National Radio Astronomy Observatory

Very Large Array

25 Sept 1980

To: Tony

From: Alan

Subject: N315 manuscript

    Have received the manuscript "as submitted".
On my copy, the word "decrease" is missing from p.21,
line 4 from the bottom.

    I guess we have crossed in the mail regarding
U. of A. Maybe this is a portent?

          Best wishes   AC

STICHTING
RADIOSTRALING
VAN
ZON EN MELKWEG

onze referentie:
uw referentie:

Westerbork, September 18, 1980.

Dear Alan,

I enclose a copy of the NGC 315 paper as we have submitted it to A&A. We have taken E.B.F.'s complete silence to mean approval of whatever is submitted!! I enclose an offer from the August issue of A&A which I think we ought to take advantage of (its an offer we can't refuse!). If we were to submit a camera ready manuscript I would suggest that preparation would be easiest via the VLA word processor (we don't have any equivalent here) which would mean your arranging to have the MS re-typed & stored on a floppy disk at the VLA site. Otherwise the paper will disappear for a year!!

Thanks for the information about jobs in Canada. I am amusing myself at the moment by applying for the position advertised at the University of Alberta in the August issue of "Physics Today". In that regard I would very much like to have you as a reference (both as a respected astronomer and as Canadian input!). I hope that is OK with you. I enclose a curriculum vitae giving my life history! So you may hear something from U. of Alberta.

Bijlage(n):

P.T.O.

I suspect I won't be able to come to the Jets workshop much as I would like to – however Strom, Schilizzi & I will discuss this whenever Schilizzi is next in Dwingeloo (he spends ~ 60% of his time travelling) & I will let you know the outcome of the discussion in a couple of weeks.

Best regards,

Tony Willis

P.S. I enclose glossies where available.

9 September 1980

Dear Tony,

Here are pages of the NGC 315 draft which have corrections — nearly all are just typos., as it's reading quite well.

In the revised Sec. 9, I'm not sure that the present text is correct when it uses the "northwestern" velocity component as an _alternative_ to the "head-tail" model. There has to be a northwestern velocity component in the geometry of the "head-tail" model, too. What may be at issue is just _how_ the structure of NGC 315 bends in 3-d. We can't settle that issue here as the data don't give enough constraints. Also, I doubt that we can really distinguish a secondary orbital effect from a secondary precessional effect in giving the Z-structure — their symmetry axes would have to be oriented differently, but again there are not enough constraints to say which is actually happening.

Regarding the fitting of the CH model, I think we should settle for the general statement that is now in the paper, plus the references to the JRASC paper and Willis _et al._ 1981. On thinking it over, I have several reasons for this. First, this paper concentrates on general deductions from the observations that do not depend intimately on modelling details. I like that and think the CH details might be out of place. Second, a proper discussion of fitting CH would, as you say, make it over-long. Third, I have refined the CH computation for the Dec-10 here at the VLA and would prefer to fit a more realistic model in which we do not set $R_A = R_S$ as in the JRASC paper. The "JRASC NGC 315" comes out of the nozzle with a rather exaggerated rotation in order to make

$R_A = R_S$, and a more realistic treatment of the situation alters the fitted numbers slightly. I'd like more time to deal with this and also with some of the other aspects of CH that were not quite right near the nozzle. The "JRASC fit" illustrates the possibility of getting such a curve and is <u>about</u> right as to the parameters, but I think we can now do better. I gather from Rick that you would like to do a bang-up job on the new NGC6251 data, and think that this would in fact be a better plan.* Not only will I have a better CH computation available, but also NGC6251 will provide much tougher constraints. Perhaps we could include an improved NGC315 fit in that discussion (as an example of fitting another jet with the same principles).

Anyway, I don't think we should hold up the NGC315 submission any longer. It's in good shape, and I don't think we should delay it for extra diagram-drawing or more text-writing. As it's going to A. and A. it may not be out too quickly as it is. Let's not delay it any longer.

Regarding the CAS, if you write to Dr. Richard Bochonko, Dept. of Mathematics and Astronomy, University of Manitoba, Winnipeg, Manitoba R3T 2N8, (he's the CAS Secretary), I'm sure he'll gladly sign you up.

Rick tells me that you're thinking of migrating back to N. America. Have you heard about the new long-term NSERC Research Fellowships? They are for two years, extendable to five (and maybe even <u>ten</u>). NSERC pays a full University faculty salary and the fellows have faculty status at a University, but no teaching. They also get an initial $15,000 p.a. research grant and access to the NSERC annual grant competition. The Universities expect to hire most new faculty from this pool. 100 were awarded in September, and 100 more are likely next April. You would need a sponsoring University. We at Queen's already have one fellow in the September competition (Kayll Lake), but if you were interested we'd be happy to try for another....

With best wishes.

TG.

* P.S. I will do reductions of the new NGC 6251 data with Rick, if we are indeed

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To: Tony

From: Alan

Subject: Comments on NGC315 draft

Here is a commented version of the paper. Basically, I like it. The comments are mainly detail. I have however redrafted Sections 8 and 9 to a slightly different emphasis. Another iteration may be necessary because of this. I think the old Figure with H_{eq} against FWHM and the R^{-1} line drawn in was useful, and might be reinstated.

I am sending a copy of this commented version directly to Ed.

Our shortened 3C31 collimation letter has been accepted for Ap.J., Part 2. Following our conversation at the VLA about page charges, I will pick up what would otherwise be your share, so that Z.W.O. does not hassle you.

On p.22 of this draft - I think an overall fit to I vs. R in the field beyond 60" from the core would be useful. Also please note that θ is used to mean different things in Sec.5, Sec.6, and Fig.10. I have suggested how to straighten this out. On p.20 at the foot, use these refs. if you like, and if you think we might try fitting NGC6251 collimation elsewhere (Rick was keen).

VLA Site, 6 August 1980

Dear Tony,

Your draft of NGC315 paper was waiting for me when I got to the VLA site yesterday. I have read it through once and have a number of detailed comments which I will organise and send separately.

My major comments relate to Sections (7) and (8). In (7) the force of the conclusions is compromised by the underlined uncertainty in P_{49}/P_{21}, given as 0.8 ± 0.2 on p.16. What this is saying is that $P_{49}/P_{21} = 1.0$ cannot be ruled out. This presumably says that $n \sim 0$ and $\dot{M} \sim 0$ there could be cannot be ruled out in Section (7). — i.e. very little thermal material and nothing we can say about entrainment. I presume that what this really stems from is the fact that we are much less confident in the total fluxes along the jet at 20cm than at 50cm due to the missing spacings. We should not emphasise the argument in (7) quite as strongly as at present if $n \sim 0$ is still consistent with our data in fact. I am also unclear why you go beyond

$$\dot{M} \propto \frac{VL}{H_L}$$

with the algebra on p.27/28. Clearly $H_L \sim L^{-1}$ for $H_L \sim H_\perp$ and $H_L \sim L^{-2}$ for $H_L \sim H_\parallel$ unless there is field amplification. Therefore

$$\dot{M} \sim VL^2 \; (H_\perp) \qquad \sim \; VL^3 \; (H_\parallel)$$

In any jet far field (away from the nozzle) we can expect $V \sim$ constant in the absence of intergalactic brick walls or current deflectors, so we will have $\dot{M} \sim L^2$ or $\dot{M} \sim L^3$. I don't understand why you are assuming $\beta \sim$ constant, in fact.

In (8) I think the discussion should be separated into "Gaps In the Jets" and "Overall Shape of NGC315 Emission" sections — perhaps as (8) and (9). The details of the "gaps" discussion depend on two assumptions — 1) that the differences in projected lengths along the jets reflect differences in physical lengths (we implicitly criticise this

assumption when we discuss reasons for the overall morphology on p. 30 and p. 31) and 2) that the flow velocity is proportional to the Alfvén velocity. I find the numbers given in Sec. 8 at top of p. 30 unconvincing because of the uncertainties resulting from these assumptions. I would be happier if at this stage we simply itemised the possible interpretations, which are:

1. Gaps are due to intermittent/energy production $\propto (\dot{M}v^2)_{total}$

2. Gaps are due to fluctuations in synchrotron emissivity $\propto n_{relativistic} B_\perp^{(\gamma+1)/}$ along basically steady jet, due to fluctuations in n_{rel} or B.

3. Gaps are due to fluctuations at the nozzle [nozzle radius, height, etc] which lead to fluctuations in collimation of beam and hence of its surface brightness.

I do not believe that we can distinguish these interpretations using the present data, because of the relatively low signal-to-noise on the counter-jet and of the projection uncertainties. — if the main jet $\underline{is}$ directed more along the line of sight than is the counter-jet, it becomes much harder to see the effects of local fluctuations in intensity on the main jet.

I'll send more detailed comments as soon as possible — within a few days.

Best wishes

Alan

I'm enclosing a copy of our jet model write-up as submitted to J.R.A.S.C.; in Section 6 we are showing a model fit to NGC 315 for illustrative purposes. I think it would be a good idea to say some more about fitting NGC 315 in our paper also, unless we want to tackle a more general collimation-fitting write-up that could include other jets — 0326+396, NGC 6251 ?

Results of Crosscut analysis on NGC 315 jet - WSRT data.

a). NW jet - as function of increasing distance from the central nucleus. (30" steps)
= location #

Position	Undecouv. HPW "	Nominal beam HP "	Deconv. HPW (values plotted) "
1 (nucleus) (21."N) (20.6)	38.02	33	18.9°
2	39.96	33	22.5
3	46.4	"	32.7
4	52.9	33	41.4
5	56.2	33	45.4
6	56.16	33	45.4
7	59.4	"	49.4
8	58.32	"	48.1
9	54.43	"	43.3
10	58.3	"	48.1
11	63.72	"	54.5
12	54.00	30.4	44.6
13	55.62	"	46.6
14	48.82	"	38.2
15	51.84	"	42.0
16	60.48	"	52.3
17	68.26	"	61.1
18	70.20	"	63.28
19	71.28	"	64.47
20	70.20	"	63.28
21	95.69	"	90.7
22	93.74	"	88.68
23	96.34	"	91.4
24	81.22	"	75.3
25	95.04	"	90.05

26	58·54	30·4	50·02
27	120·96	"	117·08
28	148·39	"	145·24
29	113·62	"	109·47
30	117·29	"	113·28