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The Eddington Ratio of H_2O Maser Host AGN

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Abstract. The Eddington ratio λ was derived for the entire maser host AGN sample, based on the intrinsic X-ray luminosity, the X-ray bolometric correction C_X and the mass of central black hole. Further the [O III] bolometric correction $C_{[O\,III]}$ was estimated for our sample. Possible relations were also investigated between the maser luminosity and the bolometric luminosity – the Eddington ratio.

Key words. Eddington ratio—bolometric correction—maser.

1. Introduction

AGN are believed to be powered by accretion of gas onto the black hole located at the center of galaxies. The AGN bolometric luminosity depends on the mass accretion rate and on the efficiency for converting gravitational energy into radiation. The Eddington ratio, i.e., ratio of the bolometric luminosity and Eddington luminosity, is very important to constrain predictions of theoretical models. Observations demonstrate that most of the H_2O maser spots are located in the nuclear region of Seyfert 2s or LINERs. As a special subsample of AGN, H_2O maser host AGN may hint some special properties. We investigated here the Eddington ratio for H_2O maser host AGN.

2. Analysis and results

We have collected 31 sources with both the [O III] emission line luminosity $L^c_{[O\,III]}$ and the intrinsic X-ray luminosity (L_X). The [O III] emission line luminosity is always considered to be one of the indicators of AGN intrinsic power (e.g., Zhang *et al.* 2010). A strong correlation between L_X and $L^c_{[O\,III]}$ (Fig. 1) confirms that intrinsic X-ray luminosity can also be used as another indicator of the nuclear AGN power.

Using the luminosity-dependent X-ray bolometric correction (C_X, L_b/L_X)) $\log[L_{AGN}/L_X] = 1.54 + 0.24£ + 0.012£^2 - 0.0015£^3$, where $£ = (\log L_{AGN} - 12)$ (Marconi *et al.* 2004), we can get C_X for different X-ray luminosities. The intrinsic X-ray luminosity L_X was combined with C_X to calculate the AGN bolometric luminosity L_b. Then the Eddington ratio can be estimated with the Eddington limit derived from $L_{Edd} = 1.3 \times 10^{38}(M_{BH}/M_\odot)$erg/s (e.g., Su *et al.* 2008). Figure 1 (right panel) shows the λ-distribution of our H_2O maser sample. We found the distribution

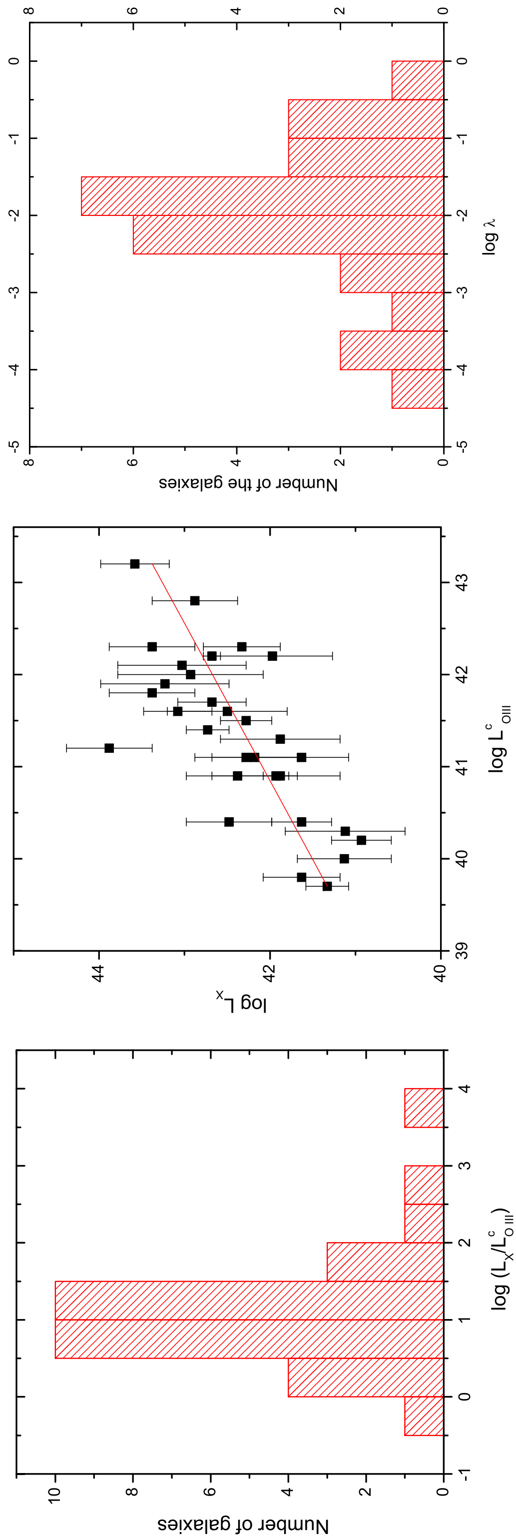

Figure 1. Left panel: the distribution of $\log(L_X/L^c_{\rm O\,III})$. Center: L_X *versus* $L^c_{\rm O\,III}$. Right: the distribution of the Eddington ratio.

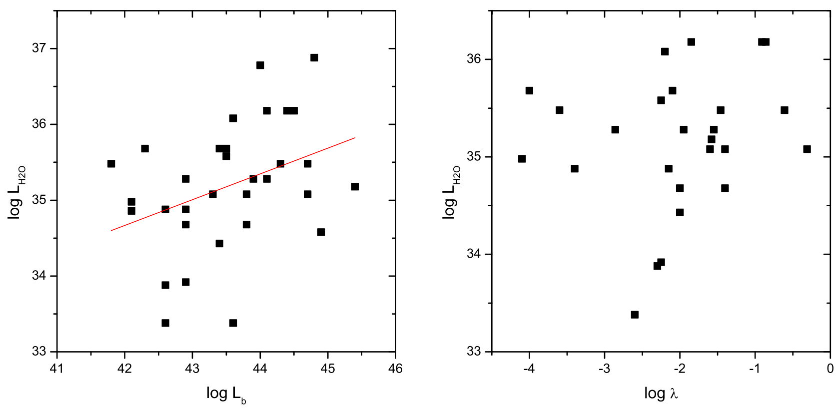

Figure 2. The H_2O maser emission luminosity *versus* the bolometric luminosity (left, in logarithm) and the Eddington ratio (right, in logarithm) of H_2O maser sample.

center at about −2, and the mean of this distribution is $\langle\lambda\rangle \simeq 0.05$, which is comparable to the mean of other AGN samples. Further the [O III] bolometric correction $C_{[\mathrm{O\,III}]}$ (the ratio of the extinction-corrected [O III] line luminosity and the bolometric luminosity) was estimated. The mean values of $C_{[\mathrm{O\,III}]}$ are 384, 284 and 78 respectively, for log $L^{c}_{[\mathrm{O\,III}]}$=39∼40, 40∼42 and 42∼44.

Possible relations are checked between the maser luminosity and the bolometric luminosity, the Eddington ratio λ. From the left panel of Fig. 2, a linear correlation can be found between $L_{\mathrm{H_2O}}$ and L_{b}. Linear fitting results show $\log L_{\mathrm{H_2O}} = (20.37 \pm 6.79) + (0.34 \pm 0.16)\log L_{\mathrm{b}}$.

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