The Metrewavelength Sky
ASI Conference Series, 2014, Vol. 13, pp 151 – 152
Edited by J. N. Chengalur & Y. Gupta

Demise of the grand unified scheme of powerful radio sources

Ashok K. Singal*
Astronomy & Astrophysics Division, Physical Research Laboratory, Ahmedabad, India 380009

We examine the consistency of the currently popular Orientation-based Unified Scheme (OUS) of powerful radio galaxies and quasars in the 3CRR sample, where it has now become possible to separate the low-excitation galaxies (LEGs) from the high-excitation ones (HEGs), as the former might not harbour a quasar within and thus may not be partaking in the unified scheme models. It comes out at low redshifts ($z < 0.5$), an expected foreshortening in the observed sizes of quasars, a must in the orientation-based model, is not seen with respect to HEGs (Fig. 1, upper left panel). This dashes the hope that the unified scheme might still work if one includes only the high-excitation galaxies. A similar inconsistency with OUS was recently shown in the BRL sample selected from the equatorial region of sky (Singal & Singh 2013a), whose selection criteria are very similar to that of the 3CRR. Also in about five times deeper MRC sample an expected shortening in radio sizes of quasar and RGs was not seen (Singal & Singh 2013b) in any of the redshift bins, casting serious doubts on the unified scheme models. It looks like that Barthel's observation that sizes and numbers of quasars were smaller than RGs in $0.5 \leq z < 1$ bin was perhaps only a statistical fluctuation as a similar thing is not seen elsewhere in other independent samples, or even in the 3CRR data in other redshift bins. It is clear that OUS is ousted.

A rather unexpected thing we notice is that the relative number and size distributions of HEGs and quasars in the 3CRR sample vary over the sky. A Kolmogorov-Smirnov test shows that we can rule out at a 95% confidence level the null-hypothesis that the two types of sources (HEGs and quasars) belong to the same parent population, which we find to be rather damaging evidence against OUS. We have compared the numbers and size ratios in two regions of the sky by dividing it in RA from 0 to 12 hours (region I) and 12 to 24 hours (region II). In Fig. 1 (upper right panel) we have shown the relative numbers and cumulative distributions of linear sizes of HEGs and quasars in these two regions. When we compare the number and size ratios separately in these two different regions of the sky, we see that the number and size distributions vary quite over the sky. In region II, quasars are definitely about half in numbers as of

*email: asingal@prl.res.in

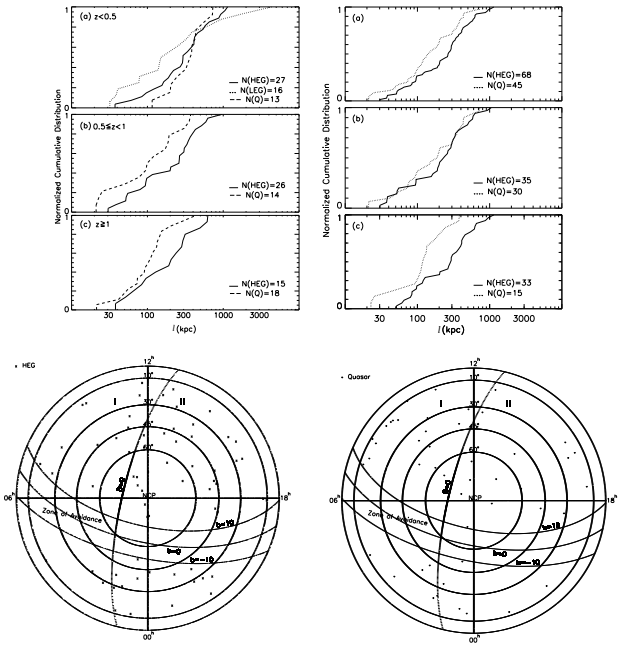

Figure 1. Upper left panel: Normalized cumulative distributions of linear sizes of HEGs (continuous curves), LEGs (dotted curves) and quasars (dashed curves) in various redshift bins. Upper right panel: Size distributions in the RA ranges (a) 00-24 hour (b) 00-12 hour (c) 12-24 hour. Lower left panel: Sky distribution of HEGs in an equal-area projection in the northern hemisphere. Lower right panel: Sky distribution of quasars.

HEGS (Fig. 1, lower left and lower right panels) and smaller in size by about a factor of 2.5 than HEGs. However, in region I of the sky not only are there about as many quasars as HEGs, even a difference, if any, in radio sizes is only marginal between the two. From that it looks as if the OUS may be valid in one half of the observed sky, but is violated in the other half. In fact this puts a lot more at stake than just OUS, as the large anisotropy in the sky distribution of quasars, some of the most distant discrete objects observed in the universe, casts strong doubts on the cosmological principle which is the basis for the standard cosmological model (Singal 2013).

References

Singal A. K., 2013, (preprint), arXiv:1305.4134
Singal A. K., Singh R. L., 2013a, MNRAS, 435, L38
Singal A. K., Singh R. L., 2013b, ApJ, 766, 37