The turn-off and recovery of accretion in classical novae as seen by XMM-Newton

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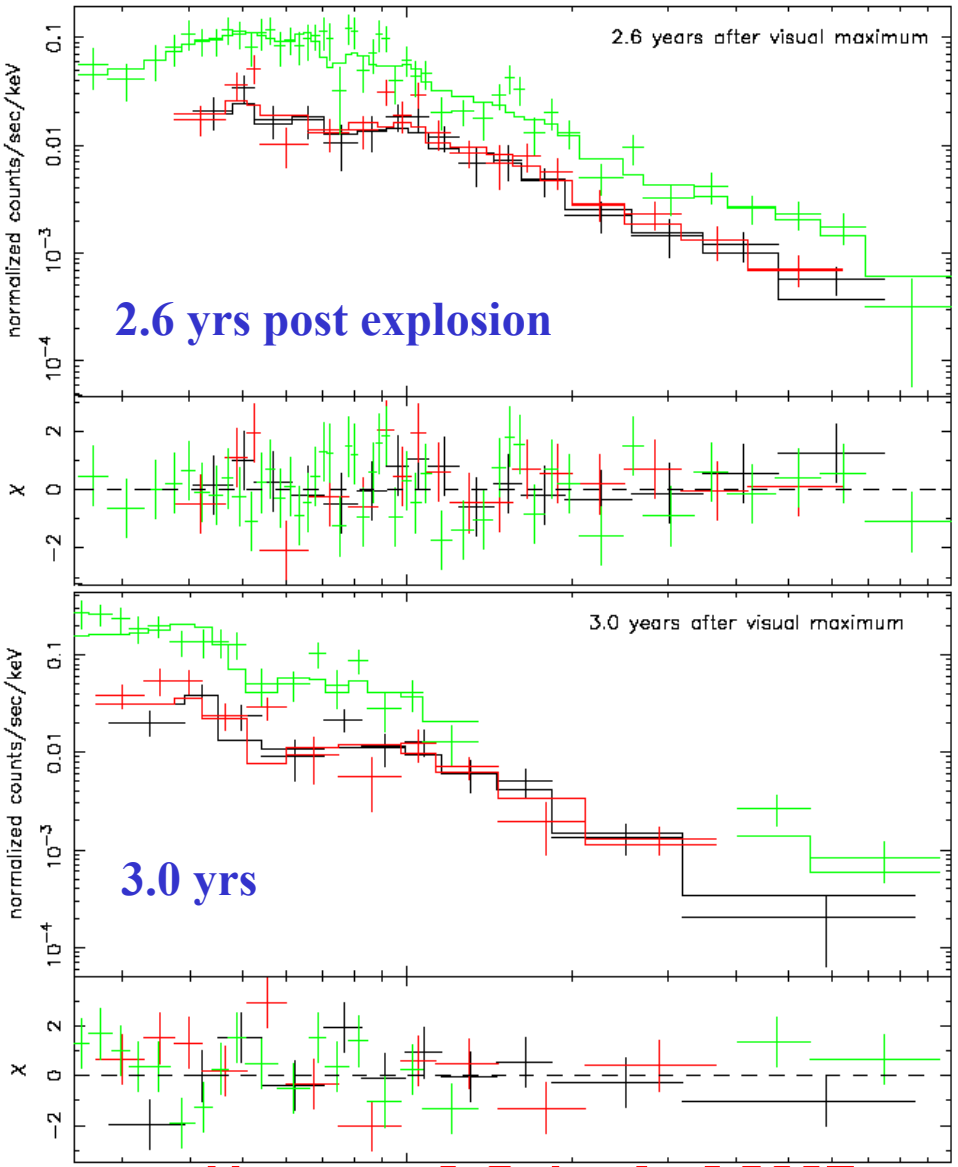
- Results of our monitoring campaign of X-ray emission from "young" post-outburst novae with XMM-Newton
- Aim (*original*): study *turn-off of H-nuclear burning* on top of accreting WDs after tey explode as classical novae
- Additional interest : *reestablishment of accretion* – properties of the *cataclysmic variable* hosting the exploding WD

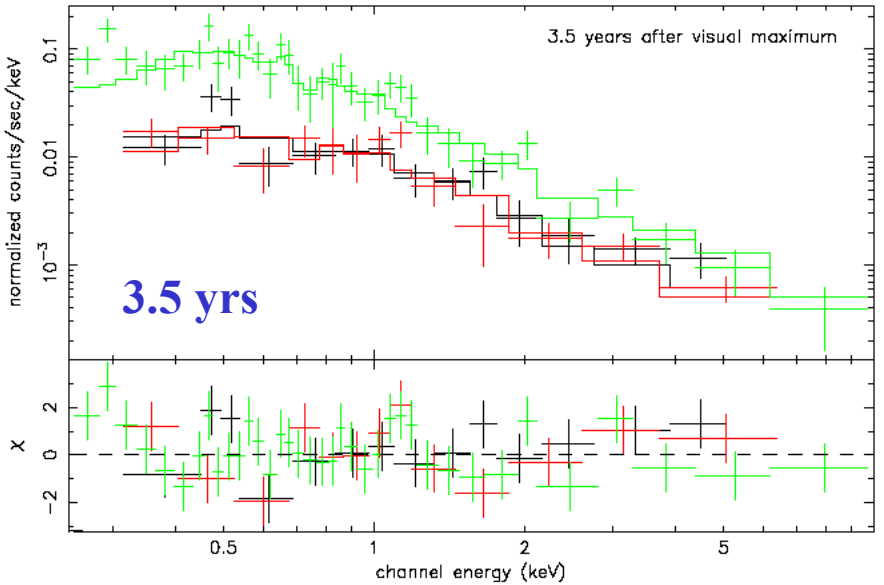
XMM-Newton - AO1 Cycle

Target	Discovery date	Date of observation – Time after outburst	Detection
N Sco 1997 V1141 Sco	June 5	Oct. 11, 2000 – 1224d, 3.4yr Mar. 24, 2001 – 1388d, 3.8yr Sep. 7, 2001 – 1555d, 4.3yr	NO
N Sgr 1998 V4633 Sgr	March 22	Oct. 11, 2000 – 934d, 2.6yr Mar. 9, 2001 – 1083d, 3.0yr Sep. 7, 2001 – 1265d, 3.5yr	YES *see details*
N Oph 1998 V2487 Oph	June 15	Feb. 25, 2001 – 986d, 2.7 yr Sep. 5, 2001 – 1178d, 3.2 yr Feb. 2002 – 1352d, 3.7yr Sept. 24, 2002 – 1559d, 4.3yr	YES *see details*
N Sco 1998 V1142 Sco	October 21	Oct. 11, 2000 – 721 d, 2.0 yr Mar. 24, 2001 – 885 d, 2.4 yr Sep. 7, 2001 – 1052 d, 2.9 yr	*2.6±0.3* *2.2±0.4* *1.2±0.2* *(10^{-2} cts/s)*
N Mus 1998 LZ Mus	December 29	Dec. 28, 2000 – 730 d, 2.0 yr Jun. 26, 2001 – 910 d, 2.5 yr Dec. 26, 2001 – 1093 d 3.0 yr	NO?

No supersoft X-ray emission related to residual H-burning detected → novae had already turned-off

Nova Sgr 1998 – V4633 Sgr





Thermal plasma only, no BB

- T (keV): 0.1, 1, >(3-5)
- EM ($10^{55}cm^{-3}$):
  - 0.3-7 if nova ejecta abundances
  - 0.4-600 if solar ⟷ accretion ab.
- L_{unabs}(0.2-10)keV (erg/s):
  - $(2\text{-}8)\times10^{33}$/ $(2\text{-}32)\times10^{33}$ ejecta/accr.

Hernanz & Sala, ApJ 2007

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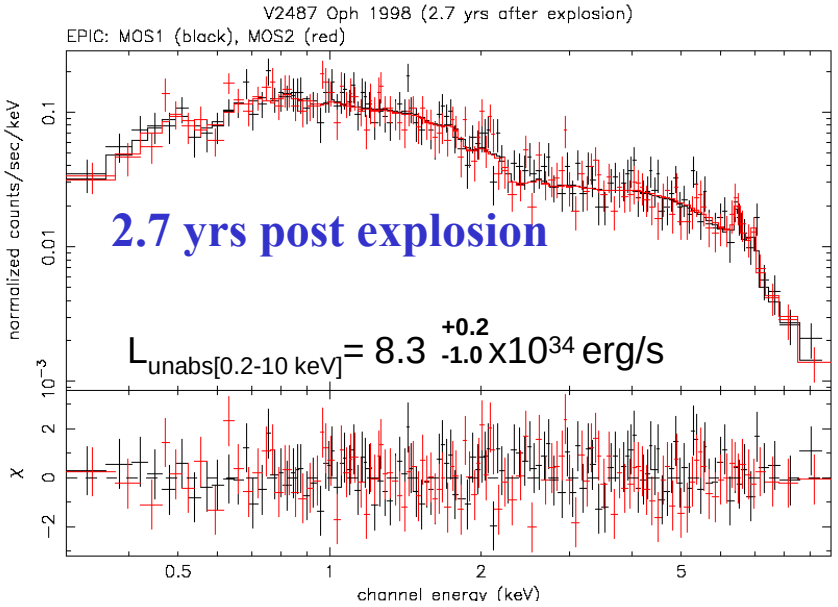
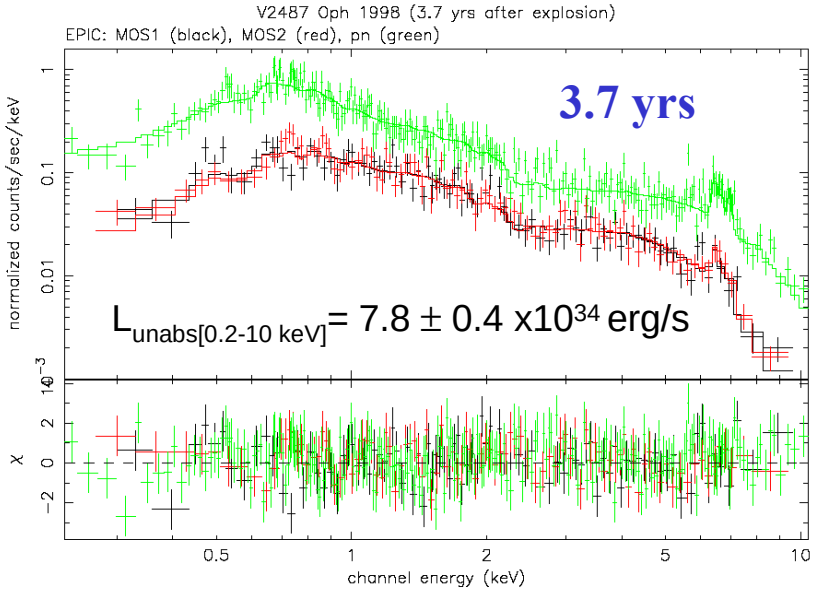
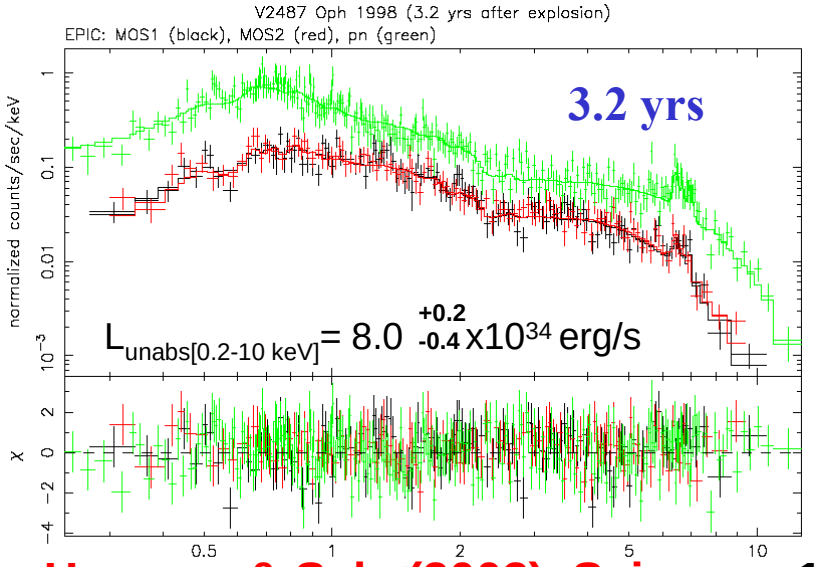
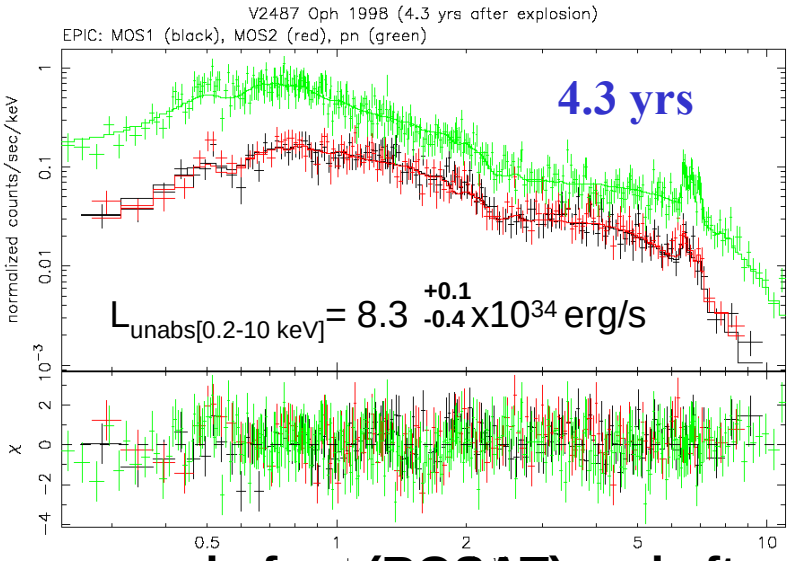




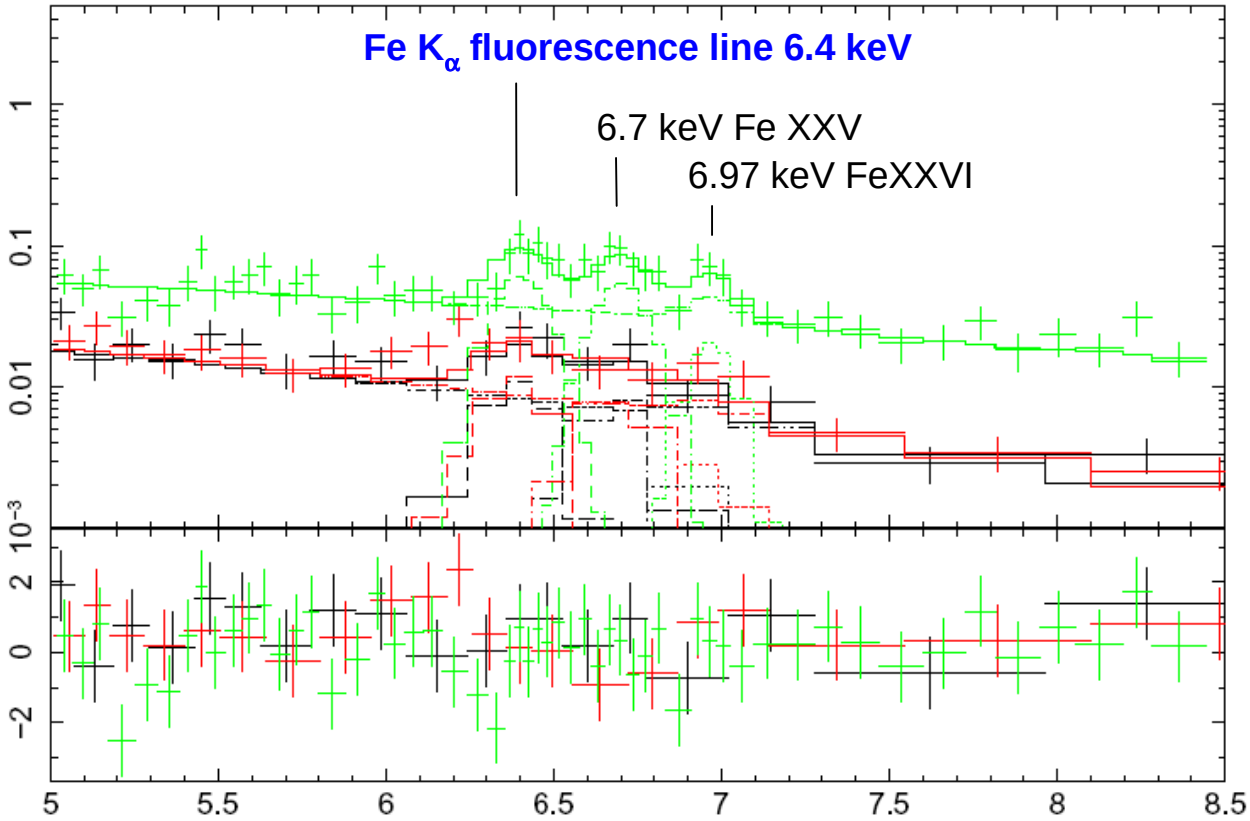




see Poster C1 (Ferri, Hernanz & Sala)

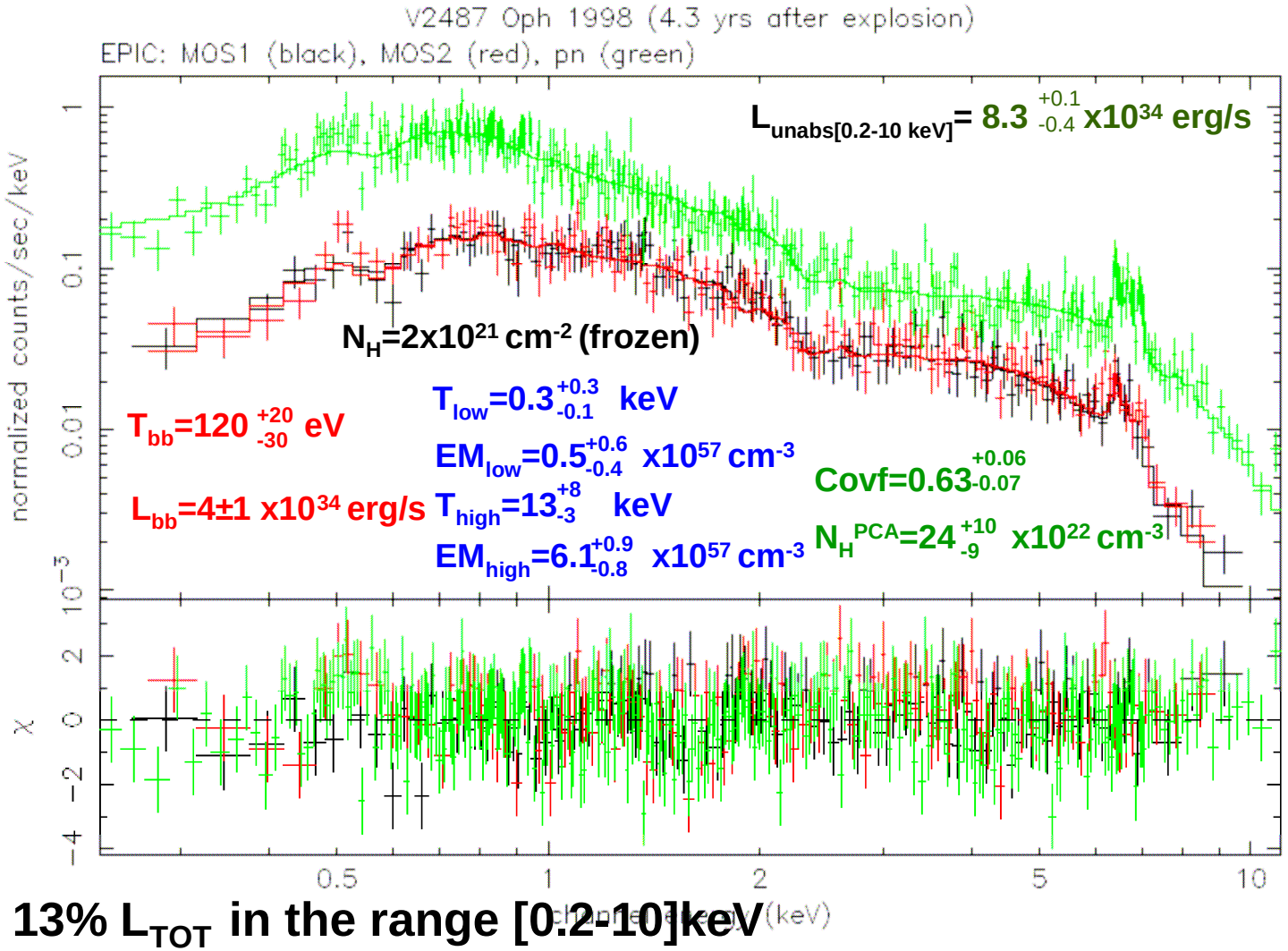
Hernanz & Sala (2002), Science : 1st nova seen before (ROSAT) and after its explosion in X-rays – Reestablishment of accretion in less than 3 years

Nova Oph 1998 – V2487 Oph



- BB+ Thermal plasma (2T) + Fe emission line complex
- Identification of three Fe emission lines: fluorescent K_α at ~6.4 keV
  He-like Fe @ 6.68 keV & H-like Fe at 6.97 keV
- If T_{high} ~ (10-20) keV, thermal lines well reproduced & only fluorescent line should be added – *Partial covering* absorption → T_{high} is low enough

Nova Oph 1998 – V2487 Oph



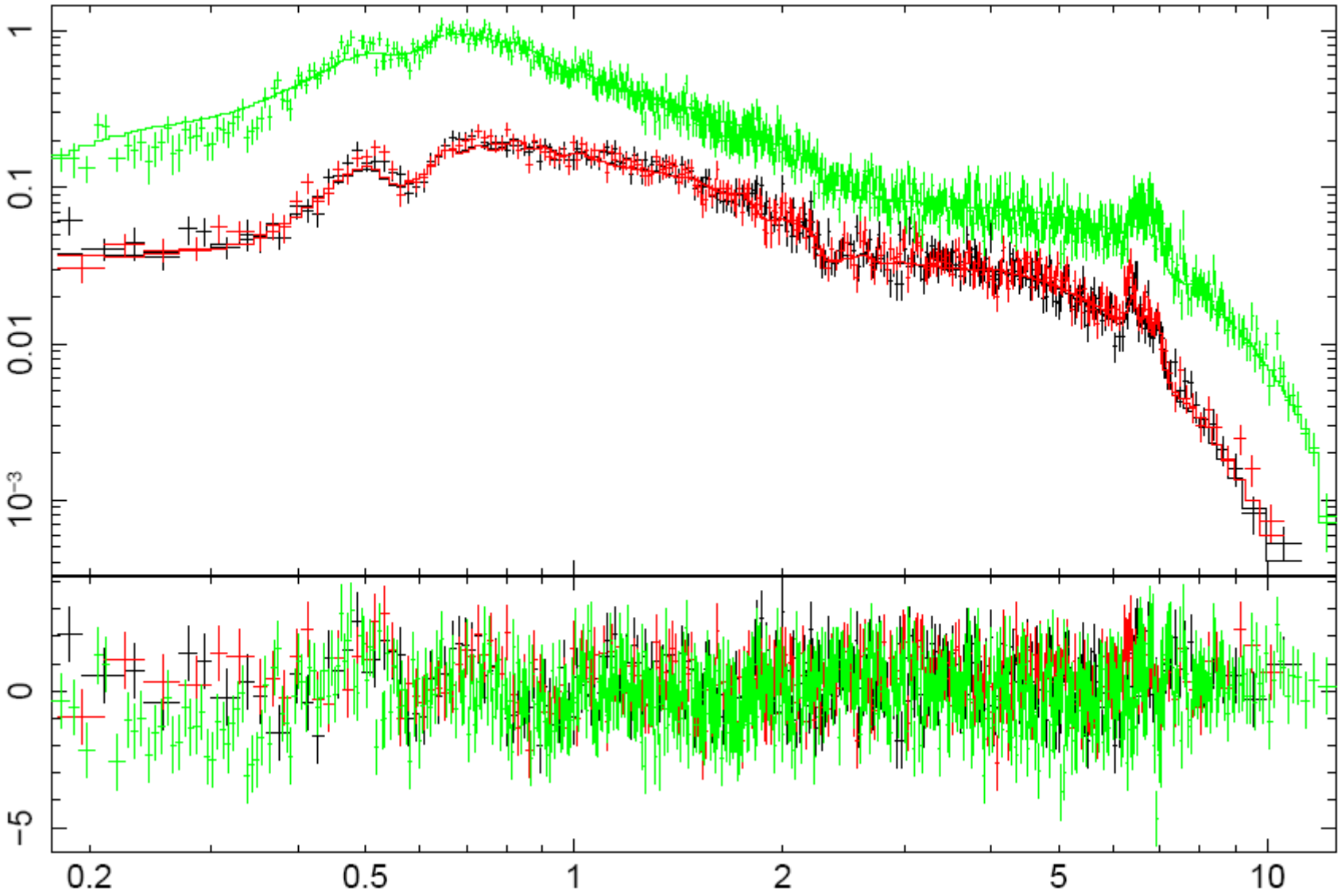
4.3 yrs post explosion

L_{BB} ~ 13% L_{TOT} in the range [0.2-10]keV

Fe K_α fluorescence line @ 6.4 keV; EW=200±100 eV - compatible with N_H(high)=(24 ±10) x10^{22} cm^{-2}

Intermediate polar?

N Oph 1998 - V2487 Oph, Mar. 24, 2007 – 8.8yr post outburst



XMM-Newton - AO1 Cycle -Summary

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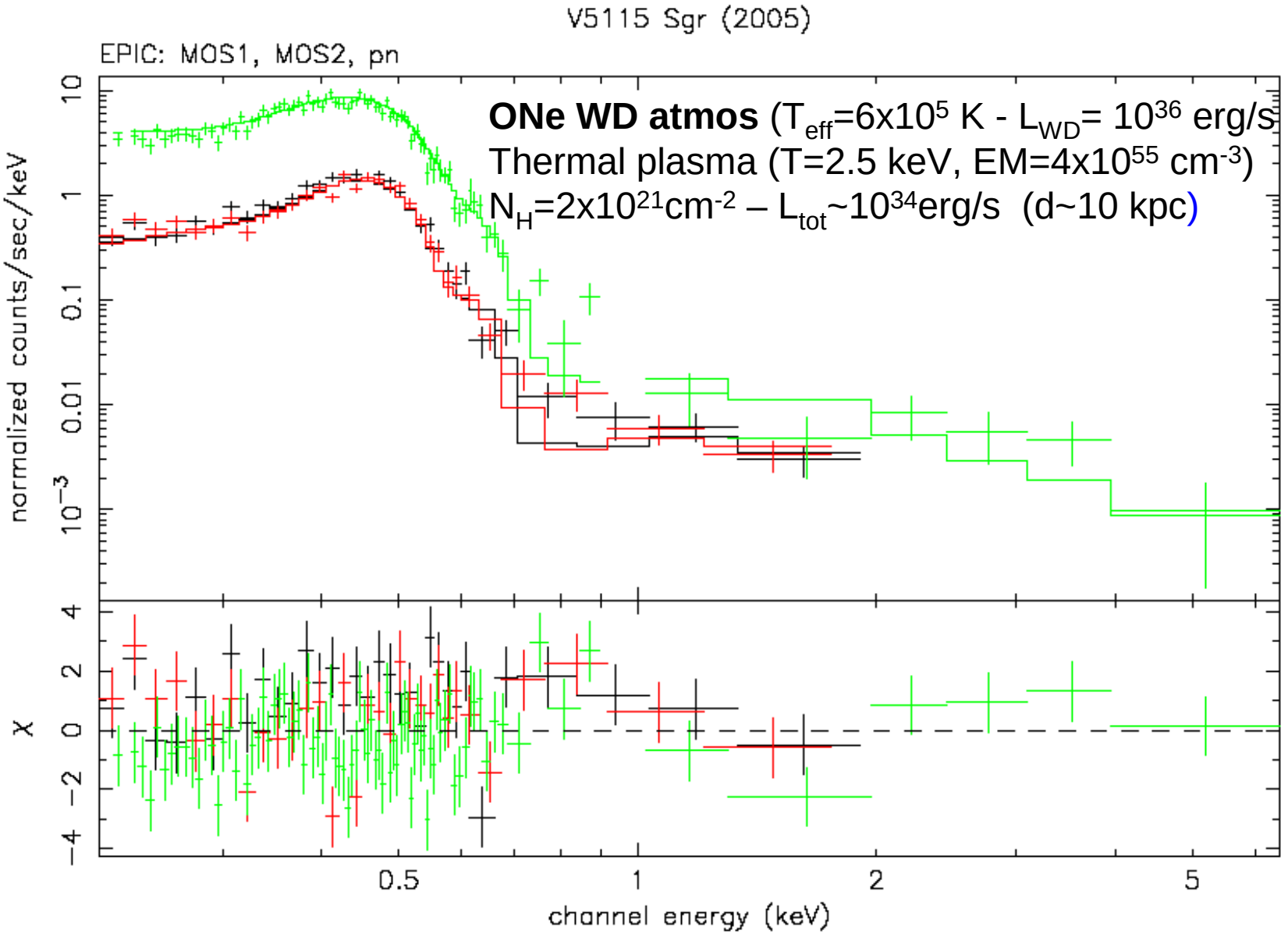
- *No supersoft X-ray emission related to residual H-burning detected*
  → *all novae had already turned-off*
- *3 out of 5 were emitting [thermal plasma + BB] spectrum → ejecta/accretion*

Target	Discovery date	Date of observation – Time after outburst	Detection
N Oph 1998 V2487 Oph	June 15	Mar. 24, 2007 – 8.8yr *AO6 long exposure*	YES *see details*
N Cyg 2005 V2361 Cyg	February 10	May 13, 2006 - 15mo – bkg October 20, 2006 - 20months *AO5*	-- YES *marginal:* $(4.0\pm0.8)\times10^{-3}$ cts/s
N Sgr 2005a V5115 Sgr	March 28	Sep. 27, 2006 – 18months *AO5*	YES *supersoft source*
N Sgr 2005b V5116 Sgr	July 4	March 20, 2007 – 20 months *AO5*	YES *supersoft source*
N Cyg 2006 V2362 Cyg	April 2	May 5, 2007 – 13 months affected by bkg *AO6*	YES *see details*
N Oph 2006a V2575 Oph	February 9	Sep. 4, 2007 – 19 months *AO6*	NO
N Oph 2006b V2576 Oph	April 6	Oct. 3, 2007 – 18months *AO6*	NO

Supersoft X-ray emission related to residual H-burning found in 2 novae from 2005 (V5115 Sgr & V5116 Sgr) → novae had not turned-off yet

Nova Sgr 2005 a – V5115 Sgr



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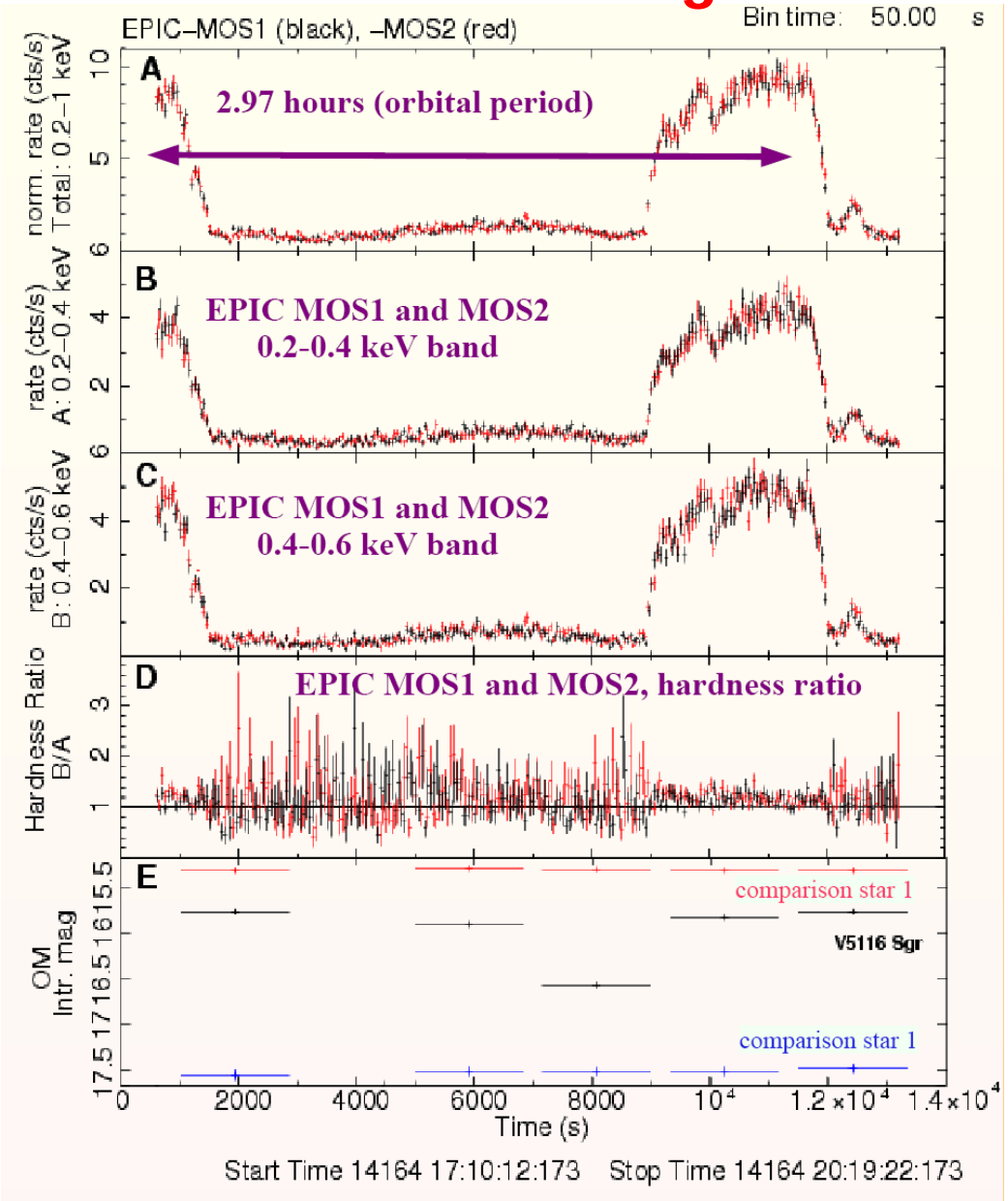
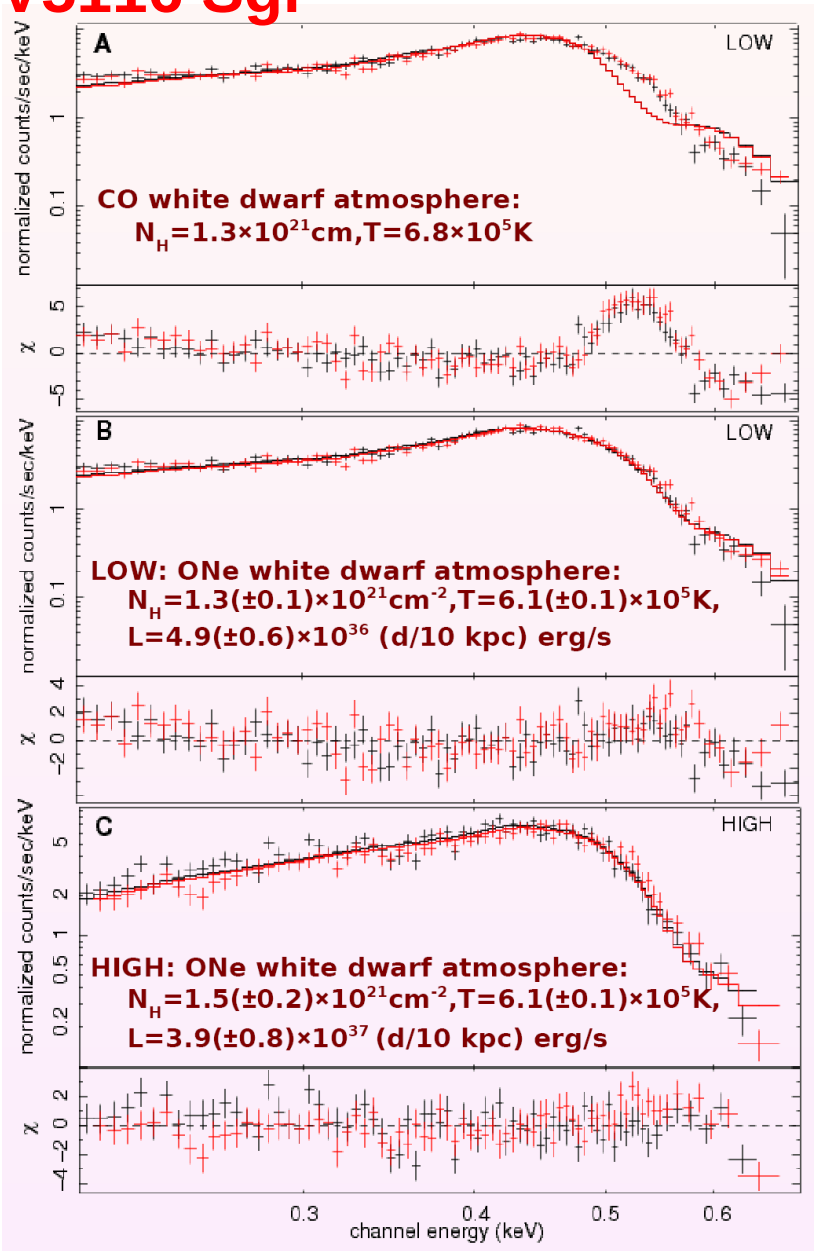
Nova Sgr 2005 b – V5116 Sgr





partial eclipse by an asymmetric disk? Sala, Hernanz, Ferri & Greiner, ApJL 2008

→ see poster C4

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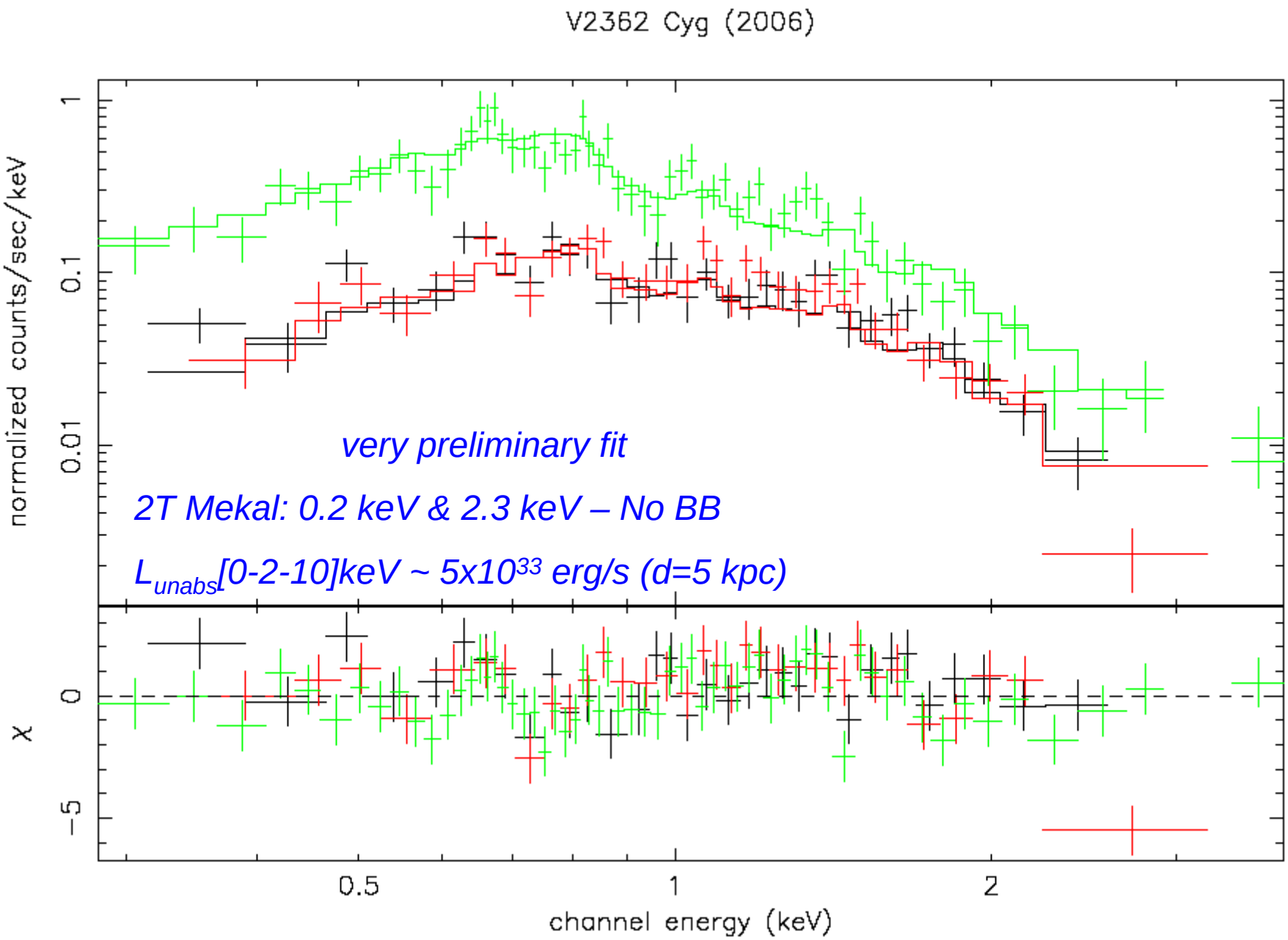

Hernanz, Ferri & Sala - ATel # 1226

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Supersoft X-ray emission related to residual H-burning found in 2 novae from 2005 (V5115 Sgr & V5116 Sgr)→ novae had not turned-off yet

SUMMARY

- 11 novae have been observed between 3 months and 5 years after outburst (9 years)
- 4 non detected and 2 detected marginally
- Only 2, V5115 Sgr 2005a and V51116 Sgr 2005b, were still bright in supersoft X-rays, revealing remaining H-nuclear burning – one of them with a puzzling temporal behavior
- V2487 Oph 1998, clearly shows recovery of accretion in a magnetic CV (most probably an intermediate polar)
- V4633 Sgr 1998 shows either hot ejecta or accretion (or both)
- V2362 Cyg 2006: mainly hard X-rays (ejecta or accretion)