Our best linear fit to data, which has the correlation coefficient $r=0.780$, is

$$\text{Dependance on an acrretion rate or an soft X-ray photon index:}$$

NLS1 but from the point of view of the X-ray variability has the properties of a BLS1. (e.g. MCG -6­30­15, Mrk 507) we do not require such multiplication and the factor is less in case of NLS1. The values of the black hole masses from X-ray excess galaxies were taken from literature. They were obtained with the reverberation mapping method.[5] We have determined the black hole masses, $M_{\text{BH}}$, using the variance method described by [5].

We confirm that in case of BLS1 the values of the black hole masses from X-ray excess show higher accretion rates and indicate soft X-ray excesses in their spectra.[1]. The last NLS1 sources, in comparison to BLS1 galaxies, generally have smaller black hole masses, and require multiplying by a factor to obtain the value of $C$.

$$\text{We also find weak if any dependence of the mass ratio on the 2-10 keV luminosity. It is related to the bi-modal distribution of the X-ray slope.}$$

The discontinuous bi-modal behaviour we have found (instead of a continuous dependence on Eddington ratio used by McHardy et al.) points toward the additional soft enhancement with bolometric luminosity for a fixed black hole mass described by [5].

We have calculated fitted values given in [10] into our relationship and obtained the value $\Gamma_{\text{BH}} = 1.41+/\cdot 0.50$. Our results of $M_{\text{BH}}/M_{\text{X-ray}}$ show bi-modal distribution (Fig. 4). Such behaviour shows $\Gamma_{\text{BH}}$. Therefore, we postulate dependence of Eq. (1) on the soft X-ray indices. Best linear fit obtained by us is:

$$\Gamma_{\text{BH}} - 2.45 = \frac{0.78 + 0.21 \log M_{\text{BH}}/M_{\text{X-ray}} + \text{const}}{0.28 - 0.28 \log M_{\text{BH}}/M_{\text{X-ray}} + \text{const}}$$

Dependence on X-ray luminosity:

[11] have supposed that X-ray variability depends on luminosity above 2 keV. We have studied that and noticed weak if any relationship between $L_{2-10keV}/M_{\text{BH}}$ and the mass ratio (Fig. 3) [i.e. in the case of taking all sources from our sample the correlation coefficient $r$ is equal to 0.125. When we take only sources with $M_{\text{BH}}$ obtained by reverberation mapping method then the correlation coefficient $r_{0.190}$. When we only take NLS1s (18 sources) we have relationship:

$$\log L_{2-10keV}/M_{\text{BH}} = (0.30 \pm 0.28) \log M_{\text{BH}}/M_{\text{X-ray}} + \text{const}$$

Conclusions:

- We calculate the ratios $M_{\text{BH}}/M_{\text{X-ray}}$ of the black hole masses in NLS1 galaxies obtained by the X-ray variability method and by reverberation/stellar velocity dispersion. The ratios for NLS1 galaxies are about of order of 1 for BLS1 objects.
- The overall enhancement of the variability for NLS1 galaxies is consistent with the variability enhancement with bolometric luminosity for a fixed black hole mass described by McHardy et al.
- For a few NLS1 galaxies $M_{\text{BH}}/M_{\text{X-ray}}$ ratio is of order of 1, as for BLS1 sources. These sources have hard X-ray spectra, typical for BLS1 galaxies.
- The $M_{\text{BH}}/M_{\text{X-ray}}$ ratios in a combined NLS1 and BLS1 sample show a bi-modal behaviour. It is related to the bi-modal distribution of the X-ray slope.
- The discontinuous bi-modal behaviour we have found (instead of a continuous dependence on Eddington ratio used by McHardy et al.) points toward the additional soft spectral component as the physical reason for the bolometric luminosity.
- We also find weak if any dependence of $M_{\text{BH}}/M_{\text{X-ray}}$ ratio on the 2-10 keV luminosity. It is in agreement with result of Gierliński et al. (2008) (for galactic black holes in low/hard state) but our sample is too small. Therefore, such dependence for galaxies might not be ruled out.

References: