

THE ASTRONOMICAL JOURNAL

COLUMBIA UNIVERSITY
PUPIN BUILDING | NEW YORK 10027

19 February 1981

Dr. J.F.C. Wardle
Department of Physics
Brandeis University
Waltham, Massachusetts 02254

Dear Dr. Wardle:

We are happy to inform you that the manuscript,

"Variability of Extragalactic Sources at 2.7 GHz. IV. Evidences for Weak Extended Emission and for Rapid Variability"

has been accepted for publication and has been tentatively scheduled for the June 1981 issue of the ASTRONOMICAL JOURNAL.

Enclosed please find the reprint order and page charge authorization form. Please return it immediately to the American Institute of Physics at 335 East 45th Street, New York, New York 10017, ATTENTION: Billing Division.

For an estimate of the number of pages, it is our experience that typical manuscripts run between one-third and two-fifths of the number of typed pages if no large figures or photo-ready, reduced tables are included.

THE EDITORS

National Radio Astronomy Observatory

Very Large Array

To: Mike

From: Alan

Subject: Our variability paper with John Wardle

It has finally been accepted by A.J. The delay was mainly due to the fact that John's grant lapsed and he had to wait to have graphics redone. Unfortunately he still does not have a grant and will not until the Fall. The payment distribution will therefore have to be 50% NRAO, 25% me and 25% you. To expedite the payment of our share, I suggest you requisition one cheque for 50% when the invoice comes. I enclose a memo to transfer my share to your account; just fill in the blanks when the invoice comes from A.J. I'm paying the graphics directly to John, as he's broke (grantwise).

I enclose a copy of the paper as accepted, also copies of the NRAO form.

Life in New Mexico is hectic, warm and exciting. The VLA is working well in the A configuration (35km baselines) and I have some exciting new jet maps showing the detailed polarization structure. I'm also working with Dick on some more jet modelling, especially on particle acceleration in turbulent jets. Mary's thesis is coming along well; she's doing research in eye contact behaviour of people with low self-esteem under different feedback conditions. Despite the fact that she will end up with a Masters in Speech Communication, she's doing research in nonverbal communication behaviours. Strange, but it seems to fly o.k. in New Mexico.

I was delighted to hear that the VLBI study was approved and that the array has approval in principle from NRC. Congratulations to your committee for a job well done. The US proposal is in bad shape because of Reagan's budget-cutting - the 25m telescope in Hawaii has been canned and NRAO can hardly go to Washington for an even more expensive project with that one's corpse lying on the doorstep. The Caltech/JPL VLBI proposal may also be in political trouble as Reagan is trying to cut all the science out of NASA, which presumably includes JPL.

Best wishes,



THE UNIVERSITY OF NEW MEXICO

DEPARTMENT OF PHYSICS AND ASTRONOMY

800 YALE BOULEVARD, N.E.
ALBUQUERQUE, N.M. 87131
TELEPHONE (505) 277-2616

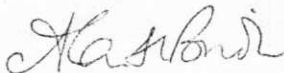
1 June 1981

Financial Services,
Queen's University,
Kingston, Ontario K7L 3N6
CANADA

Gentlemen,

Please transfer \$ from A.H.Bridle NSERC account A4727 386-006-08
to M.J.L.Kesteven account as 50% payment of Queen's
University share of the \$ publication charge for an article entitled
VARIABILITY OF EXTRAGALACTIC SOURCES AT 2.7 GHZ. IV. EVIDENCE FOR WEAK
EXTENDED EMISSION AND FOR RAPID VARIABILITY, by J.F.C.Wardle, A.H.Bridle and
M.J.L.Kesteven. The invoice from Astronomical Journal in respect of this paper
is attached to the cheque requisition from Dr. Kesteven.

Yours sincerely,



Alan H. Bridle

NATIONAL RADIO ASTRONOMY OBSERVATORY

EDGEMONT ROAD
CHARLOTTESVILLE, VIRGINIA 22901
TELEPHONE 804-296-0211
TWX 510-587-5482

POST OFFICE BOX 2
GREEN BANK, WEST VIRGINIA 24944
TELEPHONE 304-456-2011
TWX 710-938-1530

SUITE 100
2010 NORTH FORBES BOULEVARD
TUCSON, ARIZONA 85705
TELEPHONE 602-882-8250

24 Feb 81

Dear Alan,

Tis done. My graphics person moved to California, so I ended up doing it myself. AJ has accepted it and I enclose their communications.

I was very sorry to miss your workshop, which I hear was a great success. What happened was that NSF turned down Dave Roberts' and my grant proposal. We are now totally out of travel money (and everything else) till at least autumn. I think we got too ambitious and asked for too much money.

Hope you are still enjoying your sabbatical.

Cheers

John.

To: John



From: Alan

Queen's University Memorandum

Date: 18 April

Subject:

Here are my comments, and Mike's, re variables paper. Sorry they've been so long coming. Mike believes our errors are over-estimated (evidence enclosed). I do not recommend that we declare any more ^{short-term} variables however, because of the possible perverse nature of the individual data points on which the short-term variability relies must. Let's finalise it in CV at end of month.

Figure 1

R

1.1

1.0

0.9

0

10

20

30

40

50

60

ZENITH ANGLE (degrees)

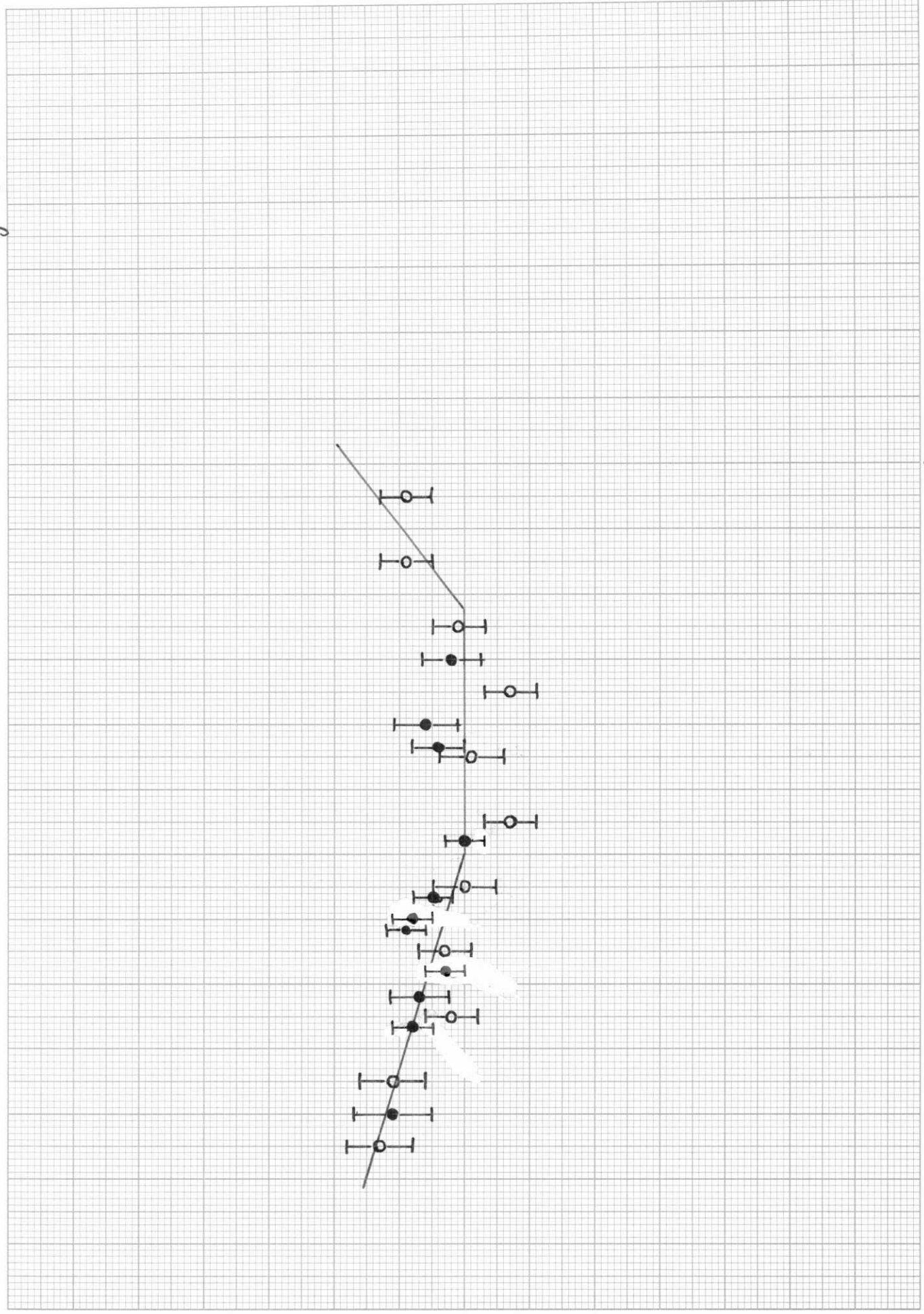
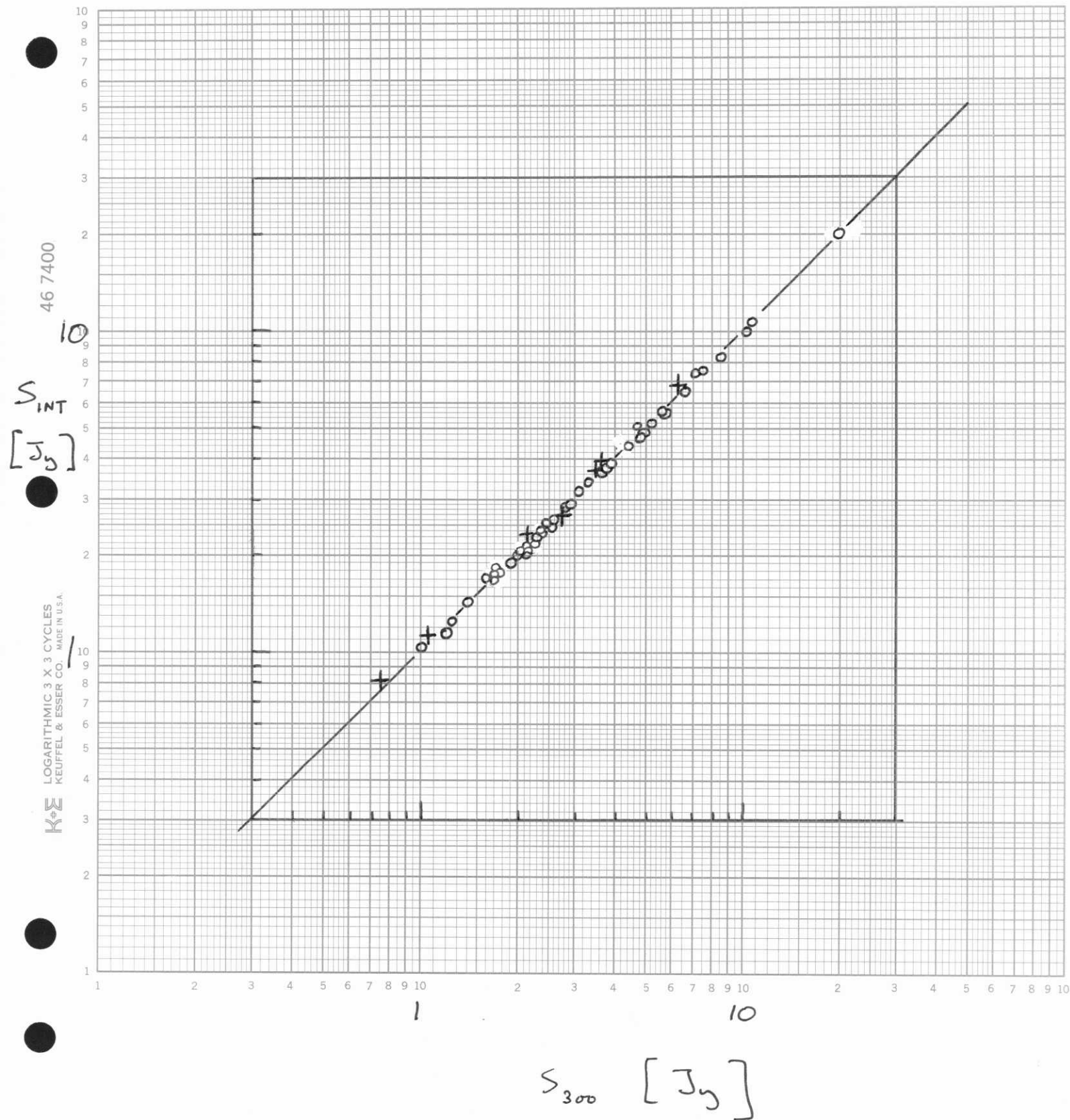


Figure 2



THE MARTIN FISHER
SCHOOL OF PHYSICS
617-647-2835

December 18, 1979

Dear Alan and Mike,

Merry Christmas to you all! Here is a small present. If it meets with your approval, please return it, and I shall get the figures drafted and send it off to AJ. I have done everything we discussed in Montréal, but there are a few new things.

- ① I decided to put a couple of $T(n)$ plots in Fig 5. I think this is helpful since it is an unusual statistic.
 - a) Please complete the plot for $0430+052$, since I don't have numbers.
 - b) If you think a couple more would be nice, please draw them for me.
- ② I have put in (section V) what the distribution of $T(n)$ is if there is no variability. This is necessary since we have to judge the significance of an enhanced value of $T(1)$. The central limit theorem is certainly an adequate approximation here. Based on this, the choice of sources for Figs 3 & 4 has to change.
- ③ I made the derivation of apparent brightness temperature (section V) as compact as possible, while still being formally correct. There is some ambiguity over the

definition of T . I have chosen the "observed" T at $\lambda = 1.1$ cm in the sense that it is the antenna temperature you would measure with a pencil beam instrument that could resolve r .

④ In section IV a, I have kept in my claim that some sources vary significantly in less than 6 days. I hope you will go along with this because

a) I have now pre defined the group of sources for which we are looking for this effect (see the daggers in Table I).

b) I used a more appropriate statistical test, and it is very significant.

c) Heeschen has been looking for exactly this sort of thing, and since it is in our data it would be a pity not to say so.

⑤ I will agree to any and all changes in the English and the science you wish to make.

⑥ Let's Publish!

Best Wishes

John.

Wardle Sources

S/L	16/17	AV	Source	Wardle
0.19			00048-09	0.13
			0106+01	≥ 0.10
	1.03		0316+41	0.85
0.50	0.48		0430+05	0.33
	0.22		0605-08	0.14
0.20	0.16		0723-00	~ 0.08
0.15	0.22		0906+43	≥ 0.24
0.01	0.24		0923+39	0.14
0.06	0.09		1055+01	0.14
			1354+19	0.40
0.78	0.62		1641+39	0.27
0.13	0.06		2236-03	~ 0.08
0.71	0.01		2251+15	≥ 0.140

NRI - 300 helos?

	VIS FRV	LIGHT CURVE ?	
0048-09	✓✓	✓ reprod	Prob OK. — looks like we fitted the reprod, but large error.
0316+41	no shar sp	✓✓	✓
0430+05	??	✓✓	✓
0723-00	✓✓	✓	✓
0735+17	??	✓?	Large scale or reprod variable
0906+43	✓✓	✓✓	✓ Not var. <u>Definive</u> extent
1345+12	not done	✓✓	
3C138(0518+16)	x	✓	only 900 ^m high — John is not happy, will hit plot
1641+39	✓	✓	
2037+51	?	dubious	Reprod variations may confuse this
2216-03	✓	✓	John will get more data plotted.
2251+15	✓	✓✓	John will get more data plotted
1334-12	✓✓		BKB data needs 2B plotted
1730-13	✓✓		
1116+12	?	✓	
0953+25	✓	?	
1055+01	✓✓	✓?	
0106-01	✓	Reprod var.	We get 0ve offsets Jerrin's 3w' errors?
0923+39	?	x	
0954+55	?	?	
1354+19	✓✓✓		No plotted
0605-08	✓	?	Evidence at end of l. curve for an offset. <u>Reprod</u> or <u>var</u> ?
0814+42	?	reprod var.	
2200+42	?	reprod var	

Other possibilities	1510-08	Offer ~	5/6	16/17
	2200+42		0.05	0.11
	1345+12		0.24	0.57
			0.12	0.05
?	0518+16		0.40	0.01
'	0440-00		0.25	0.14
	0735+17		0.14	0.06
	2037+51		0.14	

DEPARTMENT OF PHYSICS

15 Feb 1978

Dear Alan,

Le voici, enfin ! I enclose a partial form of words. It is typed, not to imply finality, but to ease eyestrain. I enclose also, the diagrams, and much of the evidence, which is not to be used against me.

① 16 sources are resolved, from the interferometer data alone. I have dropped 1638+39 from this group. Exhibit 1 lists the visibilities normalised to 1800^m & 1900^m , and exhibit 2 plots the visibility functions. Note the scrunched abscissa. I think we should show a couple of these in Figure 1. Maybe 0605-08 and 0723-00. I have also put on the zero spacing visibilities. The filled circles are from the total fit that you did, and the open circles are from session 6 direct comparison. ("Session 6" is Feb 74). These should be left off the plots, so as not to imply circularity in Figure 2 (gain-zenith angle plot, which includes the resolved sources).

② The basic data is exhibit 3. The internal scatter for the interferometer (rms day to day scatter for non-variables is 2.5%) The scatter of the corrected

data about the mean line in Fig 2 is 3.4% (Exhibit 3, column 8). But if you drop the most variable sources, it drops to 2.8%. This appears to be significant, so I think we do have rapid variability over a few days. You were going to explore this further in the last section. Exhibit 4 shows the error distribution with the most variable sources marked in red.

③ In Figure 2, the final gain-zenith angle plot, you may wish to mark or omit the most variable sources, since these seem to contribute most of the most deviant points. I simply drew straight lines through the points, because Jim Coe could not find the old $T_{\text{system}} - ZA$ plot in his archives. For making the corrections in practice, this is quite good enough.

④ My INDEX = $\langle f(\frac{\Delta S}{\sigma})^2 \rangle$, and is therefore equivalent to χ^2/N . In Exhibit 5, I ran my data through your criterion, and plot χ^2/N against INDEX. This shows that INDEX ≥ 1.0 corresponds to $P \ll .001$, so I have actually been more conservative than you. When Danny calculated INDEX, he used a rather coarse gridded ~~look~~ look up table, shown as the histogram in exhibit 5. I shall use your method from now on!

Exhibit 6 compares our variability criteria over the common period. Since we are not usually observing at the same time, there is obviously scatter. The sources I have marked as variable (interferometer) but with INDEX < 1 , have INDEX > 1 in the ~~complete~~ complete AW data set. In general your χ^2/N is $\sim \frac{1}{10}$ my χ^2/N , meaning your internal

errors are about $\frac{1}{3}$ of mine, which is right.

As I see it, all you need do is run off a couple of flux curves showing our combined data for figure 4, and also do the rapid variability bit. I hope you can get something out of this because I think it is there, even if only for a few sources. It may be nothing deeper than that a source that changes 30% in a month obviously changes a few percent in a few days. But I think it is important to show that at even $\lambda 11$ cm one can ~~see~~ see real changes over a few days.

It is hard for me to get graphics done here — can I leave that to you? Finally, since yours are the better measurements, I insist that authors go alphabetically.

Please give my greetings to Marg. How is life on the lake? We have just moved and have bought a place in the country with seven acres of incredibly old and diseased fruit trees that I am going to try to work on. We also have a small pond, but it dries up in summer. I hope to get a couple of lambs in the spring, and I am thinking of calling it "The Wrentham Institute for Astrophysics and Animal Husbandry." If you are going to be visiting this neck of the woods any time soon, we would love to have you both come and stay with us.

Best wishes
John.