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Does the Black Hole Rotation Lead to Higher X-Ray Variability in the Narrow-Line Objects?

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Abstract. This paper presents a analysis of X-ray variability for a assembled sample of broad-line Seyfert 1, narrow-lines Seyfert 1 galaxies and QSOs observed by *ASCA*, whose central black masses have been estimated. We find the significant relation between X-ray variability and the central black masses is different for Broad-line and Narrow-lines galaxies. The higher excess variance of narrow-line galaxies can be explained that they have smaller size of X-ray emission region compare to the broad-line objects. Our findings favor the hypothesis that the narrow-line galaxies have rotational black hole and hence maybe have the jets.

1. Introduction

The rapid X-ray variability of active galactic nuclei (AGNs) show the X-ray emission is coming from the innermost region of the compact objects. It will help us to get the information of the central objects. Leighly (1999) found the narrow-line objects have more X-ray variance than the same luminosity broad-line objects. Lu & Yu (2001) analysis the X-ray excess variability of a AGNs sample observed by ASCA and find there is a strong anti-correlation between X-ray excess variability and central black hole masses. There are only three 3 narrow-line objects in their sample. Here we present a larger sample including more narrow-line objects to investigate this relation.

2. Results and Discussion

We search the ASCA archive up to Oct. 1999 for the objects with estimated central black hole masses. We adopted the ASCA date from Nandra (1997), Leighly (1999), Turner (1999). The X-ray variability is qualified by excess variance. In our sample, we have 12 narrow-line objects and 19 broad-line objects. The result is shown in Figure 1.

For all the objects in Figure 1, the best linear fit is $\log\sigma^2 = (-0.60 \pm 0.015)\log M + (1.27 \pm 0.014)$. The correlation coefficient is -0.797 with a Pearson correlation coefficient of $R = -0.80$ corresponding to a probability of P=0.0001 that the correlation is caused by a random factor. The best linear fit for the narrow-line objects is $\log\sigma^2 = (-0.33 \pm 0.022)\log M + (1.56 \pm 0.02)$ ($R = -0.72$,

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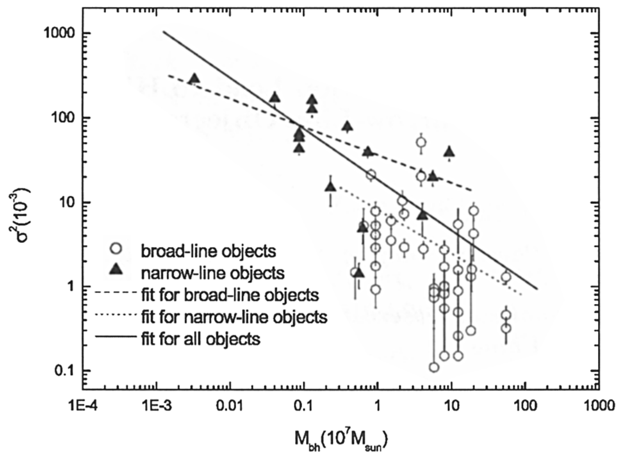

Figure 1. The "excess variance" versus the central black hole mass.

$P = 0.003$). For broad-line objects, the relation is $\log \sigma^2 = (-0.52\pm0.04)\log M +$ (0.92 ± 0.03) ($R = -0.59$, $P = 0.0001$). We also found the fit line for the narrow-line sample is flatter than that for the broad-line sample and large part of the narrow-line objects are on the top of the broad-line objects in Figure 1.

With the more narrow-line objects, the enhanced excess variance in the narrow-line objects objects is founded. If the larger excess variance means smaller size of of the X-ray emission region (Lu & Yu 2001), then narrow-line objects have smaller size of the X-ray emission region than broad-line objects with the same central black holes. We suggested the central black holes of the narrow-line objects may be rotational, namely, they are kerr black holes. Several examples of radio-loud narrow-line objects are discovered. It has been proposed that these objects have the weak jets (Grupe 1999).

In Fig. 1, we find three narrow-line objects (Mrk110, Mrk335, PG1211+143) are departed from the trend for the whole narrow-line subsample. These three objects have the $FWHM_{H\beta}$ near 2000 km s^{-1}. They may not be genuine broad-line objects. The three exceptions may also be interpreted with the central inverse rotational kerr black hole. The broad-line object, NGC3227, is also depart from the trend for broad-line subsample. It may be due to the large error for the estimated of the central black hole (Wandel 1999).

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