PROPERTIES OF RADIO SOURCES (*DISCUSSION*)

Discussion of the paper presented by *WALKER* (p. 30)

Tsvetanov: Could you remind me of the linear scale on your maps (the +10 to −10 mas bar)?

Walker: For $H_0 = 100 kms^{-1} Mpc^{-1}$, 1mas = 0.26pc

Tsvetanov: Given this linear scale, why would you refer to your model as a disk model?

Walker: Perhaps using the word "disk" is making people think of something more specific than I have in mind. Certainly the scale is at or beyond the maximum for which accretion disk parameters are usually calculated. All I mean to imply is a geometry that has material concentrated toward the center with a distribution such that the near side jet is unobscured all the way to the core while the far side jet is obscured in the inner regions. A disk is merely an obvious example of a structure with this property.

Gurvits: Is this right, that the higher the frequency the larger the angular distance between northern and southern components?

Walker: No, that is not what the data show other than a small effect from the fact that the core is weaker at low frequencies so the centroid of the bright features around the core (resolved at high frequencies) moves down a bit. Certainly the total extent of the bright jet/counterjet system (the features that extend to about 15 mas south of the core) is the same at all of our frequencies.

Krichbaum: When calculating the arm-length ratio and the jet-to-counterjet ratio you need to know where exactly the core is. Did you use the brightest feature as reference or how did you define the location of the core? (see also my poster of Cyg A).

Walker: At the high frequencies, we have much higher resolution images than those shown in this talk. I used the location of the northern-most bright feature in the 1cm image. Actually, the constraints shown in the

R. Ekers et al. (eds.), Extragalactic Radio Sources, 187–194.

https://doi.org/10.1017/S0074180900080499 Published online by Cambridge University Press

talk were based on the 1991 and 1993 data from Vermeulen, Readhead and Backer (1994) and Walker, Romney and Benson (1994).

Condon: NGC 1275 is also a luminous far-infrared source. If the dust is heated by a compact ultraluminous starburst, ionization by that starburst may cause free-free absorption of 3C84 at lower frequencies. The far-infrared spectral index $\alpha(25\mu, 60\mu)$ will be very steep in this case (so much dust implies $T_{25\mu} > 1$. Alternatively, heating of a small amount of dust by the intense AGN radiation field will yield a flat $\alpha(25\mu, 60\mu)$; and the ionization must be less extensive, due to Ly continuum absorption (see Condon et al 1991, ApJ, 378, 65).

Discussion of the paper presented by GABUZDA (p. 49)

Daly: We have studies equipartition Doppler factors and Inverse Compton Doppler factors for a large sample of AGN. We find that the core dominated quasars have high Doppler factors, lobe dominated quasars and radio galaxies have low Doppler factors, but BL Lacertae objects span the full range of Doppler factors, from very low values to very high values; this seems to be consistent with the observations presented.

Gabuzda: Yes.

De Young: Could you elaborate on your reasons why you expect fewer internal shocks (as distinguished from instability) in "stronger" BL Lac jets?

Gabuzda: My suggestion was that BL Lac jets are weaker and slower than quasar jets; this, for example, could explain the lower superluminal speeds observed in BL Lac objects or compared to quasars. The hydrodynamical simulations of Duncan and Hughes (1994) suggest that internal shocks can form more easily in modestly relativistic jets ($\gamma \sim 5$ than in very relativistic jets ($\gamma \sim 10$), so that if BL Lac jets have lower γ's than quasar jets, this might also explain the much more common occurrence of transverse shocks in BL Lacs.

Urry: Do you see any systematic differences in polarization structure or superluminal velocities between low and high-redshift BL Lac objects in the 1 Jy sample?

Gabuzda: No - we see no differences in either polarization properties or superluminal velocities for low and high BL Lacs. This supports the view that low and high B L Lacs really are the same type of source.

https://doi.org/10.1017/S0074180900080499 Published online by Cambridge University Press

Laing: Is it not the case that some quasars (eg 3C279) appear to show $\vec{B}_{\perp}$ at least in outburst? The distinction between quasars and BL Lac objects in polarization appears to be less absolute in this sense also.

Gabuzda: Yes - integrated polarization monitoring data (for example, of the University of Michigan group) does indicate that transverse magnetic fields dominate in a few quasars at some epochs.

Pohl: Is there evidence for circular polarisation or elliptical in general, in any of these sources?

Gabuzda: It is technically very difficult to extract circular polarization information from the VLBI data; for the few sources (quasars) for which this has been done, no circular polarization was detected. This is certainly something that needs to be investigated further, however.

Discussion of the paper presented by VERMEULEN (p. 57)

Gopal-Krishna: Do you attribute the 'emergence' of broad emission lines in BL Lac to a weakening of the beamed optical continuum?

Vermeulen: Thank you for reminding me of this important point the broad lines we have discovered in B L Lac (Vermeulen et al 1995 Ap J Lett 452, L5) have increased in luminosity by at least a factor of 5, probably 10-20, within the latest 6 years. The lines would have been detectable in earlier published high quality spectra.

Grueff: The correlation between absolute radio power and β could be, at least in part, the result of an observational bias: powerful sources are observed only at high z, and this fact, coupled with a limited range of observed angular speeds, could produce a spurious correlation.

Vermeulen: I believe you are suggesting a possible bias against being able to observe the slower β_{app} at the higher z. However, we do in fact, have plenty of such slower motions at high β, and our limits of detectability are not hampering us here.

Laing: What are the objects with low power and low apparent velocity? Are they galaxies? What do you mean by 'galaxy' in this context?

Vermeulen: They do indeed tend to be galaxies, of course. For the material shown here, I have simply accepted whatever classification was given in the literature for these objects. Once the analysis of the full dataset

https://doi.org/10.1017/S0074180900080499 Published online by Cambridge University Press

is done, a thorough, uniform classification scheme, probably based on spectral as well as morphological properties, will clearly be needed.

Urry: The broad emission lines have been seen in BL Lacs before the current result on BL Lac but typically in the higher redshift (higher luminosity) BL Lac objects, so what is unusual is the discovery of broad Balmer lines in a relatively nearby (z=0.069) BL Lac.

Vermeulen: I would like to see demonstrated statistically that in the higher z objects call BL Lacs the line luminosity really is lower compared to quasars or galaxies of the same bolometric (or low radio frequency) luminosity. Further, what makes the result in BL Lac particularly interesting is the fact that the line luminosity has increased by a factor ≥ 5, within 6 years (possibly more rapidly; I am not aware of good spectra from the period 1990-1995).

Urry: My question concerns the distribution of superluminal velocities - if you allow for a distribution of Lorentz factors, is $\beta_{patt}/\beta_{bulk} \sim 1$ then allowed (and what range of γ is required)?

Vermeulen: Indeed, $r = \gamma_{patt}/\gamma_{bulk} = 1$ is allowed if there is a distribution of Lorentz factors, ranging from barely relativistic, with a peak perhaps near $\gamma \sim 4$ and a long tail up to $\gamma \sim 20h^{-1}$.

Ekers: 1. Comment: Given the continuity in the distribution of β I am surprised you omit the small β bin in your modelling.
2. Given the evidence just presented for NGC1275 that the "jet" - "counterjet" ratio is caused by an obscuring torus or disk, why do you cling to the beaming aspects of the model instead of testing models which are dominated by pattern rather than bulk motions?

Vermeulen: Regarding your comment: the beaming model explored here assumes relativistic motion, and thus the stationary patterns are not encompassed by the model in the simple form I have used here. However, now answering your question, I believe that the evidence from both large (kpc) and small (pc) scales is overwhelming that beaming has at least some role to play in determining what we see. On pc-scales, the one-sidedness of jets is, I think, much too common, and over too large a range of jet lengths to be dominated by free-free absorption or obscuration in general. However, it is clear that this will have to be one of the ingredients in more sophisticated models, once testing such models is warranted by the data volume and quality.

Woltjer: How did you obtain v/c for "empty" fields?

Vermeulen: Using accurate radio coordinates, we are pursuing spectroscopy to get redshifts [ed. - directly for the "empty" fields], in preference to imaging for POSS "empty fields". Classification of the objects, based on the spectra, and on imaging in progress, remains to be done.

Discussion of the paper presented by GARRINGTON (p. 77)

Burke: L.K. Herold, S.R. Conner and I made a set of observations of CSS's and CSO's with MERLIN – 20 sources from the MG survey, a sample completely independent of the 3CR, and we find the marked asymmetry in polarization that you find in the 3CR sample.

Garrington: That is interesting. Your observations at 5GHz should reveal the depolarisation asymmetry quite clearly in these sources.

Laing: Do the correlations between spectral index and arm length/depolarization found in large FRII's occur in CSS sources?

Garrington: We shall be using our data to investigate these trends.

Discussion of the paper presented by GELDERMAN (p. 81)

Bicknell: This comment is directed towards yours and the previous papers. Bicknell, Dopita and O'Chee (poster paper) have proposed a model in which we propose that the low frequency turnover of CSS and GPS sources is due to free-free absorption in the ionized gas that you are observing. The scatter in the correlation between OIII and radio power may be due to the shock velocity resulting from the expansion of the radio source. The line widths that you observe are typical of the shock velocities required in our model.

Urry: With regard to your histograms comparing properties of CSS radio galaxies and quasars with "normal" radio galaxies and quasars, where do the comparison samples come from, and in particular are they selected in the same way?

Gelderman: The samples include most of the published flux and kinematic data for Seyferts, radio galaxies, and quasars. In particular they include most of the available data for the 3C sample, representing the radio power and redshift ranges from which my CSS sources are drawn. However, complete CSS and comparison samples would be very desirable.

Discussion of the paper presented by *HEWITT* (p. 105)

De Bruyn: In your description of 0957+56 you gave various errors. Do they include the modelling of the cluster of galaxies contributing to delays and potential?

Hewitt: Yes, and in fact it is the dominant source of error at this point.

Discussion of the paper presented by *GIOVANNINI* (p. 127)

Jones D.L. : The 1.2c proper motion you listed for N6251 was derived by assuming the component had moved out from the core; we can not rule out a local brightening of this component, so no specific velocity value is meaningful. All evidence is still consistent with this jet having only subluminal motion.

Discussion of the paper presented by *TAYLOR* (p. 133)

Booth: I think the combination of high resolution line and continuum data is away the most exciting work in current radio astronomy. I am interested, therefore, if you can point out any velocity differences in the line absorption to the N and S of the compact object and any information you might have on the enclosed mass.

Taylor: The velocity difference between the components to the N and S is 20 km/s. I have not yet attempted to use this information to construct a dynamical model.

Ekers: Much higher velocities might be expected - how far does your velocity range extend?

Taylor: What I've shown is just the inner 300 km/s. Our observations covered 8MHz or a total velocity span of 1800 km/s. No higher velocity components were detected.

Laing: What is the jet : counter-jet ratio on kpc scale?

Taylor: This is a very good question. I will put the jet : counter-jet ratio on the kpc scale in my conference proceedings submission (I can't remember it now).

https://doi.org/10.1017/S0074180900080499 Published online by Cambridge University Press

Discussion of the paper presented by *PARMA* (p. 137)

Laing: Have you mapped the rotation-measure distribution in any of the B2 sources?

Parma: We have mapped the rotation measure only in a few sources. We have data for the whole sample but the work is still in progress.

Woltjer: When you start out with a relativistic jet to make BL Lacs and slow it down to 0.01c, would you not expect to dissipate much energy somewhere? Where does it appear?

Leahy: Bowman, Komissarov and myself (MNRAS, submitted) have discussed this point in detail. Energy released by dissipation appears as heat, but is re-converted continuously into kinetic energy since the jet is propagating down a pressure gradient. The net loss of kinetic energy flux can be quite mild (less than 50%) for deceleration from Lorentz factor of 5 to $\sim$1.2. Deceleration without catastrophic kinetic energy loss is actually much easier to achieve for relativistic jets than for non-relativistic ones. Radiation loss times are much longer than dynamical times for all plasma phases involved.

Discussion of the paper presented by *HARDCASTLE* (p. 153)

Laing: The correlation between core and jet prominence in Bridle et al (1994) tightened up considerably when straight jet segments were considered. Have you tried this for your sample ?

Hardcastle: No, but we will be trying in the future. (Straight jet segments are not always as well defined in this sample).

Urry: I'd like to raise a point that is relevant to your talk and also to some of the talks this morning, and that is: how do we distinguish between radio galaxies and quasars? We can do this on the basis of optical morphology or perhaps it is more interesting to separate sources according to whether they have broad or only narrow lines. In particular, it appears from recent HST (and also much previous ground based observations), that quasars are in giant elliptical galaxies, so should we call them radio galaxies? Instead, I would call broad -line radio galaxies, for example, the local quasar counterparts of your $z < 0.3$ FRIIs. How would this narrow-line/broad-line division affect your findings?

Hardcastle: I think this is a good point. In my talk I follow the definers of my sample in using "quasar" to mean an object which is stellar on a photographic plate, but a less subjective definition would be useful. As I said, the broad- line objects do not show any significant tendency to have stronger jets. The problem in this sample is the prevalence of so-called "dull" FRIIs which have no line emission and so no orientation indications.

Perley: Elias Fernini at NMSU is studying a similar RG sample but finding jets in only $\sim$ 10%. His sensitivity is about the same as yours, I believe, so why do you find such a higher detection rate? Do you think this is due to using different criteria?

Hardcastle: We believe that at least 50% of our jets meet the Bridle and Perley (1984) criteria. It may be worth noting that Fernini and co-workers are looking at objects matched to quasars, i.e. in unified schemes their sources are all near the plane of the sky. In the same unified schemes our sources would be at all angles to the line of sight and thus might show more beaming and so more jets.

https://doi.org/10.1017/S0074180900080499 Published online by Cambridge University Press