# RAPID X-RAY VARIABILITY AND THE Fe II PROBLEM IN I Zw 1 OBJECTS

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ABSTRACT. X-ray variability in the 0.1 - 2.4 *keV* ROSAT energy band with a doubling timescale of 800 s and a factor of 4 within a few hours has been detected in a 20 ksec pointing on the IRAS AGN 13224-3809. The optical spectrum indicates that IRAS 13224-3809 is a narrow-line Seyfert 1 galaxy with strong permitted Fe II emission, a member of the unusual I Zw 1 class objects. IRAS 13224-3809 appears to be one of the most rapidly variable AGN known so far. This is the first time that variability on a timescale smaller than 1000 s is reported at such high $L$ (0.1 - 2.4 *keV*) = $3 \cdot 10^{44} erg \cdot s^{-1}$ X-ray luminosity in Seyfert galaxies. It is also the first reported X-ray variability in I Zw 1 class objects. The $\Delta t$ = 800 s variation indicates that the X-rays come from a compact region of about 17 light minutes in size. Our results from the X-ray spectral analysis favour a scenario in which a hard X-ray source irradiates the accretion disk which reemits at soft X-ray energies. The absence of broad H I wings can be explained if only a part of the BLR, far from the centre, is observed and the bulk of the region, which emits the wings, is hidden. We want to draw attention to the fact that rapid X-ray variability could also be connected with the absence of broad H I lines in IRAS 13224-3809.

## 1. X-ray Observation

Figure 1 shows the X-ray (0.1 - 2.4 *keV*) lightcurve of IRAS 13224-3809. Coherent variations on timescales of about 800 s by a factor of 2 between epochs at 18,000 and at 128,000 s after the beginning of the observation have been detected. Amplitude variations of a factor of about 4 can be seen on timescales between 8 and 16 hours.

## 2. Optical Observations

A CCD image of IRAS 13224-3809 and two long-slit spectra were taken with the La Silla 3.6 m telescope using the EFOSC spectrograph on December 24, 1992 (see Fig. 3 of Boller et al. 1993). Numerous emission lines are seen in the galaxy spectrum. The Fe II lines from the multiplets around 4570 and 5270 Å, $H_\beta$ and [OIII]$\lambda\lambda$ 5007, relevant to the present study, were measured. IRAS 13224-3809 appears to be one of the most intense Fe II emitters with $FeII(4570)/H_\beta = 2.4$. The intensity of the narrow $H_\beta$ emission is only slightly broader than the forbidden line [O III] $\lambda\lambda$ 5007. No indications for broad wings of $H_\beta$ are apparent.



*H. T. MacGillivray et al. (eds.), Astronomy from Wide-Field Imaging,* 660–661.

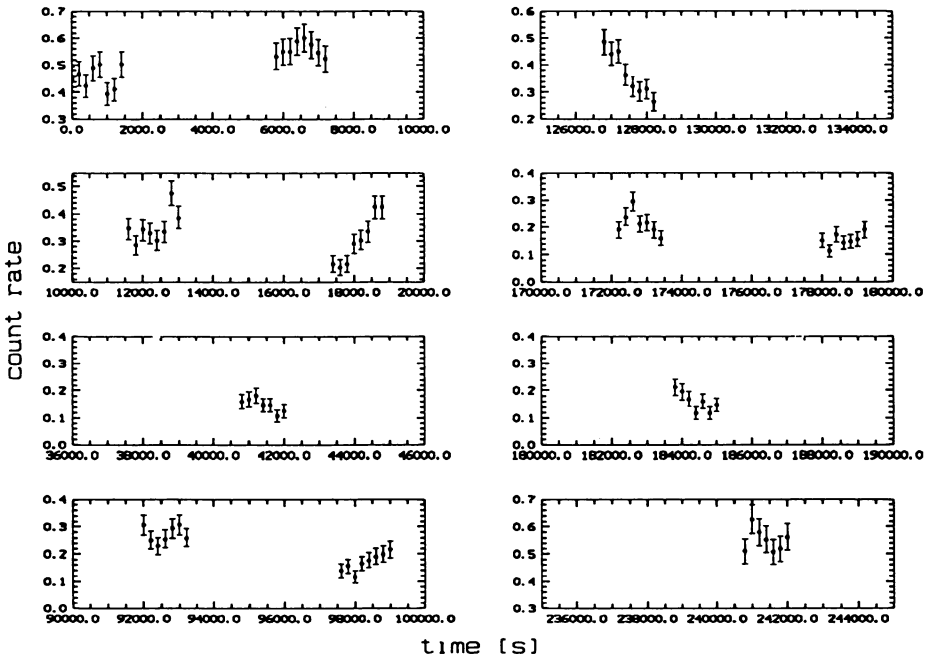


**Figure 1.** X-ray lightcurve of IRAS 13224-3809 (count rate versus time in seconds). The doubling timescale is only 800 s.

## 3. Discussion

Our results from the X-ray spectral analysis favour a scenario in which a hard X-ray source irradiates the accretion disk which re-emits at soft X-ray energies. Following Collin-Souffrin (1988) a hard X-ray source is a necessary condition for the optical Fe II emission supposed to arise from outer regions of an accretion disk. The absence of broad H I wings can be explained if only a part of the BLR, far from the centre, is observed and the bulk of the region, which emits the wings, is hidden. We want to draw attention to the fact that rapid X-ray variability could also be connected with the absence of broad H I lines in IRAS 13224-3809.

The detailed discussion can be found at Boller et al. (1993).

## References

Boller, Th., Trümper, J., Molendi, S. et al., 1993. MPE Preprint 260.
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https://doi.org/10.1017/S0074180900048312 Published online by Cambridge University Press