

# THE ASTRONOMICAL JOURNAL

Department of Astronomy, FM-20  
University of Washington  
Seattle, Washington 98195

(206) 545-2150

June 3, 1986

Dr. Alan H. Bridle  
National Radio Astronomy Observatory  
Edgemont Road  
Charlottesville, Virginia 22903-2475

Dear Dr. Bridle:

Thank you for your letter of May 27. Thank you for sending a copy of the form to Dr. Henriksen at Queen's University in Ontario. Thank you also for sending your addition to the list of references directly to Hal Henglein, who is now more directly involved with the publication of your paper, "Collimation and Polarization of the Jets in 3C 219."

Yours sincerely,

A handwritten signature in black ink that reads "Paul Hodge". The signature is written in a cursive style with a large initial "P".

Paul Hodge  
Editor

PH:jcs

## National Radio Astronomy Observatory

EDGEMONT ROAD, CHARLOTTESVILLE  
VIRGINIA 22903-2475, U.S.A.

Dr. A.H.BRIDLE  
tel. [804]296-0375 TWX 910-997-0174

May 27, 1986

Dr. Paul Hodge  
Editor, *The Astronomical Journal*  
Department of Astronomy, FM-20  
University of Washington  
Seattle, WA 98195

Dear Dr. Hodge,

I am pleased that the paper "Collimation and Polarization of the Jets in 3C219" by A.H.Bridle, R.A.Perley and R.N.Henriksen has been accepted for publication in *The Astronomical Journal*.

Your letter to me of 22 May 1986 did not state whether your office had sent a copy of the page charge authorization and reprint order forms separately to Dr. Henriksen as I suggested. I have therefore forwarded a copy of the forms to him from here. As mail to Canada is slow, there may be some delay in your receipt of his completed forms if you did not in fact mail them to him directly.

Since submitting the revised version of the paper, I noticed that a reference is missing from the reference list. The following should be added to the reference list:

Schmidt, M. (1965). *Astrophys. J.* **141**, 1.

I am sorry for this oversight on our part. I have sent a note mentioning this addition to Mr. Henglein at AIP in parallel with this letter.

Yours sincerely,

Alan H. Bridle

## National Radio Astronomy Observatory

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VIRGINIA 22903-2475, U.S.A.

Dr. A.H.BRIDLE

tel. [804] 296-0375 TWX 910-997-0174

May 27, 1986

Mr. Hal Henglein  
American Institute of Physics  
335 East 45th Street  
New York, NY 10017

Dear Mr. Henglein,

This concerns the paper "Collimation and Polarization of the Jets in 3C219" by A.H.Bridle, R.A.Perley and R.N.Henriksen which has been accepted for publication in *The Astronomical Journal* and is now scheduled for the September 1986 issue.

Since submitting the paper, I have noticed that a reference is missing from the reference list. Please add the following to the reference list:

Schmidt, M. (1965). *Astrophys. J.* **141**, 1.

I am sorry for this oversight on our part.

Yours sincerely,

Alan H. Bridle

## National Radio Astronomy Observatory

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VIRGINIA 22903-2475, U.S.A.

Dr. A.H.BRIDLE  
tel. [804] 296-0375 TWX 910-997-0174

May 27, 1986

Prof. R. N. Henriksen  
Department of Physics  
Queen's University at Kingston  
Ont. K7L 3N6  
CANADA

Dear Dick,

The A.J. has accepted our paper, and they sent what appears to be the only publication charge and reprint form to me here, contrary to what I had asked them to do. Here are blank copies of the form, plus a copy of the order that NRAO will be placing, for your information.

The paper is tentatively scheduled for the September 1986 issue.

I now plan to be around in Kingston during the first week of August; a fixed point is John and Paula's mortgage-burning (and John's 50th birthday) celebration at the log house on the first weekend of August. Will keep in touch on our plans as they develop. I am definitely interested in staying in close contact with your jet emission modeling work, having developed a fair bit of code in that area myself. It might also be profitable for your student to have access to our new "minisupercomputer" (Convex C-1) at NRAO for some of that work. It is about 40 times faster than a Vax for scalar code, and has a vectorizing, optimizing compiler that accepts Vax standard FORTRAN and makes it run like a bat out of hell. (Top speed is about one-tenth of a Cray X-MP). So I could offer access to a fast machine as well as my thoughts on what the critical problems are. It would also be interesting to interface the code to AIPS so that we could use the full range of display and smoothing algorithms that have been developed for radio astronomy data processing, in order to view the models in a way that matches what observers actually do.

I look forward to talking with you both about all this.

Best wishes,

Alan

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TENTATIVE  
SCHEDULED ISSUE DATE:

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AUTHORS:

Alan H. Bridle, Richard A. Perley, and Richard N. Henriksen

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# THE ASTRONOMICAL JOURNAL

Department of Astronomy, FM-20  
University of Washington  
Seattle, Washington 98195

(206) 545-2150

May 22, 1986

Dr. Alan H. Bridle  
National Radio Astronomy Observatory  
Edgemont Road  
Charlottesville, Virginia 22903-2475

Dear Dr. Bridle:

We are happy to inform you that your manuscript, "Collimation and Polarization of the Jets in 3C219," written with Richard A. Perley and Richard N. Henriksen, has been accepted and is tentatively scheduled for the September 1986 issue of The Astronomical Journal.

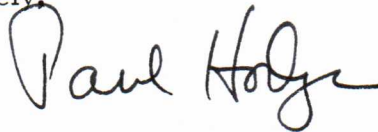
We have not specified to our Production Editor at AIP to make any of the seven figures plates. If you had intended Figure 4 to be a plate, would you please let Hal Henglein know right away?

We will make every effort to see to it that your article appears in this issue. If you are planning to be out of town within the next few weeks, it would be helpful if you could make arrangements for the proofs to be forwarded or otherwise appropriately handled in your absence. It is important, of course, that they not be delayed.

Please consult the enclosed blue sheet of guidelines to answer any questions you might have about the next steps in the process of publishing your paper. The yellow form is to be sent to the AIP offices in New York as soon as possible.

I look forward to seeing your paper in the Journal.

Yours sincerely,



Paul Hodge  
Editor

PH:jcs  
Enclosures

## National Radio Astronomy Observatory

EDGEMONT ROAD, CHARLOTTESVILLE  
VIRGINIA 22903-2475, U.S.A.

Dr. A.H.BRIDLE  
tel. [804] 296-0375 TWX 910-997-0174

May 16, 1986

Dr. Paul Hodge  
Editor, *The Astronomical Journal*  
Department of Astronomy, FM-20  
University of Washington  
Seattle, WA 98195

Dear Dr. Hodge,

I enclose two copies of a revised version of the manuscript of the paper "Collimation and Polarization of the Jets in 3C219" by A.H.Bridle, R.A.Perley and R.N.Henriksen.

Our responses to the referee's points are as follows:

1. We believe that both Figures are needed, as they emphasize different aspects of the data. Figure 4 is the clearest display we have found for the degree of polarization variations while Figure 5 emphasizes the magnetic field direction and orderliness.
2. We now quote the error on the 58% polarization ( $\pm 6\%$ ) on page 7. The referee's question about the three-dimensional structure of the field can be answered only by making the observations that we outline in § VI (pages 18-21).
3. This comment, and discussions with several of our colleagues, have prompted us to elaborate the relativistic jet models in more detail. § VII has therefore been broken into four subsections. The first three sections (pages 21 to 24) now explicitly discuss the chain of argument that leads to the class of model that we adopted here, and also show why simpler models would fail. We believe that this expanded discussion should answer the referee's main comment.

The referee's parenthetical remark invokes a wide range of possibilities that cannot be constrained *ab initio*. However, since submitting the original version of this paper we have realised that one possibility (that of reducing the jet sidedness ratio by disordering the jet velocity field near shocks), is particularly attractive in the context of relativistic jet models. We now discuss this possibility explicitly, and have modified our critique of the relativistic jet models in §§ VII, VIII and IX in the light of it. Our main conclusions are unaltered, however, as they depend on the fact that the main jet does not reach the lobe, but terminates in a feature whose properties resemble those of a lobe hot spot.

§VII (p. 25-26) and § IX (p.30) also now mention a second possibility related to the referee's third comment—namely that interactions between a jet and ambient clouds could produce intrinsic asymmetries (whether or not the jet has a relativistic velocity).

4. We now use "kpc" throughout.

We have also updated the references, and have stated more clearly (on page 13) the assumptions that are conventionally made by the model we used to describe the hot cluster atmosphere—namely that both the velocity dispersion and the gas temperature are constant throughout the cluster. This approximation (common in the X-ray literature) is inexact, but is adequate for our purposes.

I hope the paper will now be accepted for publication in the *Astronomical Journal*. As I mentioned in my original letter, two-thirds of the publication costs will be borne by NRAO, and one-third by Dr. Henriksen. It will expedite obtaining signatures for the page charge approval if you will send copies of the reprint order and page charge authorization simultaneously to me and to Dr. Henriksen at Queen's University. All other correspondence in connection with the paper should be sent to me at NRAO, except for any which will arrive during the period June 9 to June 27 1986, for which my address will be: c/o Aspen Center for Physics, Astrophysics Program, P.O. Box 1208, Aspen, CO 81612.

Yours sincerely,

Alan H. Bridle

# THE ASTRONOMICAL JOURNAL

Department of Astronomy, FM-20  
University of Washington  
Seattle, Washington 98195

(206) 545-2150

April 8, 1986

Dr. Alan Bridle  
National Radio Astronomy Observatory  
Edgemont Road  
Charlottesville, Virginia 22903-2475

Dear Dr. Bridle:

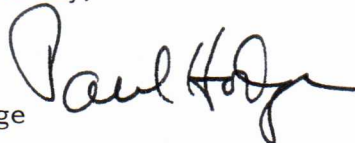
Your interesting paper, "Collimation and Polarization of the Jets in 3C219," written with Richard A. Perley and Richard N. Henriksen, has been reviewed carefully, and the reader's report is enclosed.

I encourage you to consider the reviewer's recommendations for your manuscript and to return it after you have made appropriate changes. Please send us two copies of your revised paper. It would be very helpful to have a detailed listing of your responses to each of the referee's points.

Thank you for submitting your manuscript to The Astronomical Journal.

Yours sincerely,

Paul Hodge  
Editor



PH:jcs  
Enclosures

# THE ASTRONOMICAL JOURNAL

Review of the paper "Collimation and Polarization of the Jets in 3C 219"

by Alan H. Bridle, Richard A. Perley, and Richard N. Henriksen

I am happy to recommend this paper for publication. It reports on some important observations of the source 3C219 (which contains one of the first radio jets discovered). While I do not agree with all of the emphases, the discussion is clear and thoughtful. I only have minor suggestions whose implementation (or not) I am happy to leave to the authors.

1. Do you need both Figures 4 and 5?
2. The 58 percent maximum polarization is striking. What's the error? Do the authors believe that it is compatible with a sheared, but tangled field or does it have to be unidirectional?
3. Don't the difficulties with relativistic beaming disappear if you stop trying to associate features in the jet with the counterjet? (Also, there is no reason that there only be one speed in the source.)
4. I know it's illogical but surely it's kpc not Kpc.

The referee's report on 3C219 came yesterday. It says:

I am happy to recommend this paper for publication. It reports on some important observations of the source 3C219 (which contains one of the first radio jets discovered). While I do not agree with all of the emphases, the discussion is clear and thoughtful. I have only minor suggestions whose implementation (or not) I am happy to leave to the authors.

1. Do you need both Figures 4 and 5 ? Yes.
2. The 58 per cent maximum polarization is striking. What's the error ? Do the authors believe that it is compatible with a sheared but tangled field or does it have to be unidirectional ?
3. Don't the difficulties with relativistic beaming disappear if you stop trying to associate features in the jet with the counterjet ? (Also, there is no reason to suppose that there be only one speed in the source). Expand §VII
4. I know it's illogical but surely its kpc not Kpc.

=====

We have much more significant suggestions for revision internally !

I propose to add some discussion of the fact that IF the counterjet is the redshifted counterpart of the main jet and both are freshly burrowing their way out into the cocoon, then the brightness ratio can indeed be anything we like just at the tip, because this is where the velocity field gets disordered by shocks and the beaming geometry no longer applies. This penny dropped during a discussion with Steve Gull over beer and steaks at Datil, so I propose to thank Steve in the acknowledgments (note that the existing ones are made even more relevant by this). I think the relativistic jet picture is made much more viable by this, and propose that we say so.

We should emphasise more that the approximation to the isothermal sphere holds only over a few core radii, but that this is where most of the X-ray emission comes from, so it is valid for our purposes. Geoff Bicknell was somewhat misled by this, though our calculations are in fact valid in the context we are applying them. We might also give some more emphasis to the fact that the X-ray luminosity measured at 3C219 would be rather high for an individual galaxy. This strengthens everything we are saying about a cluster being involved. We might also emphasise the fact that it makes a very plausible story that we see the jet brightening because it is a previously free jet hitting a cluster component of the pressure at about a cluster core radius (we imply this but we might say it more explicitly so that the casual reader doesn't lose it).

=====

Any comments on the referee's comments, or FINAL ones on the text ? I'll try to send this back this week despite the imminent arrival of Bob Sanders in C'ville to work on the 157-source alignment mapping !

From: CVAX::BRIDLE "Alan Bridle" 15-MAY-1986 15:44  
To: VAX3::RICK,CVAX::ST%"lokenc@qucdn.bitnet",BRIDLE  
Subj: FINAL edits requested by RAP/RNH to 219

You both sent me some last-minute suggestions. Here's what I have done with them:

=====

In the subsection VIIb and c titles: Add "symmetric" before "relativistic flows"

=====

Following the paragraph on "why it isn't all due to expansion" in Sect. VIId:

A bend in the jets could also contribute to the decrease in  $S$  at the counter-jet knot. A bend in the counter-jet similar to the observed  $\theta$  'kink' in the main jet could make  $S$  larger near the core by increasing  $(v_j/c)\sin\theta$  there.

Finally, we note that moving shocks may also arise if the jet entrains, or collides with, ambient clouds (e.g., Blandford and Königl 1979a,b; Henriksen 1984a). If this occurs, the shocks in the jet and counter-jet could be intrinsically asymmetric around the core. If moreover a real collision occurs between the jet and a cloud (i.e., if the mean free path in the cloud for a jet particle is less than the cloud scale) then initially a strong shock should appear. This could be a most effective means of decelerating a counter-jet and of removing an unfavorable beaming from it. In time, however, this situation would translate itself into an accelerating terminal shock. If moving shocks are introduced into relativistic jets by such jet-cloud interactions, the asymmetries in the observed knot locations would be governed by randomness in the cloud geometry rather than by expression (2) above. As there is indeed evidence for such cloud-jet interactions in some radio galaxies (e.g., van Breugel et al. 1985), we emphasize that the above interpretations of knot asymmetries in terms of  $\theta$  relativistic jets are not mandatory.

We conclude that a relativistic jet containing symmetric fast-moving shocks could readily display apparent asymmetries similar to those we have observed in 3C219 ....

=====

New penultimate paragraph in the Conclusions:

The jet/counter-jet asymmetries might also be the result of strong shock formation in the both jets by jet-cloud collisions at random distances from the core; in this case the appearance of the jets would be a manifestation of circumgalactic 'weather' rather than a consequence of bulk relativistic motions.

=====

It goes back in the mail tomorrow unless I hear from one of you to the contrary. I have added the necessary references and updated some of those that were preprints when we submitted, with their journal pages.

Let's F\*I\*N\*I\*S\*H it tomorrow !!

=====

From: CVAX::BRIDLE  
To: VAX3::RICK,BRIDLE  
Subj: RE: 3C219

"Alan Bridle" 14-MAY-1986 17:45

OK -- in the context of smooth jets there's nothing to measure the geometric asymmetry with, so I'm happy to leave that as it is. You need some kind of discontinuity in order to be able to see whether or not anything is moving. And the shocks are the thing we're using as the discontinuity.

The bending sentences are back in, as you requested. I just dropped them for brevity, but who needs to be that brief ?

From: VAX3::RICK  
To: CVAX::BRIDLE  
Subj: RE: 3C219

14-MAY-1986 16:49

The angle asymmetry is the  $\theta(1)/\theta(2)$  relationship for identifiable knots moving relativistically, after having been 'launched' at the same time, same velocity, opposite angles, etc. That is, your equation (2). The relation holds for smooth jets, except that there are no features to track. In section a), you stated the only asymmetries visible is the brightness asymmetry, which is true for a smooth flow, as you have stated. My suggestion was to point out the difference in angular expansion which would be noted, if there were any features to follow. Your developer has this point being brought out later, when discussion the shock propagatic model. I was only wondering if the two effects - the brightness asymmetry, and the angular expansion asymmetry, may better be mentioned together.

This is not an important point by any means.

The bending argument is a rather obvious one, at least to 'beamers' (defined as those who truly believe in Doppler favoritism), and I think it would be appropriate to at least mention it in passing - perhaps in the sense that it does give another way of explaining the observed structures.

More MAIL to follow on other subjects...