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Is the perceived dependence of FR 1/2 break radio luminosity on absolute magnitude of the host galaxy merely due to a Malmquist bias?

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It has been claimed (Ledlow & Owen 1996) that the FR 1/2 break value in radio luminosity first pointed out by Fanaroff & Riley (1974) may itself be a function of the optical luminosity of the host galaxy. However, because of a very strong redshift-luminosity correlation (Malmquist bias) in a flux-limited sample, any effect related with redshift could appear as a luminosity-dependent effect. Could then the construed dependence of the break value in radio luminosity on the optical luminosity be due to the Malmquist bias? Further, could some of the other correlations claimed in the literature between radio luminosities and other observed properties of FR1 and FR2 sources, e.g. the line or continuum optical luminosities of the host galaxies etc., be wholly or partially effects of the Malmquist bias? We examine these possibilities here.

We have chosen the essentially complete MRC (Molonglo Reference Catalog, Kapahi et al. 1998) sample with $S_{408} \geq 0.95$ Jy, and which has the required radio and optical information. Figure 1 demonstrates how in the MRC data a correlation in radio luminosity and redshift (upper left panel) due to the Malmquist bias and a correlation of the absolute visual magnitudes of the host galaxy with redshift, especially for FR1 types, shows up as a correlation between radio luminosities and the absolute visual magnitudes of the host galaxies. Such a semblance of a correlation between radio luminosities and the absolute visual magnitudes of the host galaxies for FR1 types could be mistakenly interpreted as shift in the radio luminosity-break between FR1s and FR2s with the absolute visual magnitudes of the host galaxies.

A plot of the line luminosity of the host galaxy against radio luminosity at 408 MHz for a sample of FR1s and FR2s was shown by Zirbel & Baum (1995) to have a tight correlation between the two quantities (Fig. 1, lower left panel). However this all could merely be a manifestation of the Malmquist bias which can be seen from Fig. 1 (lower right panel) where we have plotted a 3d-plot of the distribution of redshift in radio luminosity–optical line luminosity plane for both FR1 and 2 type sources in

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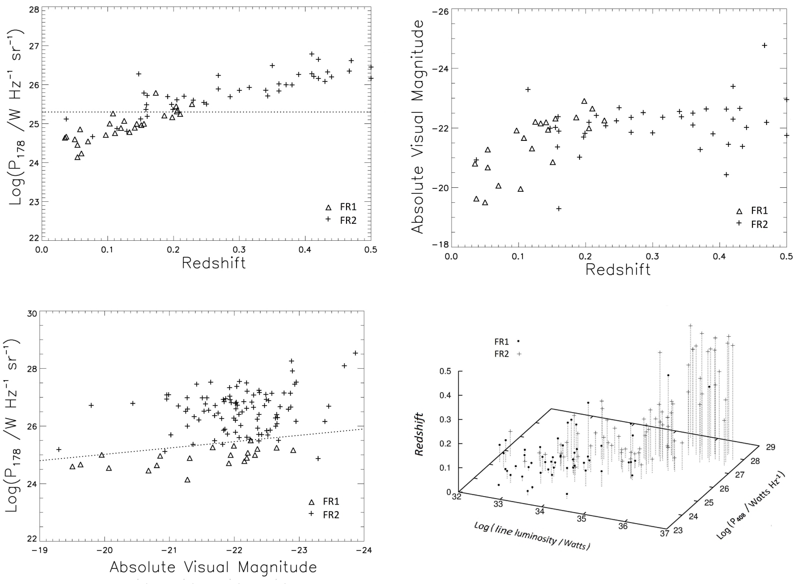

Figure 1. Upper left panel: A plot of the radio luminosity against redshift for for both FR1 and 2 type sources in the MRC sample. The dotted line indicates the FR1/2 break-luminosity value from Fanaroff & Riley (1974). Upper right panel: A plot of the absolute visual magnitude of the host galaxy as a function of redshift for the MRC sample. Lower left panel: A plot of the radio luminosity against absolute visual magnitude of the host galaxy for the MRC sample. The dotted line indicates the FR1/2 break-radio luminosity value. Lower right panel: A 3d-plot of the redshift in the line luminosity-radio luminosity plane in the Zirbel & Baum (1995) sample.

the Zirbel & Baum (1995) sample. It is obvious that the apparent correlation seen in Zirbel & Baum (1995) was mostly because higher radio luminosity sources, as a result of the Malmquist bias, are predominantly picked at higher redshifts and which will also be necessarily of higher optical line luminosities to be able to find their place in the sample. Thus the perceived correlation is mainly due to this selection effect and may not represent any real intrinsic correlation in the source properties. Of course it will be a non-trivial task to isolate true correlation, if any, between the two luminosities in the presence of a Malmquist bias.

References

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