figure=31MODPOL.PS,height=3.3in}}

\vfill\eject\end

From VM Mon Jun 3 11:41:20 1996
X-VM-v5-Data: ([nil nil nil nil nil nil t nil nil]
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id AA30606; Mon, 3 Jun 1996 05:01:05 -0400
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FAA08331 for <ABRIDLE@NRAO.EDU>; Mon, 3 Jun 1996 05:00:48 -0400 (EDT)
Message-Id: <960603110022.20200c7a@astbo1.bo.cnr.it>
From: PHONE 39 51 6399415 OR 6305716 FAX 39 51 6399431 <GGIOVANNINI@astbo1.bo.cnr.it>
To: ABRIDLE@NRAO.EDU
Cc: GGIOVANNINI@astbo1.bo.cnr.it
Subject: 3c31 proposal
Date: Mon, 3 Jun 1996 11:00:22 +0200 (MET-DST)

Dear Alan,
the 3C31 proposal is very good.
You and Robert have obtained very good results.

The only comment that I can give you is that from global VLBI observations
we give the following constraints on 3C31:

the angle with respect to the line of sight should be < 60 (from the
j/cj ratio in the parsec scale) and > 34 (> 45 if you vant v > 0.8c)

the parsec scale jet velocity should be > 0.62c and < 0.998c

results have been just submitted to Apj (Lara et al., 1996, Bill should have
a copy of the paper, ask him, if not I can send you a copy)

so you could add in the proposal that the 60 degree angle for 3c31 is
in agreement also with global vlbi data....

and in future a vlbi - vla comparison may be useful....

==========

I have seen that 3C31 and NGC315 were observed with MERLIN in 1992,
I am sending a mail to Robert to check the data quality; we could ask for
them and we could take care to reduce them in Bologna and after to combine
with VLA to have high resolution (even if the MERLIN sensitivity is not as
good as the VLA one...)

gabriele

From VM Mon Jun 3 11:41:22 1996
X-VM-v5-Data: ([nil nil nil nil nil nil t nil nil]
["77" "Mon" "3" "June" "1996" "11:17:28" "+0200" "PARMA@astbo1.bo.cnr.it" "PARMA@astbo1.bo.cnr.it" nil "4"
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id AA33869; Mon, 3 Jun 1996 05:19:12 -0400
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SMTP id FAA08559 for <abridle@nrao.edu>; Mon, 3 Jun 1996 05:18:48 -0400 (EDT)
Message-Id: <960603111728.20200905@astbo1.bo.cnr.it>
From: PARMA@astbo1.bo.cnr.it
To: abridle@nrao.edu
Subject: RE: 3C31 A array proposal
Date: Mon, 3 Jun 1996 11:17:28 +0200 (MET-DST)

Dear Alan,
I read the proposal and for me is OK as it is.
Best wishes
Paola

From VM Mon Jun 3 11:41:24 1996
X-VM-v5-Data: ([nil nil nil nil nil nil t nil nil]
["256" "Mon" "3" "June" "1996" "12:08:36" "+0200" "Phone IRA" "LFERETTI@astbo1.bo.cnr.it" nil "7" "RE: 3C31
A array proposal" "^From:" nil nil "6" nil nil nil nil]
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id AA24101; Mon, 3 Jun 1996 06:09:25 -0400
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Message-Id: <960603120836.20200c8d@astbo1.bo.cnr.it>
From: "IRA, Phone 39-51-639 9412" <LFERETTI@astbo1.bo.cnr.it>
To: abridle@crao.edu
Cc: LFERETTI@astbo1.bo.cnr.it
Subject: RE: 3C31 A array proposal
Date: Mon, 3 Jun 1996 12:08:36 +0200 (MET-DST)

Dear Alan,
the proposal is very nice to me. Maybe we could add a quantitative justification why we request 12 hours, what is the sensitivity that we need to properly map the polarization structure, especially in the counterjet.
Best regards, Luigina

From VM Mon Jun 3 11:41:59 1996
X-VM-v5-Data: ([nil nil nil nil nil nil nil nil nil]
["1090" "Mon" "3" "June" "1996" "10:56:56" "-0400" "Alan Bridle" "abridle@nrao.edu" nil "27" "3C31" "^From:" nil nil "6" nil nil nil nil]
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id AA30370; Mon, 3 Jun 1996 11:01:01 -0400
Received: from polaris.cv.nrao.edu (root@polaris.cv.nrao.edu [192.33.115.101]) by cv3.cv.nrao.edu (8.7.5/8.7.1/CV-2.1) with SMTP id LAA12069 for <abridle@nrao.edu>; Mon, 3 Jun 1996 11:01:00 -0400 (EDT)
Received: from dogwood.cv.nrao.edu by polaris.cv.nrao.edu (AIX 3.2/UCB 5.64/4.07)
id AA19046; Mon, 3 Jun 1996 10:57:40 -0400
Message-Id: <9606031457.AA19046@polaris.cv.nrao.edu>
Comments: Authenticated sender is <abridle@polaris.cv.nrao.edu>
Organization: NRAO Charlottesville
Priority: normal
X-Mailer: Pegasus Mail for Windows (v2.23)
X-UIDL: 833815013.000
Status: RO
From: "Alan Bridle" <abridle@NRAO.EDU>
To: ggiovannini@astbo1.bo.cnr.it
Cc: abridle@nrao.edu
Subject: 3C31
Date: Mon, 3 Jun 1996 10:56:56 -0400

Gabriele:

Thank you for the quick reply; I have added a sentence re the VLBI limits on the inclination angle, and have now submitted the proposal. I am very excited by how well this is turning out so far!

I agree that acquiring the MERLIN data will be worthwhile. Even if we cannot easily co-image it with the VLA data to the same quality, it will be interesting when attempting the chi-squared optimization of models (the next important step!) to test the goodness of fit against I, Q and U images at various resolutions. Once we have a model, then it should be straightforward (in principle) to test evaluate the goodness of fit against whatever images (or maybe even u-v data) are available; and of course extra resolution will always be a useful constrain on shear layer structures, etc.

I'll send a printout of the proposal as submitted to everybody in the regular mail,

Best wishes, A.

==========

Alan H. Bridle (abridle@nrao.edu)
National Radio Astronomy Observatory
Charlottesville, Virginia, U.S.A.
http://www.cv.nrao.edu/~abridle/

From VM Mon Jun 3 11:42:07 1996
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with SMTP id LAA12494 for <abridle@nrao.edu>; Mon, 3 Jun 1996 11:20:55 -0400 (EDT)
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Message-Id: <9606031519.AA28202@polaris.cv.nrao.edu>
Comments: Authenticated sender is <abridle@polaris.cv.nrao.edu>
Organization: NRAO Charlottesville
Priority: normal
X-Mailer: Pegasus Mail for Windows (v2.23)
From: "Alan Bridle" <abridle@NRAO.EDU>
To: lferetti@astbo1.bo.cnr.it
Cc: abridle@nrao.edu
Subject: 3C31 proposal
Date: Mon, 3 Jun 1996 11:18:37 -0400

Luigina,

Thank you for the speedy reply. I've enlarged the last paragraph to
state the sensitivity and dynamic range explicitly as you suggest
(I agree it's a good idea not to make a busy reader look for them
in the source table).

The proposal is now submitted and I will send everyone the printout
of the submitted version.

I think this project is getting some very exciting results. Our next
move will be to try to iterate around the parameters in the current
model to see what is the best fit to the I, Q and U images in a
chi-squared sense. Robert will be working on the code for that when
he comes back from his holiday in the Scottish islands.

Best wishes, A.

==========

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From VM Wed Jun 5 14:05:12 1996
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id AA13608; Wed, 5 Jun 1996 13:23:56 -0400
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Message-Id: <199606051723.LAA20477@zia.aoc.nrao.edu>
X-UIDL: 833997723.000
Status: RO
From: Observe Proposals <propsoc2@aoc.nrao.edu>
To: abridle@zia.aoc.nrao.edu
Cc: jnance@zia.aoc.nrao.edu, lappel@zia.aoc.nrao.edu
Date: Wed, 5 Jun 1996 11:23:55 -0600

R. Laing

Received your proposal "Kinemataics of jet..." by R. Laing etal and have
assigned it No. AL 405.

thanks
lori