VLA OBSERVATIONS OF THE CAMBRIDGE-CAMBRIDGE ROSAT SURVEY

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1. Introduction

We report the result of the VLA observations of all the 80 AGN in the Cambridge-Cambridge *ROSAT* Serendipity Survey (CRSS, Boyle et al. 1995), a new well defined sample of 80 X-ray selected AGN with f_x(0.5-2.0keV)$\geq 2 \times 10^{-14}$ erg s^{-1} cm^{-2}. Our aim was to obtain a complete classification of the sample members as Radio-loud (RL) or Radio-quiet (RQ) in order to determine well-constrained X-ray luminosity function (XLF) for X-ray selected RQ and RL AGN separately.

Of the 80 AGN in the sample, seven show radio emission at 5 σ level and only two ($2.5^{+4.0}_{-1.7}$ %) qualify as Radio-Loud (RL) objects ($\alpha_{ro} \geq$0.35, see Ciliegi et al. 1995 for a detailed description of these VLA observations of the CRSS AGN sample). This result, compared with 13% RL in the EMSS sample of AGN (flux limit f_x(0.3-3.5 keV)$\sim 2 \times 10^{-13}$ erg s^{-1} cm^{-2}) confirms the prediction of Della Ceca et al. (1994) that the expected fraction of RL should drops rapidly as the X-ray flux limit is lowered.

2. The X-ray luminosity function

In order to determine well-constrained XLFs for X-ray selected RQ and RL AGN separately, we have combined the CRSS data with the EMSS data. Using the V_e/V_a variable of the $1/V_a$ method of Avni and Bahcall

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(1981) we find that both RL and RQ samples exhibit significant cosmological evolution. Following Boyle et al. (1993), we parameterized the XLF with a two-power-law form $\Phi_X(L_X) = \Phi^*_X L_{X_{44}}^{-\gamma_1}$ for $L_X < L^*_X(z=0)$ and $\Phi_X(L_X) = (\Phi^*_X \times L_{X_{44}}^{-\gamma_2})/L_{X_{44}}^{(\gamma_1-\gamma_2)}$ for $L_X > L^*_X(z=0)$ where Φ^*_X is the normalization of the XLF and γ_1 and γ_2 are the faint and bright end slopes respectively. $L_{X_{44}}$ is the 0.3-3.5 keV X-ray luminosity expressed in units of 10^{44} erg s^{-1}.

Using a cosmological model with q_0=0 and H_0=50, we find that the best-fit parameters are Log $L^*_X = 44.3 \pm 0.2$, $\gamma_1 = 0.80 \pm 0.22$, $\gamma_2 = 3.03 \pm 0.20$ for the RL subsample and Log $L^*_X = 43.9 \pm 0.0.2$, $\gamma_1 = 1.82 \pm 0.15$, $\gamma_2 = 3.70 \pm 0.10$ for the RQ subsample. These data show that the shape of the XLF of the two classes appear to be different both in their low luminosity and high luminosity slopes (parameters γ_1 and γ_2).

We have investigated the possibility of explaining the difference between the XLFs of the two classes of objects in terms of an additional beamed radio-linked component producing X-rays. This component, intrinsically weak, becomes dominant when the direction of the jet with which it is associated is oriented close to the line of sight. In this "X-ray beaming" model, the total X-ray luminosity L_x of AGN can be written as $L_x = L_{xb} + L_{xu}$ where L_{xu} is the unbeamed X-ray luminosity associated with the radio-quiet mechanism which occurs in both RQ and RL and L_{xb} is the beamed X-ray luminosity which is dominant in core-dominated RL due the beaming effect. Using the relation LogL_x = 0.13$\times$Log(L_{xb}/L_{xu}) + 27.52 found by Kembhavi 1993, we obtained the L_{xu} for all the RL AGN in our sample. Using L_{xu} we have re-calculated the XLF for RL AGN. The best-fit parameters for this "unbeamed" XLF are Log $L^*_X = 44.4 \pm 0.2$, $\gamma_1 = 1.65 \pm 0.22$ and $\gamma_2 = 3.66 \pm 0.20$. The XLF for RQ AGN and for unbeamed RL AGN are now consistent (parameters γ_1 and γ_2) within the 1σ errors.

Therefore, we can conclude that the differences in the shape of XLF between RQ and RL AGN can be explained introducing the X-ray beaming model where the "radio-linked" component in RL objects is orientation-dependent, but larger samples of X-ray selected AGN are needed to strengthen this conclusion.

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