Classical Nova Observations and Using Swift to uncover the true nature of the V723 Cas

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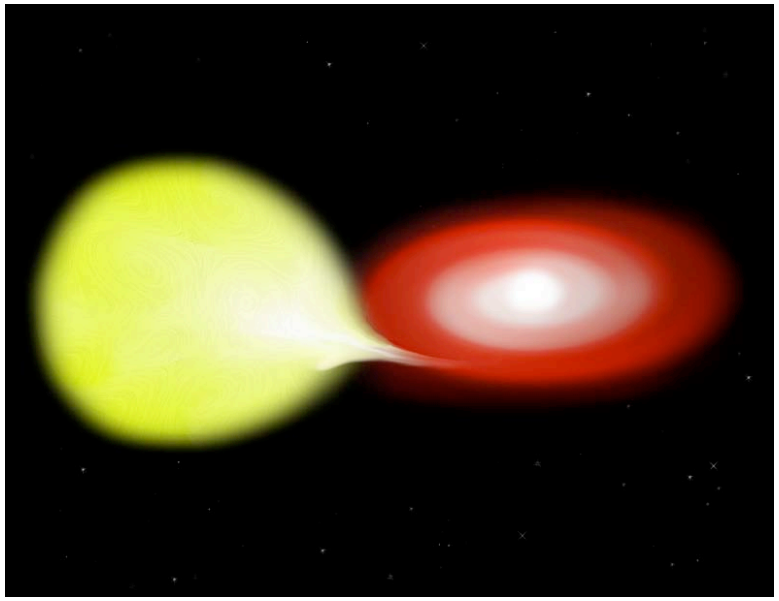
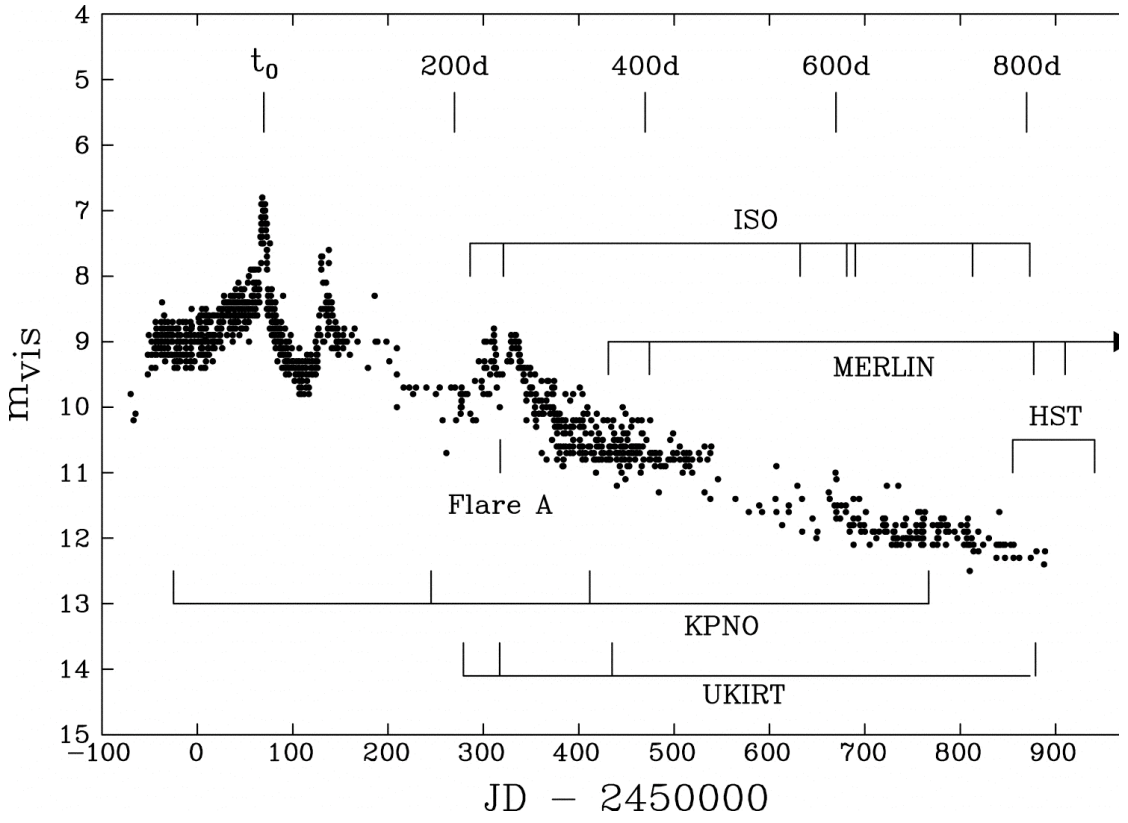
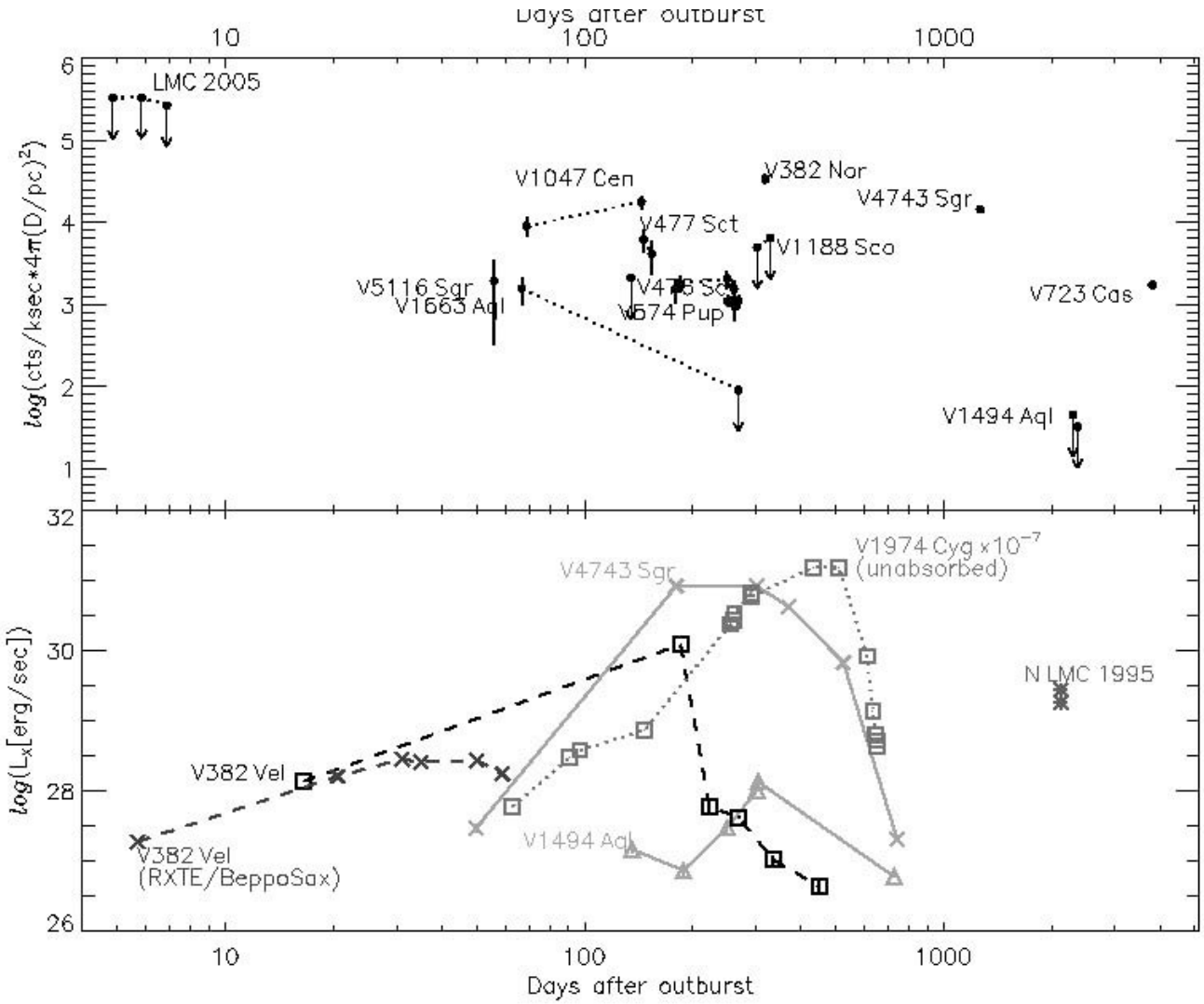
Swift Workshop @ Penn State (May 2, 2007)



Early visual light curve of V723 Cas (Evans et al. 2003, AJ, 126, 1981)

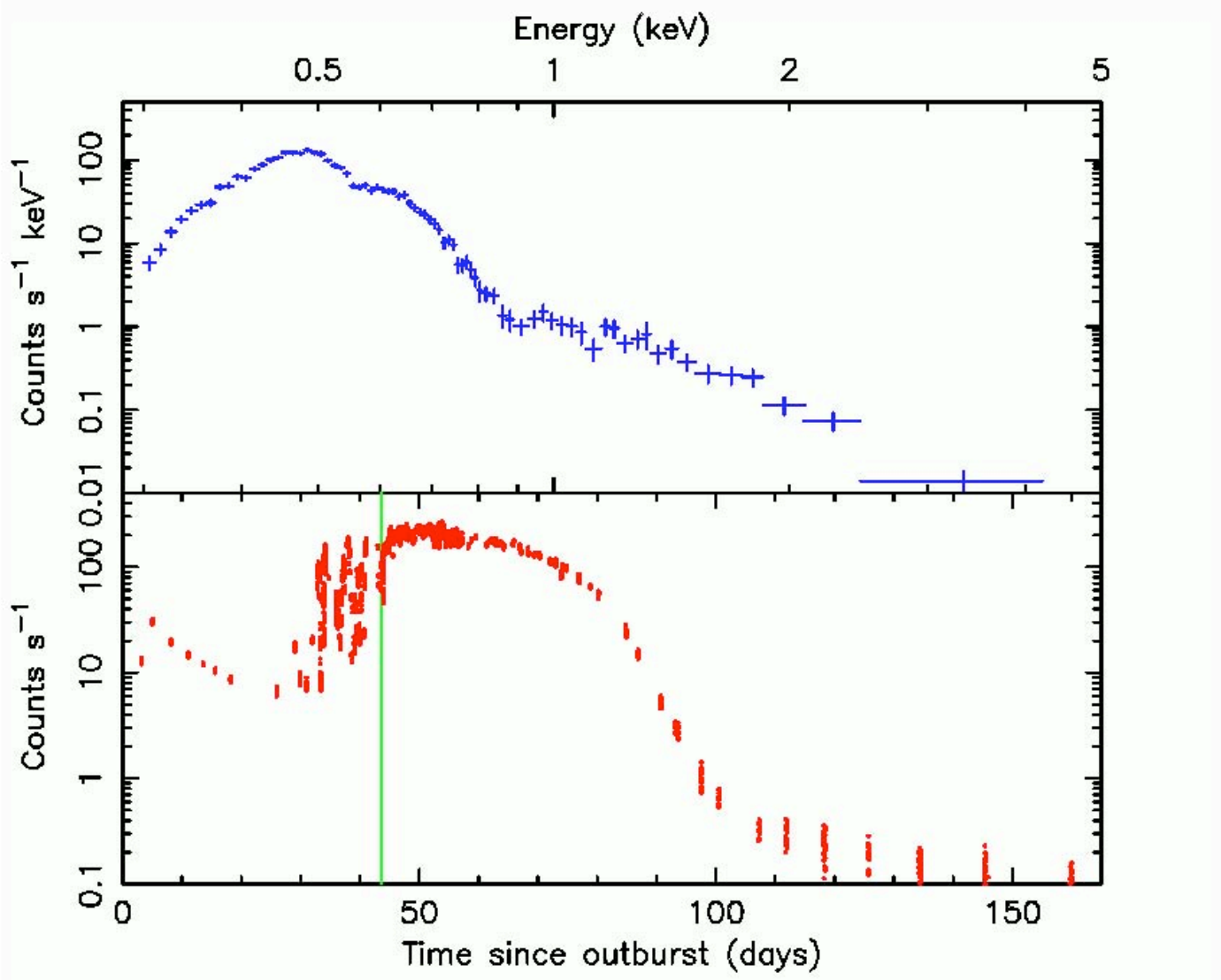


The X-ray light curves of Classical novae

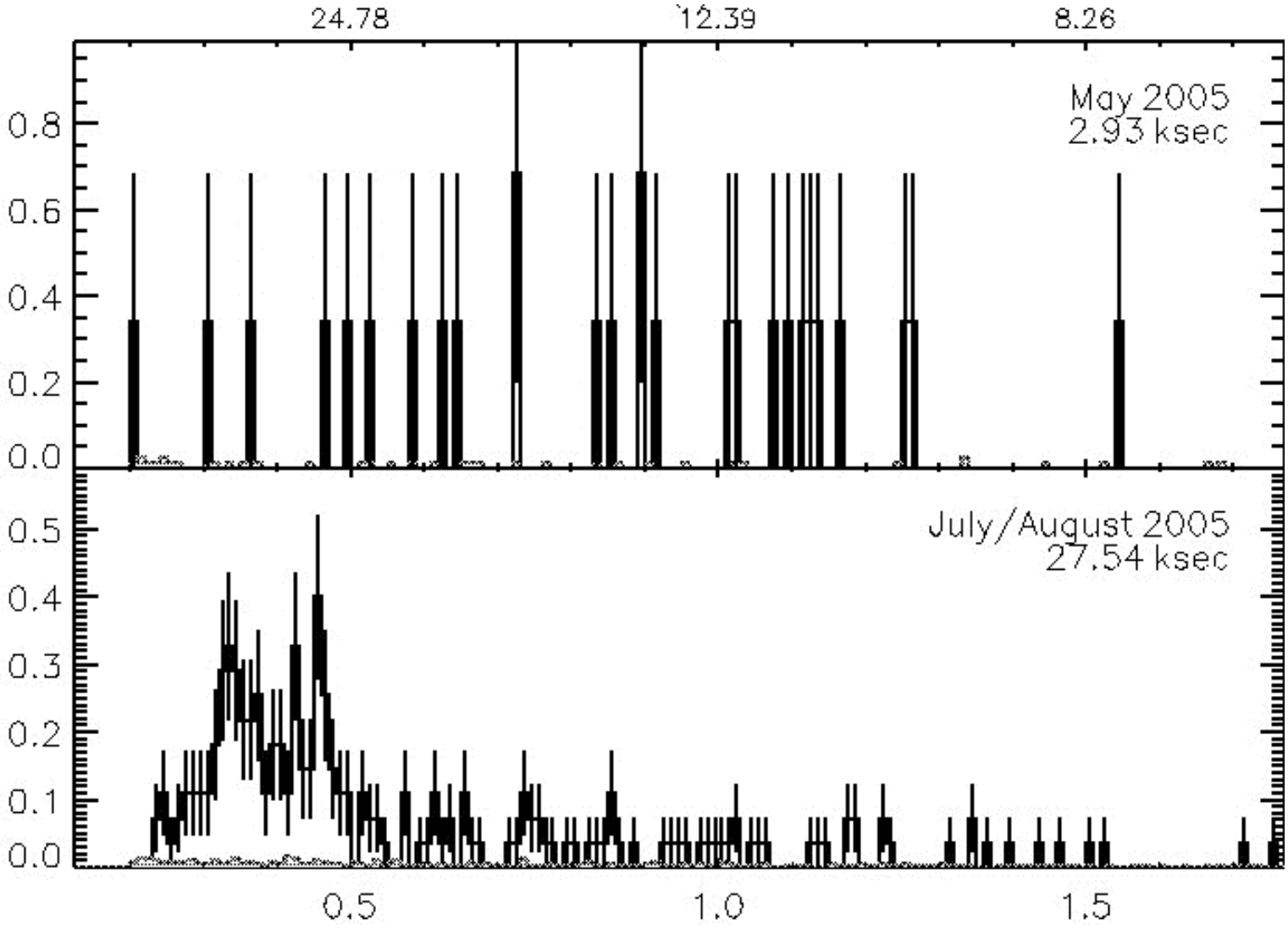


Ness et al. ApJ in Press (astrop-ph/07032886)

RS Oph XRT light curve evolution



Evolution of the X-ray spectrum of V574 Pup



V2362 Cyg

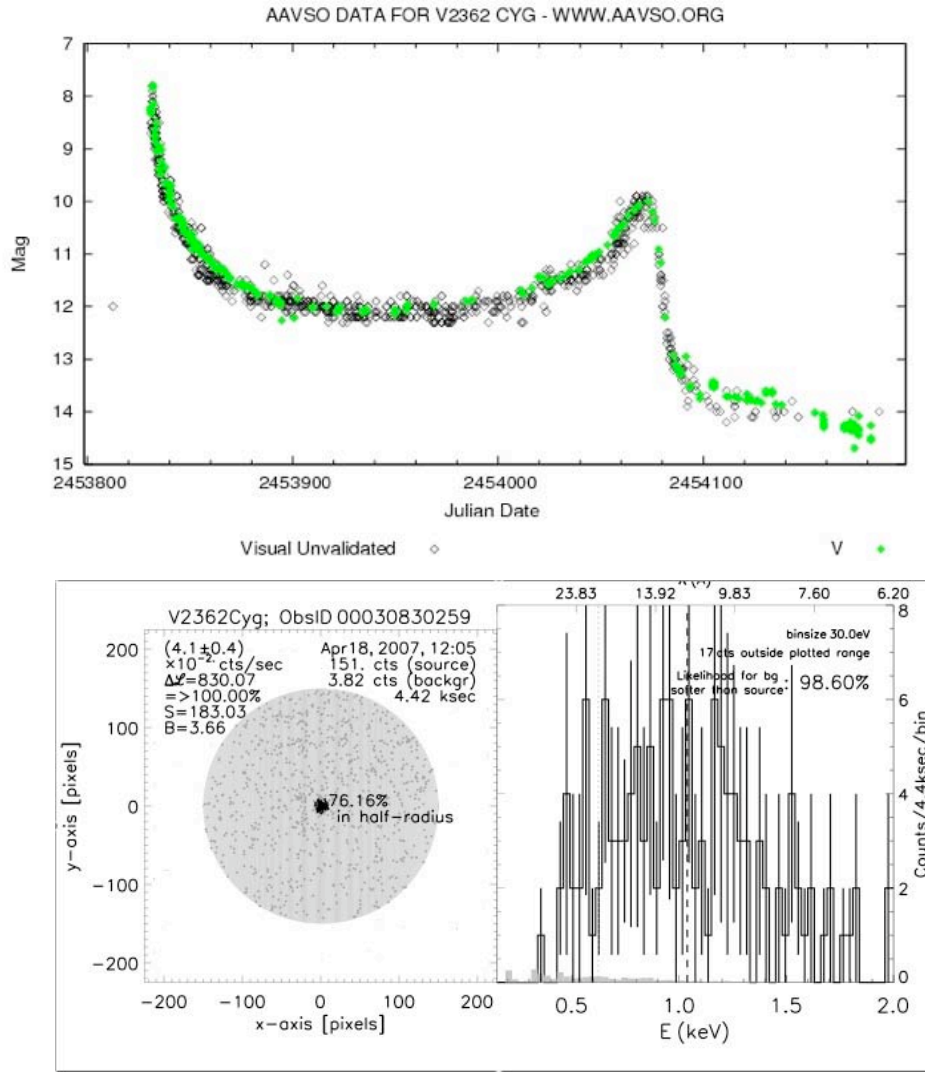
Strange light curve of with a strong secondary peak ~200 days after maximum.

Four observations starting on the secondary rise and recently continuing

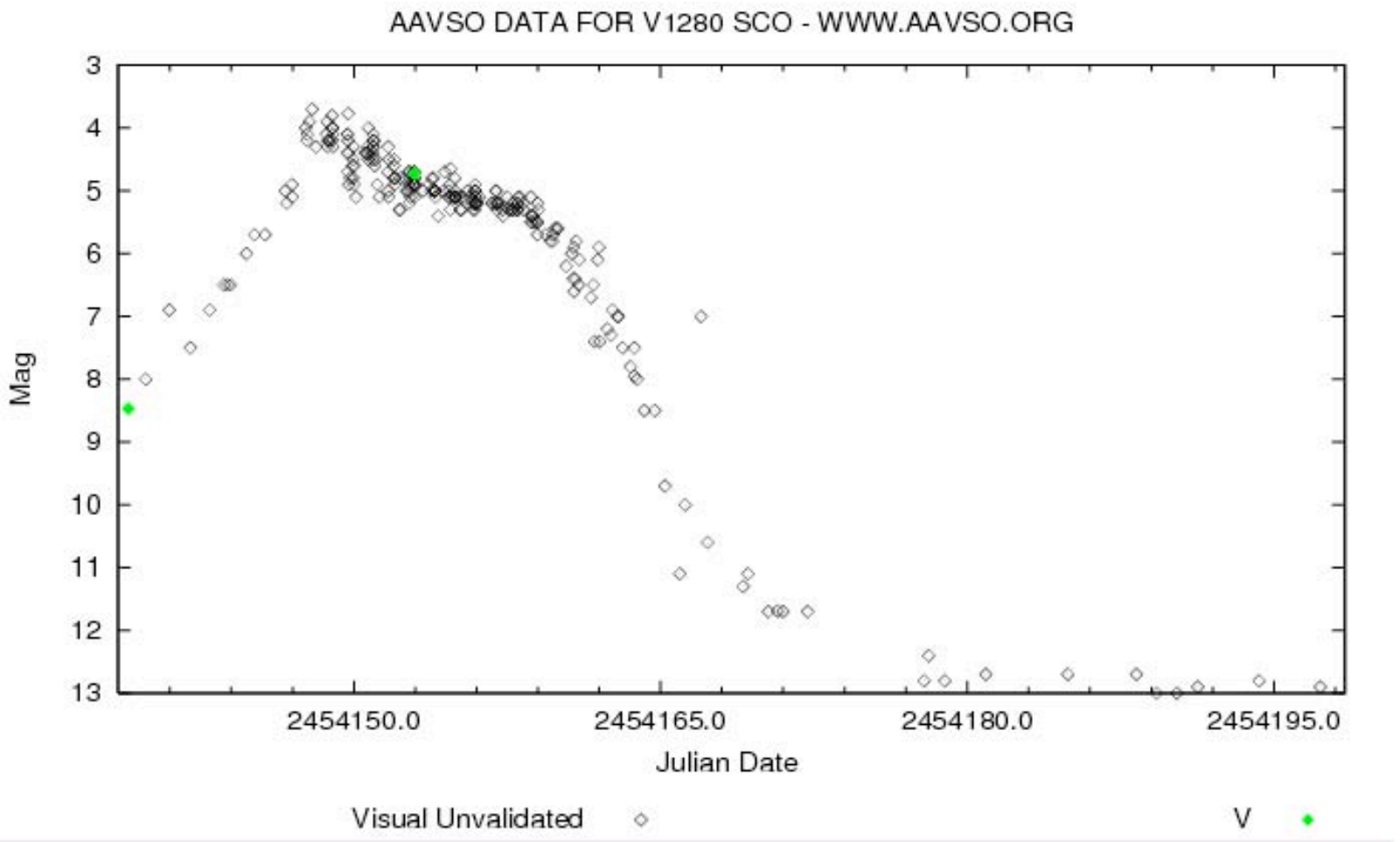
10/14/06 (0.7 +/- 0.2) * 1e-2 ct/s
11/21/06 (1.1 +/- 0.2) * 1e-2 ct/s
12/20/06 (2.1 +/- 0.3) * 1e-2 ct/s
04/18/07 (4.1 +/- 0.4) * 1e-2 ct/s

Getting brighter and softer!

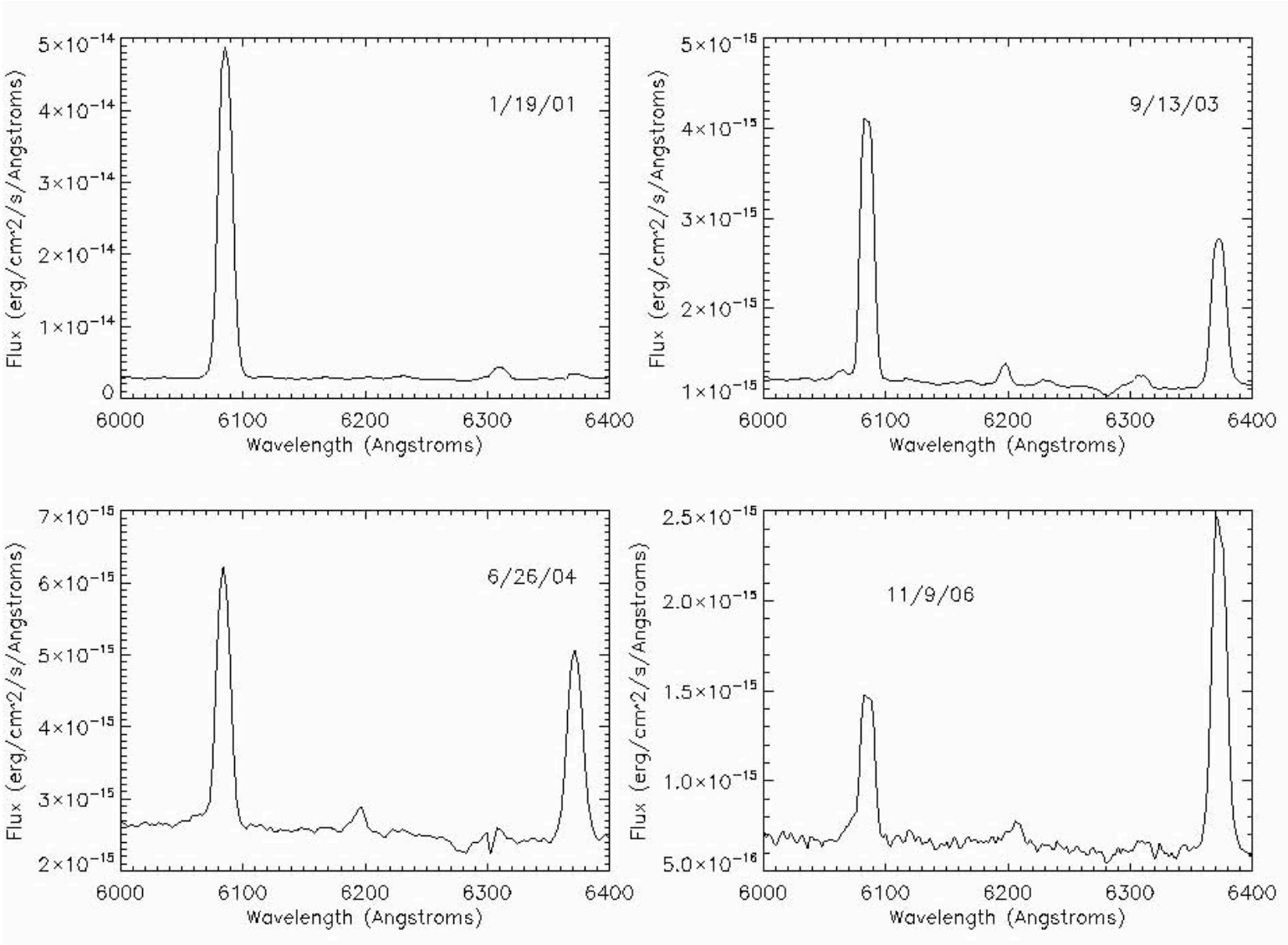
Part of a multiwavelength campaign



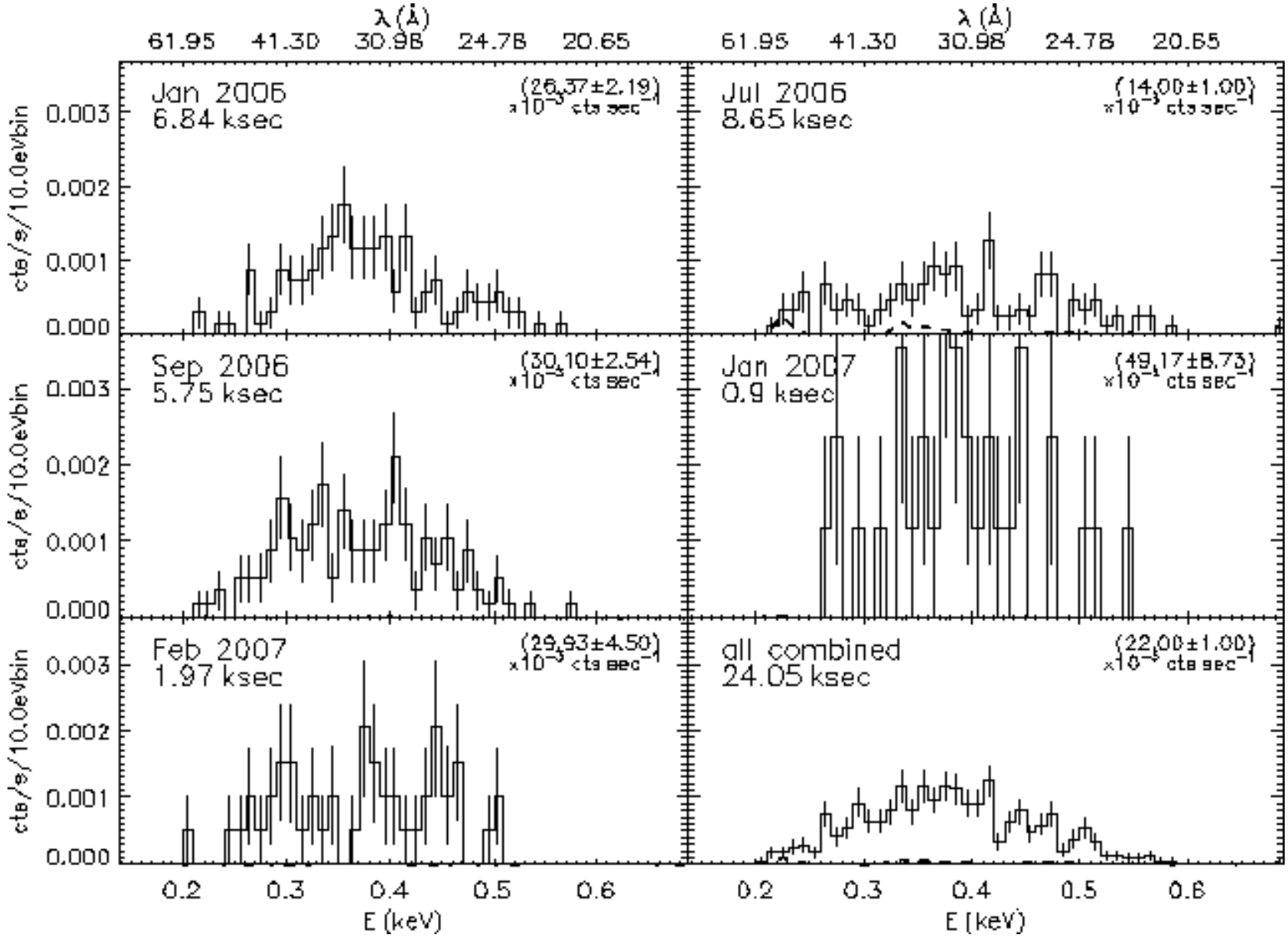
V1280 Sco (large dust formation event)



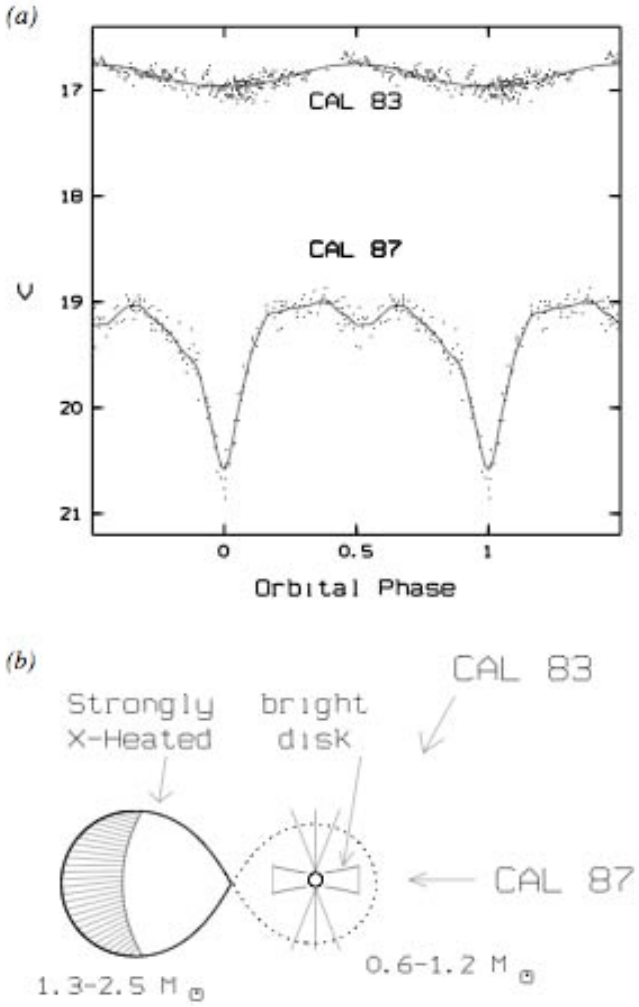
Evolution of the [Fe VII] (6087) and [Fe X] (6375) line emission in V723 Cas



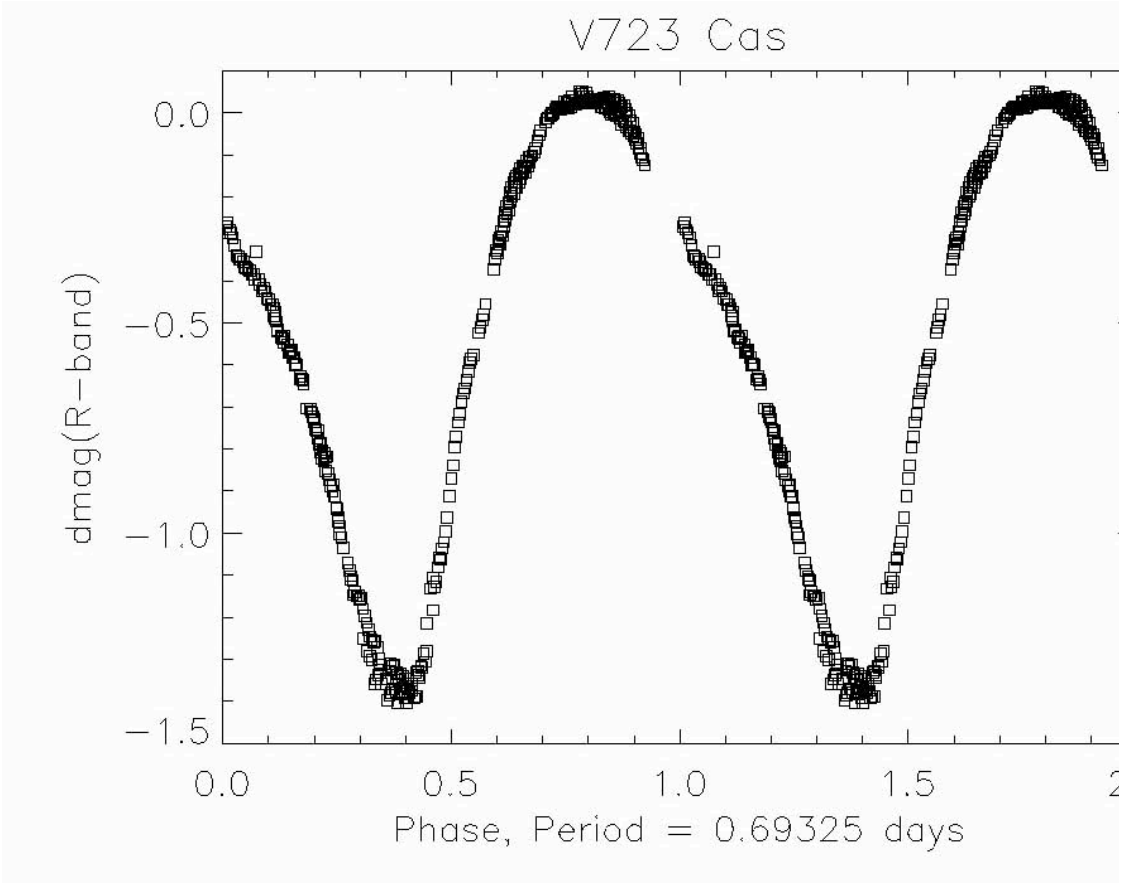
Swift XRT spectra of 5 ToO visits



A close binary SSS?



Kahabka & van den Heuvel 1997, ARA&A, 35, 69

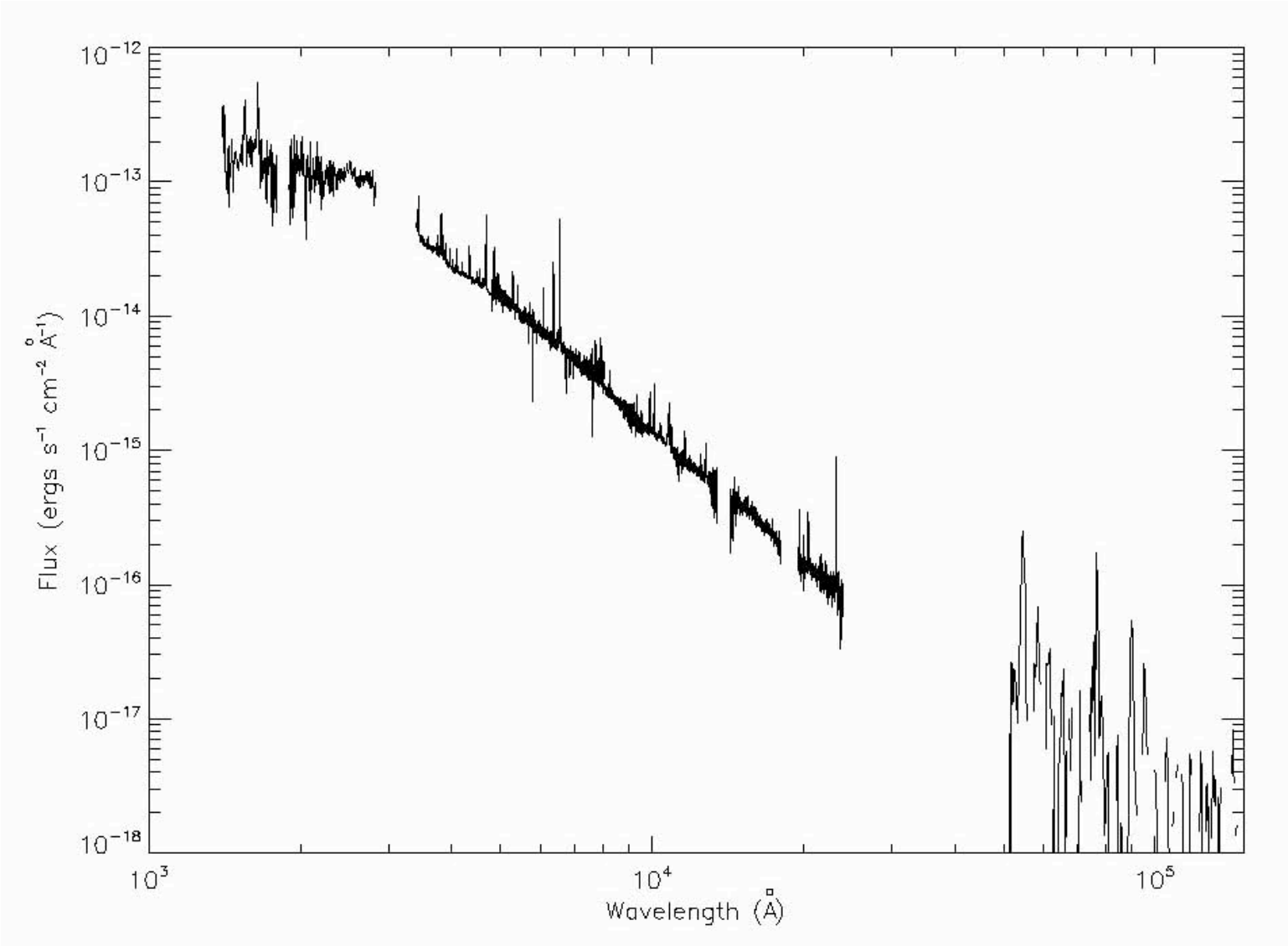


R band photometry (10/16-19/2006) of V723 Cas

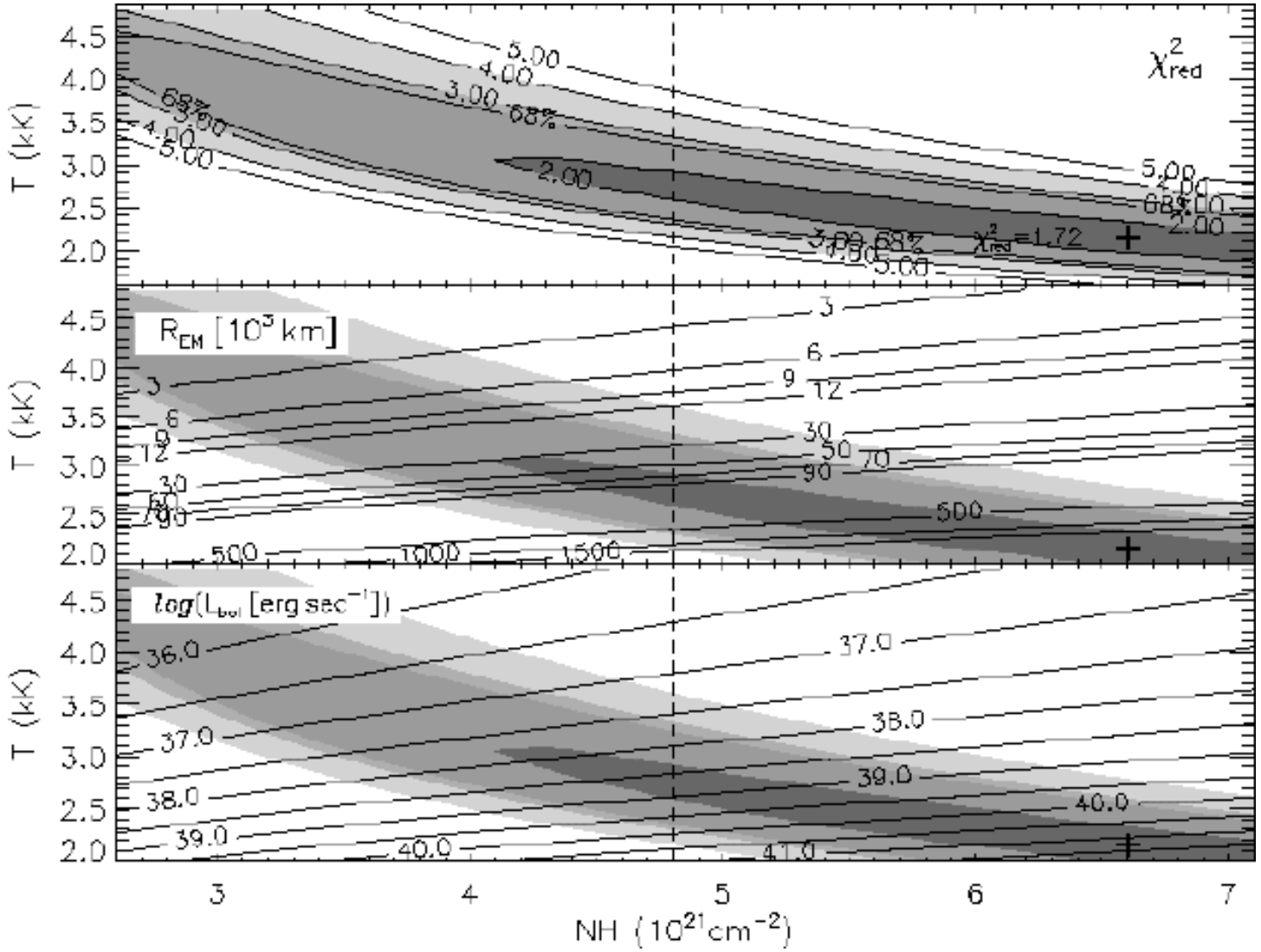
Conclusions

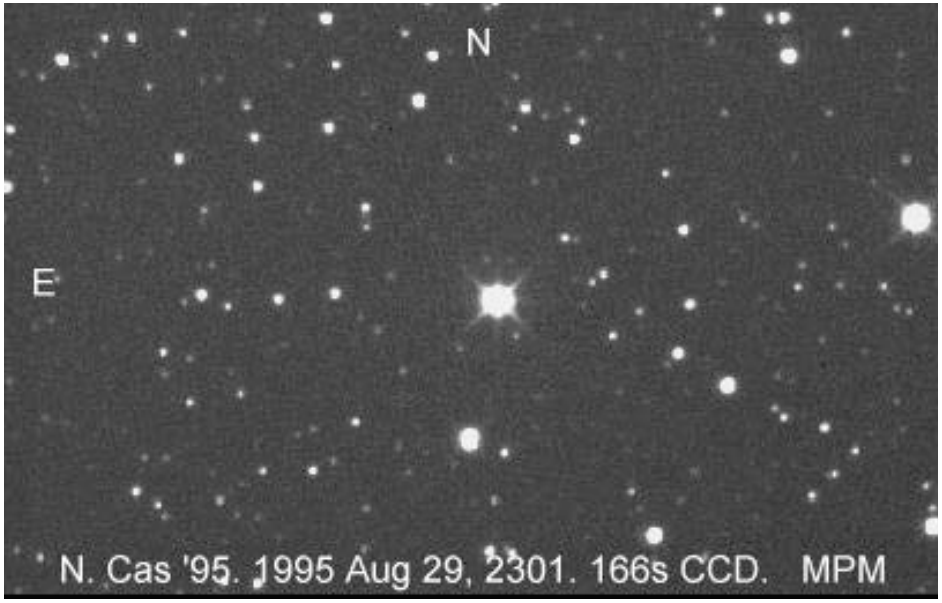
- The X-ray regime is crucial for the observational coverage of classical novae because many phenomena are only observable at these wavelengths
- Currently, the X-ray picture is far from complete and systematic. Only few galactic novae have been observed in X-rays
- Classical novae are excellent Swift ToO and fill-in sources as their X-ray evolution is relatively slow and doesn’t affect Swift's primary GRB mission
- Swift monitoring also provides valuable exposure information for grating observations with Chandra or XMM of bright sources.
- Simultaneous information from the UVOT is also useful and not easily obtained elsewhere given the demise of STIS and the large FOV on Galex.

V723 Cas UV (GALEX) – Mid-IR (Spitzer) Spectral Energy Distribution

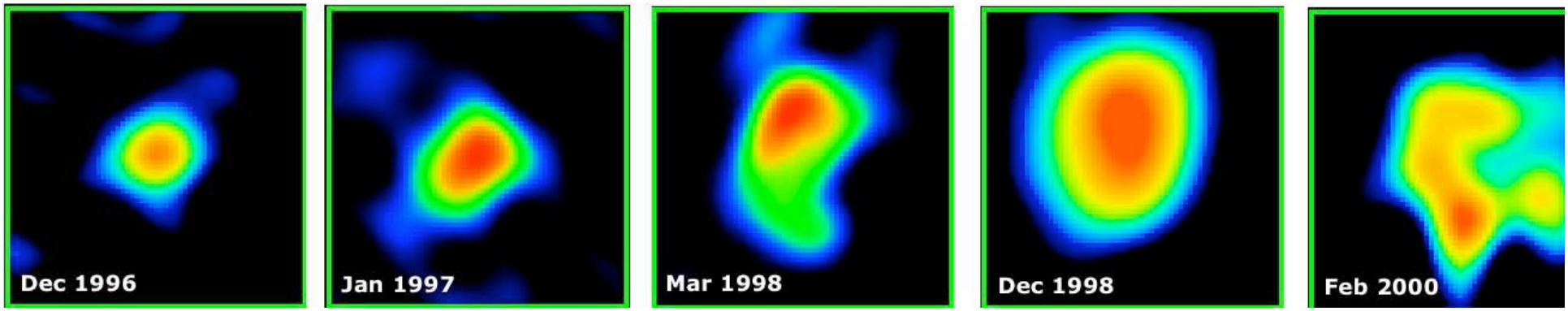


Model fits to combined Swift XRT spectrum





Early V723 Cas CCD image



MERLIN of the ejecta of V723 Cas

X-ray observations of Classical novae: The undiscovered country

Two major phases:

- Early low luminosity, hard spectrum from shocks within the expanding ejecta
- Later high luminosity, soft spectrum (SSS phase) from nuclear burning on the WD surface

Problems:

- Very few X-ray observations of CN and even fewer with extensive observations over all phases
- Unpredictable nature makes proposing/scheduling difficult

So what type of SSS is V723 Cas?

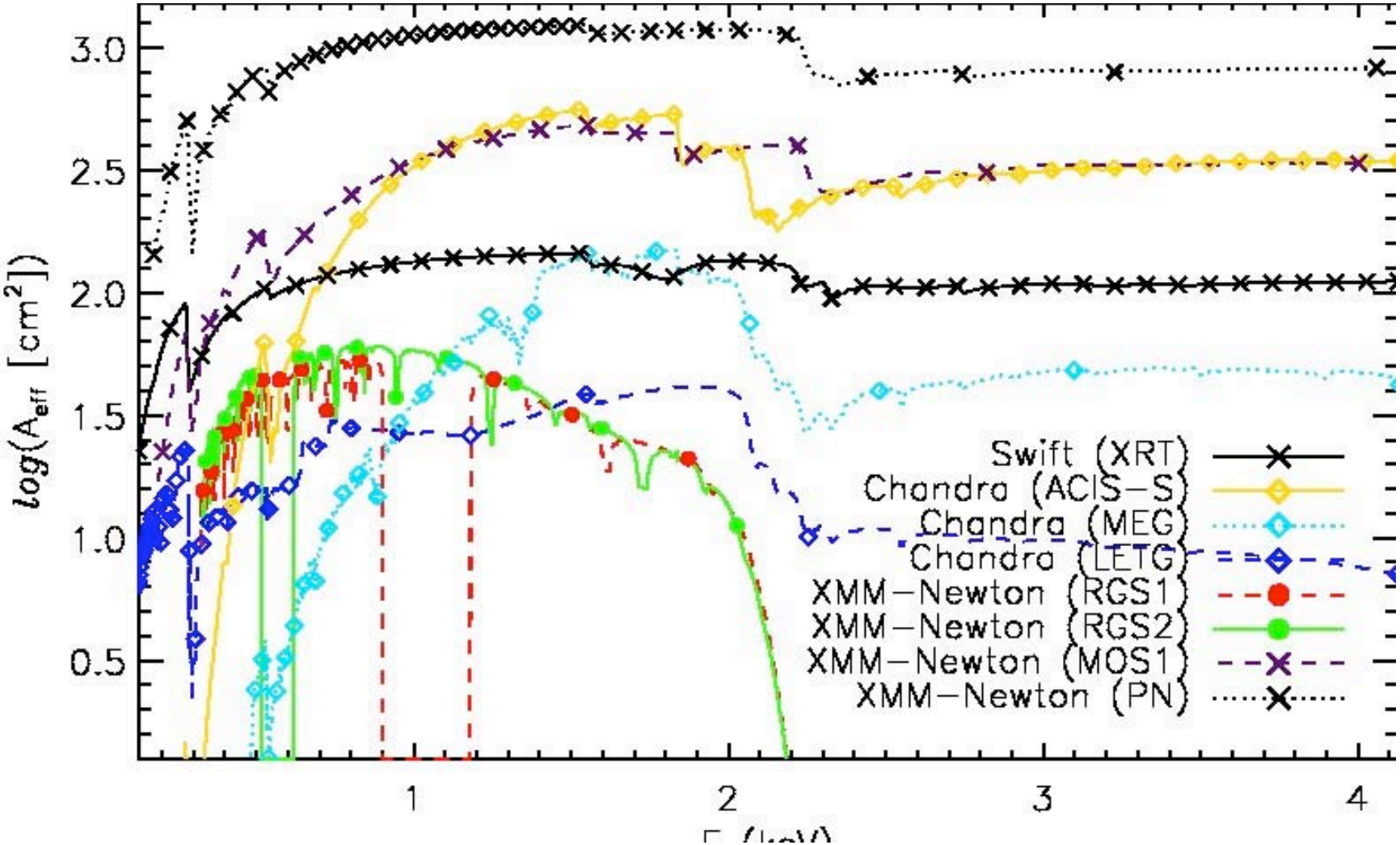
A CV SSS?

- All classical novae believed to go through a SSS phase with a duration related to WD mass
- SSS phase ends when nuclear fuel on WD is gone. System returns to “normal”
- V723 Cas is now the longest galactic novae to be observed in the SSS phase

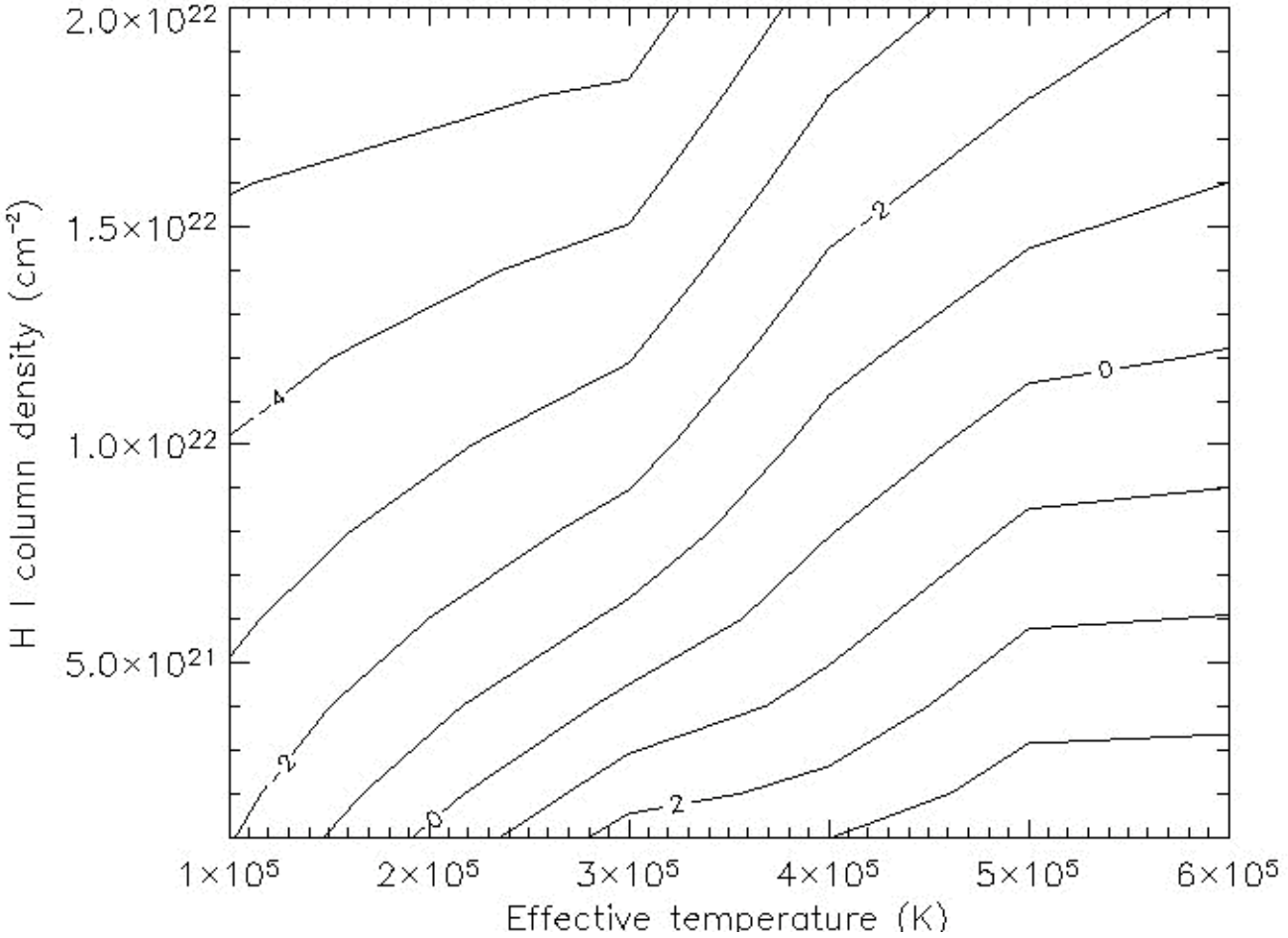
A close binary SSS?

- Secondary star is a subgiant, more massive than the WD
- Accretion great enough to produce steady nuclear burning, a permanent SSS!
- WD mass can build toward the Chandrasekhar limit and therefore SN Ia candidates

Comparison of effective areas of active X-ray instruments



Predicted Swift XRT counts for a 1ks observation of a classical novae in the Super Soft Source phase at 1 kpc



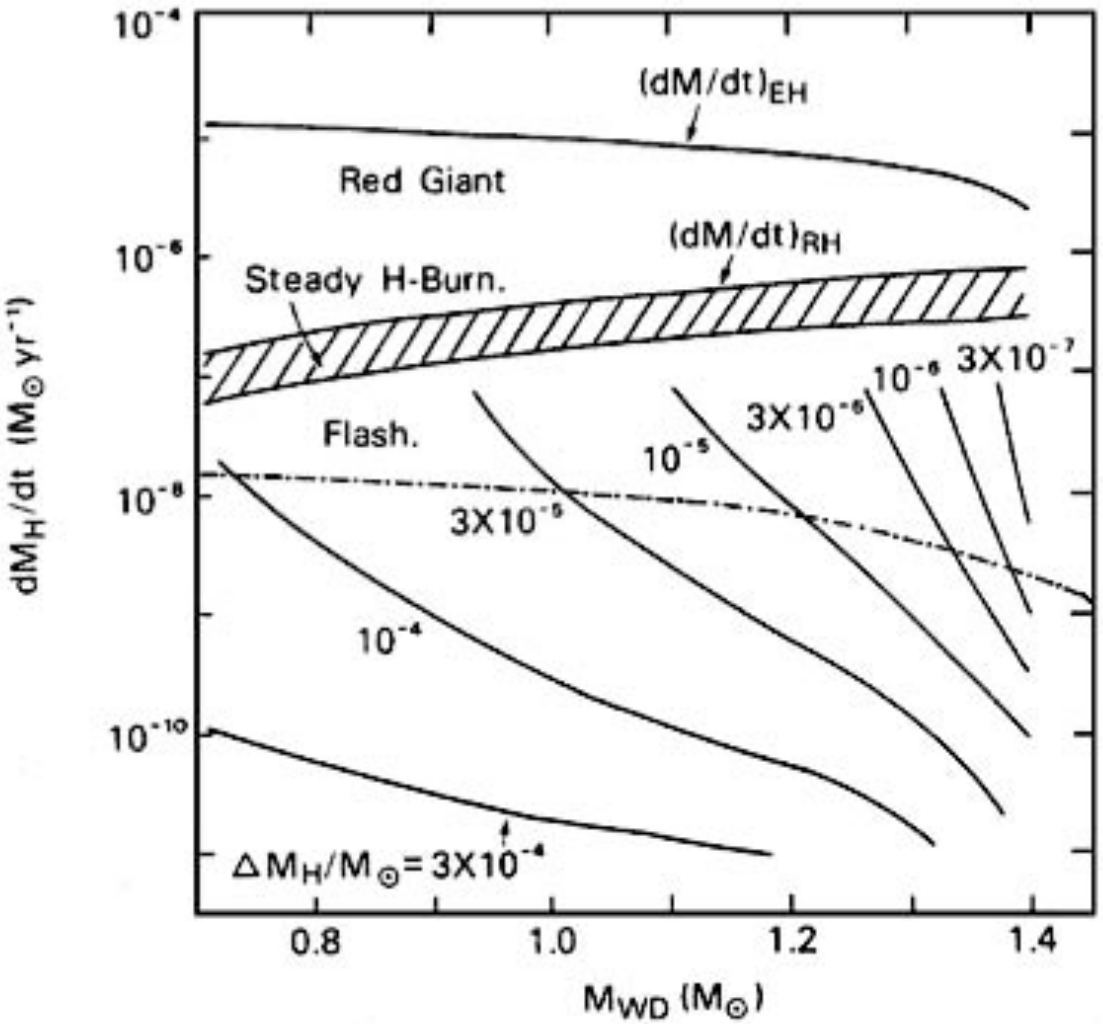


Figure 5 Regimes of steady nuclear burning, weak flashes (cyclic burning), and strong flashes (novae) in the $\dot{M}$–M_{WD} plane (cf Fujimoto 1982a,b, Nomoto 1982, DiStefano & Rappaport 1995). The ΔM_H values indicate envelope masses (for a given accretion rate) at which burning is ignited. Below the *dash-dot line*, flashes produce nova explosions.

Collaborators

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