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The Relativistic Beaming Model and Superluminal Motions[1]

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1. Introduction

In this paper, we consider a compilation of 55 objects with known superluminal motions (SM), and whose flux density (X-ray, optical, radio), core dominance parameter (R), superluminal velocity, and radio Doppler factor (δ_R) are known. Our study shows that SM is consistent with the beaming model, and the relation

$$\delta_\gamma = \delta_o^{1+\frac{1}{8}\log(\nu_o/\nu_\gamma)}$$

is reasonable. The statistical correlation between superluminal velocity and redshift is a result of selection and the statistical correlation between R and brightness temperature (T_{ob}) is actually a reflection of the correlations between δ, R, and T_{ob} for objects with SM. Up to now, 59 objects have been reported to have SM, but for reasons discussed elsewhere (Vermeulen & Cohen 1994), only 55 are considered here.

2. Acceleration Model

We proposed a formula between Doppler factor and frequency (the 'acceleration model', as we call it),

$$\delta_\gamma = \delta_o^{1+\frac{1}{8}\log(\nu_o/\nu_\gamma)}, \tag{1}$$

which is true for BL Lac objects (Fan et al. 1993, 1994) and Seyfert galaxies (Xie et al. 1995), and has been confirmed (Fan & Xie 1996). Here, we give another confirmation of SM.

From our previous paper (Fan et al. 1996), we have

$$\delta_R = \delta_o^{1.93\pm0.22},$$

which is consistent with the theoretical result $\delta_R = \delta_o^{1.67}$obtained from eq. (1) with ν_R =5 GHz, and $\nu_o = 10^{14.74}$ Hz. So, the acceleration model is reasonable.

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3. Statistical Results

When linear regression analysis is applied to the data, following statistical results are obtained at a confidence level of greater than 99%: $\log R - \log \delta$, $\log R - \log T_{ob}$, $\log S_r - \log \delta$, and $\log \beta - \log z$. However, when the method of Padovani (1992) is used, we find that there are no longer correlations for $\log R - \log T_{ob}$ and $\log \beta - \log z$; these statistical correlations are actually a reflection of the correlations between δ, R and T_{ob}, and a result of selection, respectively.

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