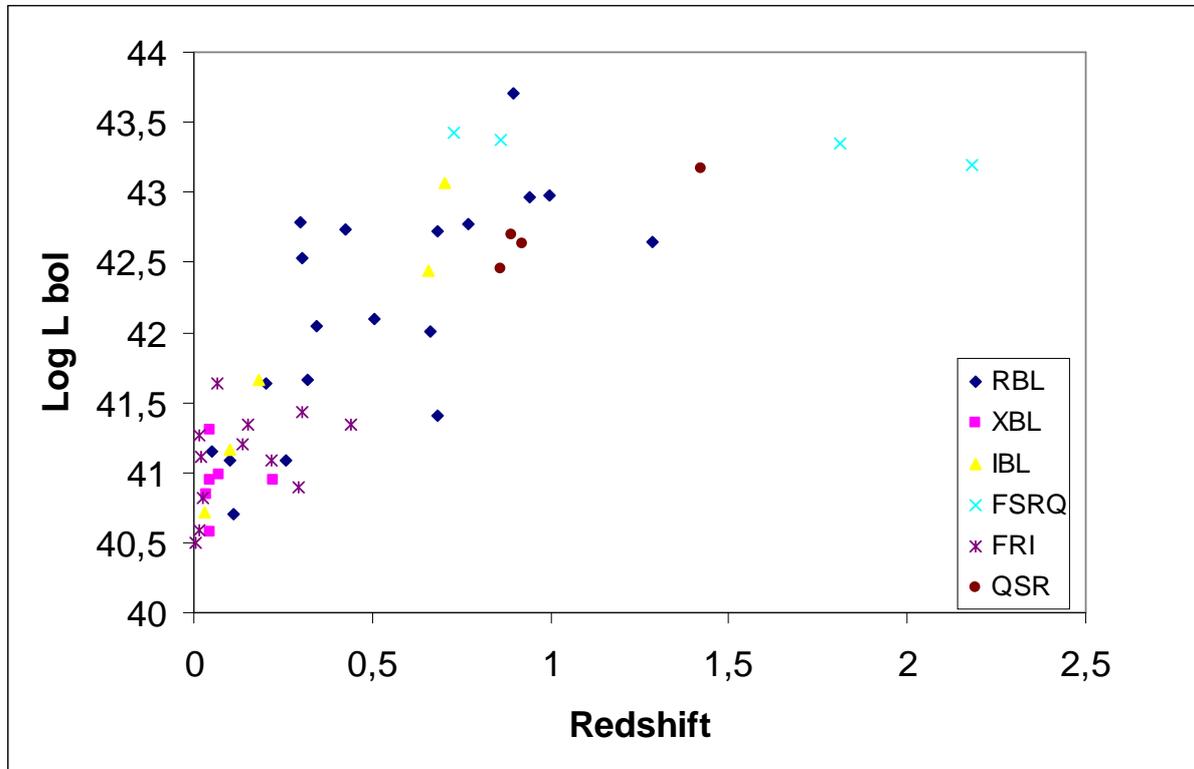


Unification of BL Lac Objects and FRI Galaxies

ABSTRACT

To understand the unification scheme for BL Lac objects with FR I radio galaxies and Flat spectrum radio quasars (FSRQ), here the correlations of the bolometric luminosities with redshifts and brightness temperatures of these objects are studied. The bolometric luminosity versus brightness temperature distribution shows a good correlation except a few scattered objects, mostly RBLs. The bolometric luminosities vary linearly with redshifts but here also a few scattered objects at high redshift. The FSRQs are at high redshifts and the bolometric luminosities and brightness temperatures of these objects are also high relative to XBLs and RBLs. The bolometric luminosities and brightness temperatures of FR I radio galaxies with low redshift (< 0.1) and low Spectral index ($\alpha_{rx} < 0.75$) are comparable to those of XBLs and those characteristics of FR I radio galaxies, with relatively high redshift (> 0.2) and high spectral index, can be comparable with RBLs with low redshift (< 0.5) and low bolometric luminosity. Those scattered RBLs with high redshifts (> 0.5) are believed to be in complex environment with companion galaxies, most of these objects are still unresolved. The bolometric luminosity and brightness temperature of these objects are comparable to those of quasars. These results support the unification scheme. It suggests that, the FR I radio galaxies with high redshifts and spectral indices and those with low redshifts and spectral indices may be the parent populations of the RBL and XBL objects respectively.

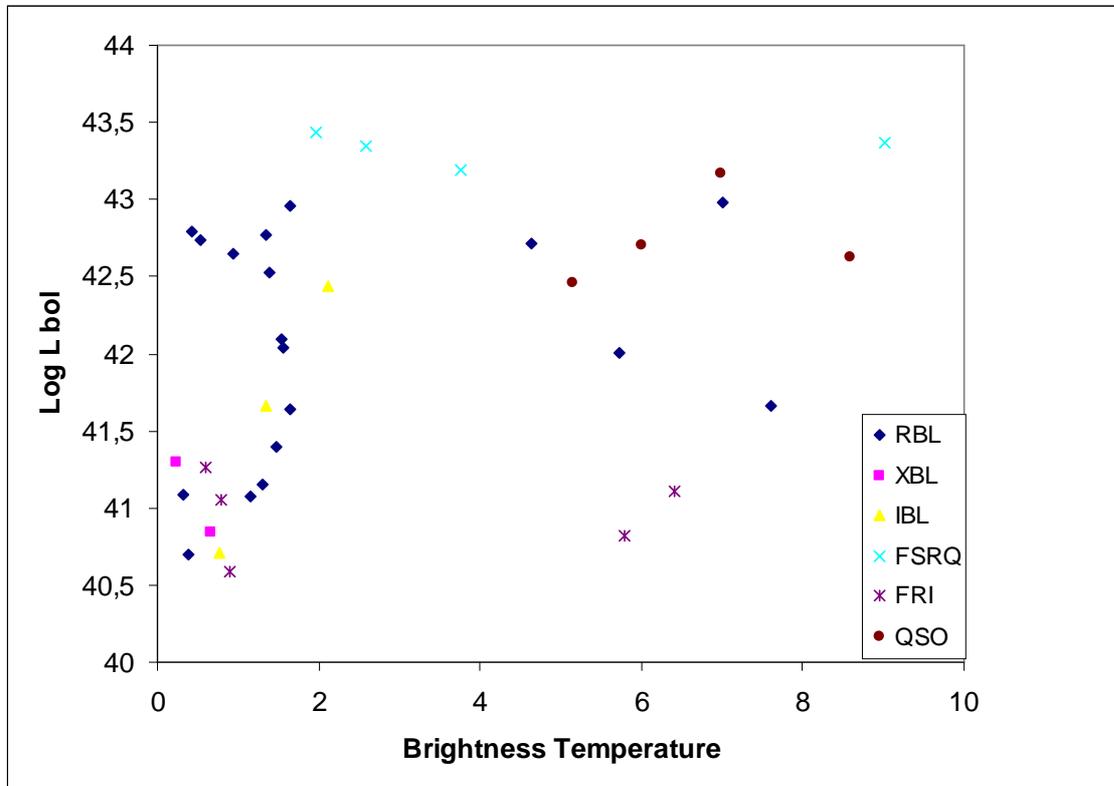
Bolometric Luminosity and Redshift diagram:



Discussion

As appears in the bolometric luminosity and Redshift graphic plane, the bolometric luminosity of the objects varies linearly with the redshift. Two objects are slightly scattered on the rightside of the diagram. Those two objects are RBLs; S4 0218+357 (OD 330) and PKS 2131-021. Rector et al. 2003 confirmed S4 0218+357 as a lensed system. It may also be a reason that the redshift of these two objects are still not known accurately, (S4 0218+357, $z > 0.685$ (Padovani & Giommi 1995) and PKS 2131-021, $z = 0.557?$ (Padovani & Giommi 1995) and $z = 1.285$ (Kotilainen et al 2005).

Variation of Bolometric Luminosity (erg/s) with Brightness Temperature $\times 10^{10}$ K



Discussion

The Bolometric luminosity in ergs/s (determined following Elvis et al. 1994) and Brightness Temperature $\times 10^{10}$ K (Kellerman et al. 1998) diagram shows a few scattered objects on the right side of the diagram but from the variation of bolometric luminosity with brightness temperature of other XBLs and RBLs it can be suggested that probably there is a correlation between these two components.

From this figure we see that the bolometric luminosities and brightness temperatures of FR I radio galaxies with low redshift (< 0.1) and low Spectral index ($\alpha_{rx} < 0.75$) are comparable to those of XBLs and those characteristics of FR I radio galaxies, with relatively high redshift (> 0.2) and high spectral index, can be comparable with RBLs, only with low redshift (< 0.5) and low bolometric luminosity. The bolometric luminosities of FRI radio galaxies are low and cannot be compared with most of the RBLs.

The scattered objects on the right side of the diagram are RBLs, B2 1308+326 (OP313), PKS 1749+096, S5 1803+784 and S4 1823+ 568 (4C 56.27). Three of those RBLs are recently studied by Kotilainen et al 2005. It was suggested that B2 1308+326 is probably a composite quasar/ BL Lac also a probability of microlensing, S5 1803+784 still remain unresolved and S4 1823+568 is highly distorted and faint

galaxies are in the field. PKS 1749+096 is recently studied by Rector and Stocke (2003) but this object is still unresolved probably a FR I radio galaxy. The Bolometric luminosity and Brightness Temperature of these objects are comparable to those of quasars 0133+476, 0748+126, 1548+056.

Conclusion

Here the bolometric luminosity of the objects are compared with their redshift and brightness temperature. Comparing the bolometric luminosity, redshift and brightness temperature of RBLs, XBLs and IBLs with those characteristics of Flat spectrum radio quasars (FSRQ), FRI radio galaxies, it is found that, those properties of FRI radio galaxies are comparable to those of mostly XBLs and a few RBLs; those properties of FSRQs are high compared to BL Lac objects. In both the diagrams we see a continuity from FRI radio galaxies – XBLs – IBLs – RBLs. It supports the unification scheme of BL Lac objects with FRI radio galaxies.

References

- Elvis M. et al ApJ supp. 95, 1, 1994
Kellerman K.L. et al AJ 115, 1295, 1998
Kotilainen J.K. et al A&A 440, 831, 2005
Padovani P. & Giommi P. Mon.Not.R.Astro.Soc. 277, 1477, 1995
Rector T.A. & Stocke J.T. AJ 125, 2447, 2003
Veron-Cetty M.P. & Veron P. Astron. Astrophys. 374, 92, 2001