Galactic Bulge Survey

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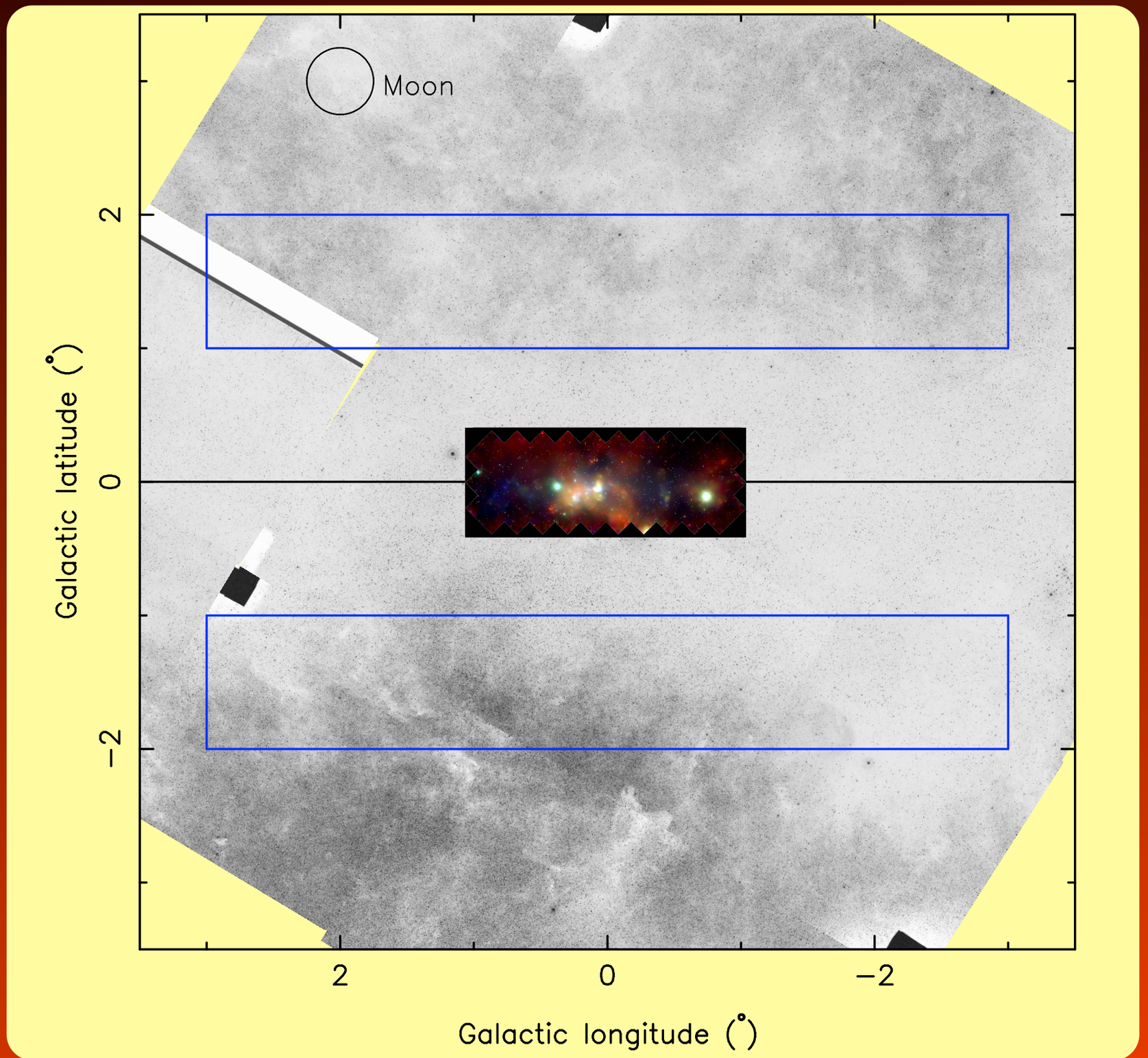
for the GBS team (15 active people)
see http://www.sron.nl/~peterj/gbs

SRON
Netherlands Institute for Space Research

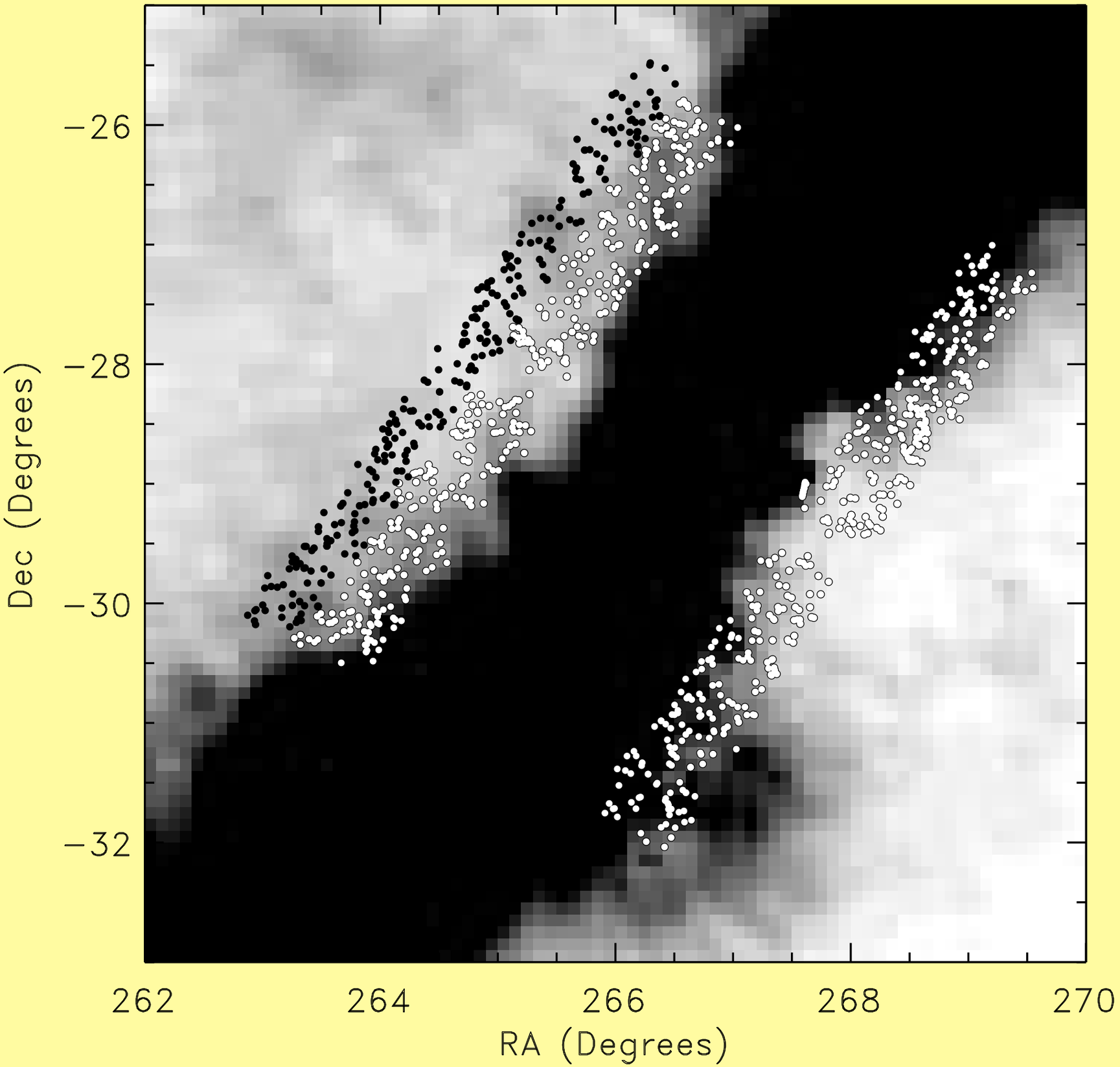
NWO
Netherlands Organisation for Scientific Research

What is the Galactic Bulge Survey?

Chandra+Blanco r′,i′, Hα imaging of 12-sq.deg



196 Chandra observations, 2 ks each



Science goals

- Find eclipsing low-mass X-ray binaries

  Model independent mass measurements
  black hole formation & neutron star EoS

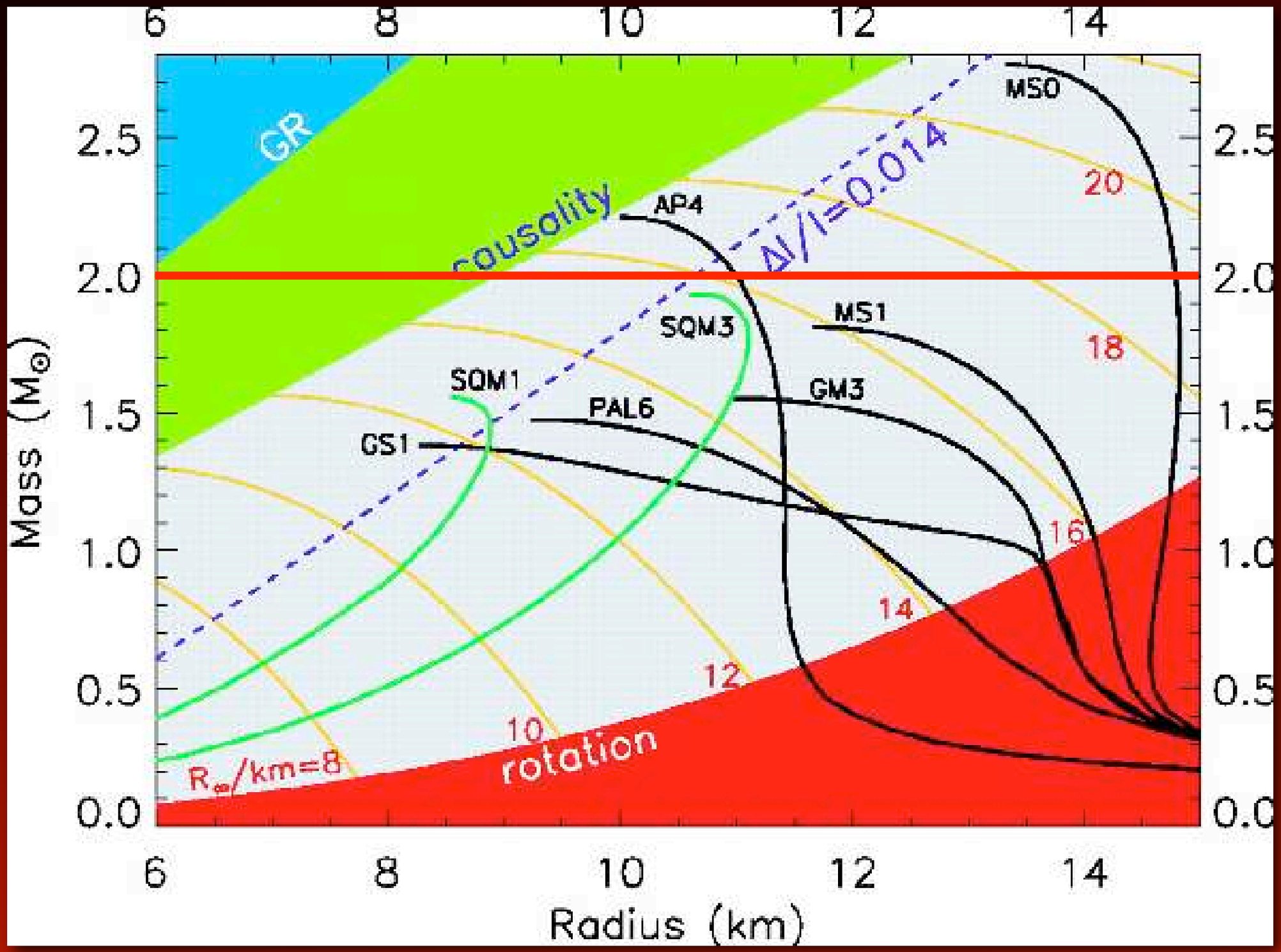
- Constrain common envelope evolution via number count

  Cataclysmic variables and ultra-compact
  low-mass X-ray binaries

- Use quiescent LMXBs to map the Galactic structure
  and constrain LMXB formation

  X-ray binaries trace stellar mass distribution
  (modulo kick)

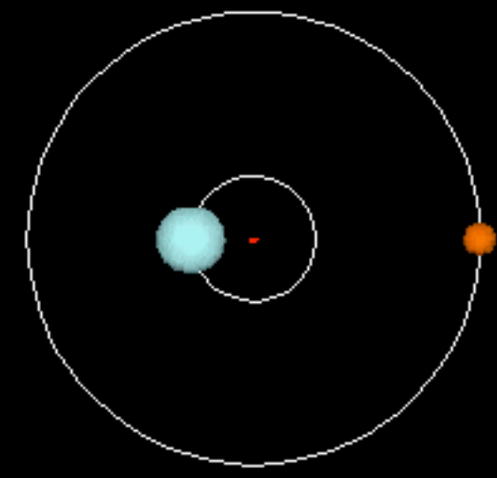
Differentiate between various EoS

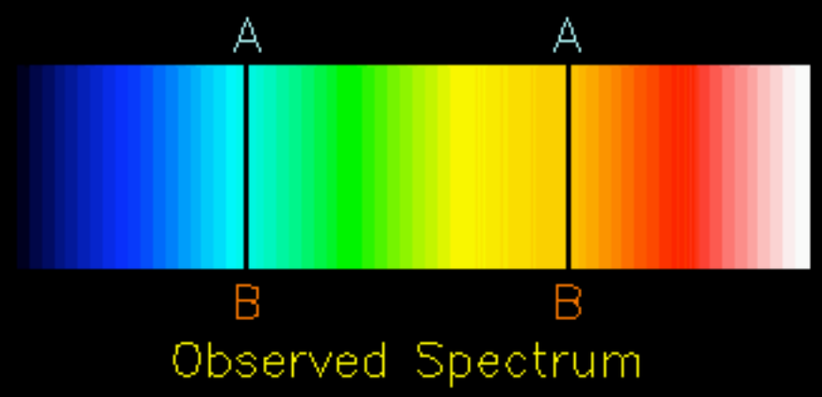


Lattimer & Prakash 2004

Measure mass and/or radius
e.g. Shapiro & Teukolski 1983

Quiescence: X-ray faint this is good!



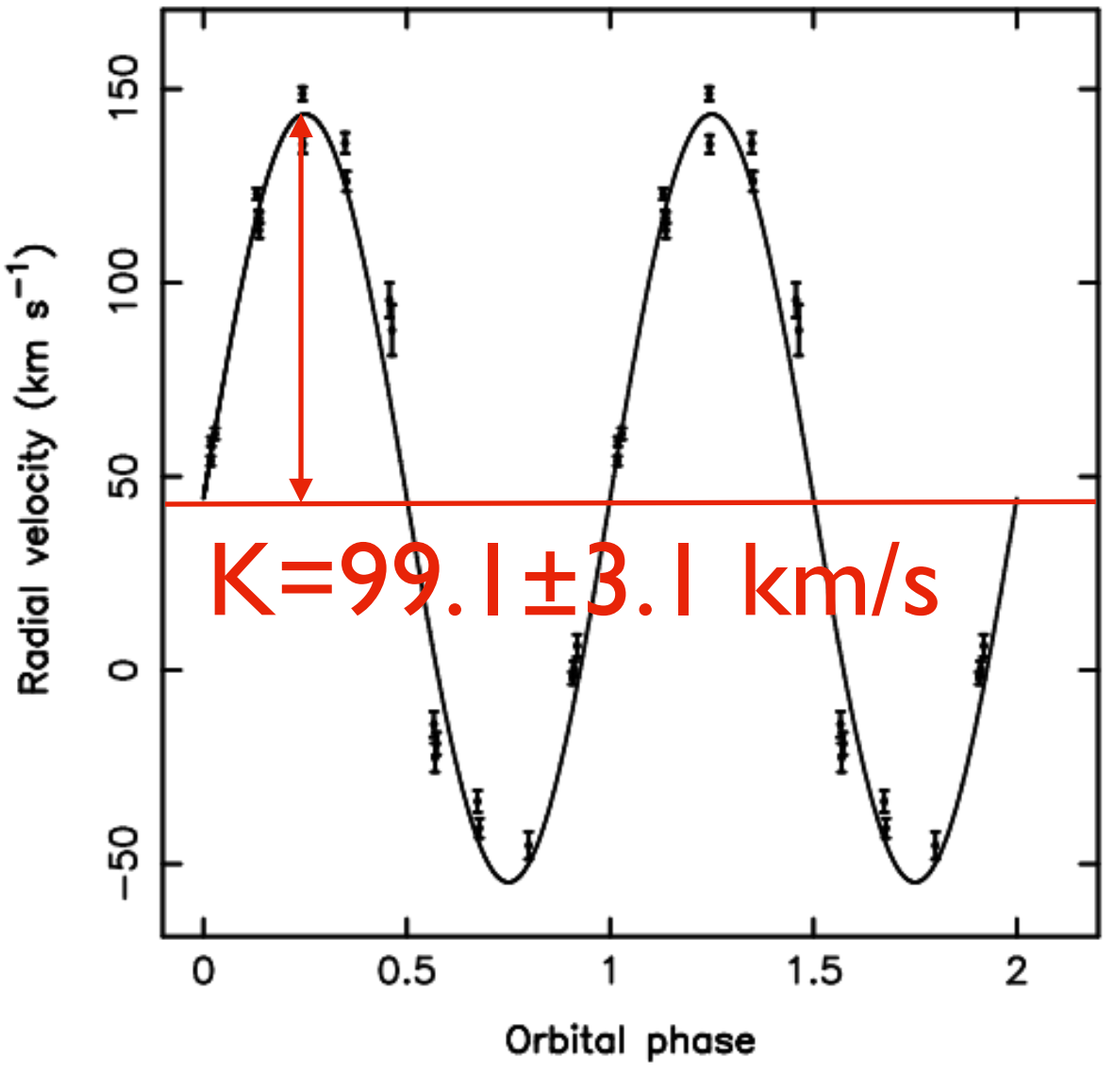


study the NS and the small companion star

BinSim R. Hynes

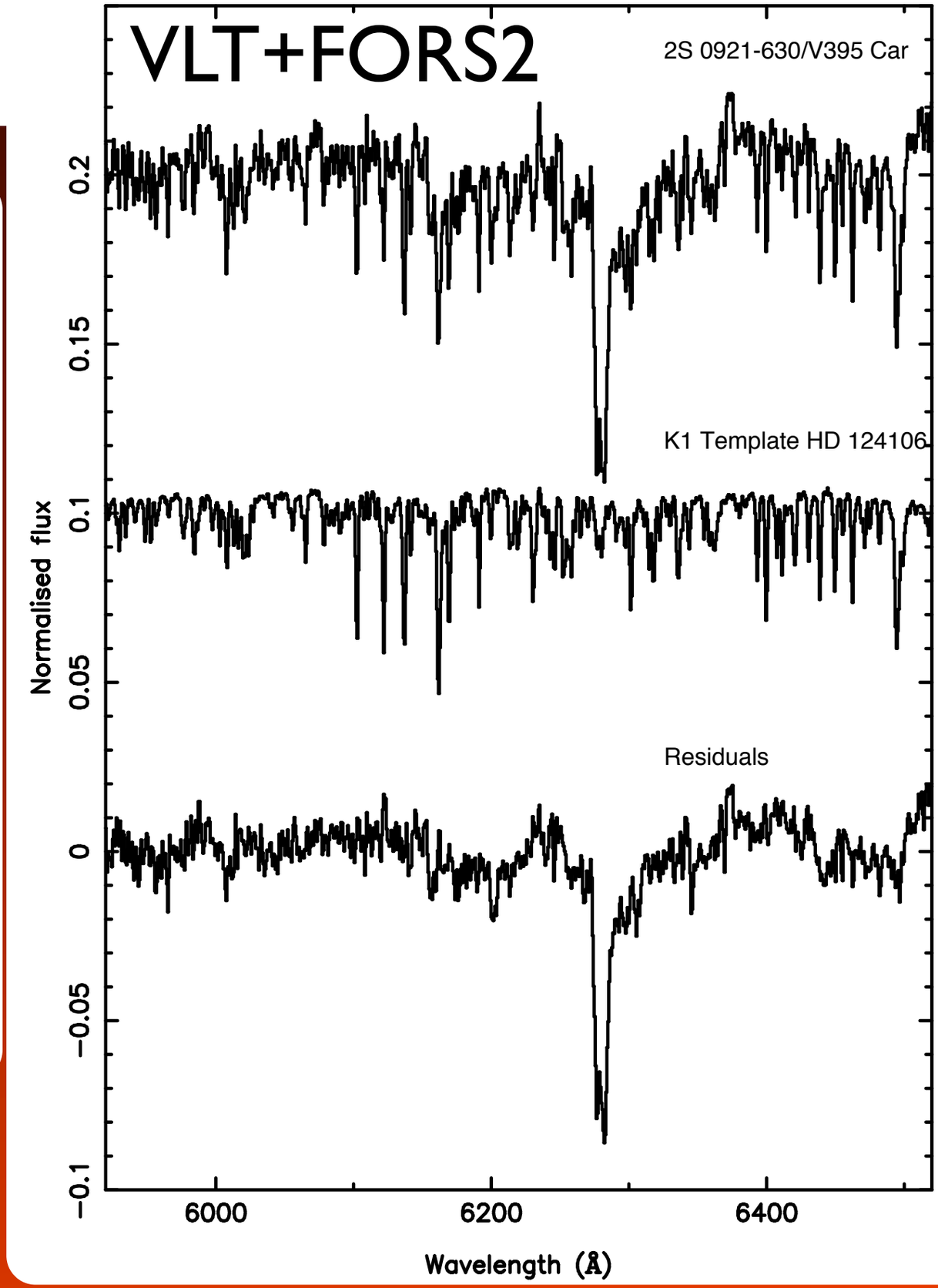
Neutron star or black hole mass measurement:

$$\frac{P_{orb}K^3}{2\pi G} = \frac{M_{NS}\,sin^3 i}{(1+q)^2}$$



Outburst system, partial eclipse

Jonker et al. 2005

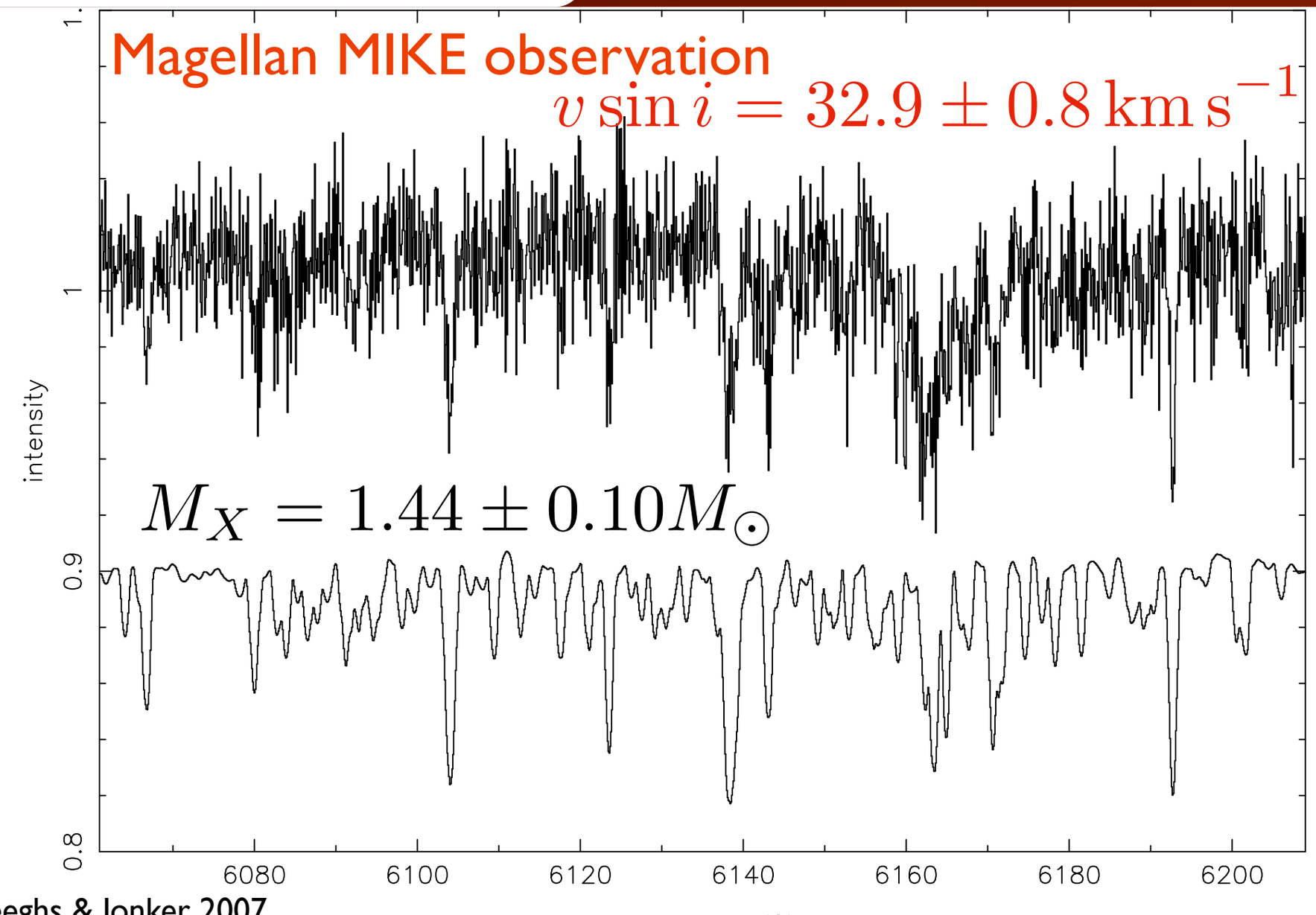


Measure rotational line broadening

$$\frac{P_{orb}K^3}{2\pi G} = \frac{M_{NS}\,sin^3 i}{(1+q)^2}$$

$$\frac{v\ sin\ i}{K} = 0.46[(1+q)^2 q]^{1/3}$$

395 Car / HD99322



Steeghs & Jonker 2007

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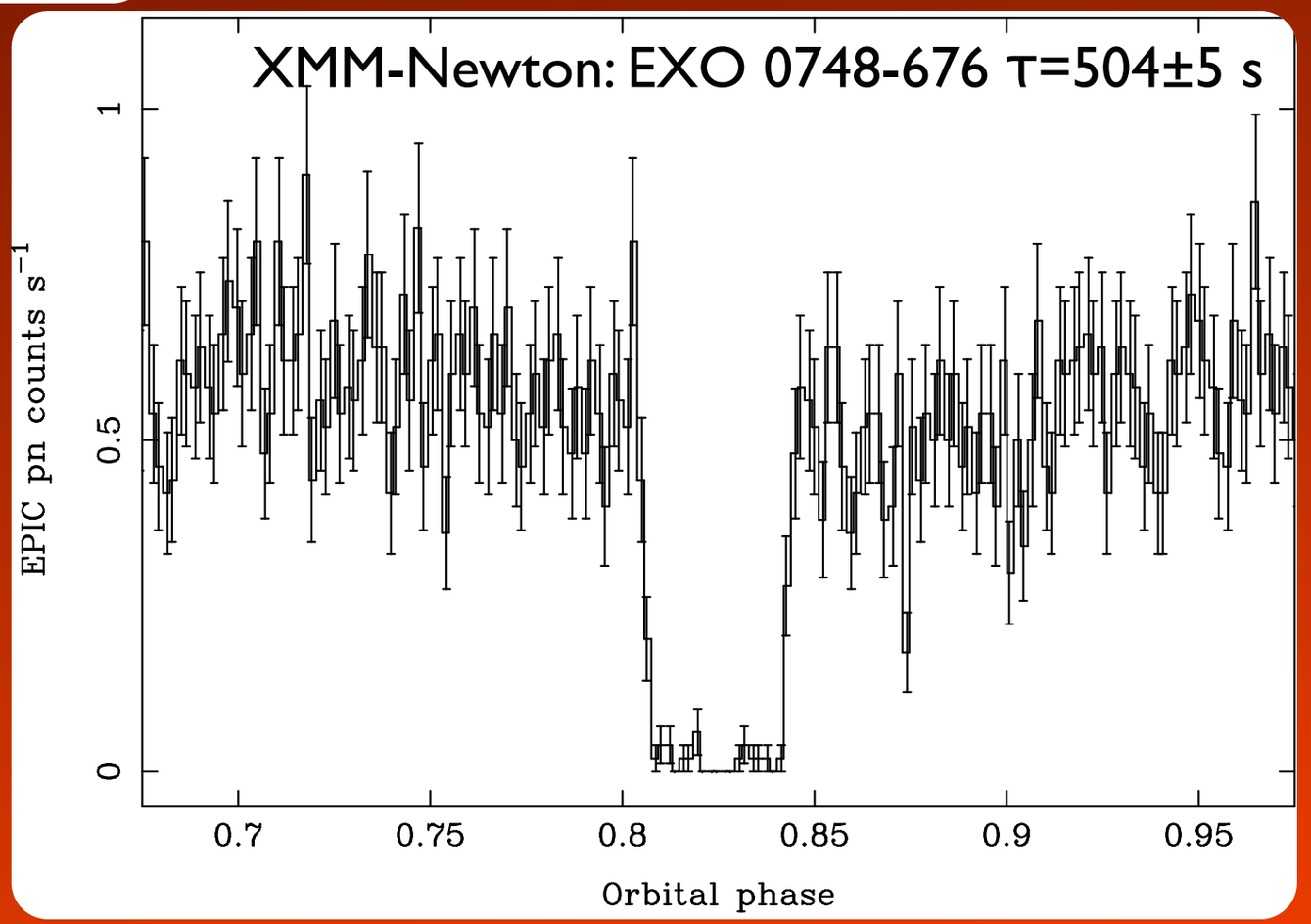
$$\frac{v\ sin\ i}{K} = 0.46[(1+q)^2 q]^{1/3}$$

$$\Delta\phi^2 = \left(\frac{0.49\,q^{2/3}}{0.6\,q^{2/3}+\ln(1+q^{1/3})}\right)^2 - \left(\frac{\cos i}{1+q}\right)^2$$ Horne 1985

Best results: quiescent eclipsing systems



Bassa et al. 2009

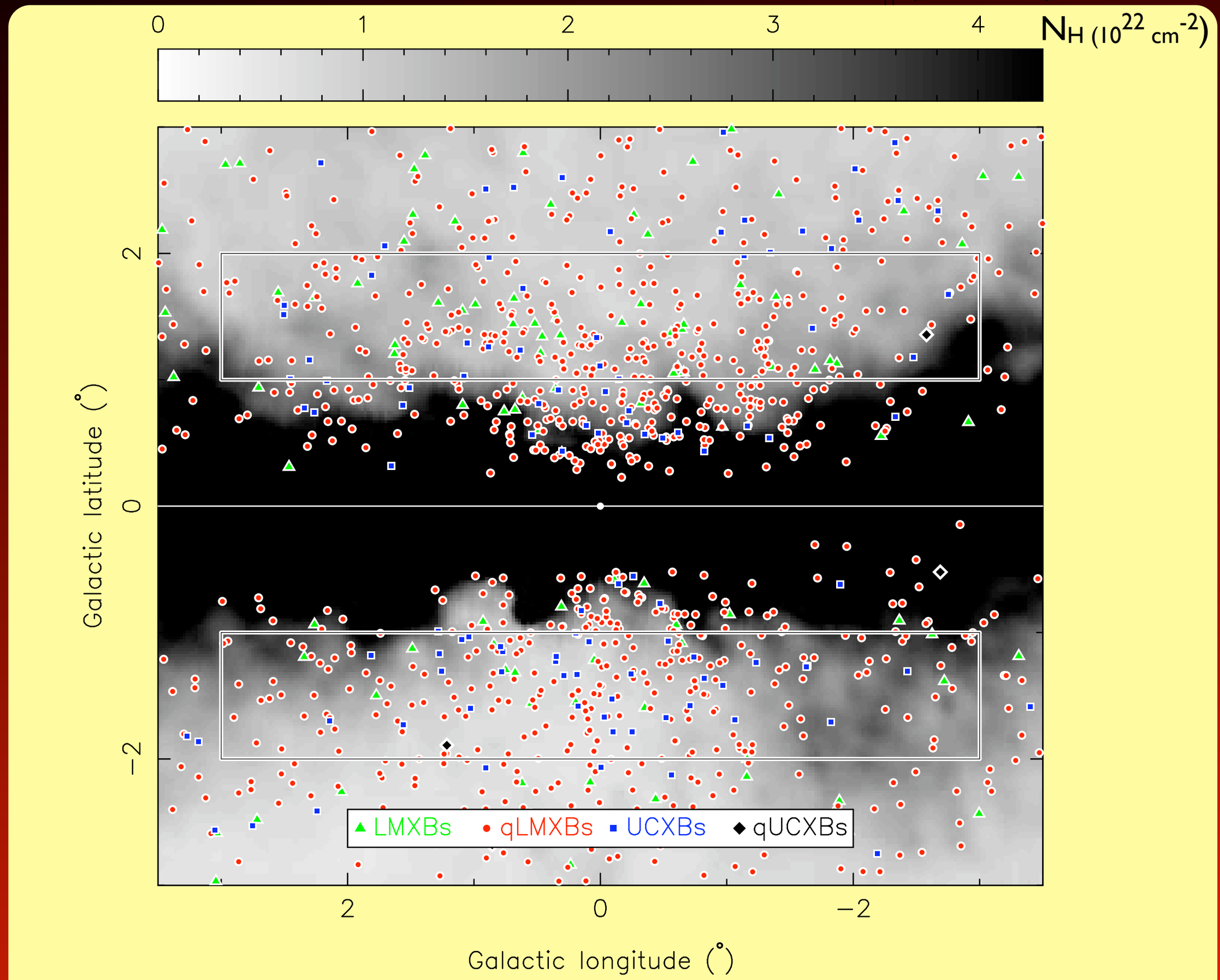
Predictions: ~400 LMXBs

CVs ~450

qLMXBs ~350

UCXBs ~50

RS CVn ~550



Details of Galactic model: Nelemans et al. 2004

Chandra results:

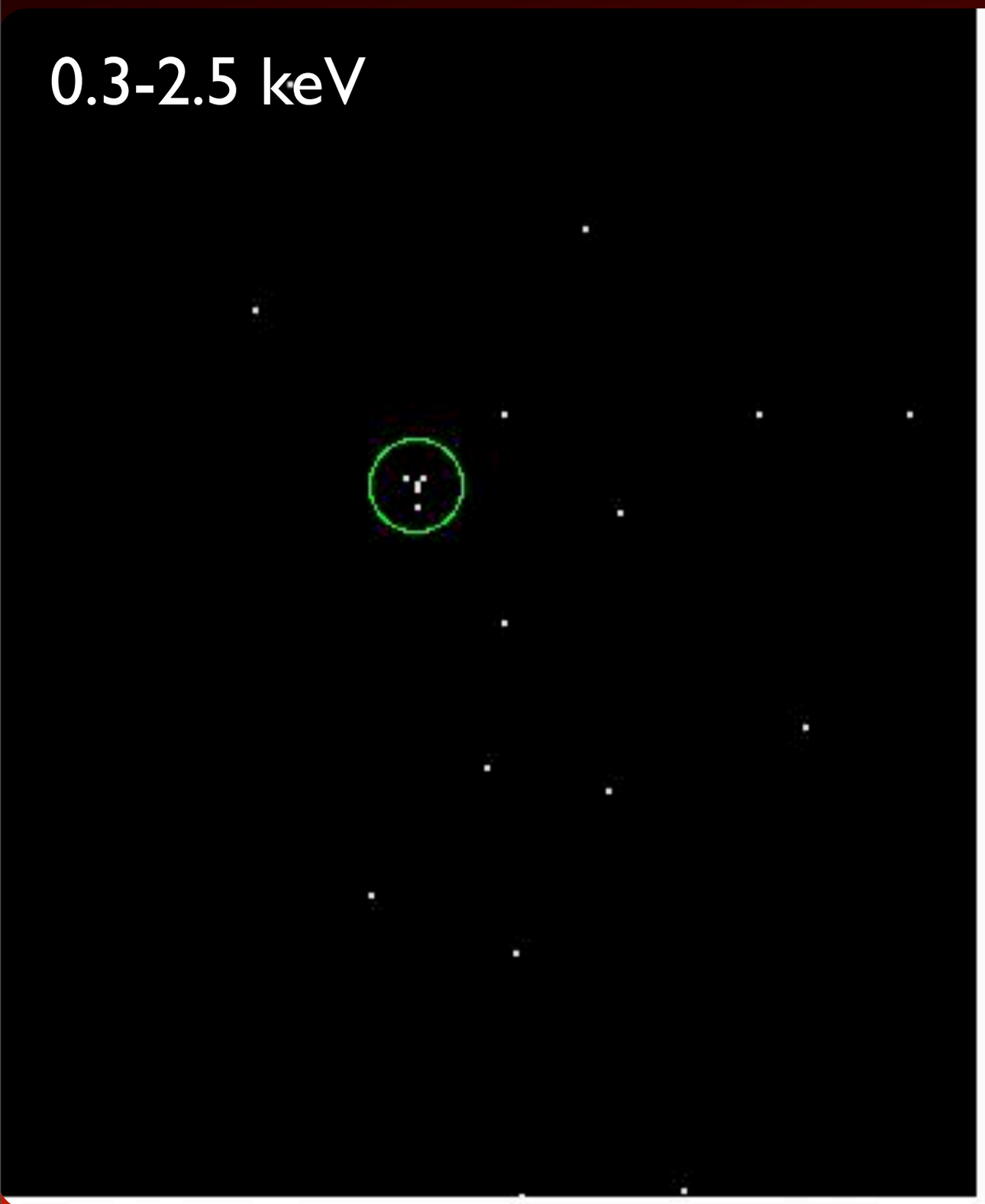
	Total	SFT	HRD
AO10 sources:	276	66	54
AO09 sources:	900	221	181

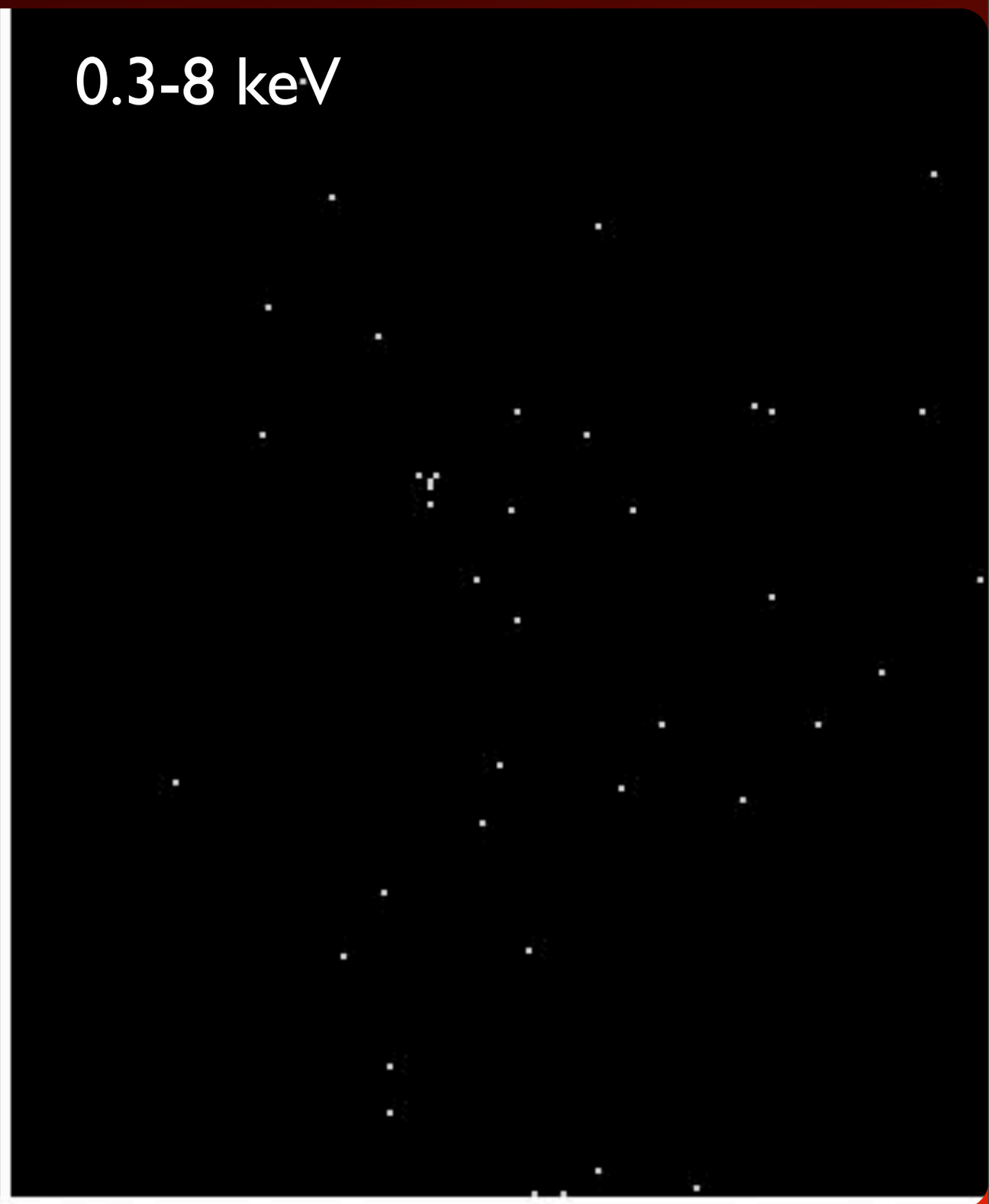
AO10 sum: 396

AO09 sum: 1302

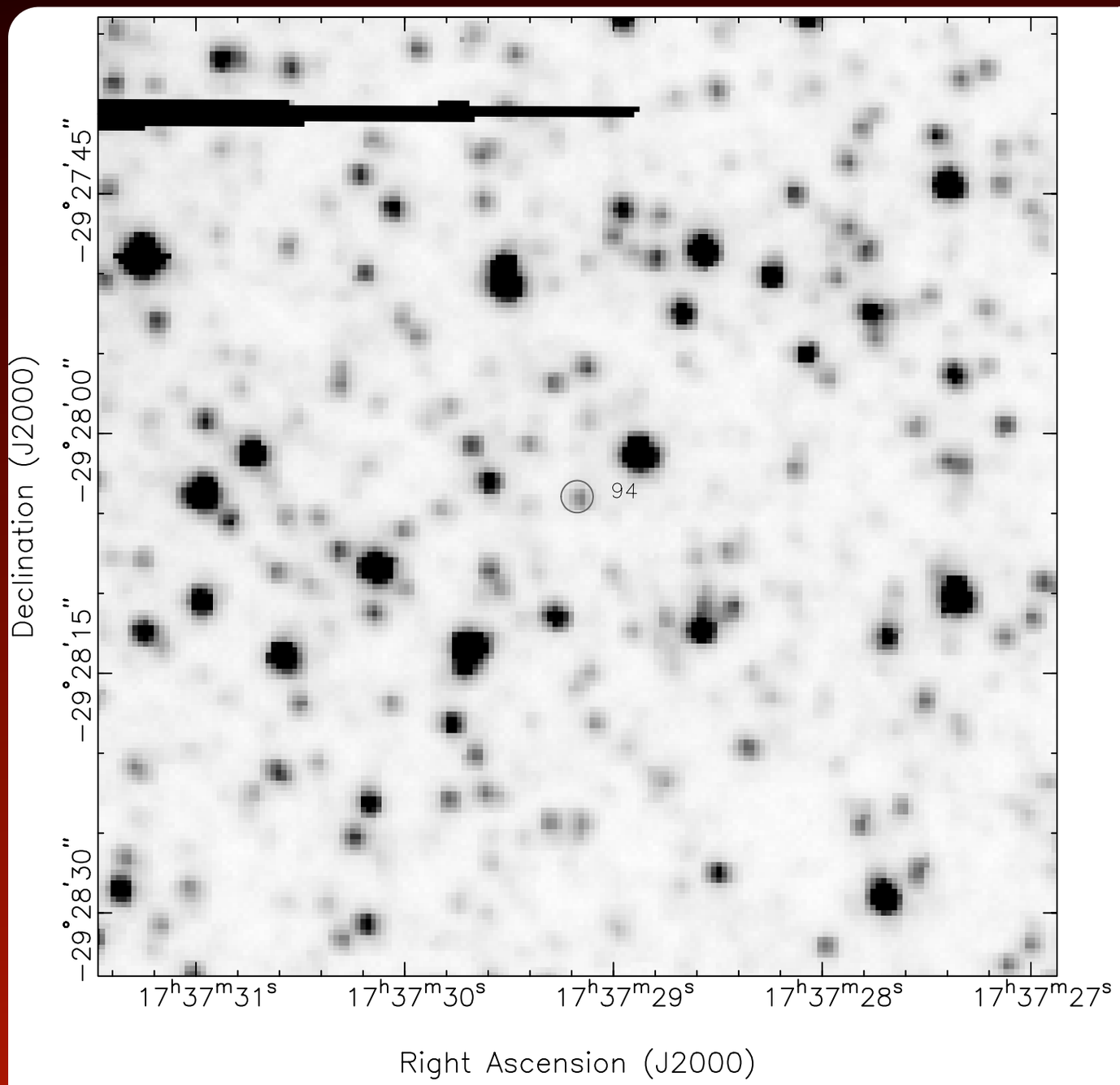
TOTAL SUM 1698

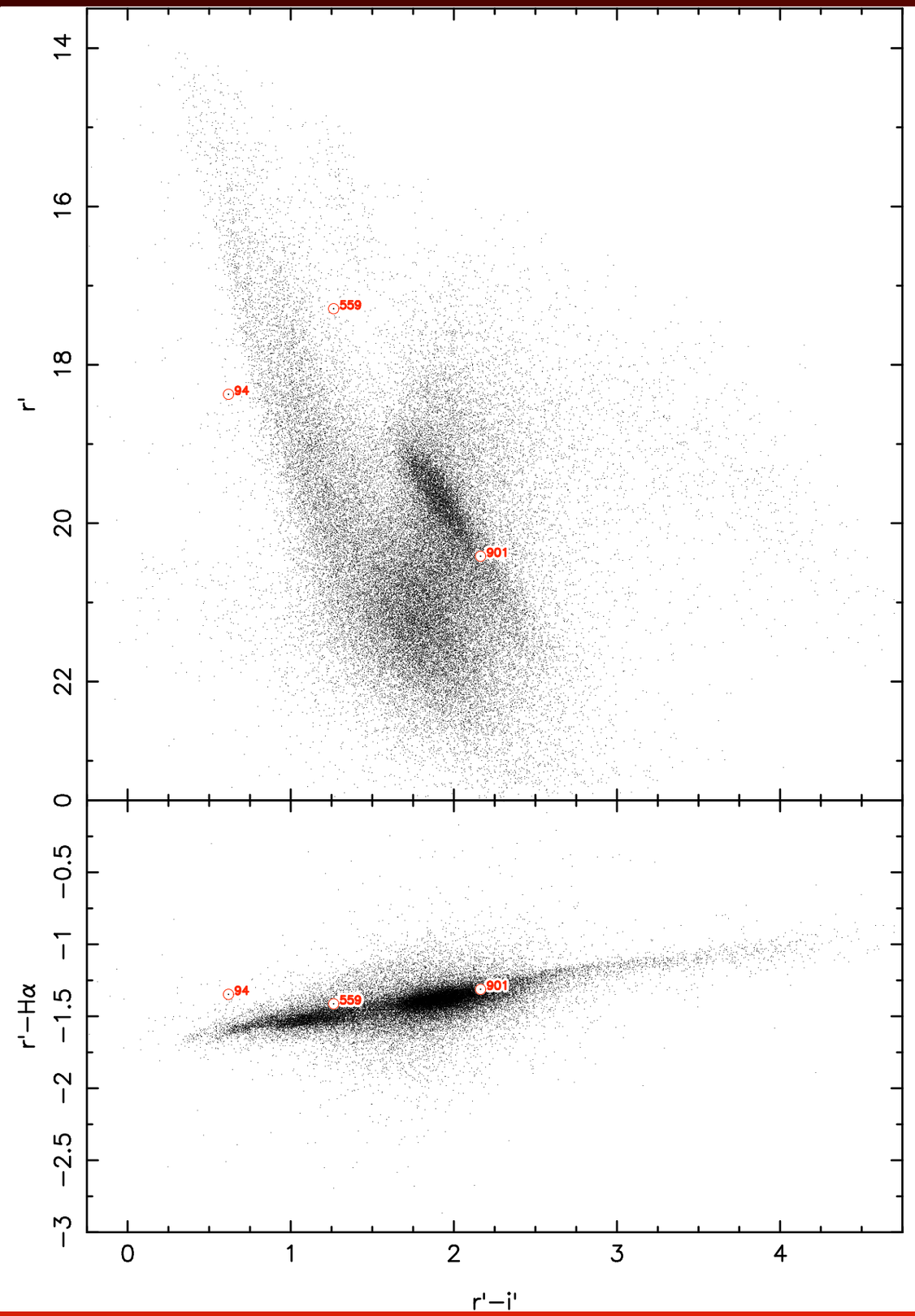
Extra sources in 0.3-2.5 keV with respect to 0.3-8 keV





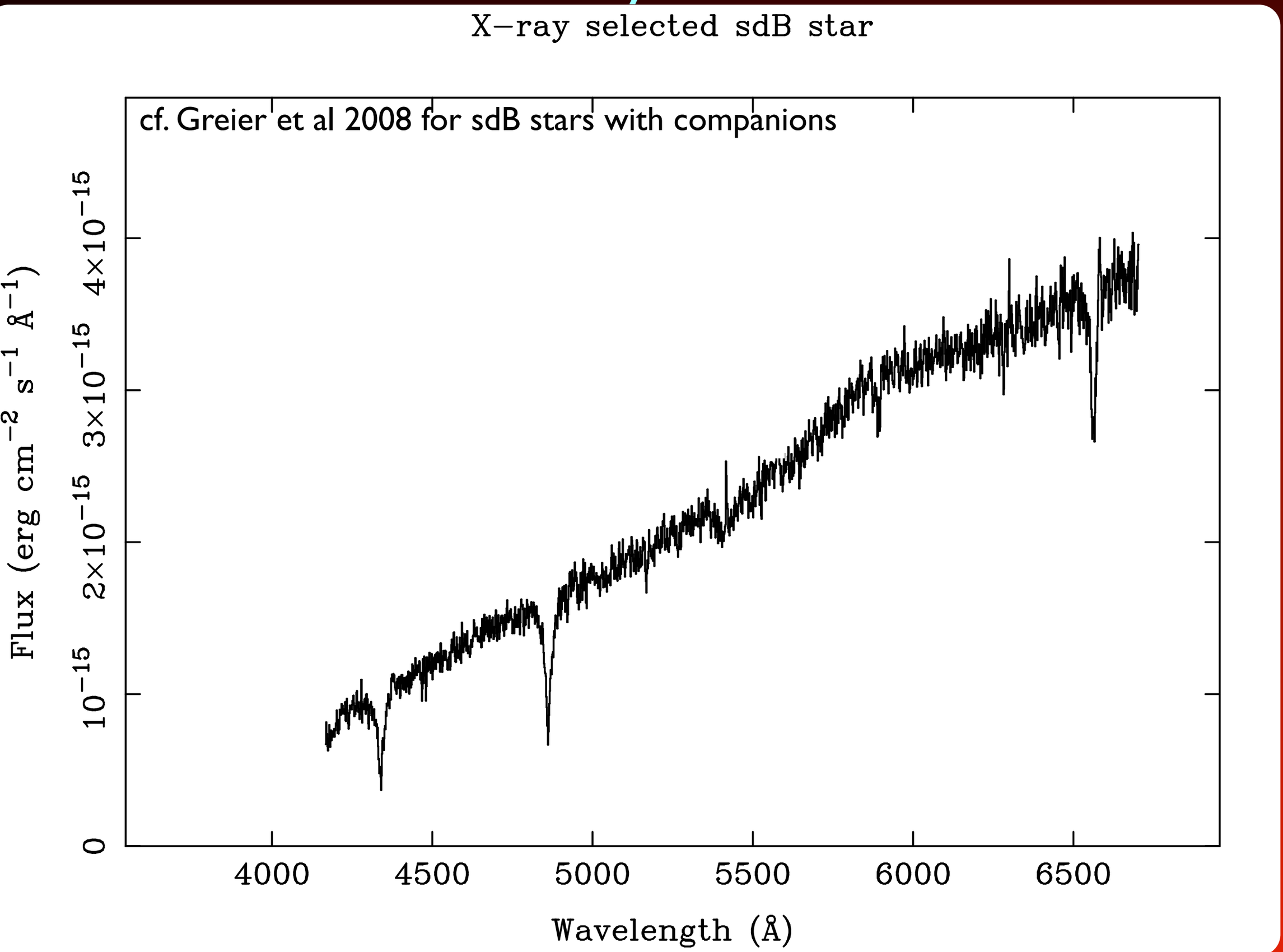
Chandra localisations + CMD (instrumental mag)



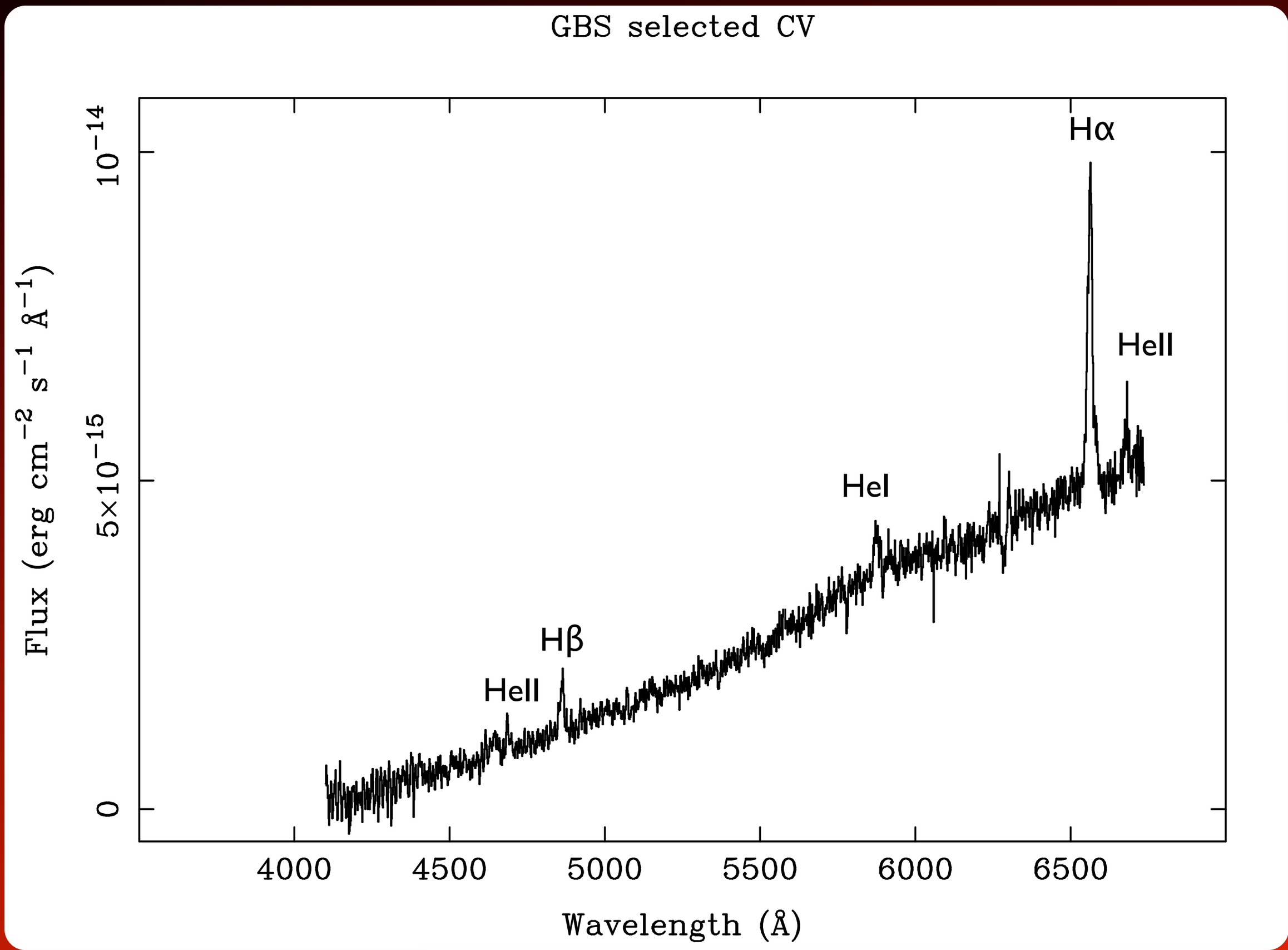


First optical spectroscopic observations: Hydra

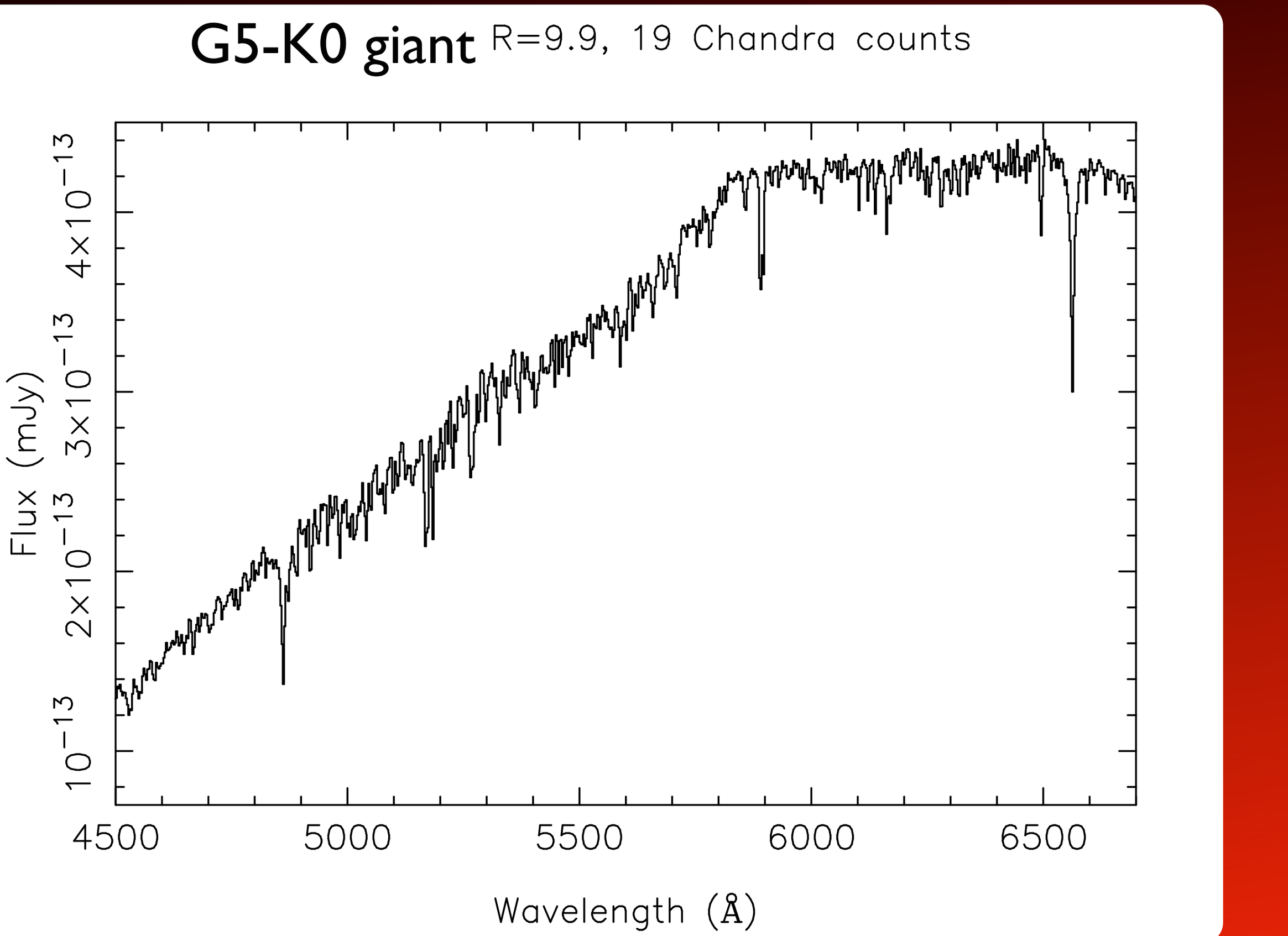
Initial Hydra results



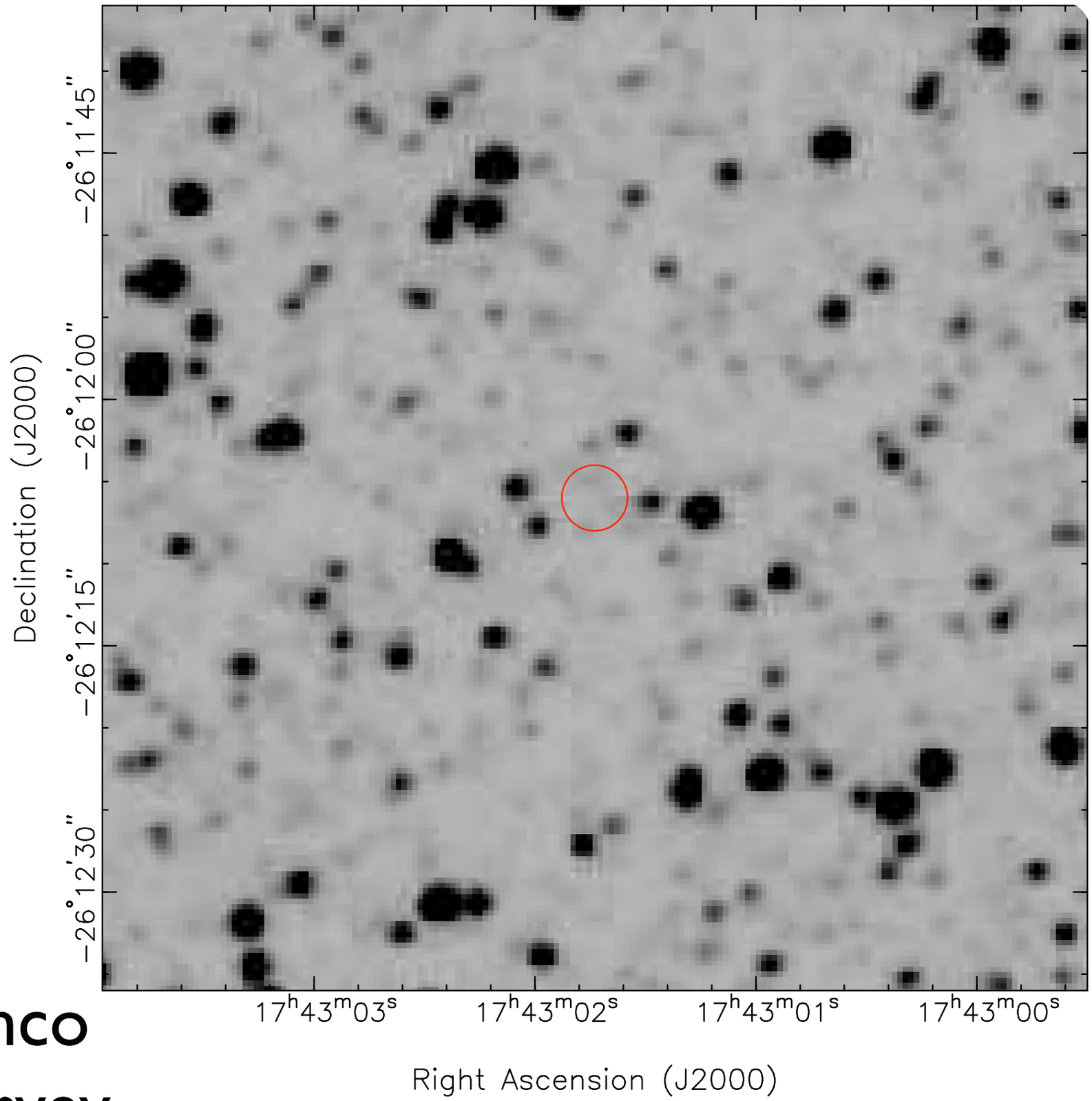
Initial Hydra results (ii)



Initial Hydra results (iii)



First quiescent LMXB?
Not much absorption, faint possible optical counterpart



From our Blanco MOSAIC II Survey

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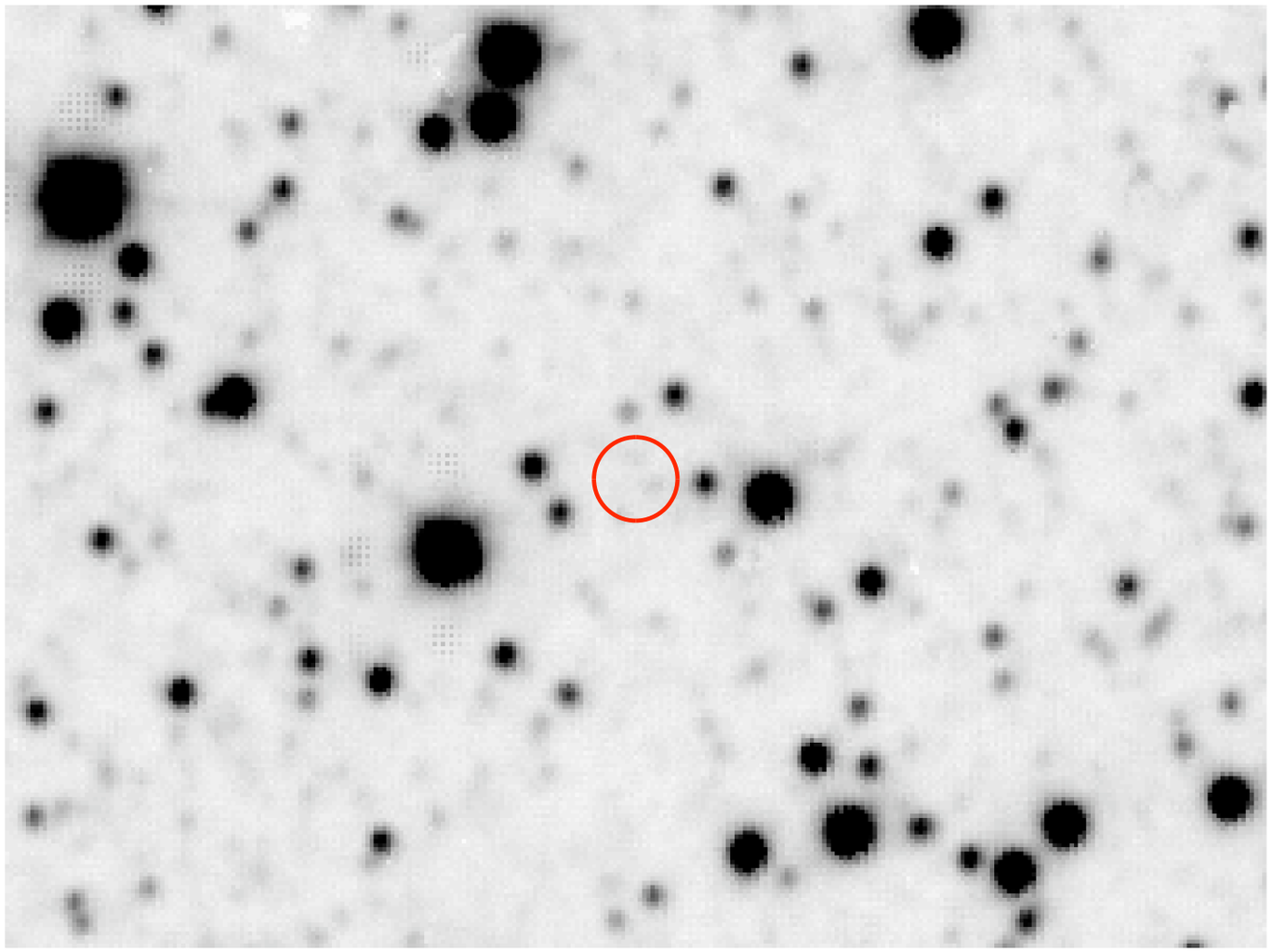

UKIDDS K band image

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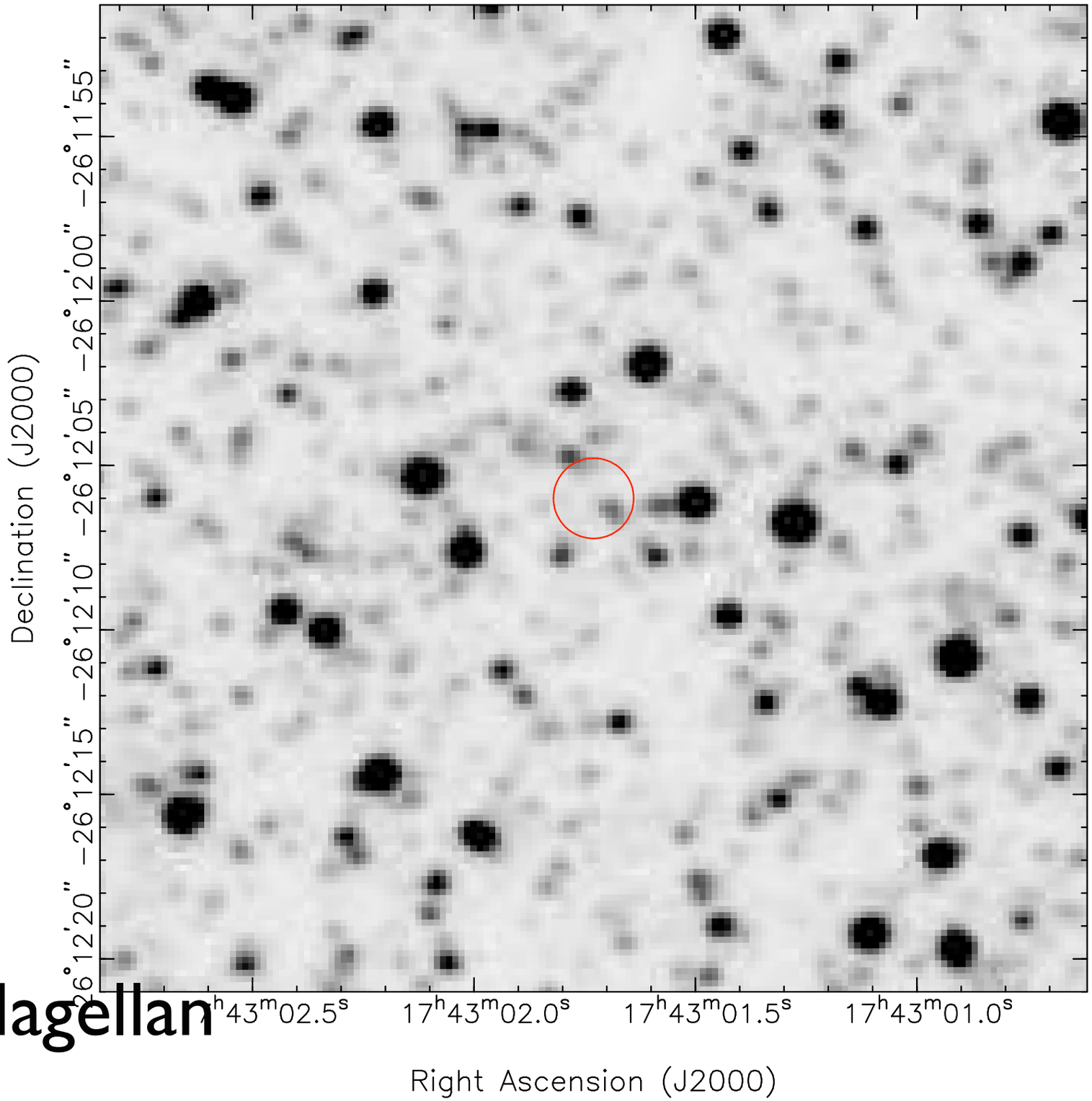
$F_x/F_{opt} > 10$



Deep LDSS3 Magellan image

Finally:

Optical spectroscopy proposals for AAT, Magellan, VLT and Gemini to be submitted

Swift XRT + UVOT proposal to be submitted, UV pick out foreground CVs

A 3 year post-doc position for an optical astronomer available, ask me if interested