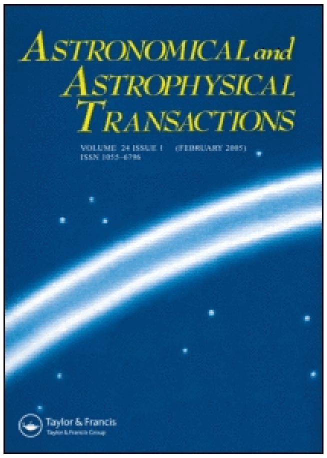

Astronomical & Astrophysical Transactions
The Journal of the Eurasian Astronomical Society
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t713453505

On the orientation of magnetic fields in extragalactic radiosources

R. Andreasyan [a]; H. Sol [b]; S. Appl [c]
[a] Byurakan Astrophysical Observatory, Armenia
[b] DAEC, Observatoire de Paris-Meudon, Meudon, Cedex
[c] Institut fur Angewandte Mathematik, Universitat Heidelberg, Heidelberg, Germany

Online Publication Date: 01 August 2001
To cite this Article: Andreasyan, R., Sol, H. and Appl, S. (2001) 'On the orientation of magnetic fields in extragalactic radiosources', Astronomical & Astrophysical Transactions, 20:2, 291 - 294
To link to this article: DOI: 10.1080/10556790108229713
URL: http://dx.doi.org/10.1080/10556790108229713

Astronomical and Astrophysical Transactions, 2001, Vol. 20, pp. 291–294
Reprints available directly from the publisher
Photocopying permitted by license only

ON THE ORIENTATION OF MAGNETIC FIELDS IN EXTRAGALACTIC RADIOSOURCES

R. ANDREASYAN,[1] H. SOL,[2] and S. APPL[3]

[1]*Byurakan Astrophysical Observatory, 378433, Armenia*
[2]*DAEC, Observatoire de Paris-Meudon,*
5, place Jules Janssen-92195 Meudon Cedex
[3]*Institut fur Angewandte Mathematik, Universitat Heidelberg,*
Im Neuenheimer Field 293, D-69120 Heidelberg, Germany

(Received November 11, 2000)

We studied the relative orientation of position angles of the integrated intrinsic radio polarization (perpendicular to the intrinsic direction of the magnetic field) and the major axes of extragalactic radiosources for different types of radiosources, classified by their elongation (Andreasyan and Sol, 1999) and also according to their Fanaroff–Riley (FR) type. We considered data for about 300 extragalactic radiosources and found that there are large differences in relative orientations for different types of radiosources. The directions of integrated intrinsic magnetic fields are correlated with major radio axes for the more elongated sources (with a ratio of major to minor radio axes larger than 2.5) and for FRII radiosources, while they appear not correlated with radio axes for stocky and for FRI-type radiosources.

KEY WORDS Extragalactic radiosources, magnetic field, radio polarization

1 INTRODUCTION

Multifrequency emissions from Active Galactic Nuclei (AGN) are clues to their various components (central engine, accretion disk, clouds, jets, gas and stars). They also reveal environmental effects such as inflow or outflow, jet propagation, interactions and star formation triggering, all of them at low and high redshifts. One can expect that a detailed pattern of formation and evolution of AGN in relation to their host galaxy, dark matter in the Universe, the diffuse background and primeval stellar formation will soon emerge. Evolutionary aspects are in this respect extremely important. The presence of a central massive engine is now suspected in many galaxies, suggesting the universality of active phenomena with a possible AGN phase in all galaxies.

However a number of very basic questions related to the formation of AGN and extragalactic radio sources are still open. We want here to focus on one of them, the relation between the radio sources, their host galaxies, and the ambient magnetic field. Some common evolution in the past, especially during the formation period, or some reciprocal influence should now be written in the morphology of the radio sources and in the relative orientation of radio jets, gaseous and stellar components of the galaxy, magnetic field and rotation axes. The alignment between radio and optical axes is a well-known effect at high redshifts (Best etl, 1997; Chambers *et al.*, 1996; McCarthy *et al.*, 1995; Roettgering *et al.*, 1996). In our recent study at low redshifts (Andreasyan and Sol, 1999), we showed that the major radio axes of nearby galaxies are correlated with the minor optical axes of the host galaxy for more elongated radiosources (for which K, the ratio of major to minor radio axes, is larger than 2.5) and for FRII radiogalaxies, while they appear correlated with the major optical axes for stocky radiogalaxies ($K < 2.5$) and for FRI radiogalaxies. In both cases, the correlation was more significant for the classification by elongation than for the Fanaroff–Riley classification. This classification by elongation, which has some theoretical ground (Andreasyan and Sol, 1999), therefore appears quite interesting for our understanding of global properties and formation of extragalactic radiosources. In this contribution, we investigate another difference between these two types of radiosources, elongated and stocky.

2 ORIENTATION OF THE MAGNETIC FIELD

The orientation of the magnetic field relative to the radio and optical axes of extended extragalactic radiosources may reveal important information on the physical mechanisms responsible for these objects. Indeed, many attempts have been made to find the relative orientations of the position angle of the integrated intrinsic radio polarization (corrected from the Faraday rotation effect) and the radio source axis (Clarke *et al.*, 1980; Davis *et al.*, 1983; Haves and Conway, 1975 and references therein). These studies show that the distribution of the acute angle between radio axis and radio electric vector has a dominant peak at 90 degrees and a secondary peak at 0 degrees.

We study the distribution of such angles between the integrated intrinsic radio polarization (perpendicular to the intrinsic magnetic field's direction) and the major axes of extragalactic radiosources for different types of radiosources, classified by their elongation (as described above) and FR classification. All available data for integrated polarization angles and radio position angles (for 278 objects), and FR classification of radiosources have been gathered from the literature and databases. Classification by elongation was done using the published radiomaps and available radio surveys.

The histograms of angles between radio and polarization axes are shown here, for all the data independently of the radio source types (Figure 1*a*), for the stocky radiosources only (Figure 1*b*), and for the elongated radiosources only (Figure 1*c*). The three histograms appear quite different. A clear maximum of the distribution

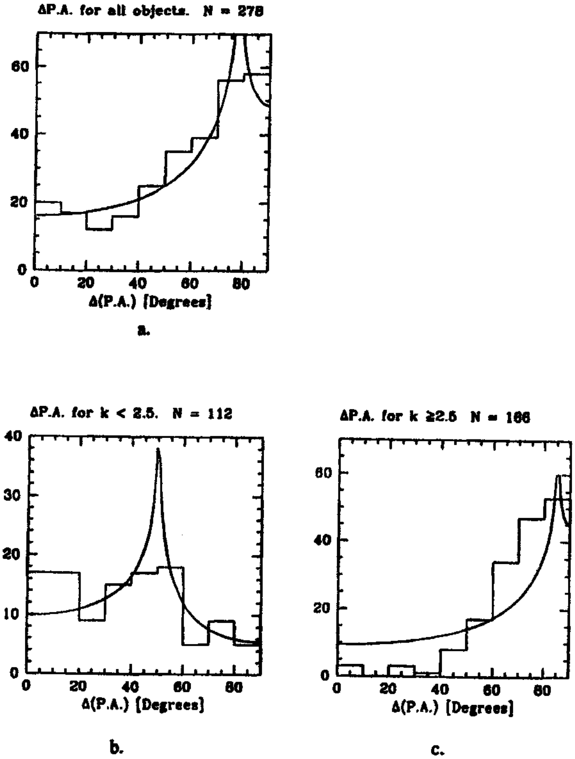

Figure 1 The distribution of angles between the integrated intrinsic radio polarization and the major axes of extragalactic radiosources.

is observed in the more elongated radiosources at 90 degrees, with no secondary peak at zero degrees (Figure 1*c*), while for the stocky radiosources (Figure 1*b*) there is no significant maximum. The secondary maximum near 0 degrees found in earlier studies (quoted above) appears only in the first histogram containing all types of radiogalaxies (Figure 1*a*). The fit of the observed histograms of these relative orientations was done using the method developed in (Appl *et al.*, 1996), taking into consideration projection effects. The continuous lines show the best fits obtained from primary distributions of intrinsic angles described by a delta-function. This rather well describes the case of elongated sources which suggests that their intrinsic integrated polarization is perpendicular to their intrinsic major radio axis. Conversely the stocky sources do not show any specific intrinsic angle and cannot be fitted by such a simple scenario.

A similar picture is found when classifying the different types of radiosources according to Fanaroff and Riley. A clear maximum near 90 degrees appears for FRII types and no significant maximum for FRI types.

Magnetic fields in optically thin synchrotron radiosources are perpendicular to the polarization electric vector. So the main result of this study is that integrated magnetic fields can be described as intrinsically aligned with major radio axes for elongated and FRII radiosources, while they appear not correlated at all with radio axes for stocky and FRI radiosources. Such a correlation admits a simple explanation if the integrated magnetic field is a signature of the ambient external magnetic structure in which the source was formed since jets injected along ambient magnetic field probably lead to more developed elongated radiosources. Another explanation related to jet physics is possible if the integrated magnetic field reflects the field inside the jets. Indeed, the more Poynting flux is converted into kinetic power, the smaller will be the toroidal component, the higher will be the Lorentz factor, and the further the jet will propagate. Alternatively, MHD instabilities could decollimate jets with a dominant perpendicular magnetic field more efficiently.

References

Andreasyan, R. R. and Sol, H. (1999) *Astrofizika* **42**, 365.

Appl, S., Sol, H., and Vicente, L. (1996) *Astron. Astrophys.* **310**, 419.

Best, P. N., Longair, M. S., and Rottgering, H. J. A. (1997) *Mon. Not. R. Astr. Soc.* **292**, 758.

Chambers, K. C., Miley, G. K., Van Breugel, W. J. M., Bremer, M. A. R., Huang, J.-S., and Trentham, N. A. (1996) *Astrophys. J. Suppl.* **106**, 247.

McCarthy, P. J., Spinrad, H., and Van Breugel, W. (1995) *Astrophys. J. Suppl.* **99**, 27.

Clarke, J. N., Kronberg, P. P., and Simard-Normandin, M. (1980) *Mon. Not. R. Astr. Soc.* **190**, 205.

Davis, R. J., Stannard, D., and Conway, R. G. (1983) *Mon. Not. R. Astr. Soc.* **205**, 1267.

Haves, P. and Conway, R. G. (1975) *Mon. Not. R. Astr. Soc.* 173, 53.

Roettgering, H. J. A., West, M. J., Miley, G. K., and Chambers, K. C. (1996) *Astron. Astrophys.* **307** 376.