

# V5116 Sgr: a disc-eclipsed SSS post-outburst nova?

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Nova V5116 Sgr 2005 No. 2 was observed with XMM-Newton on 2007 March 5 and on 2009 March 13. The March 2007 X-ray spectrum showed that the nova had evolved to a pure supersoft X-ray source 20 months after outburst, with its light-curve showing abrupt changes of the flux by a factor ~8 with a periodicity of 2.97h, consistent with the orbital period of the system. The white dwarf atmosphere temperature is the same both in the low and the high flux periods, ruling out an intrinsic variation of the X-ray source and pointing to a possible partial eclipse as the origin of the variable light curve. The RGS high resolution spectra showed an absorption features during the high flux periods, while emission lines appear in the low flux periods. This is consistent with the partial eclipse scenario. In March 2009 the SSS on V5116 Sgr had turned off. XMM-Newton detects a weak X-ray source, harder than in 2007 and five orders of magnitude fainter.

**Discovery** (Liller 2005, IAUC#8559):  
**Maximum observed V:**  
 $t_2$  (time to decline 2 magnitudes):  
 $M_V$  (with Della Valle & Livio. 1995 (ApJ, 452, 704)  $M_V - t_2$  relation):  
 $E_{B-V}$  (Gilmore & Kilmartin IAUC#8559):

2005 July 4.049, V-8

V~7.2 (2005 July 5.085)

6.5+/-1 day

8.8+/-0.4

+0.48

## Nova V5116 Sgr 2005 No.2: Basic facts

**Distance** (with above numbers, Sala et al. 2008, ApJ, 675, L93)

11+/-3 kpc

**Orbital period** (Dobrotka et al. 2008, A&A, 478, 815):

2.9712+/-0.0024 hr

Possible **high-inclination** system with **irradiation** on the secondary star (Dobrotka et al. 2008, A&A, 478, 815).

1st X-ray pointing: Swift, August 2005, not detected (Ness et al. 2007, ApJ, 663, 505)

1st X-ray detection: XMM-Newton, March 2007 (Sala et al. 2007, A&A, #1184)

Swift & Chandra detection: August 2007 (Ness et al. CBET#1030; Nelson & Orlo, A&J#102)

## XMM-Newton observation on 5 March 2007 (610 days since outburst)

### LIGHT CURVES

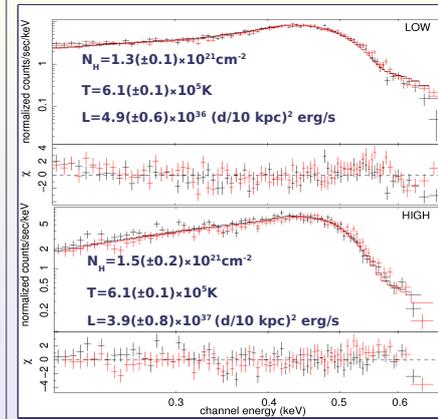
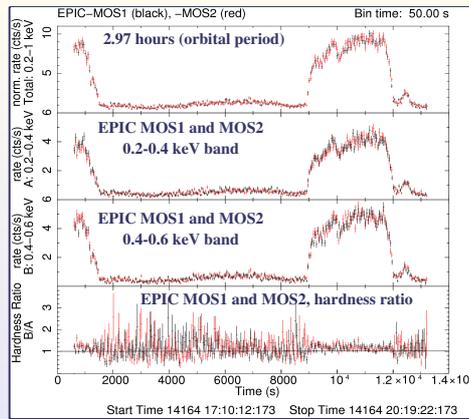
12.7 ks exposure with EPIC MOS1 and MOS 2 obtained on 2007 March 5 (pn piled up).

Light-curve modulation, with factor ~8 changes in flux.

Compatible with orbital period

No hardness ratio variations observed.

Piled-up (spectra extracted from annulus, only MOS1+2)



For more details see Sala, Hernanz, Ferri, Greiner ApJ, 675, L93 (2008)

### EPIC BROAD-BAND SPECTRUM

Black-body provides very bad fit (reduced  $\chi^2 > 4$ ); fit improves with white dwarf atmosphere models from MacDonald & Vennes (1991, ApJ, 373, L51).

CO atmosphere provides bad fit (due to deep C absorption edges); but ONE atmosphere model provides a good fit.

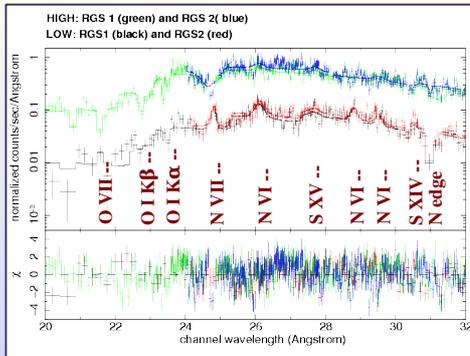
When flux is 8 times higher, spectral model is the same.

### HIGH RESOLUTION SPECTRA

Possibly ISM absorption lines (commonly detected in X-ray binaries)

Emission lines stronger during eclipse, probably originated at the photoionized material. Absorption features only in high flux.

Identification	$\lambda$ (Å)	FWHM (eV)	Eq. width (eV)
O VII	21.602	High < 10 Low 1 (frozen)	-5.3 <sup>+2.3</sup> <sub>-6.8</sub> > -6
O I K $\beta$	22.887	High < 13 Low 1 (frozen)	-3.7 <sup>+1.6</sup> <sub>-6.5</sub> > -6
O I K $\alpha$	23.507	High < 14 Low 1 (frozen)	-1.6 <sup>+0.7</sup> <sub>-2.0</sub> > -4
N VII	24.78	High 4 $\pm$ 2 Low 1.0 $\pm$ 0.5 (1 $\sigma$ )	-6 $\pm$ 2 5.2 <sup>+4.5</sup> <sub>-2.5</sub>
N VI	26.12	High 2 (frozen) Low 2.0 $\pm$ 0.5	< 1 4 $\pm$ 2
S XV	27.56	High 2 (frozen) Low 2 (frozen)	< 1.2 1 <sup>+1</sup> <sub>-0.8</sub> (1 $\sigma$ )
N VI	28.79	High 5 (frozen) Low 5 $\pm$ 3 (1 $\sigma$ )	< 1.3 3 <sup>+7</sup> <sub>-1</sub>
N VI	29.534	High 2 (frozen) Low 2 $\pm$ 1 (1 $\sigma$ )	< 1.1 2 <sup>+2</sup> <sub>-1.5</sub>
S XIV	30.47	High 1 (frozen) Low 1 (frozen)	< 0.4 1.4 <sup>+0.1</sup> <sub>-0.1</sub> (1 $\sigma$ )



L and kT indicate R=6x10<sup>9</sup>cm (for 10 kpc)

Whole white dwarf visible during high flux periods.

### ORIGIN OF FLUX CHANGES?

NO intrinsic variation of the SSS (because constant spectrum.)

NO eclipse by secondary (would produce short eclipses.)

Partial eclipse by an asymmetric disk?

Sala, Hernanz, Ferri et al (in preparation)

## XMM-Newton observation on 13 March 2009 (1348 days since outburst)

### X-RAY RESULTS

26 ks exposure with EPIC cameras, obtained on 2009 March 13 (but only 14 ks free of high background)

V5116 Sgr is detected as a weak X-ray source, with a (0.2-10 keV) flux in the range (5-8)x10<sup>-14</sup> ergs/cm<sup>2</sup>. At 10 kpc, that is a luminosity of L=(3-7)x10<sup>32</sup> (d/10 kpc)<sup>2</sup> erg/s

The source is too faint for detailed spectral analysis, but the SED is harder than in 2007.

The SSS is off, as with Swift in June 2008, 2065 days after outburst.

The X-ray source is 2-3 times fainter than in the last Swift observation

### OPTICAL MONITOR

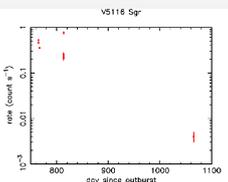
The OM was used with filters U and UVW1, image and fast mode.

Fainter than in 2007 (in 2007 only U filter in image mode) => in agreement with irradiation of the secondary star as the origin of the optical emission

Two sources in the fast mode window. Data under analysis.

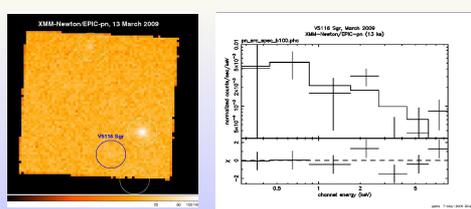
### Swift XRT light curve

(from Swift nova-CV group)



Assuming the same SED for the last Swift observation as in March 2009, the Swift/XRT count rate (0.004 +/- 0.1 cts/s) implies a flux of 1.6 (+/- 0.4) x10<sup>-13</sup> ergs/cm<sup>2</sup> (0.2-10 keV).

### XMM/EPIC-pn image and SED



Sala, Hernanz, Ferri et al (in preparation)

