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REVERBERATION MAPPING OF THE SEYFERT 1.5 GALAXY H 0507+164

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Light curves of the continuum at 5100 Å and Hβ line are obtained from spectroscopic monitoring observations of the Seyfert 1.5 galaxy H 0507+164. The mass of the black hole is calculated based on cross-correlation analysis of these light curves.

Using the technique of reverberation mapping the size of the broad line region (BLR) of Active Galactic Nuclei (AGNs) can be obtained by calculating the time lag between the variations of the broad Hβ line emission and the continuum at 5100 Å using cross-correlation techniques. Using this BLR size, the mass of the black hole can be estimated (Blandford & McKee 1982; Peterson et al. 2004).

Previous reverberation observations have shown a correlation between the mass of the black hole and the continuum luminosity at 5100 Å (Kaspi et al. 2000; Denney et al. 2010). Extending this relation to luminosities lower than 10^{43} erg sec^{-1} requires reverberation observations of objects of lower luminosities. With this aim, we observed a low luminosity AGN, H 0507+164. Spectroscopic observations were obtained for 22 nights, during November-December of 2007 using the 2 m Himalayan Chandra Telescope (HCT). Spectra covering a spectral range of 3800–6700 Å at a resolution of ∼8 Å were obtained. They were reduced using standard procedures in IRAF and inter-calibrated with respect to the narrow [O III]λ5007 Å line.

The excess variance ($F_{\rm var}$; Edelson et al. 2002), a measure of the intrinsic variability amplitude is estimated to be 16% and 18% for the continuum and the Hβ line respectively. These are similar to that of the other variable AGNs (Denney et al. 2010). In order to estimate the time lag, the light curves (Figure 1) of the Hβ line and the continuum are cross-correlated using the methods of Interpolated Cross Correlation Function (ICCF; Gaskell & Peterson 1987) and the Discrete Correlation Function (DCF; Edelson & Krolik 1988). The cross correlation curves (Figure 2) show an overall shift towards positive lags. Using the centroid of the cross-correlation curves, the time lag is estimated to be 3.06 and 4.11 days respectively for the ICCF and DCF methods. Using this estimate of the time lag, the width of the Hβ line in the observed spectra and the equation (1) of Peterson et al. (2004), the mass of the black hole of the Seyfert 1.5 galaxy H 0507+164 is estimated to be $\sim 9.6 \times 10^6\ M_\odot$.

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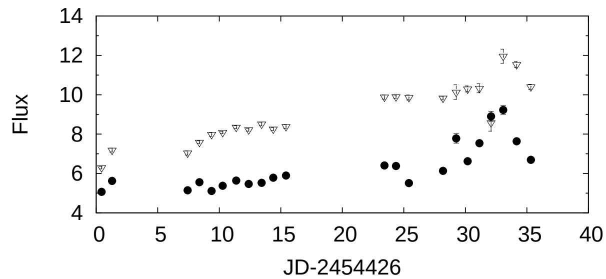

Fig. 1. The fluxes of Hβ ($\times 10^{-14}$ erg cm^{-2} s^{-1}; triangles) and the continuum ($\times 10^{-16}$ erg cm^{-2} s^{-1} $Å^{-1}$; circles) at 5100 Å are plotted against time in days.

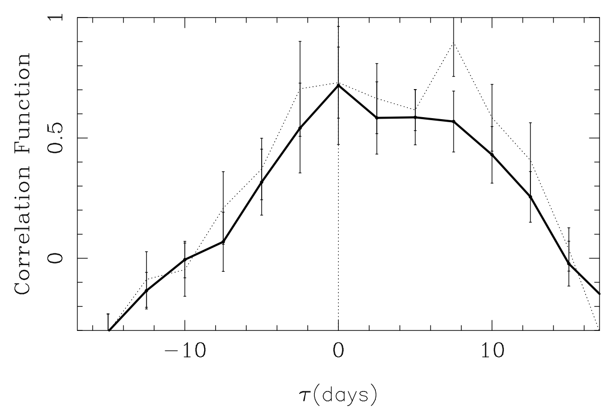

Fig. 2. The cross correlation functions of Hβ and continuum light curves using the ICCF (solid) and the DCF (dotted) methods are plotted for a bin size of 2.5 days.

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