Variability Analysis of the Seyfert 1 Galaxy MCG-6-30-15 observed by ASCA and Suzaku
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Abstract
We analyzed long observations of the Seyfert 1 Galaxy MCG-6-30-15 in 1999 and 2006 using ASCA and Suzaku, respectively. We carried out model independent RMS (Root Mean Square) variability analysis, and confirmed that the RMS variability spectrum in 1999 indicates a significant decrease in the Fe line energy band more rapidly than those in other energy bands, when time-scale increases from $10^3$ to $10^5$ sec, as already reported by Matsumoto et al. (2003). On the other hand, the RMS variability spectrum in 2006 does not show such a dramatic decrease at the Fe line energy band. Examining the structure function (variability time-scale vs RMS variability), we found a common characteristic in 1999 and 2006 that RMS variability is most significant on a time-scale of $\sim 10^3$ sec in all the energy bands. Our results of differential spectral analysis are also consistent with the results of the structure function analysis.

1. Introduction

1.1 Active Galactic Nucleus MCG-6-30-15

- Mass $\sim 10^5$ solar mass (Morini et al. 2001)
- Having been observed for more than 10 years, using ASCA/Tanaka et al. 1995 et al., XMM-Newton, Suzaku satellite, and so on.

1.2 Long exposure with ASCA and Suzaku

- Exposure time about 405 ksec in 1999 (ASCA)
- Exposure time about 346 ksec in 2006 (Suzaku)

1.3 We have studied spectral variation.

In particular, iron line region.

2. Observation & Data analysis

Suzaku satellite: <2006> Jan 9—14th (ID:70007010) 23—26th (ID:70007020), 27—30th (ID:70007030) Total about 346 ksec (exposure time)

ASCA satellite: <1999> July 19—21st (ID:77003000) Total about 405 ksec (exposure time)

These figures are light curves of 1.0 $\times 10^3$ sec in all the energy bands. Our results confirm that the RMS variability in 1999 indicates a significant decrease in the Fe energy band when time-scale increases from $10^3$ to $10^5$ sec as already reported by Matsumoto et al. (2003). On the other hand, the RMS variability spectrum in 2006 does not show such a dramatic decrease at the Fe line energy band. Examining the structure function (variability time-scale vs RMS variability), we found a common characteristic in 1999 and 2006 that RMS variability is most significant on a time-scale of $\sim 10^3$ sec in all the energy bands. Our results of differential spectral analysis are also consistent with the results of the structure function analysis.

3. Results of RMS analysis in 1999

The RMS variability spectrum in 2006 does not show such a dramatic decrease at the Fe line energy band as observed with ASCA in 1999.

4. Results of RMS analysis in 2006

The RMS variability spectrum in 2006 does not show such a dramatic decrease at the Fe line energy band as observed with ASCA in 1999.

5. Data analysis with differential spectrum

6. Summary

We confirmed that the RMS variability in 1999 indicates a significant decrease in the Fe energy band when time-scale increases from $10^3$ to $10^5$ sec, as already reported by Matsumoto et al. (2003).

The RMS variability in 2006 does not show such a dramatic decrease in the Fe line energy band.

We found a common characteristic in 1999 and 2006 that RMS variability is most significant on a time-scale of $\sim 10^3$ sec in all the energy bands.

We have analyzed the differential spectra in 2—50 keV on time scale of $10^3$ to $10^5$ sec, and found that all spectra are fitted with a power-law model. Photon index is constant at $\sim 2.2$.

7. Reference

- Matsumoto et al (2003), PASJ, 55, 615
- McHardy et al. (2005), MNRAS, 359, 1469
- Fabian et al. (2002), MNRAS 335, 1
- Fabian et al. (2004), MNRAS, 348, 1415
- McHardy et al. (2007), PASJ, 59, 315