# XMM-Newton observation of the Supersoft Classical Nova V5116 Sgr 2005 No. 2


## Glòria Sala[1], Margarita Hernanz[2], Carlo Ferri[2], Jochen Greiner[1]

*1. **Max-Planck-Institut für extraterrestrische Physik***
*P.O. Box1312. D-85741 Garching bei München (Germany). **gsala@mpe.mpg.de**, jcg@mpe.mpg.de*
*2. **Institut de Ciències de l'Espai (IEEC-CSIC)***
*Campus UAB, Facultat de Ciències, 08193 Bellaterra (Barcelona, Spain). hernanz@ieec.uab.es, ferri@ieec.uab.es*



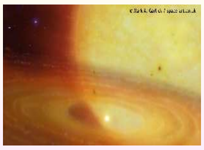
**Nova V5116 Sgr 2005 No. 2 was observed with XMM-Newton on 2007 March 5, 20 months after the optical outburst.**
**The X-ray spectrum shows that the nova had evolved to a pure supersoft X-ray source, indicative of residual H-burning on top of the white dwarf.**
**The X-ray light-curve shows abrupt changes of the flux by a factor ~8 with a periodicity of 2.97h, consistent with the orbital period of the system.**
**The EPIC spectra are well fit with an ONe white dwarf atmosphere model, with the same temperature both in the low and the high flux periods.**
**This rules out an intrinsic variation of the X-ray source and points to a possible partial eclipse as the origin of the variable light curve.**
**The RGS high resolution spectra shows a number of absorption and emission features, some of them only during eclipse.**


## X-RAY EMISSION FROM CLASSICAL NOVAE

A classical nova outburst is caused by the explosive **burning of hydrogen** on the surface of a **white dwarf** in a cataclysmic variable.

During the outburst, a fraction of the accreted material is **ejected** while part returns to hydrostatic equilibrium**.**

**Steady nuclear burning** of the residual H-rich envelope is responsible for **supersoft X-ray** emission in post-outburst classical novae.

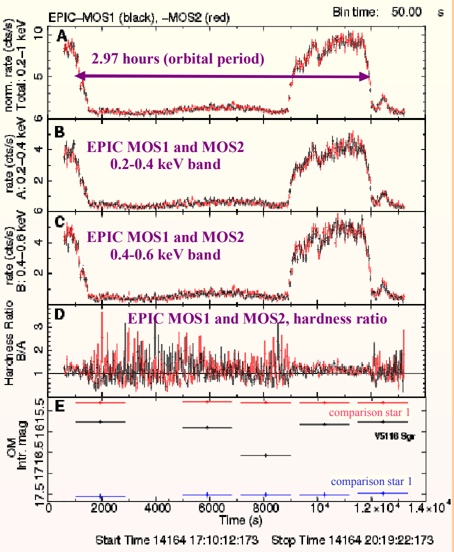


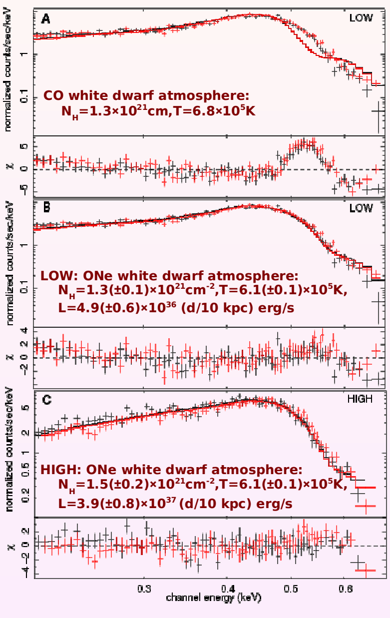
## Nova V5116 Sgr 2005 No.2

- **Discovery** (Liller 2005, IAUC#8559): **2005 July 4.049, with V~8**
- **Maximum observed V:** **V~7.2 (2005 July 5.085)**
- $t_2$(time to decline 2 magnitudes): **6.5+/-1** day
- $M_V$ (with Della Valle & Livio. 1995 (ApJ, 452, 704) $M_V - t_2$ relation): **8.8+/-0.4**
- $E_{B-V}$(Gilmore & Kilmartin IAUC#8559): **+0.48**
- **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, Atel #1184)
- Also detected by Swift and Chandra on August 2007 (Ness et al. CBET #1030; Nelson & Orio, ATel#102)

## XMM-NEWTON EPIC RESULTS

- **12.7 ks exposure with EPIC MOS1 and MOS 2 obtained on 2007 March 5** (EPIC-pn is highly piled up).
- **Light-curve modulation, with factor ~8 changes in flux.**
- **Compatible with orbital period**
- **No hardness ratio variations observed.**
- **OM (U filter) light-curve also compatible with orbital period (but only 5 long exposures available).**



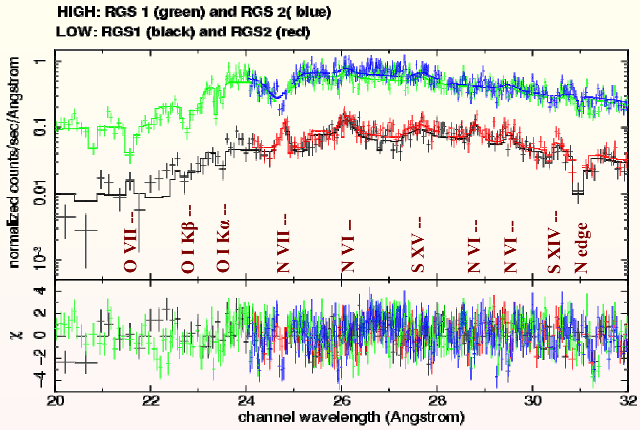

- **Piled-up** (spectra extracted from annulus, only MOS1+2)
- **Very soft spectrum**
- **Black-body provides very bad fit (reduced $\chi^2$ > 4)**
- **We use white dwarf atmosphere models from MacDonald & Vennes (1991, ApJ, 373. L51).**
- **CO white dwarf (WD) atmosphere model provides bad fit (due to deep C absorption edges)**
- **ONe white dwarf atmosphere provides best fit.**
- **When flux is 8 times higher, spectral model is the same.**

*More details in:*
**Sala, Hernanz, Ferri, Greiner 2008, ApJ, 675, L93**

- **L and kT indicate R=6x10$^8$cm (for 10 kpc)**
- **Whole white dwarf visible during high flux periods.**
- **ORIGIN OF FLUX CHANGES?**
  - **NO intrinsic variation of source (because constant spectrum.)**
  - **NO eclipse by secondary (would produce short eclipses.)**
  - **Partial eclipse by an asymmetric disk?**

## XMM-NEWTON RGS RESULTS

**HIGH: RGS 1 (green) and RGS 2( blue)**
**LOW: RGS1 (black) and RGS2 (red)**




**Possibly ISM absorption lines (commonly detected in X-ray binaries; see for example poster B24 *"Three black-hole binaries observed with XMM-Newton"*, Sala et al.)**

**Emission lines stronger during eclipse, probably originated at the photoionized material (disk? ejecta?)**

**Note that some of the NVI and NVII lines were also detected in the novae V4743 Sgr and RS Oph.**

| Identification | λ (Å) | | FWHM (eV) | Eq. width (eV) |
|---|---|---|---|---|
| O VII | 21.602 | High | < 10 | $-5.3^{+2.3}_{-6.8}$ |
| | | Low | 1 (frozen) | > −6 |
| O I Kβ | 22.887 | High | < 13 | $-3.7^{+1.6}_{6.5}$ |
| | | Low | 1 (frozen) | > −6 |
| O I Kα | 23.507 | High | < 14 | $-1.6^{+0.7}_{-2.0}$ |
| | | Low | 1 (frozen) | > −4 |
| N VII | 24.78 | High | $4 \pm 2$ | $-6 \pm 2$ |
| | | Low | $1.0 \pm 0.5(1\sigma)$ | $5.2^{+4.5}_{-2.5}$ |
| N VI | 26.12 | High | 2 (frozen) | < 1 |
| | | Low | $2.0 \pm 0.5$ | $4 \pm 2$ |
| S XV | 27.56 | High | 2 (frozen) | < 1.2 |
| | | Low | 2 (frozen) | $1^{+1}_{-0.8}(1\sigma)$ |
| N VI | 28.79 | High | 5 (frozen) | < 1.3 |
| | | Low | $5 \pm 3(1\sigma)$ | $3^{+7}_{-1}$ |
| N VI | 29.534 | High | 2 (frozen) | < 1.1 |
| | | Low | $2 \pm 1(1\sigma)$ | $2^{\ 2}_{-1.5}$ |
| S XIV | 30.47 | High | 1 (frozen) | < 0.4 |
| | | Low | 1 (frozen) | $1.4^{+0.7}_{-1}(1\sigma)$ |

**FIND OUT MORE ABOUT POST-OUTBURST NOVAE**
**INCLUDED IN OUR XMM-NEWTON OBSERVATIONAL PROGRAM.**
**DO NOT MISS:**

**TALK by MARGARITA HERNANZ in session C2.**
**"The turn-off and recovery of accretion in classical novae as seen by XMM-Newton"**

**POSTER C1 by C. FERRI, M. HERNANZ and G. SALA:**
**"The recovery of accretion in a Classical Nova seen in X-rays"**