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The Spectral Index and Beaming Effect for Radio Sources

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Abstract. In this paper, we revisited the relationship between the spectral index and the core-dominance parameter using a larger sample of blazars. Conclusively, we explain that the spectral index is associated with the core-dominance parameter using the two-component relativistic beaming model.

Key words. Active galactic nuclei (AGNs)—BL Lac objects—quasars—relativistic beaming effect.

1. Introduction

In a two-component beaming model, the observed total flux of a radio source, $s^{\rm ob}$, is the sum of the unbeamed flux, $s_{\rm unb}$, and the beamed one, $s_j^{\rm ob}$ (Urry *et al.* 1995). One defines the ratio of the beamed emission to the unbeamed one, $R = s_j^{\rm ob}/s_{\rm unb}$, as a core-dominance parameter. The core-dominance parameter is found to be correlated to the spectral index of our previous studies (Fan *et al.* 2010), namely $\alpha_{\rm t} = [R/(1 + R)]\alpha_j + [1/(1 + R)]\alpha_{\rm unb}$, here α_j, $\alpha_{\rm unb}$ and $\alpha_{\rm t}$ indicate respectively the spectral indexes for the beamed, the unbeamed components, and the total emission. In this paper, we will use a larger sample to revisit this correlation.

2. Data analysis and discussion

To discuss the relation between the spectral index and the core-dominance parameter for blazars, we have compiled the spectral indexes and the core-dominance parameter from available literature. Thus we obtained a sample of 157 blazars (23 BL Lacs and 134 FSRQs).

As in the above discussion, if we know α_j and $\alpha_{\rm unb}$, we can obtain an association between the total spectral index, $\alpha_{\rm t}$, and the core-dominance parameter, log R. Figure 1 shows the results of different adopting parameters. The solid curve, chain dotted curve, dashed curve and dotted curve are obtained for $\alpha_{\rm unb}$=1.0 and $\alpha_j = 0.5$, 0.0, -0.5 and -1.0, respectively.

Figure 1 suggests that it is difficult to use one curve to fit all the points. This may be due to the fact that the spectral indices for the beamed and the unbeamed components differ from object to object. But, we can also see that the curves obtained

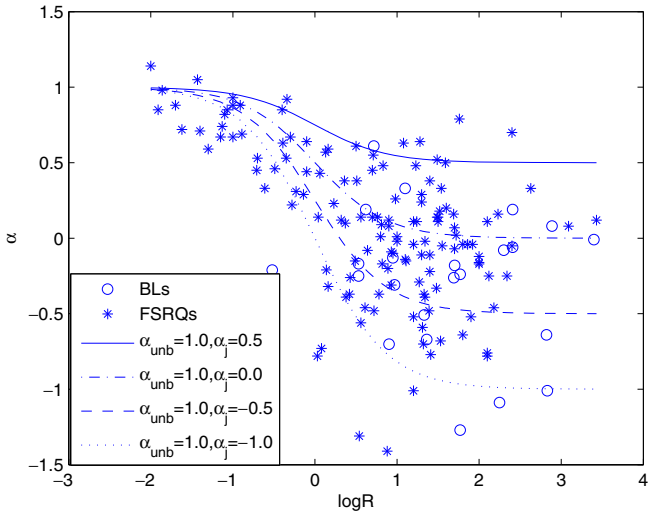

Figure 1. Results of different adopting parameters. The solid curve, chain dotted curve, dashed curve and dotted curve are for $\alpha_{\rm unb} = 1.0$ and $\alpha_j = 0.5$, 0.0, -0.5 and -1.0, respectively.

cover nearly a large range of the spectral index. Figure 1 also suggests that the two-component relativistic beaming model can explain the correlation between spectral index and core-dominance parameter theoretically.

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