Suzuk observations of the peculiar cataclysmic variable FS Aurigae

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INTRODUCTION AND OBSERVATIONS

FS Aurigae is a peculiar cataclysmic variable showing multiple periodic photometric and spectroscopic variabilities (Neustroev et al. 2013). The orbital period (OP) of 86.7 min which is only sometimes visible in the optical light curve, is determined from the radial velocity variations of emission lines. The light curve is usually dominated by modulations with a long photometric period (LPP) of 205.5 min (Neustroev 2002; Tovmassian et al. 2009) whose shape undergoes dramatic changes from almost perfectly sinusoidal to a double-hump shape. In addition, the system shows a second long spectroscopic period (LSP) of 147 min, appearing in the far wings of emission lines (Tovmassian et al. 2009). It is interesting that the LPP has never been detected spectroscopically, whereas the LSP is barely seen in the photometric data. However, there is a definite relation between all the three periods: \( \frac{1}{\text{OP}} = \frac{1}{\text{LPP}} = \frac{1}{\text{LSP}} \).

The puzzling behaviour of FS Aur is explained within the frame of the enhanced intermediate polar scenario with a rapidly rotating magnetic white dwarf processing with the LSP (Tovmassian et al. 2003, 2007; Neustroev et al. 2013).

TEMPORAL ANALYSIS

We folded the X-ray light curve of FS Aur with the OP, LPP and LSP according to epheemria from Neustroev et al. (2013). The OP modulation is clearly apparent and has a rather smooth, sine-like shape. There also is an apparent phase shift between modulations at softer and harder energy ranges that results in a significant variability in the hardness ratio.

The analysis of previous X-ray observations of FS Aur also revealed a strong modulation with the OP which shape varied significantly between different X-ray sets (Neustroev et al. 2013). The existence of modulations with two other periods in the previous observations is not so obvious. In the case of short observations multiple variabilities can strongly interfere with each other, making any conclusion on reality of modulations in folded light curves difficult. The longer observations with Suzuki allowed us to smear the concurrent modulations out and to make a confident conclusion on the reality of modulations with all the three periods.

The LPP modulation has a double-hump shape in an agreement with the previous observations. The variability with the LSP is less apparent in the folded light curve, but is clearly seen in the hardness ratio curve.

As a further check we created an artificial light curve of a sine wave with the OP and amplitude similar to the observed one, and with the same time-sampling and count-rate as our dataset. This fake light curve folded with the LPP and LSP, shows no variability with the corresponding period.

SPECTRAL ANALYSIS

For the spectral analysis we used a combined time-averaged spectrum from the front-illuminated XSi5 and XIS3 detectors. The spectrum is best fitted by the sum of MFRAL, plasma emission models with three different temperatures, modified by the interstellar absorption (PHABS in XSPEC). The fitted value of abundance is about 1 (using the Solar abundance table from Asplund et al., 2009). The best-fit spectral parameters are \( N_H=1.2(3)\times10^{22} \text{ cm}^{-2} \), \( K_T=0.67(3) \), \( 3.6(2) \), \( 40(20) \) keV; \( \text{Abund}=1(1) \).

DETECTION OF THE 6.4 keV LINE

The high quality of the data allowed us to detect, for the first time from this source, an iron fluorescence line at 6.4 keV (see red line in fig. 2). The presence of this feature in the spectrum suggests reflection from the white dwarf plays an important role (Hellier et al., 1998) and has to be taken into account in the future modelling.

REFERENCES:

Asplund M. et al., 2009, ARA&A, 47, 481


