MAXI J0158-744:

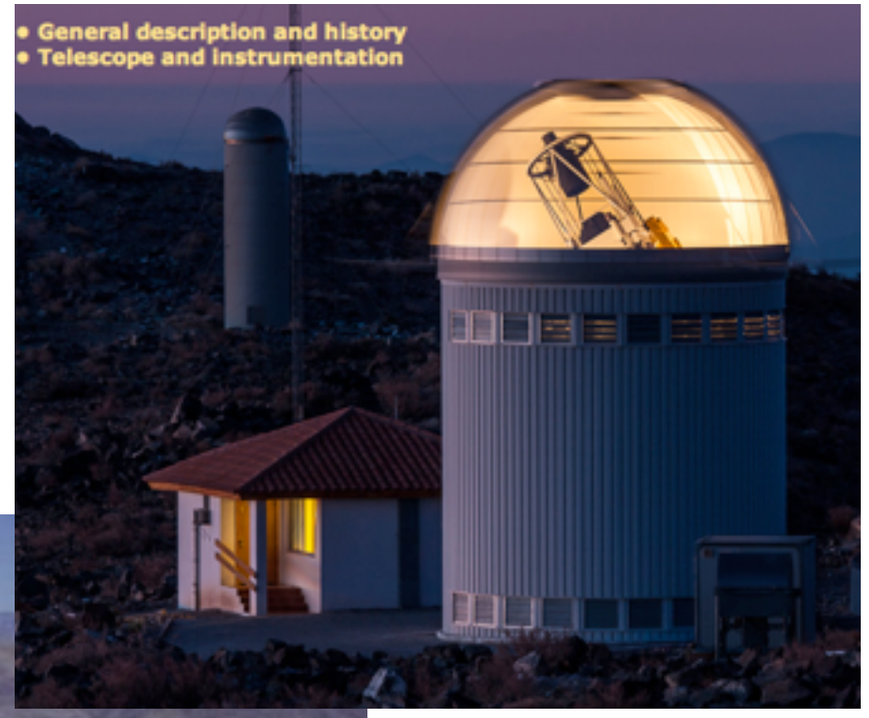
a luminous SSS in the Magellanic Bridge

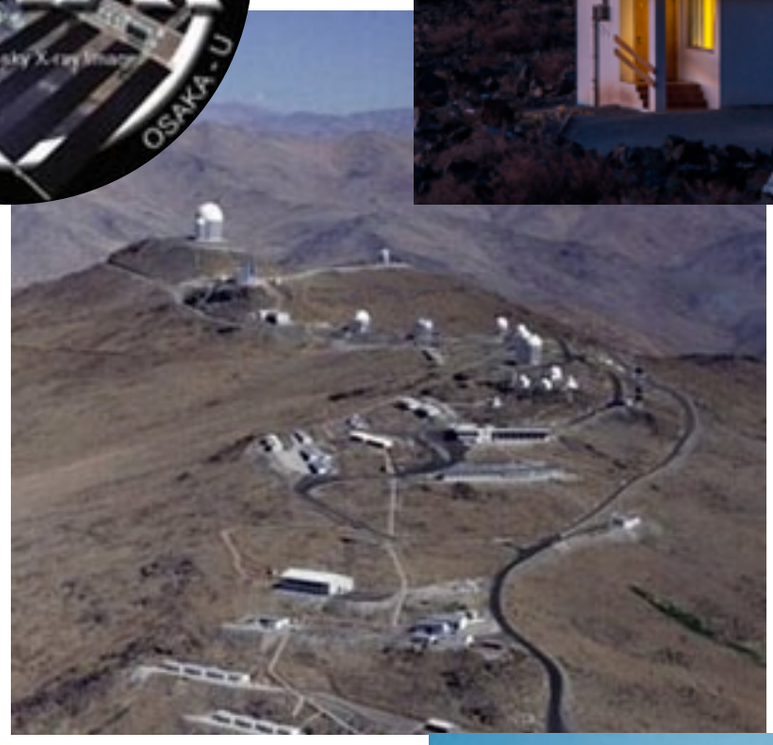
Vanessa McBride

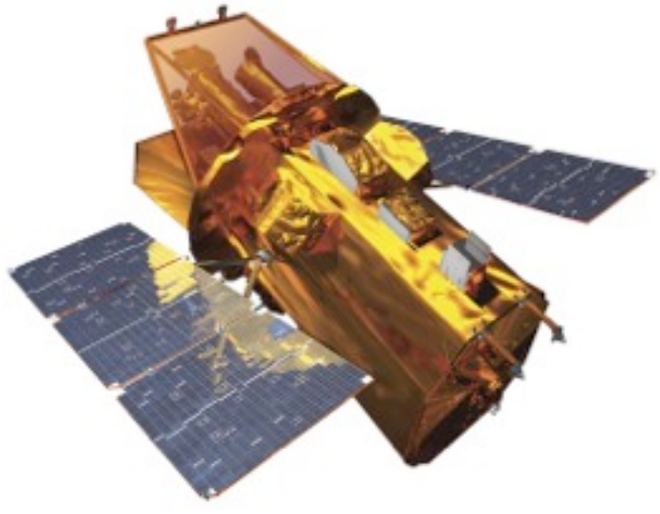
Li et al. 2012, ApJ 761, 99

Overview

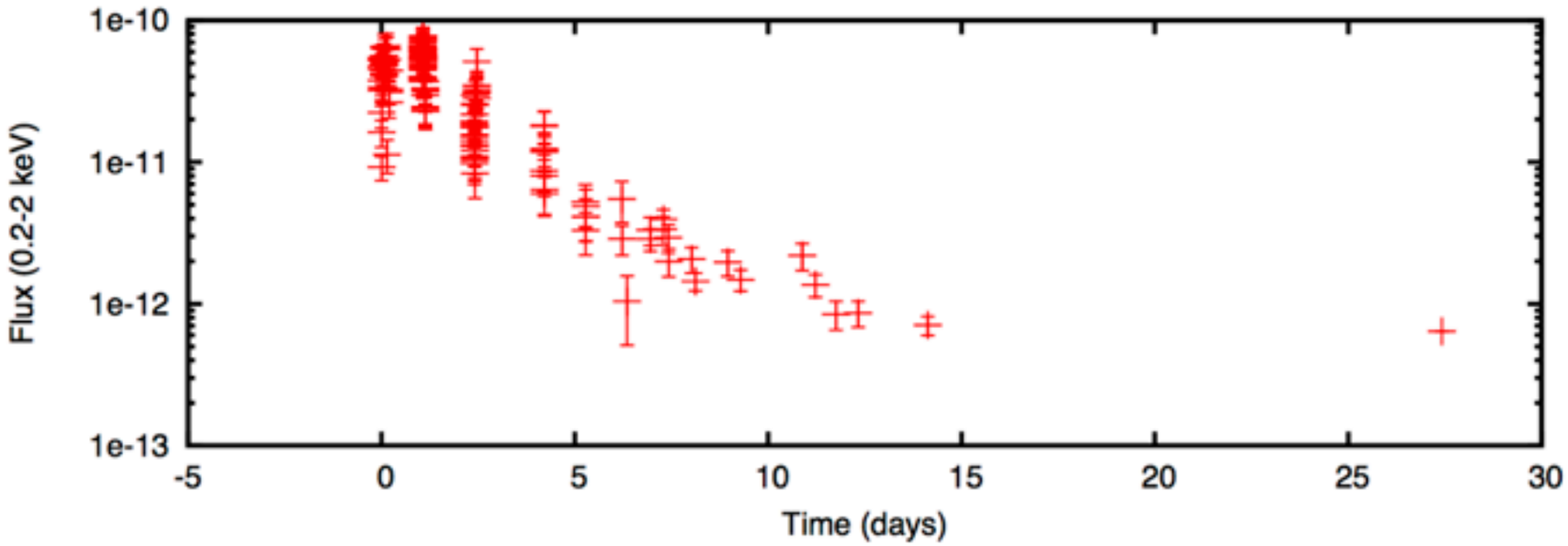
- Hard X-ray flash (~1 hour)
- Softer X-ray decline over ~2 weeks
- Optical spectral evolution
- In the Magellanic Bridge
- Massive white dwarf
- Accreting from Be star

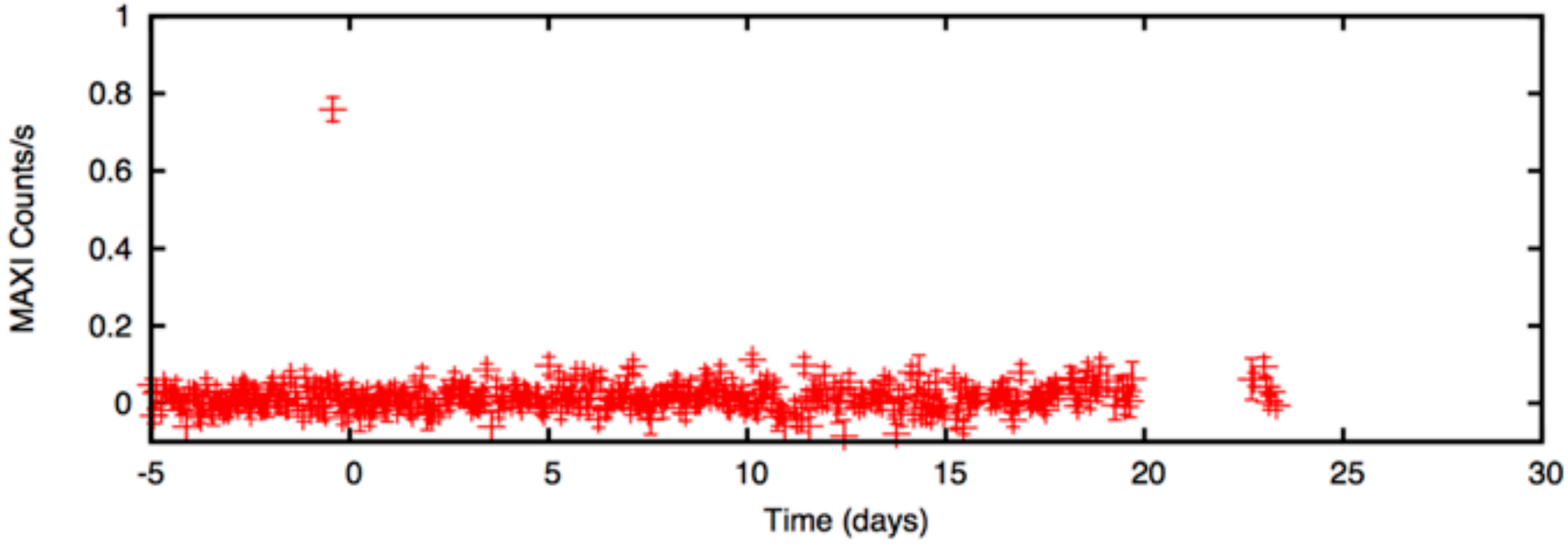






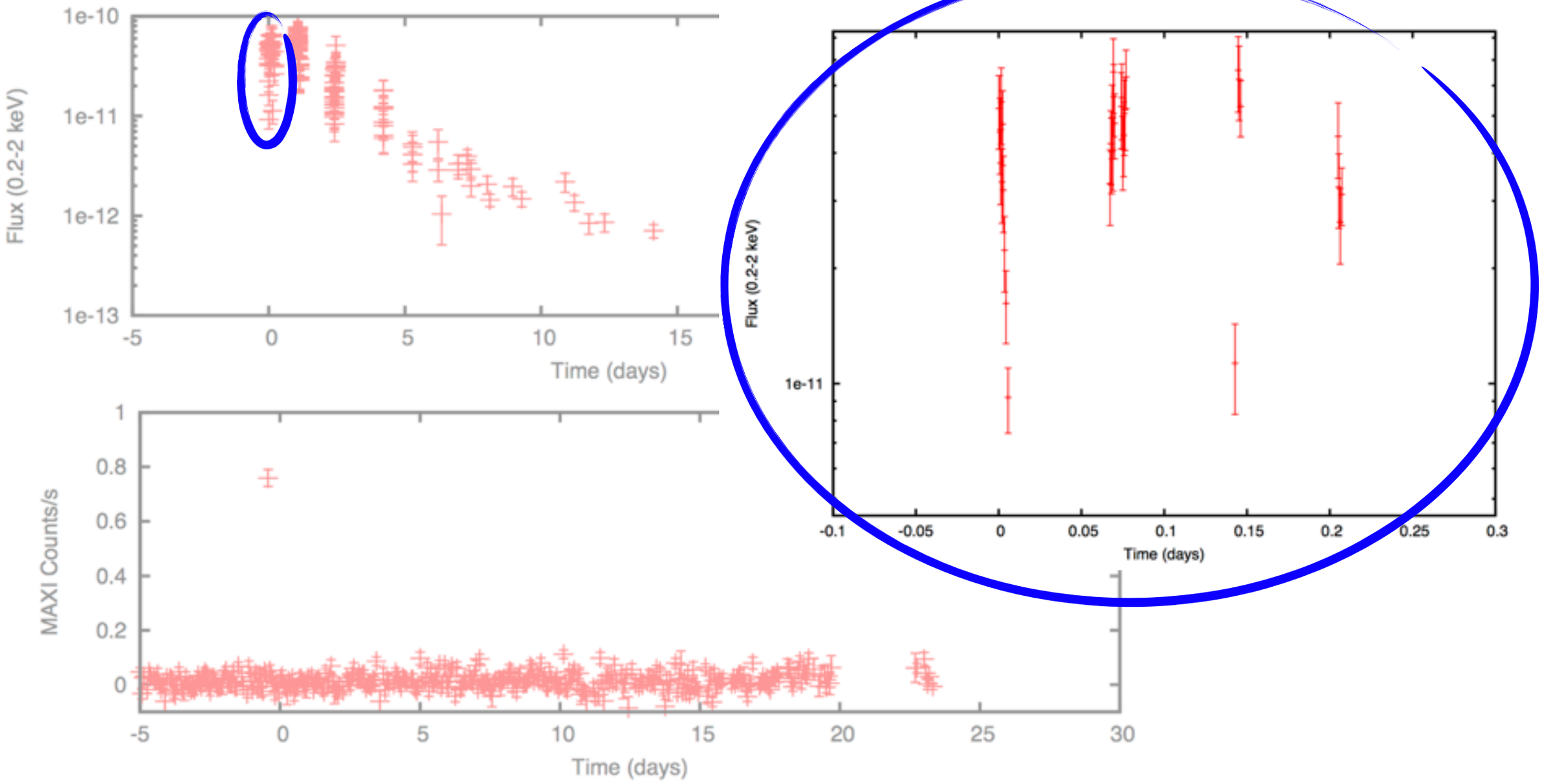
Detection & X-ray lightcurves





t_0= 11 November 2011 15:33 UT

Detection & X-ray lightcurves



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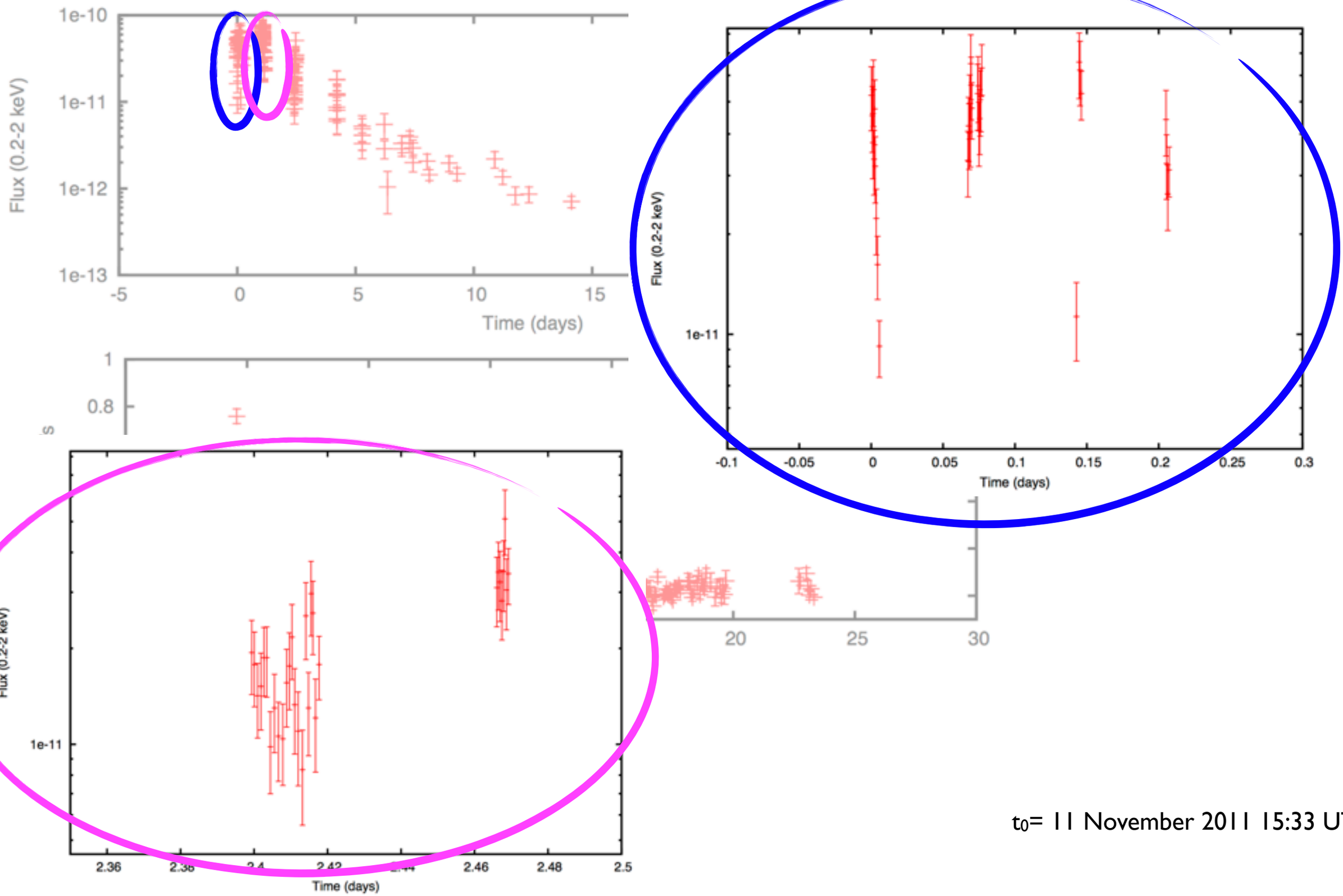

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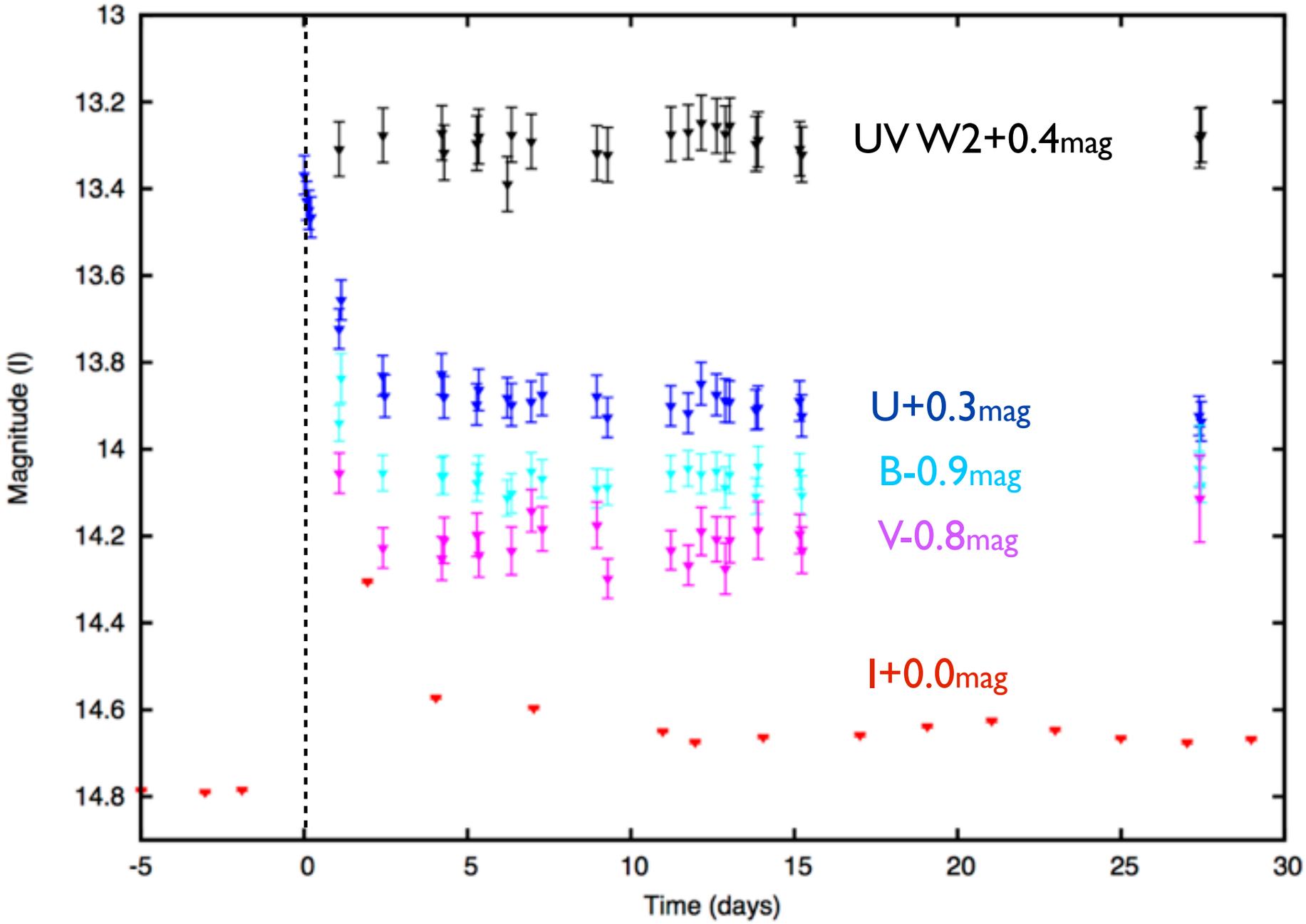
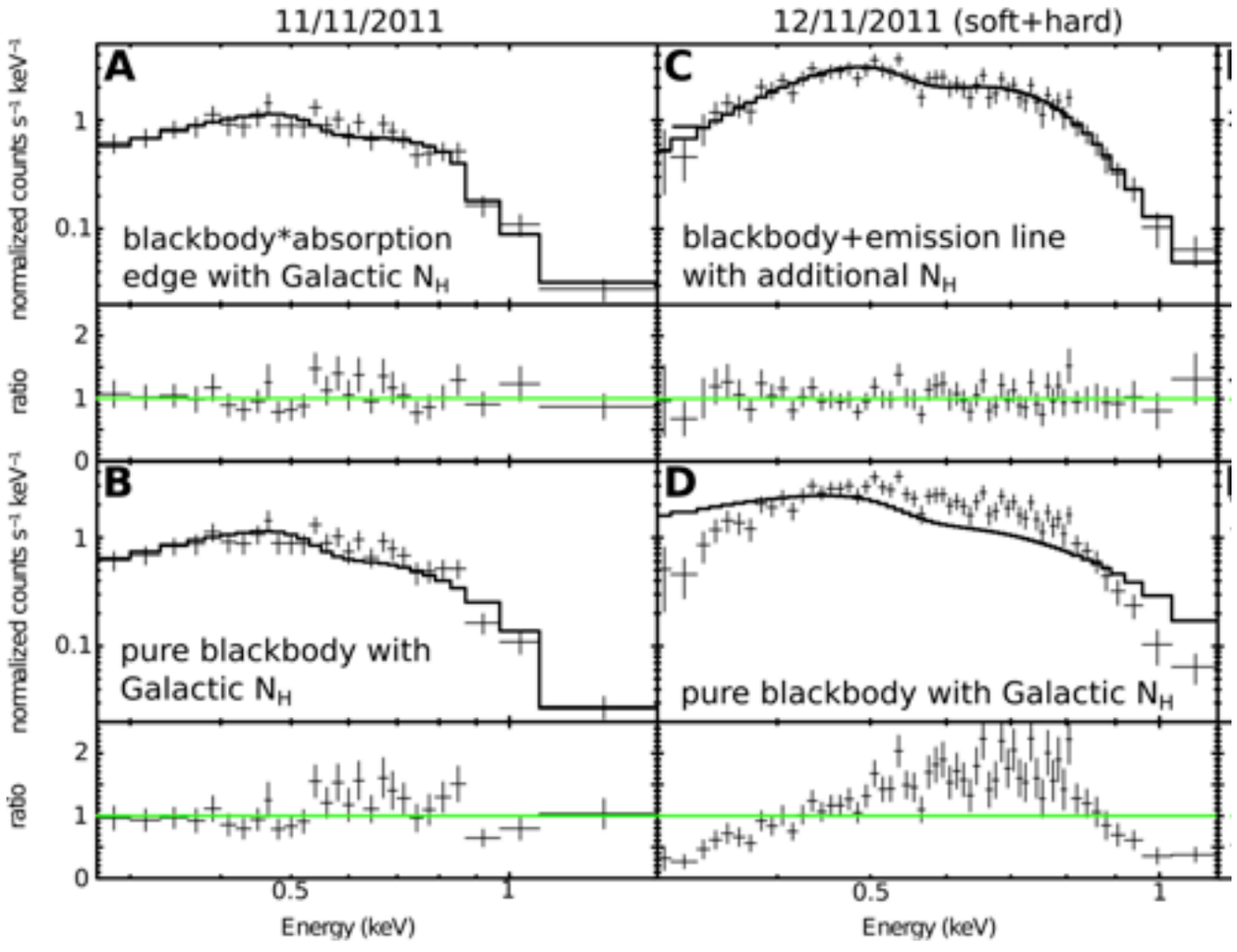
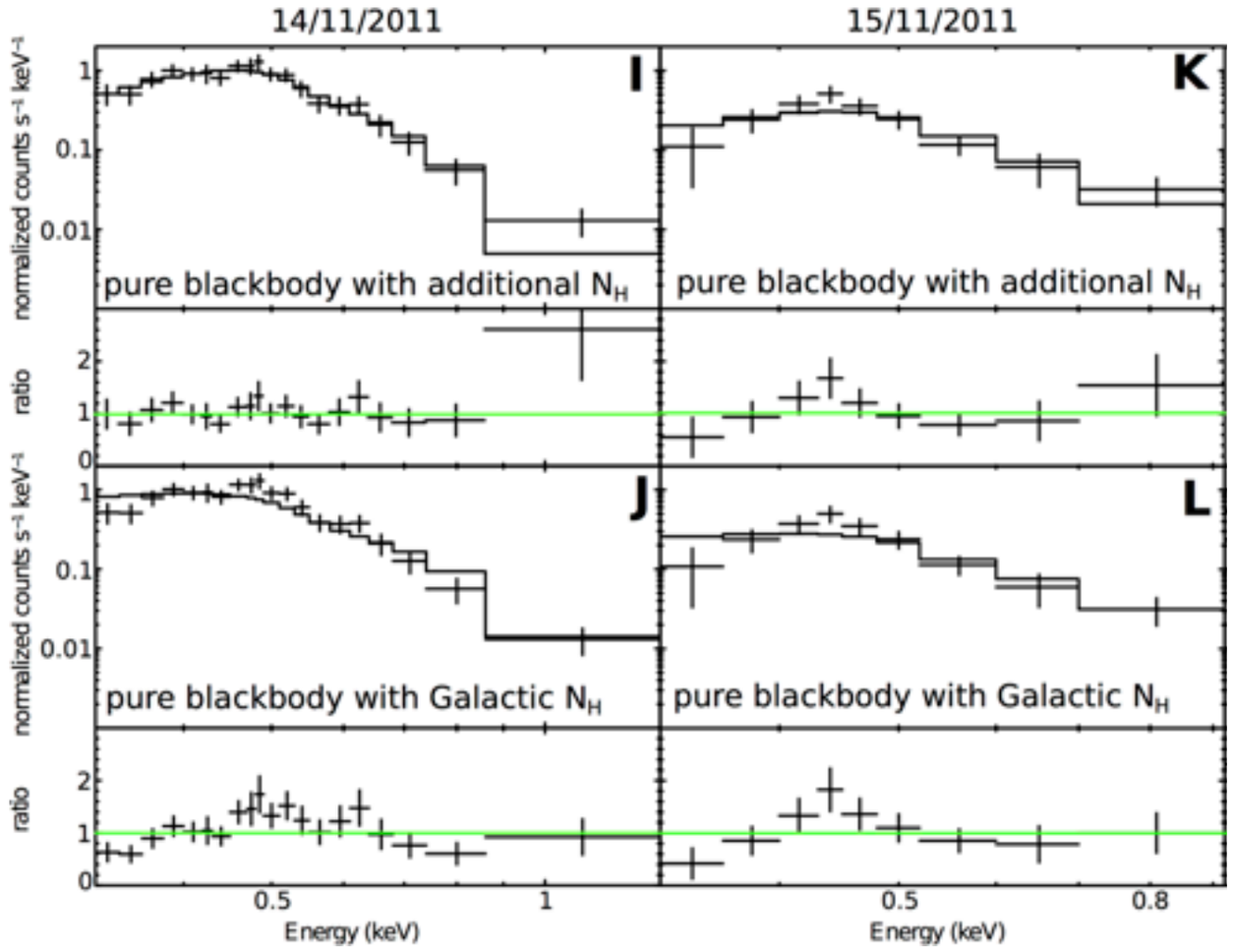
Optical lightcurves



X-ray spectral evolution





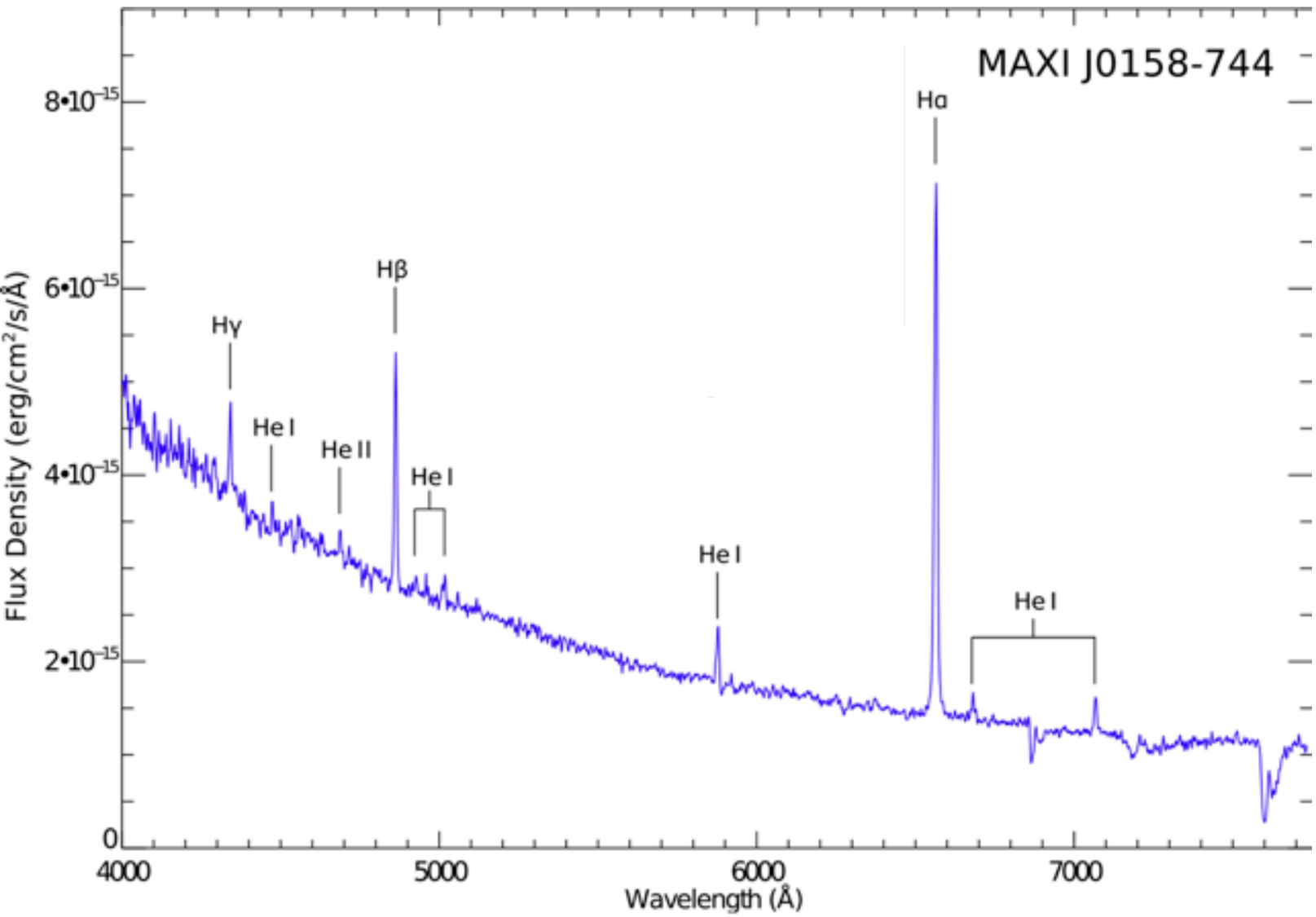
Best fit model:

blackbody + Galactic absorption + additional absorption + (sometimes) absorption edge or line

T~100 eV -> 60 eV R_{BB}~ 0.1-> 2.0 x10^9cm

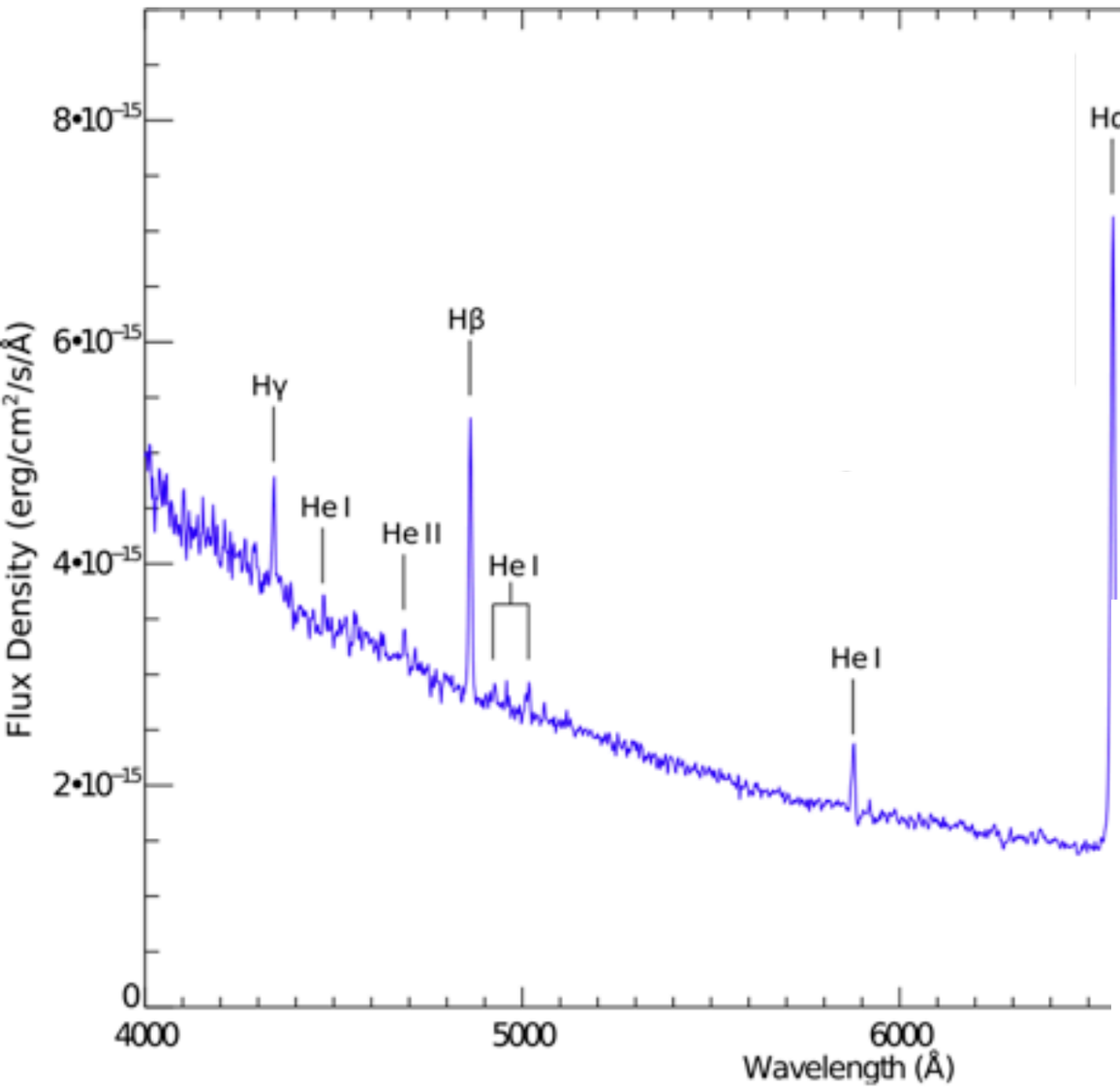
Variable absorption peaking 12 November

Optical spectral evolution



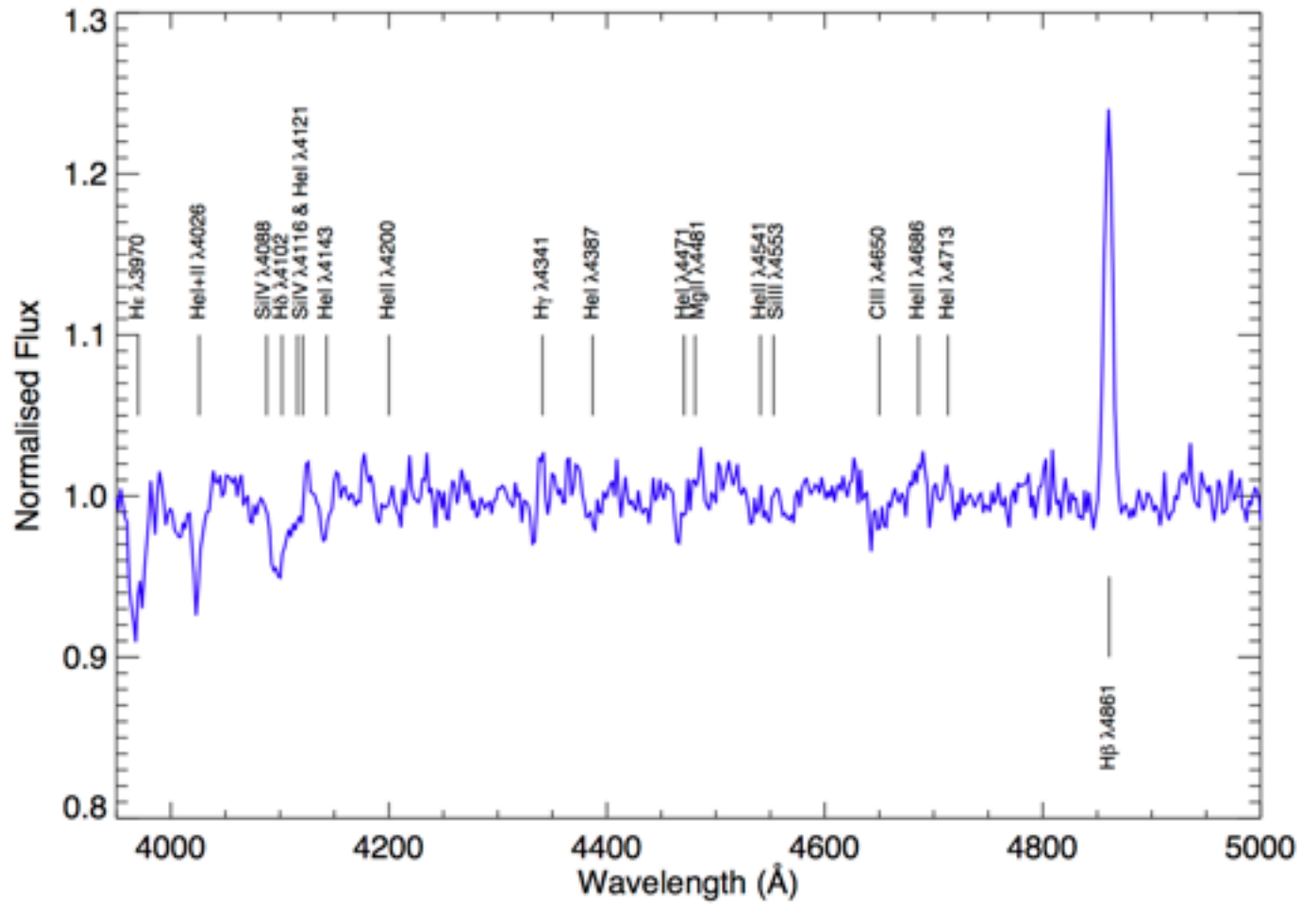
Spectrum from 1.9m SAAO
~ 6 days after X-ray flare

Optical spectral evolution



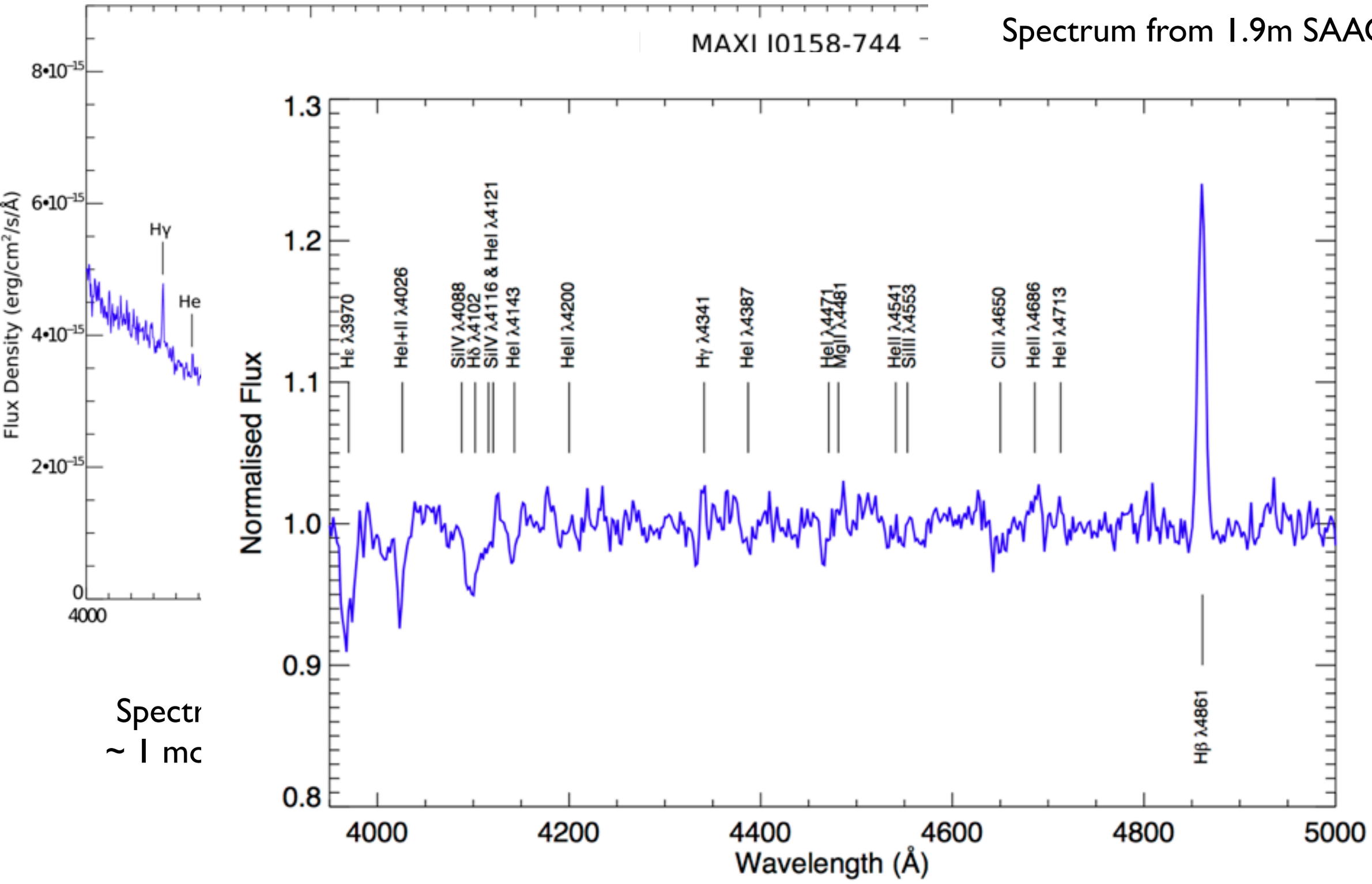
Spectrum from 1.9m SAAO
~ 6 days after X-ray flare

Spectrum from NTT ESO
~ 1 month after X-ray flare



Optical spectral evolution

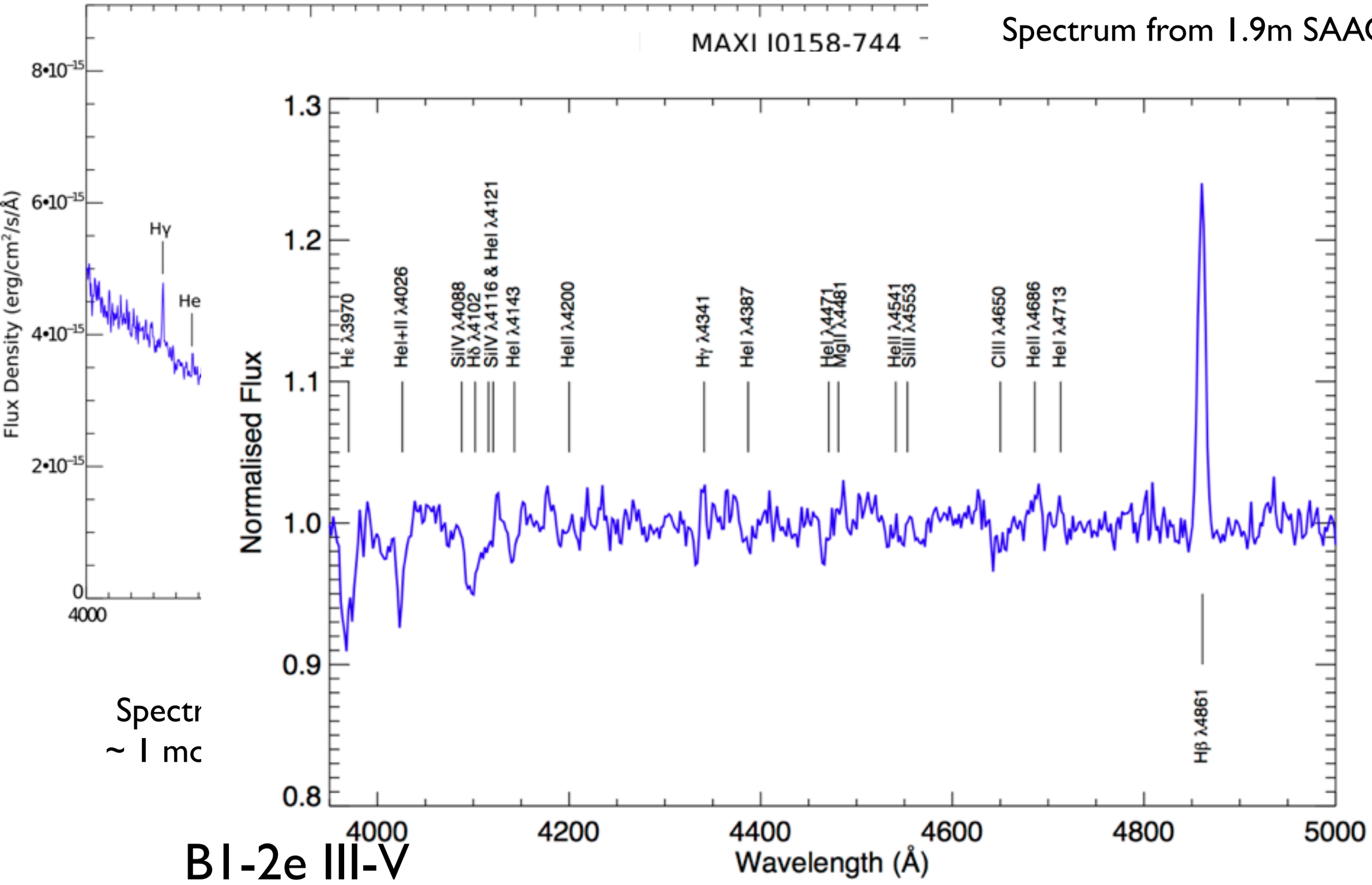
Spectrum from 1.9m SAAO



Spectr
~ 1 mc

Optical spectral evolution

Spectrum from 1.9m SAAO

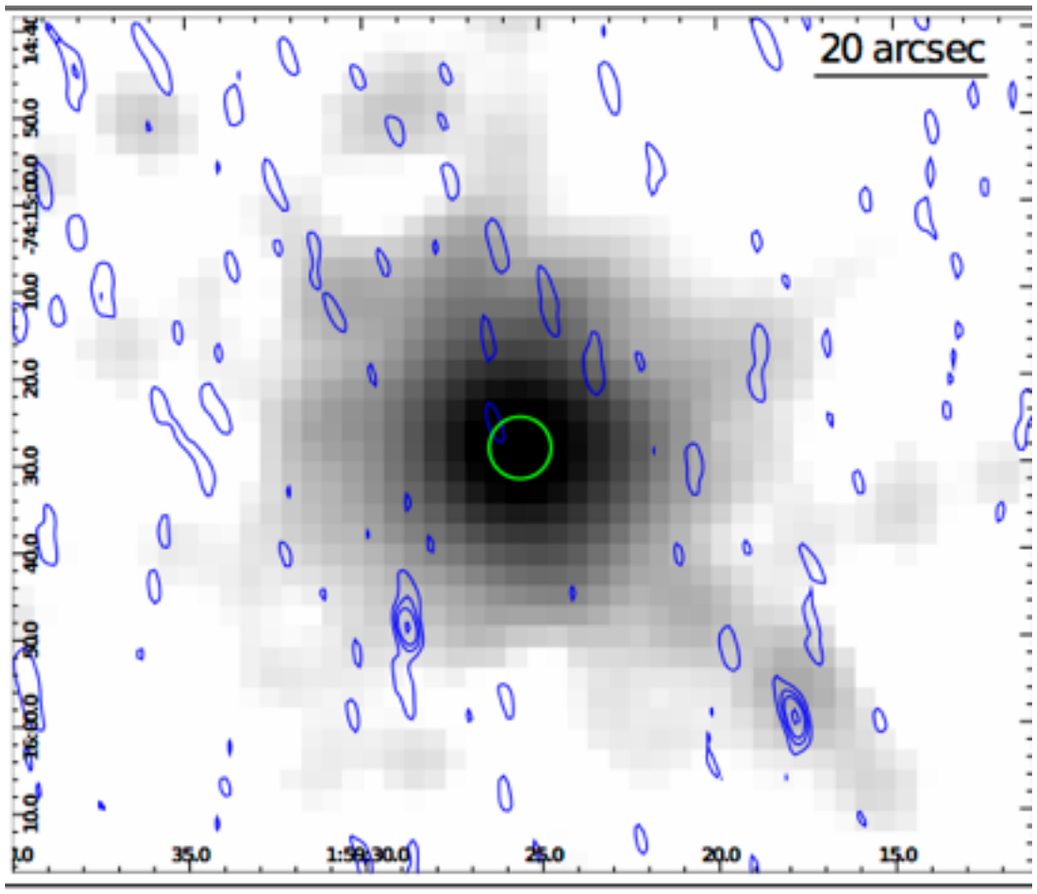


Spectr
~ 1 mc

B1-2e III-V

Radio emission

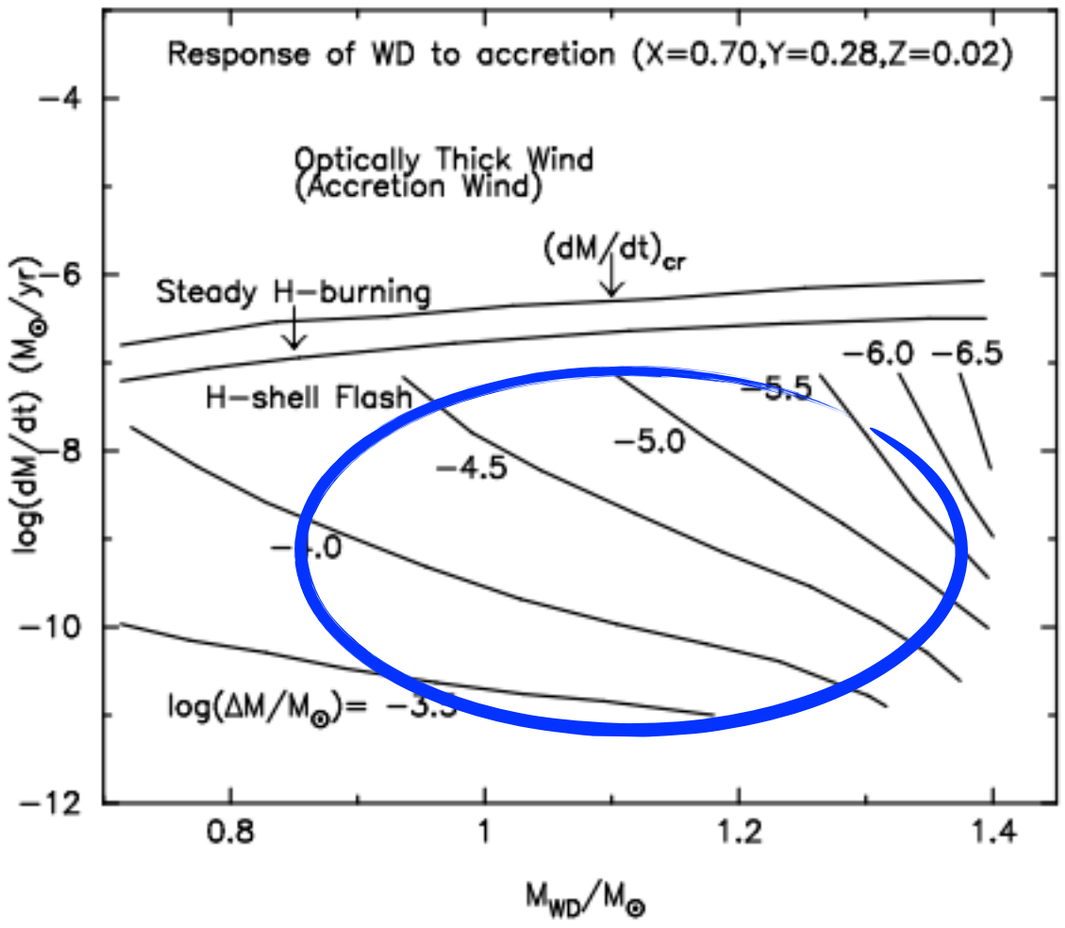
- Observed 23 December 2011
- ATCA 5.5 GHz & 9 GHz
- 3 sigma upper limit of 45 μJy beam^{-1}



Halftime stats:

- Object is in Magellanic system (redshifted spectral features)
- Emission spectrum has partly disappeared (transient accretion disk?)
- Early type counterpart
- X-ray behaviour like a SSS, but overluminous
- Inferred blackbody radius implies white dwarf

Is this outburst a nova?



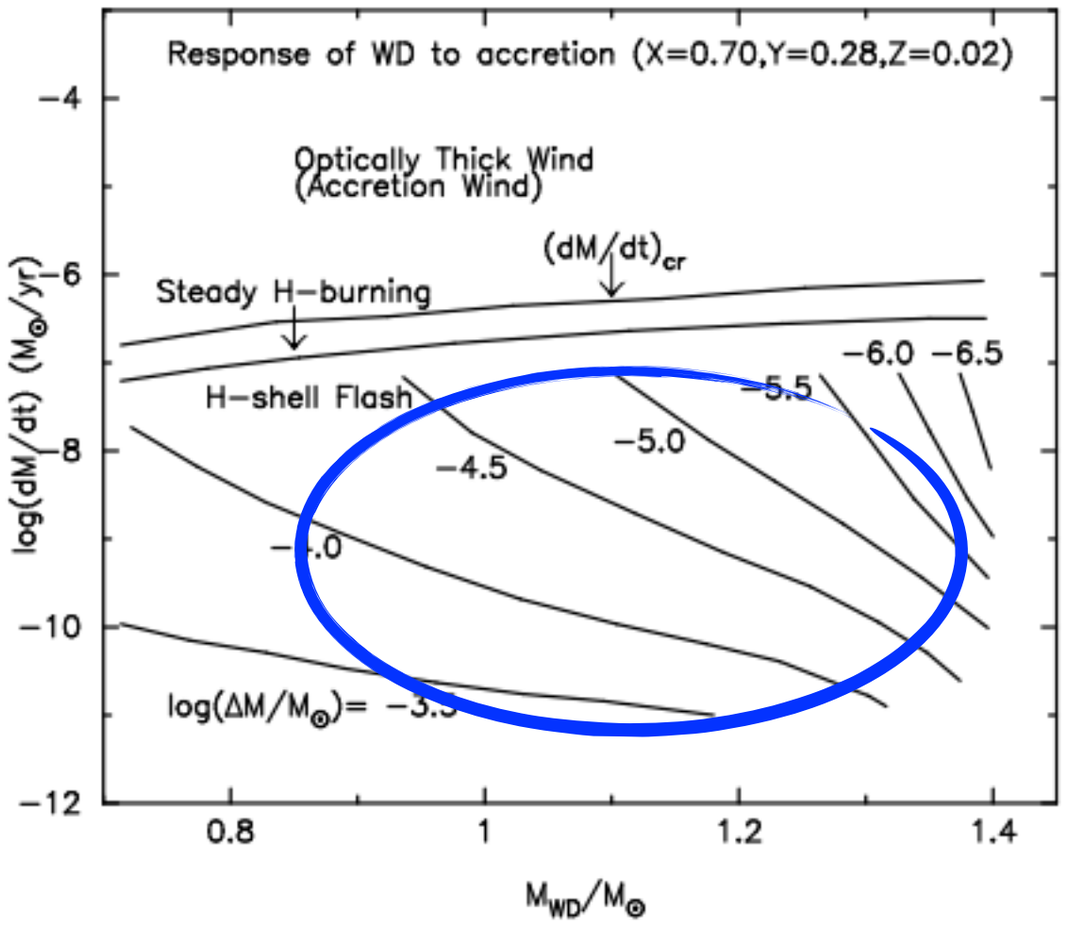
Kato (2010)

Behaviour suggests a low mass accretion rate:
SS phase as part of nova

Where is the nova?

Max B ~ 14.7

Is this outburst a nova?



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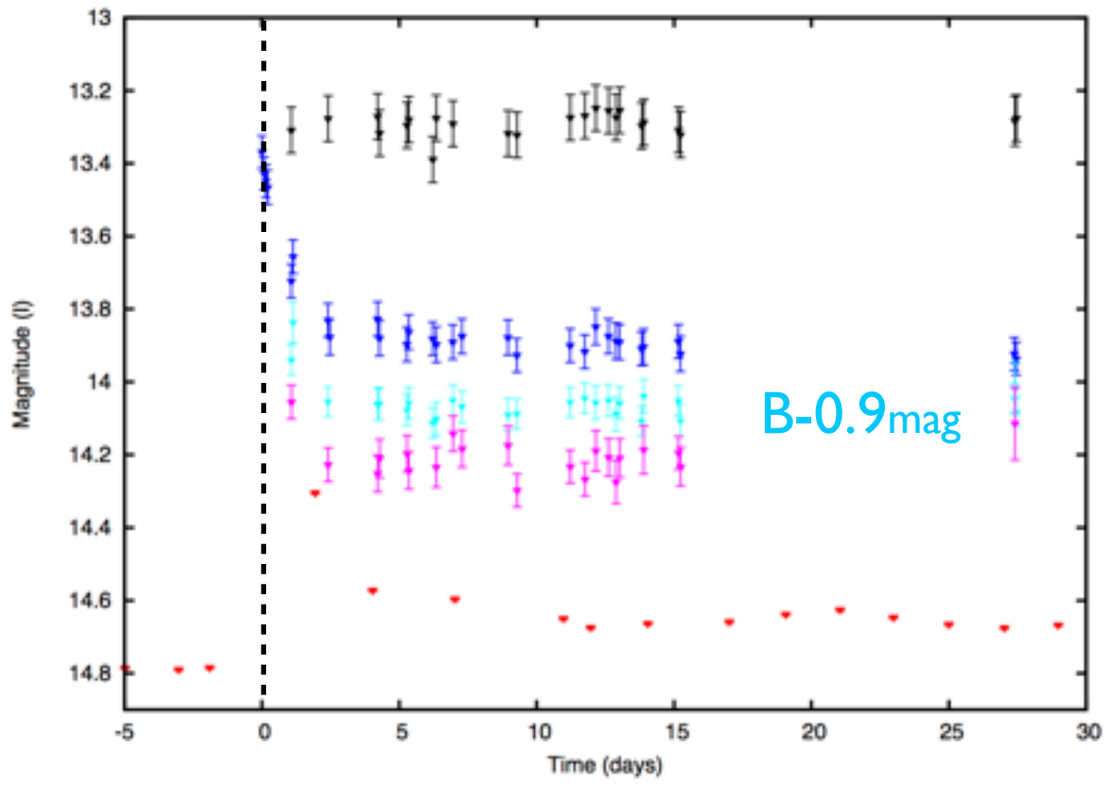
Where is the nova?

Hiding behind a B star
Magnitude at peak ~13.3

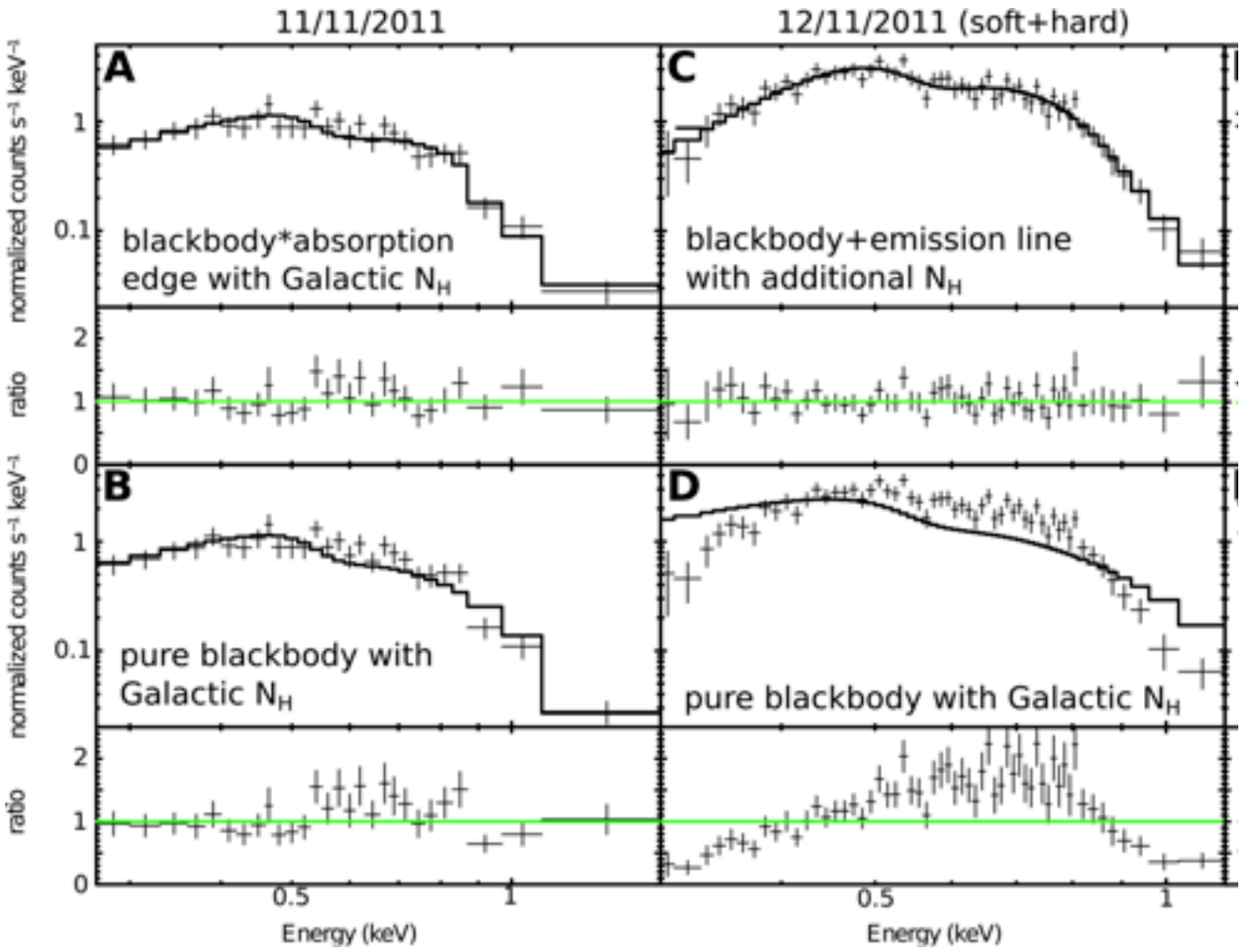


Max B ~ 14.7

MAXI J0158-744 probably hosts a massive white dwarf

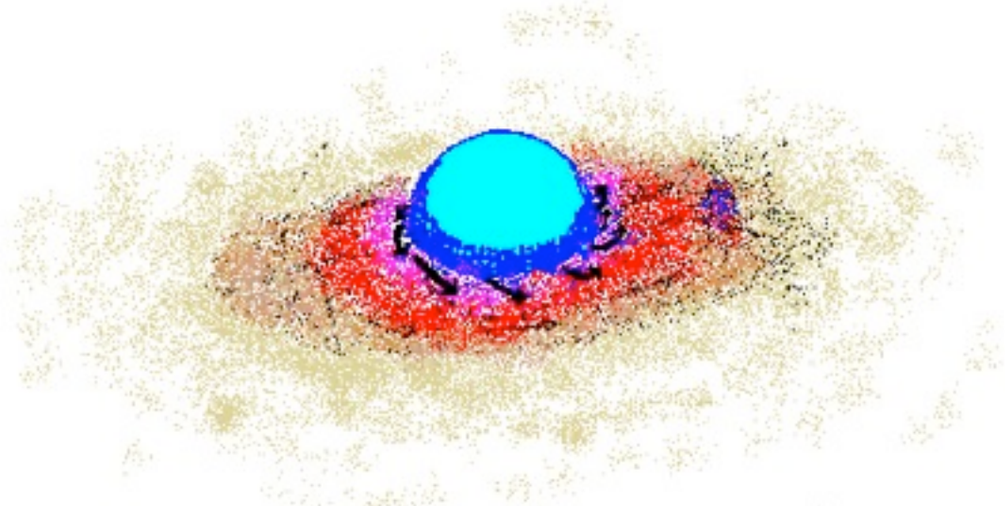
- hot blackbody temperature (Nomoto+ 2007)
- very fast SSS phase (15 days)
- presence of emission lines and absorption features around 0.7 and 0.89 keV (O, Fe, Ne?)

Mass ~1.3 Msun



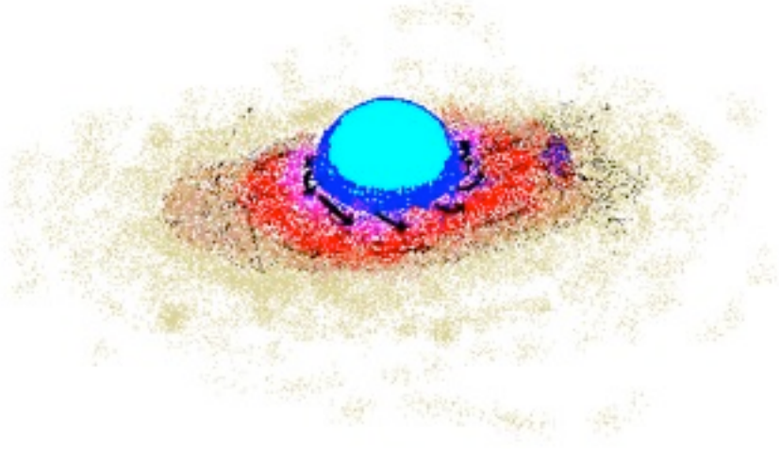
Origin of X-ray flash

- Luminosity 1.6x10^{39} erg/s (2-4 keV)
- Duration of <92 minutes
- Dynamic range of 20 in this time
- Shock interaction of nova shell with Be star plasma?



Be + WD systems

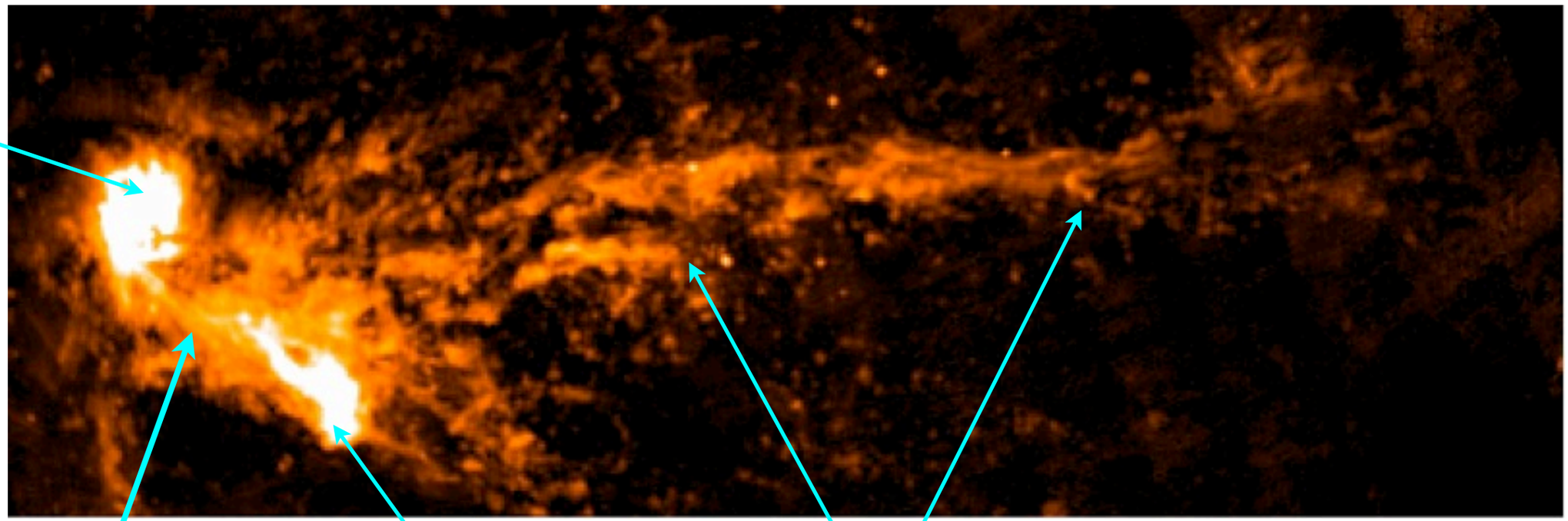
- Predicted to exist (Rapport & van den Heuvel 1982), but hard to find.
- Two Be+WD in the Magellanic Clouds (Kahabka+ 2006, Sturm+2012)
- Detection hampered by local extinction



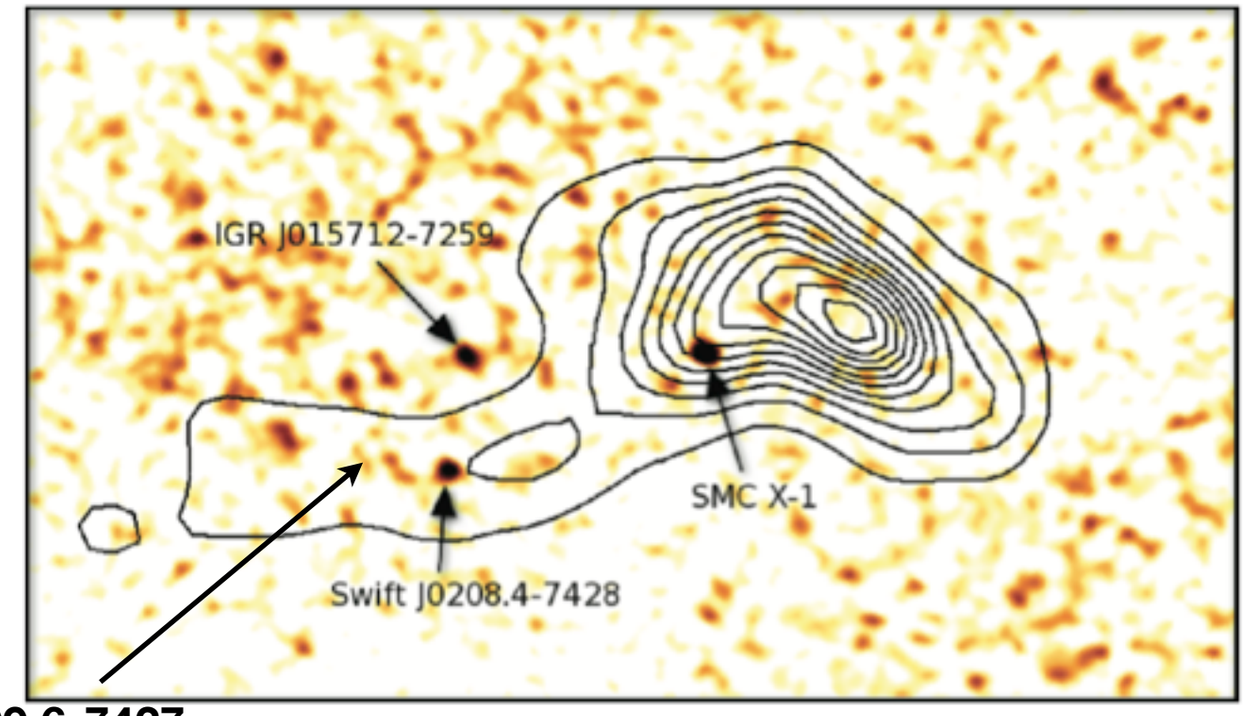
M1		M2	a	T
Solar masses		Solar masses	Solar radii	Million years
10.24	MS	MS	4.42	58.59	0.00
9.93	Giant	MS	4.40	59.92	21.54
9.92	RLO fast	MS	4.40	59.95	21.59
4.54	RLO slow	MS	4.54	40.71	21.60
2.60	He star	Be	4.93	66.09	21.90
2.34	He RLO	Be	4.92	68.47	22.42
1.43	Hot core	Be	4.93	144.90	22.42
1.43	ONe WD	Be	4.92	144.90	22.55

Raguzova 2001

Nova in the Magellanic Bridge



HI image from Putman et al 2005



McBride+ 2010

Conclusions

- Hard X-ray flash (~1 hour)
- Softer X-ray decline over ~2 weeks
- Optical spectral evolution
- In the Magellanic Bridge - tidally stripped or formed in situ?
- Massive white dwarf accreting from a Be star
- Shock interaction with dense circumstellar matter could give rise to X-ray flash