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Effective Spectral Indices of Core and Extended Emissions for Radio Sources

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Abstract. From some available literatures, a sample of 393 radio sources is selected. The core and extended spectral indices are calculated. Results show that the core spectral index is different from the extended spectral index with the middle values approximately being 0 and 0.8 respectively.

Key words. Active galatic nuclei: radio emission.

1. Introduction

Most blazars show flat radio spectrum, but spectral indices for core and extended components are not very clear, while many authors (e.g., Fan *et al*. 2010, 2011 and references therein) usually use $\alpha_{\rm Core} = 0$ and $\alpha_{\rm Ext} = 1$ which stands for the radio core and extended spectral indices, respectively. Is it true? To answer this question, in this paper we will use the observed core and extended flux densities to determine the spectral indices for radio sources.

2. Sample and results

From literature (Fan *et al*. 2011 and references therein), 393 radio sources are selected. In the sample, 387 sources have core flux density and 244 radio sources have extended flux density at frequencies 1.5, 2.7, 5 and 8 GHz.

From a two-component model, radio emissions ($S_{\rm T}$) are from the core ($S_{\rm C}$) and the extended ($S_{\rm E}$) components, viz., $S_{\rm T} = S_{\rm C} + S_{\rm E}$. Assuming that the core and extended spectral indices are $\alpha_{\rm C}$ and $\alpha_{\rm E}$, respectively, we have $\alpha_{\rm C} = -\frac{\log(S_{\rm C}^{\nu_1}/S_{\rm C}^{\nu_2})}{\log(\nu_1/\nu_2)}$, and $\alpha_{\rm E} = -\frac{\log(S_{\rm E}^{\nu_1}/S_{\rm E}^{\nu_2})}{\log(\nu_1/\nu_2)}$.

Calculations give that the averaged values of spectral index are $\overline{\alpha_{\rm C}} = 0.058$ and $\overline{\alpha_{\rm E}} = 0.484$ for our sample. The corresponding histogram of core and extended spectral indices are shown in Fig. 1, from which, we have $\alpha_{\rm C}^{\rm mid} = 0.006 \pm 0.021$ and $\alpha_{\rm E}^{\rm mid} = 0.839 \pm 0.034$.

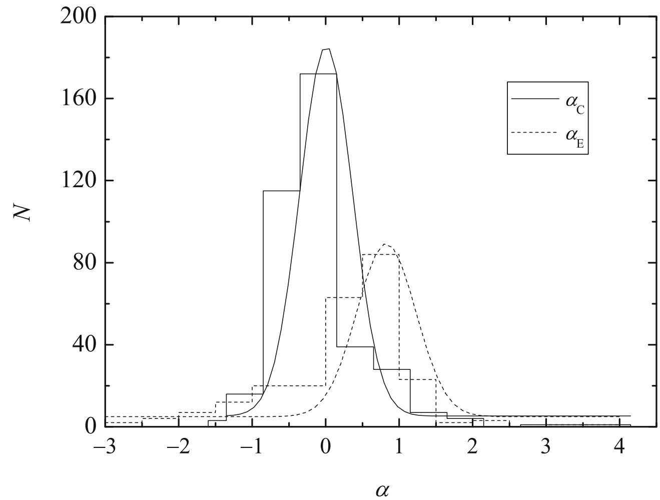

Figure 1. Distributions of core and extended spectral indices. The real curve stands for core spectral index, while the broken curve stands for extended spectral index. Fit curves are obtained by the Gauss model of $y = y_0 + \frac{A}{w\sqrt{\pi/2}} e^{-2(\frac{x-x_c}{w})^2}$.

3. Discussion and conclusion

The emissions in AGNs are divided into a compact relativistically beamed core component and an unbeamed lobe component in a two-component model. The emissions from the core are generally beamed, and it is possible that the emissions from core and extended components are from different mechanisms.

Our statistical results show that the core spectral indices are different from the extended spectral indices. The core emission spectrum is flatter than the extended spectrum, viz. $\overline{\alpha_C} \ll \overline{\alpha_E}$. From the corresponding diagram shown in Fig. 1, we know that $\alpha_C \sim 0$, while $\alpha_E \sim 0.8$. So, it is reasonable that some authors use $\alpha_{Core} = 0$ and $\alpha_{Ext} = 1$ which stands for the radio core and extended spectral indices, respectively.

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