SUPERLUMINAL EXPANSION IN 3C 179

R.W. Porcas
Max-Planck-Institut für Radioastronomie, Bonn, F.R.G.

ABSTRACT

The detection of apparent faster-than-light motion (v=7.6c) in the core of 3C 179 poses some problems for the simple relativistic jet explanation.

I wish to report the detection of superluminal expansion in the core of the 18^m quasar 3C 179 (z=0.843). Unlike the other known superluminal sources, 3C 179 has pronounced outer double-lobed structure (LAS = 14" in PA $\sim 80^o$) which produces the dominant radio emission at frequencies $\leq$1 GHz. The compact, flat-spectrum core of 3C 179 is only $\sim$0.4 Jy. Transatlantic VLBI observations at 10.7 GHz, using the antennas at Effelsberg, Haystack, Green Bank and Owens Valley have revealed an inner double structure in PA = 92^o, with flux ratio 2:1. The separation of these components, however, has changed between 2 observing epochs, spaced 1.2 years apart, increasing from 1.07 to 1.24 mas, corresponding to an apparent transverse relative velocity of 7.6c (with "traditional" H_o=55 km/s/Mpc, q_o=0.05). The stronger, eastern component has also increased in flux density by $\sim$15%. If one interprets this apparent superluminal velocity as due to bulk relativistic motion in a jet directed at the observer[1] then the minimum Lorentz factor, γ, of the motion is 7.6 and the required small angle to the line of sight, θ, is $1/\gamma = 7.5^o$.

Scheuer and Readhead[1] have emphasized the significance of outer double-lobed radio emission because such sources in flux-limited samples can be expected to have random orientations. Thus estimates of the likelihood of selecting a given source orientation are not confused by the possibility of relativistically beamed emission from a one-sided jet morphology as with previous superluminal sources.

3C 179 was selected from the 30 quasars mapped by Owen et al.[2] which have flux densities $\geq$0.7 Jy at 0.97 GHz, $m_B \leq 19$ and LAS $\geq$ 10". Since no beaming of the optical emission is thought to occur, there is no selection effect operating to produce preferential alignment to the

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line of sight for sources in this sample. The a priori probability of a source having $\theta \leq 7.5$ is 1-cosine (θ) = 1/110. 3C 179 was chosen from the sample because of its strong core (which made possible the VLBI observations reported here) and its clearly defined outer double-lobed morphology. This selection within the sample favours a small value of θ because of the associated Doppler enhancement of core flux density, and we might expect (possibly) one of the 30 sources to have the requisite 7.5° alignment. We cannot also expect, however, that this source will have an unusual value of γ, and thus one finds that γ of 7.6 must be typical for sources in the sample. This is in direct conflict with the argument of Scheuer and Readhead that the typical value of γ in the cores of double sources is ≤ 2, based on the statistics of the ratio of core (beamed) to lobe (unbeamed) flux densities in samples of double sources. We must conclude either that (i) 3C 179 is a freak, (ii) the argument of Scheuer and Readhead is incorrect, (iii) a revaluation of H_o even more dramatic than the presently fashionable value 100 is required, or (iv) some mechanism other than collimated, relativistic bulk motion is responsible for the superluminal effect.

REFERENCES

1. Scheuer, P.A.G. and Readhead, A.C.S.: 1979, Nature 277, pp. 182-5
2. Owen, F.N., Porcas, R.W. and Neff, S.G.: 1978, Astron. J. 83, pp. 1009-20

DISCUSSION

COHEN: The history of 3C 345 and 3C 273 shows that recent maps yield a proper motion greater than that obtained in the early days when a double was forced into limited data. It seems likely that this will be true for 3C 179 also and thus your present value should be regarded as a lower limit.

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