Weird Compact Objects from SDSS

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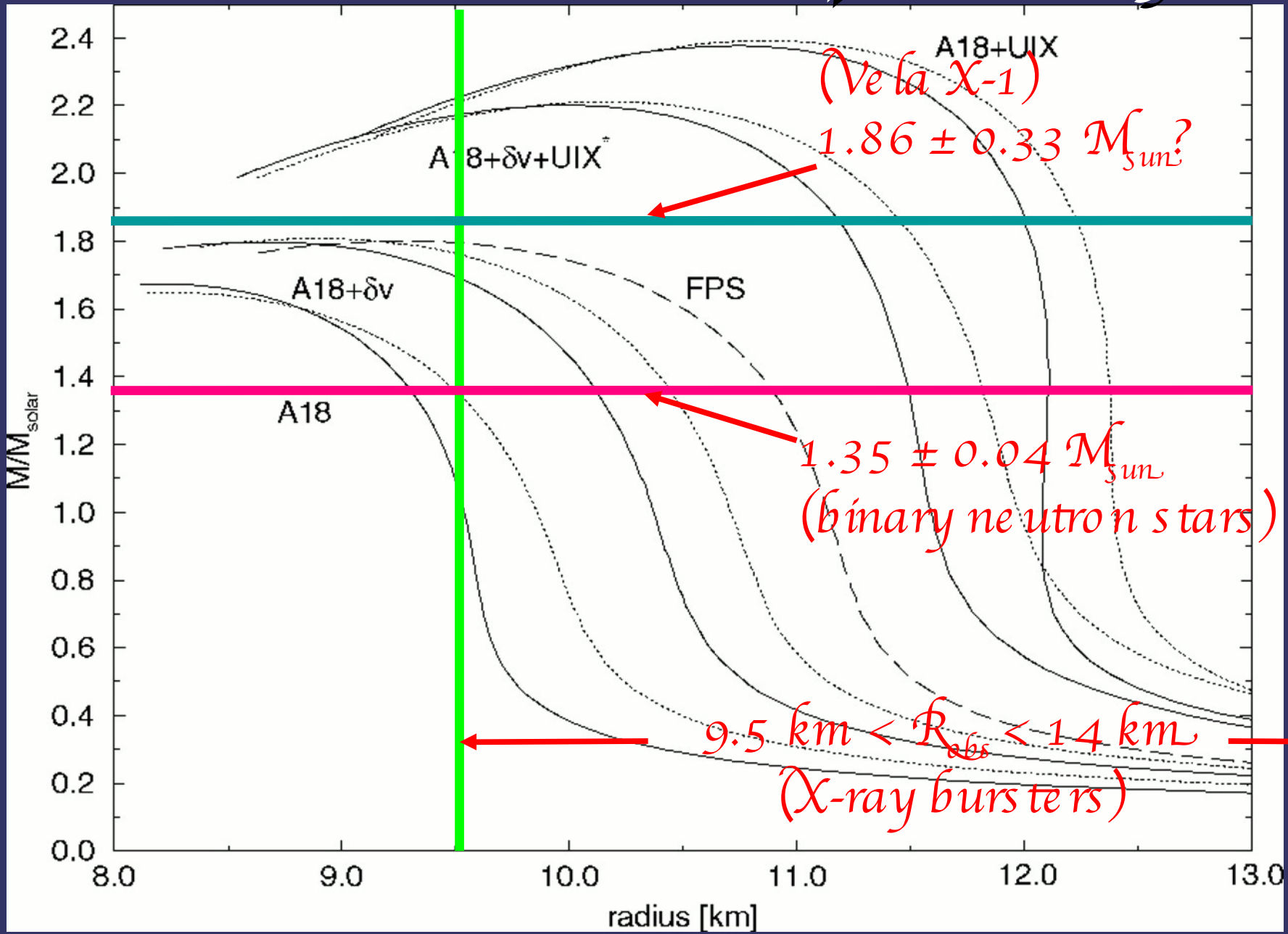
How I used to spend my January 6ths...

The Neutron Star Equation of State



(Vela X-1)
$1.86 \pm 0.33\ M_{sun}$?

$1.35 \pm 0.04\ M_{sun}$
(binary neutron stars)

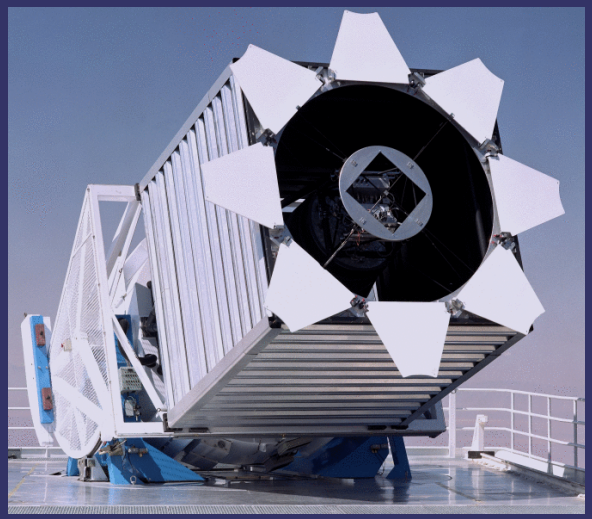
$9.5\ km < R_{abs} < 14\ km$
(X-ray bursters)

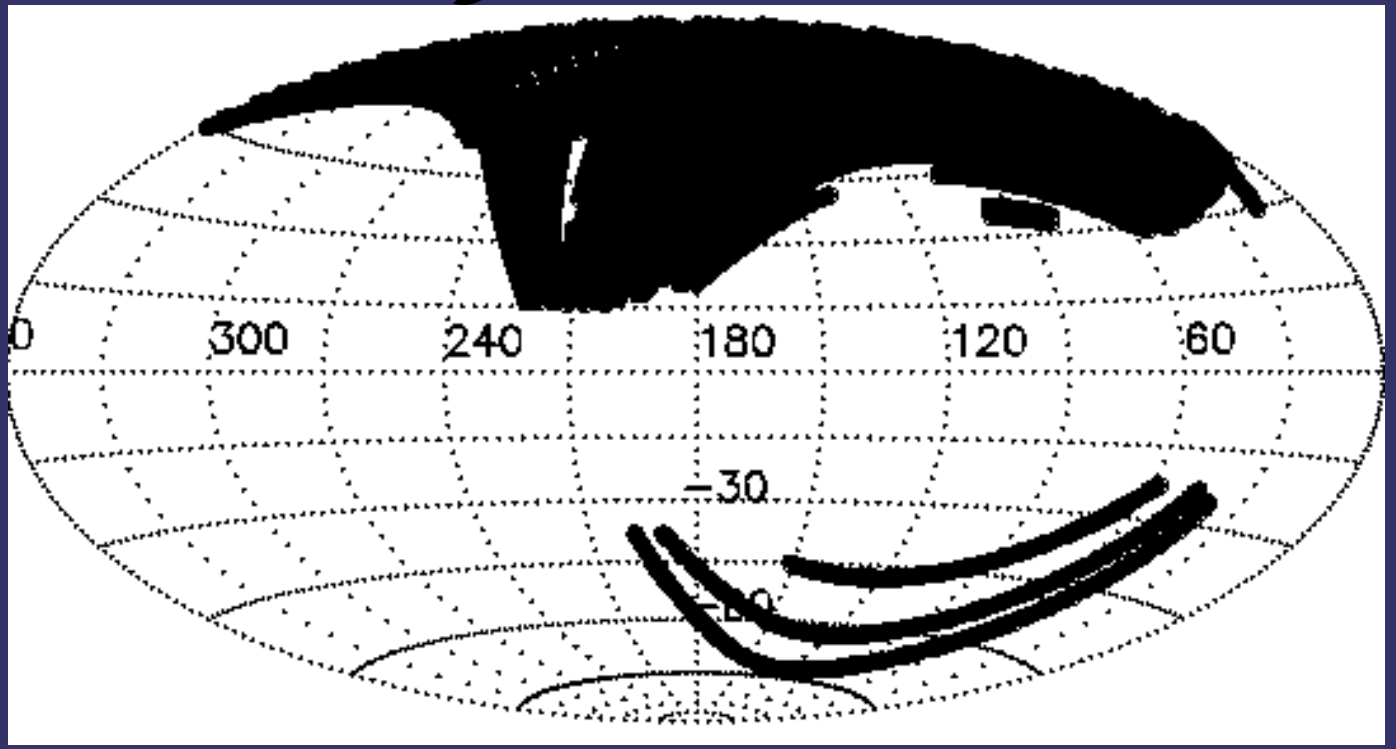
Heiselberg & Pandharipande 2000

The Talk

I. Introduction: The Surveys
II. New Isolated Neutron Star Candidates
III. Low-Mass WDs — Companions to Millisecond Pulsars?
IV. Conclusions

1 The Surveys: SDSS





Sloan Digital Sky Survey (SDSS; 2000-2006)

- six public data releases; most recent: Data Release 5
- 8000 deg^2 of imaging (*u,g,r,i,z*)
- photometry for > 2 x 10^8 objects; faint limit ~ 22.5 mag
- spectroscopy for 10^6 galaxies, 10^5 quasars, & 10^5 stars

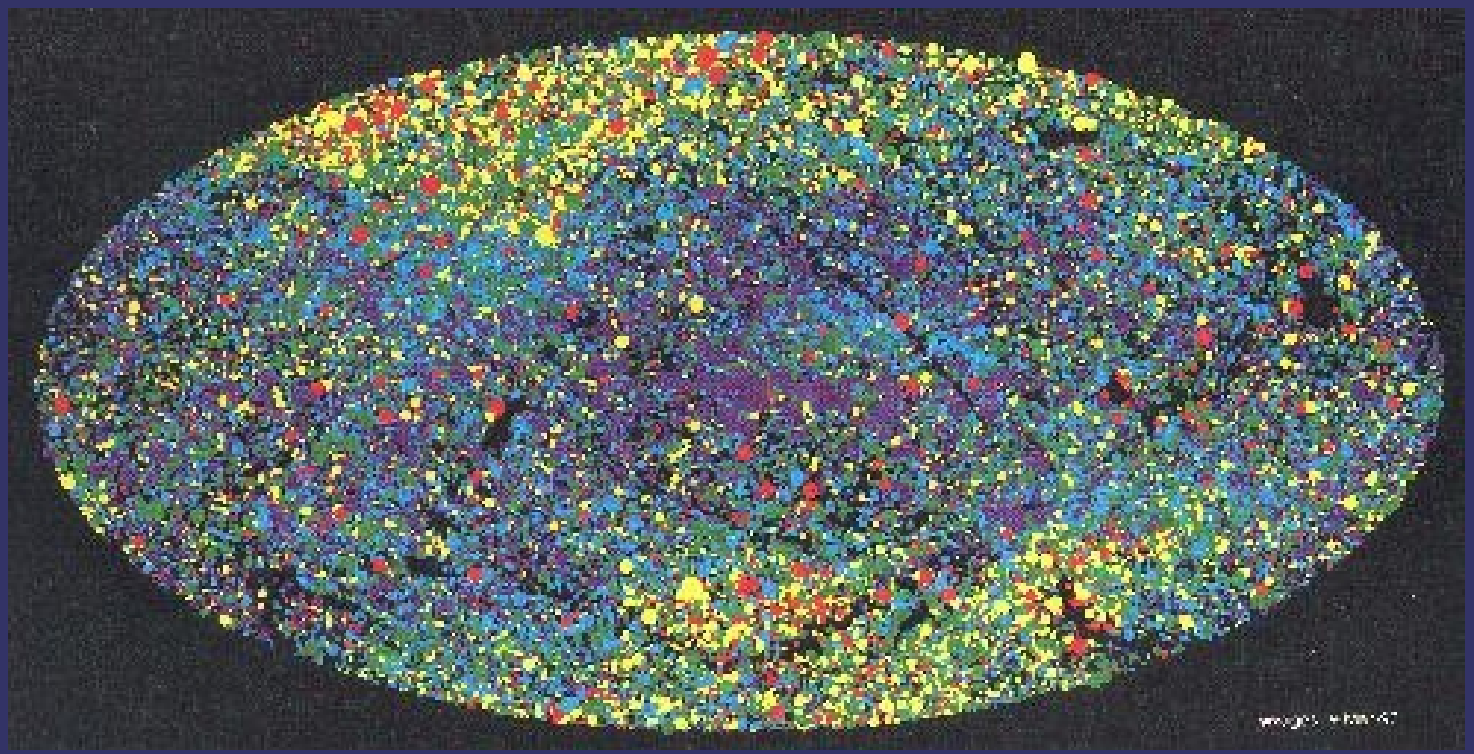
(Adelman-McCarthy et al. 2007)

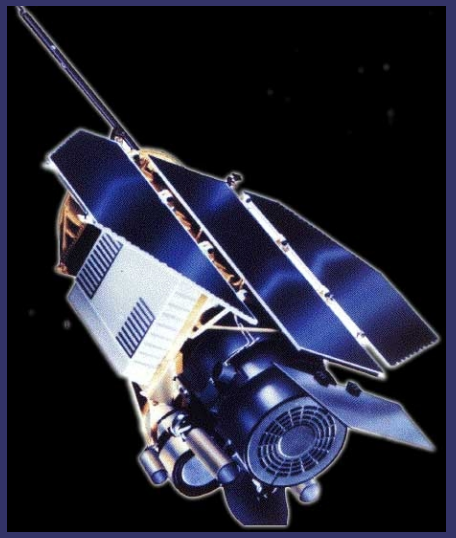
The Surveys: RASS

ROentgen (X-ray) SATellite All-Sky Survey (RASS; 1990-1999)

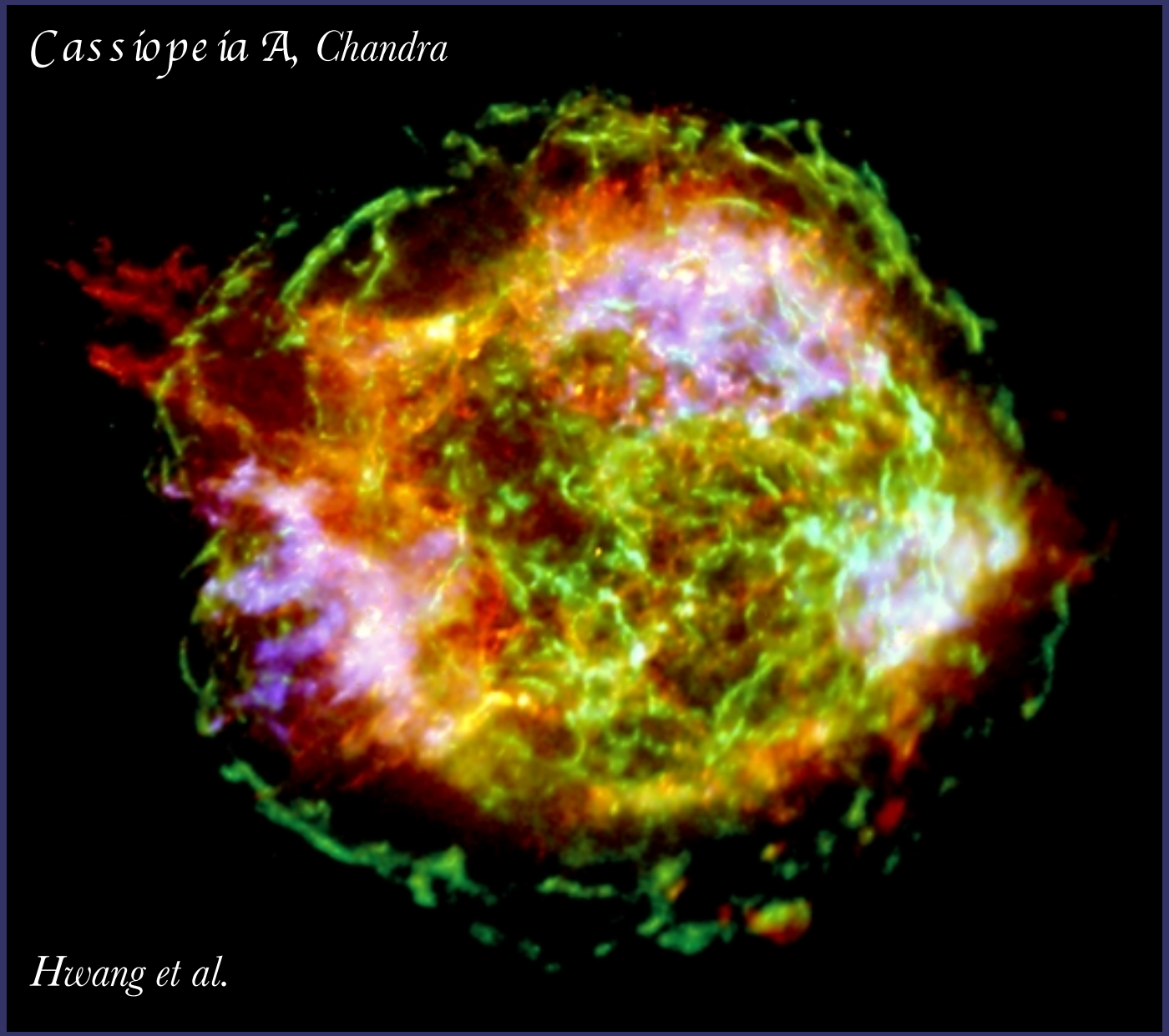
- ~ 400 to ~ 40,000 s exposures; covered 99.7% of sky
- typical limiting sensitivity ~ 10^{-13} ergs cm^{-2} s^{-1}
- > 124,000 sources in merged Bright Source & Faint Source Catalogs

(Voges et al. 1999, 2000)



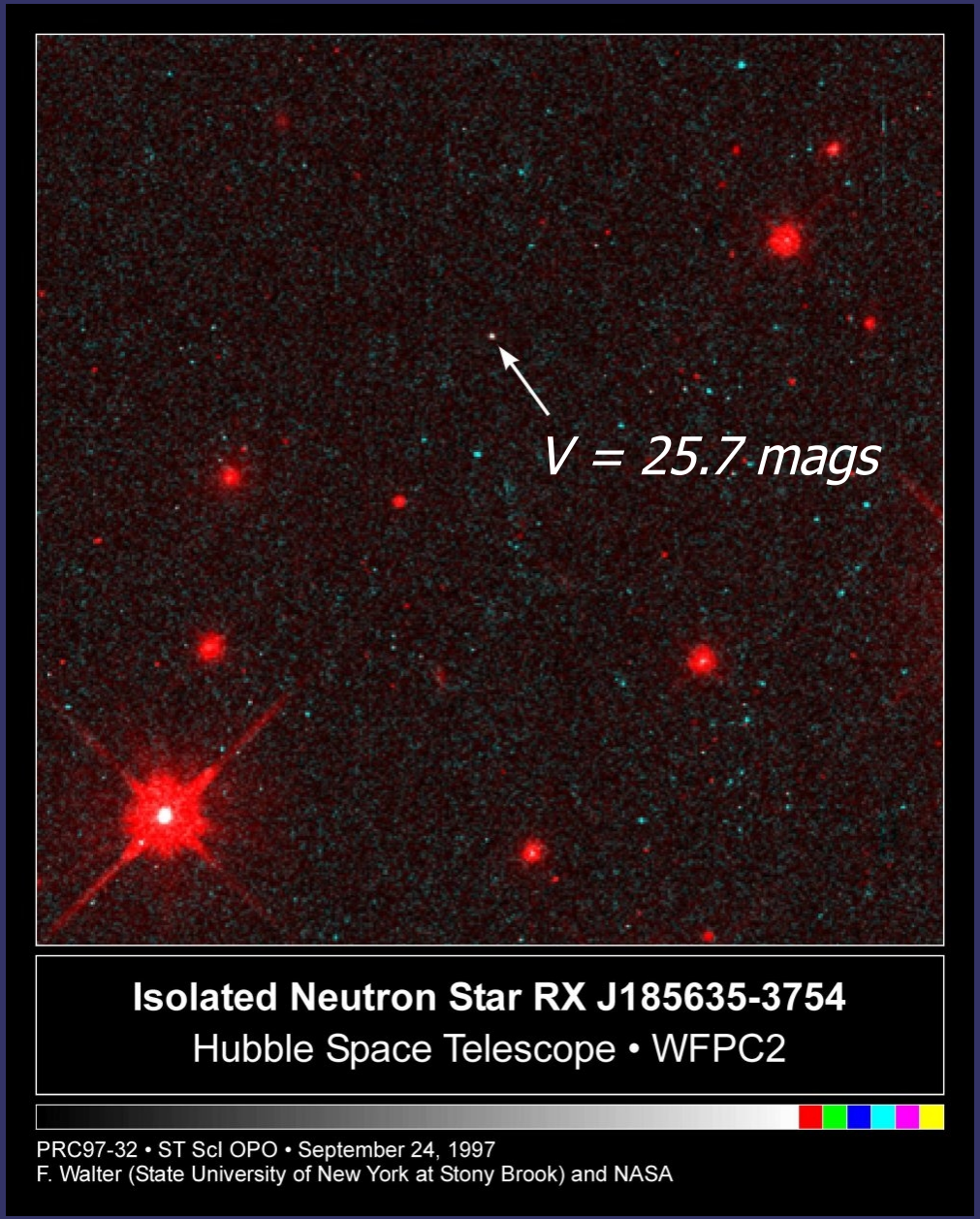


II. Isolated Neutron Star Candidates

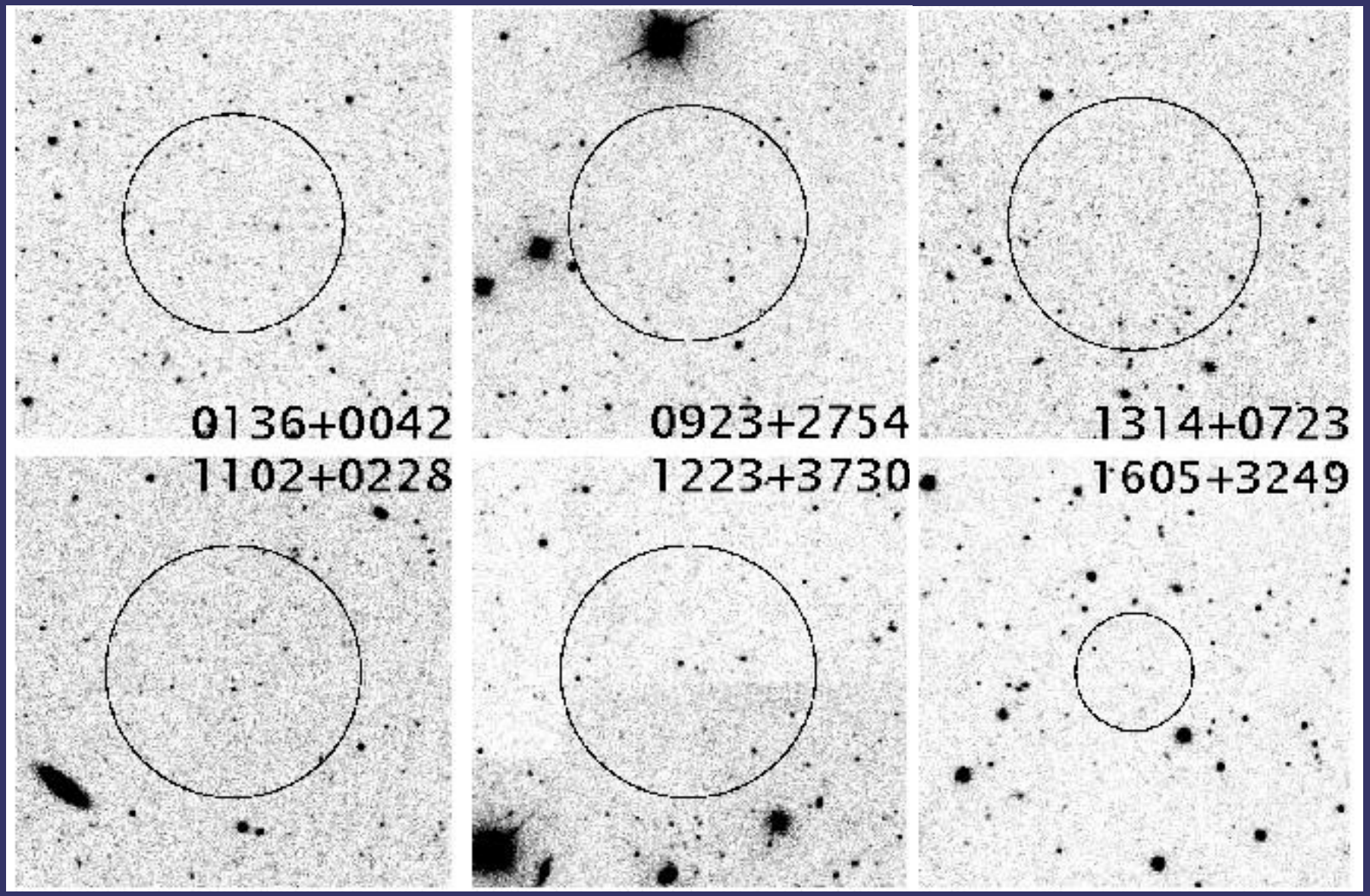


Radio-Quiet Isolated Neutron Stars

- Offer opportunity to study uncontaminated emission from star ("no" accretion, "no" magnetic processes)
- Many predicted, handful discovered with ROSAT
- Have not "solved" NS equation of state



The Candidates



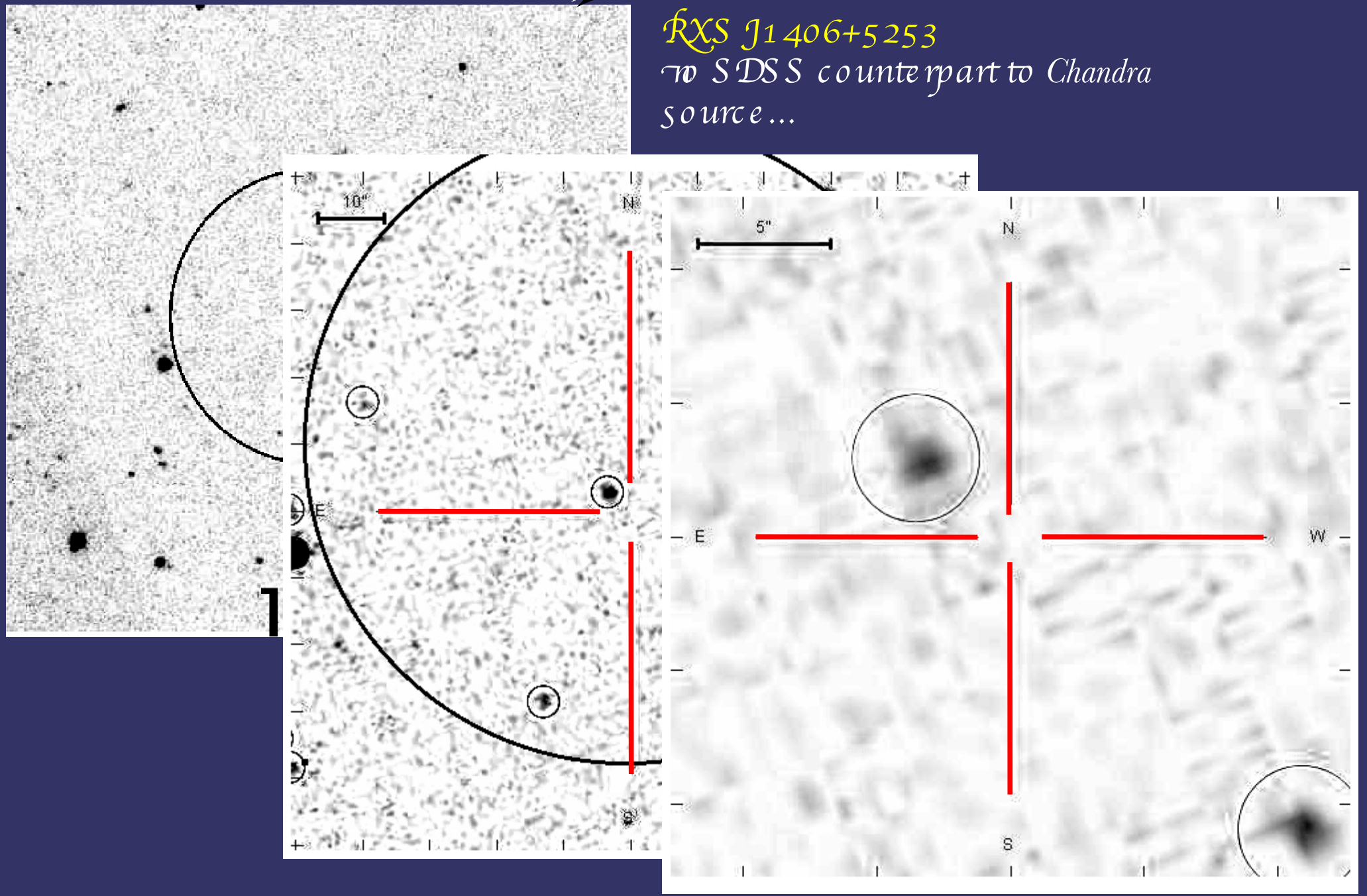
Brightest SDSS object in error circles: g > 21.5

Agüeros et al. 2006

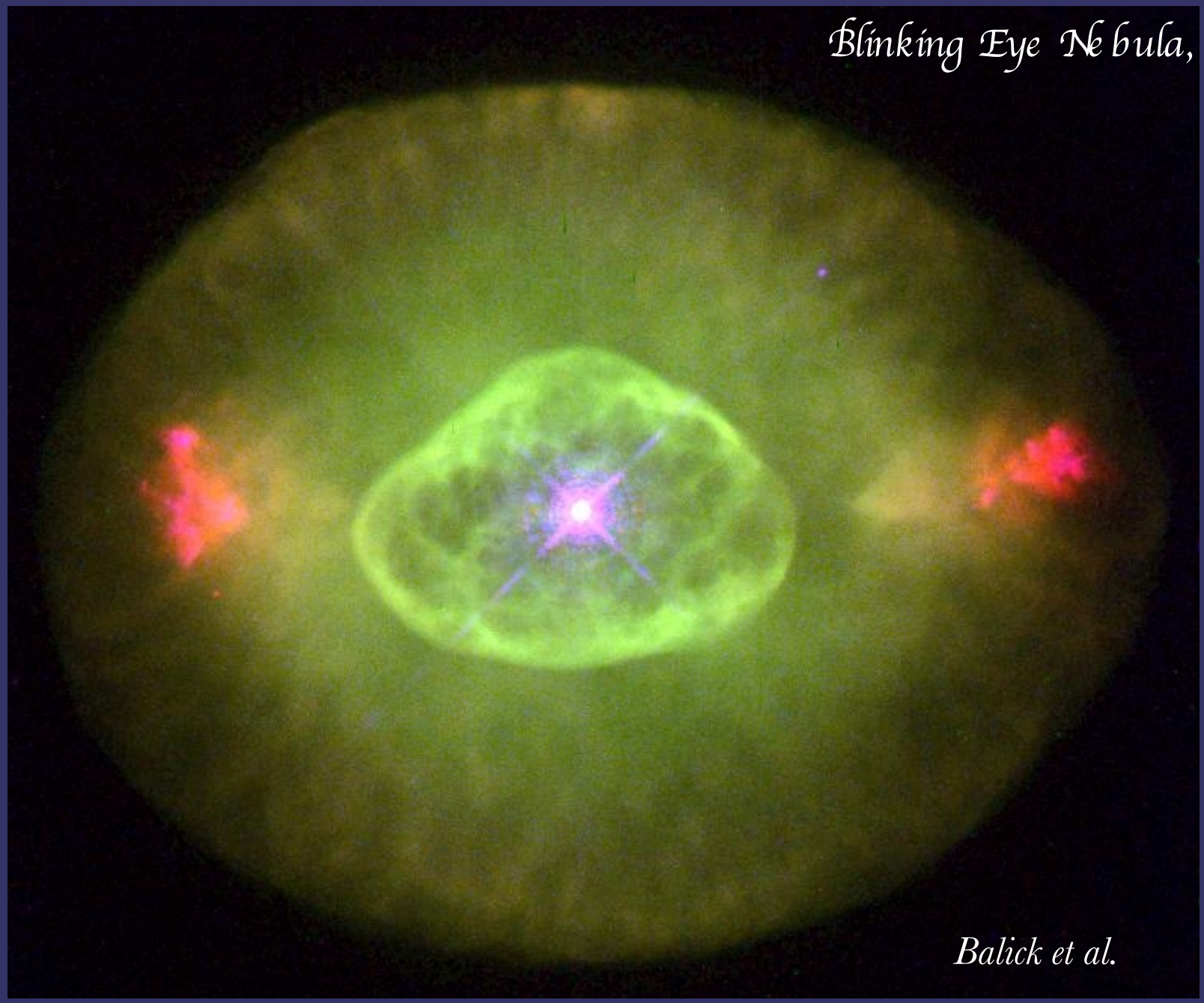
Preliminary Chandra Results

RXS J1406+5253

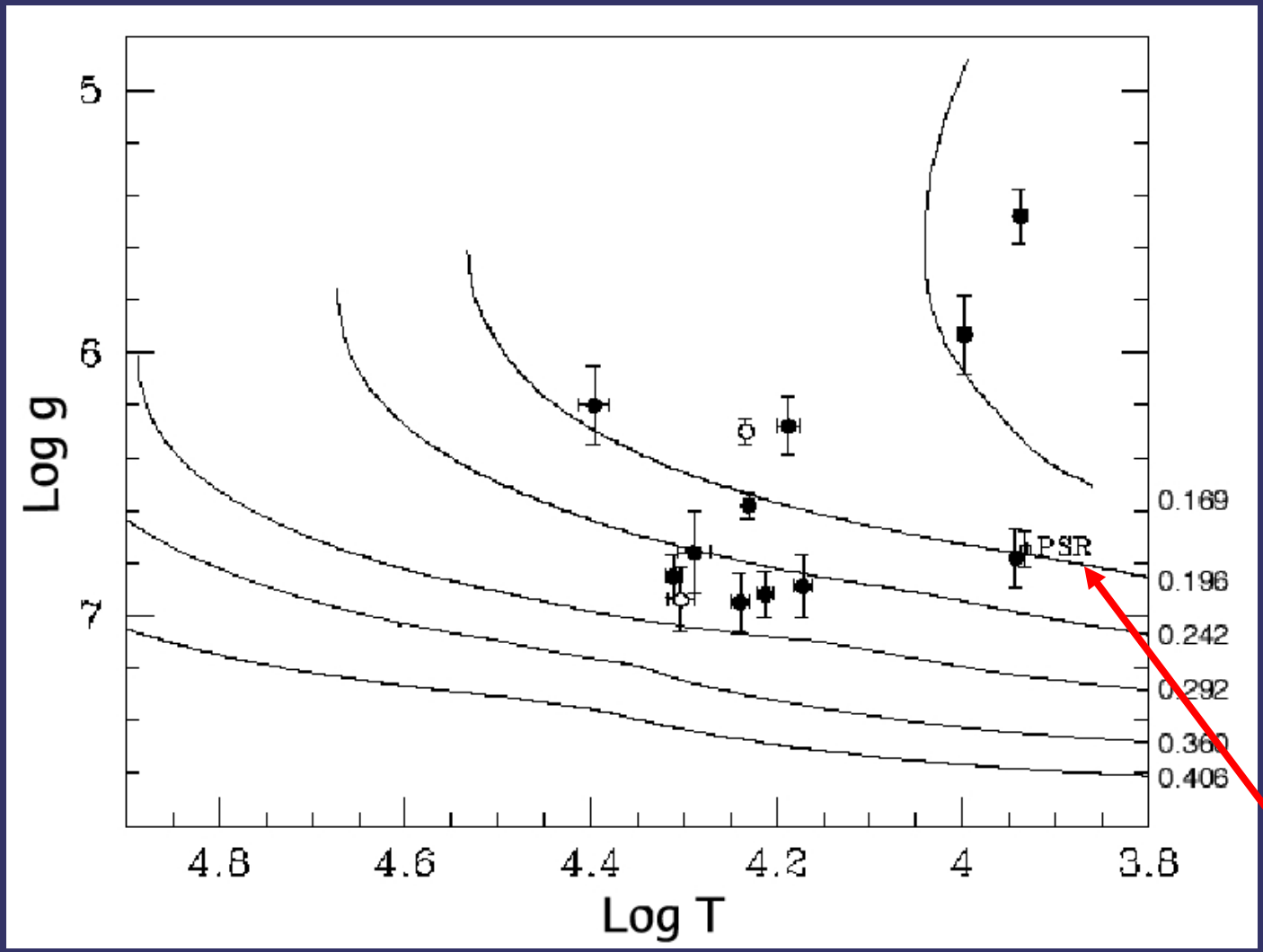
No SDSS counterpart to Chandra source...



III Low-Mass White Dwarfs



New SDSS Low-Mass White Dwarfs

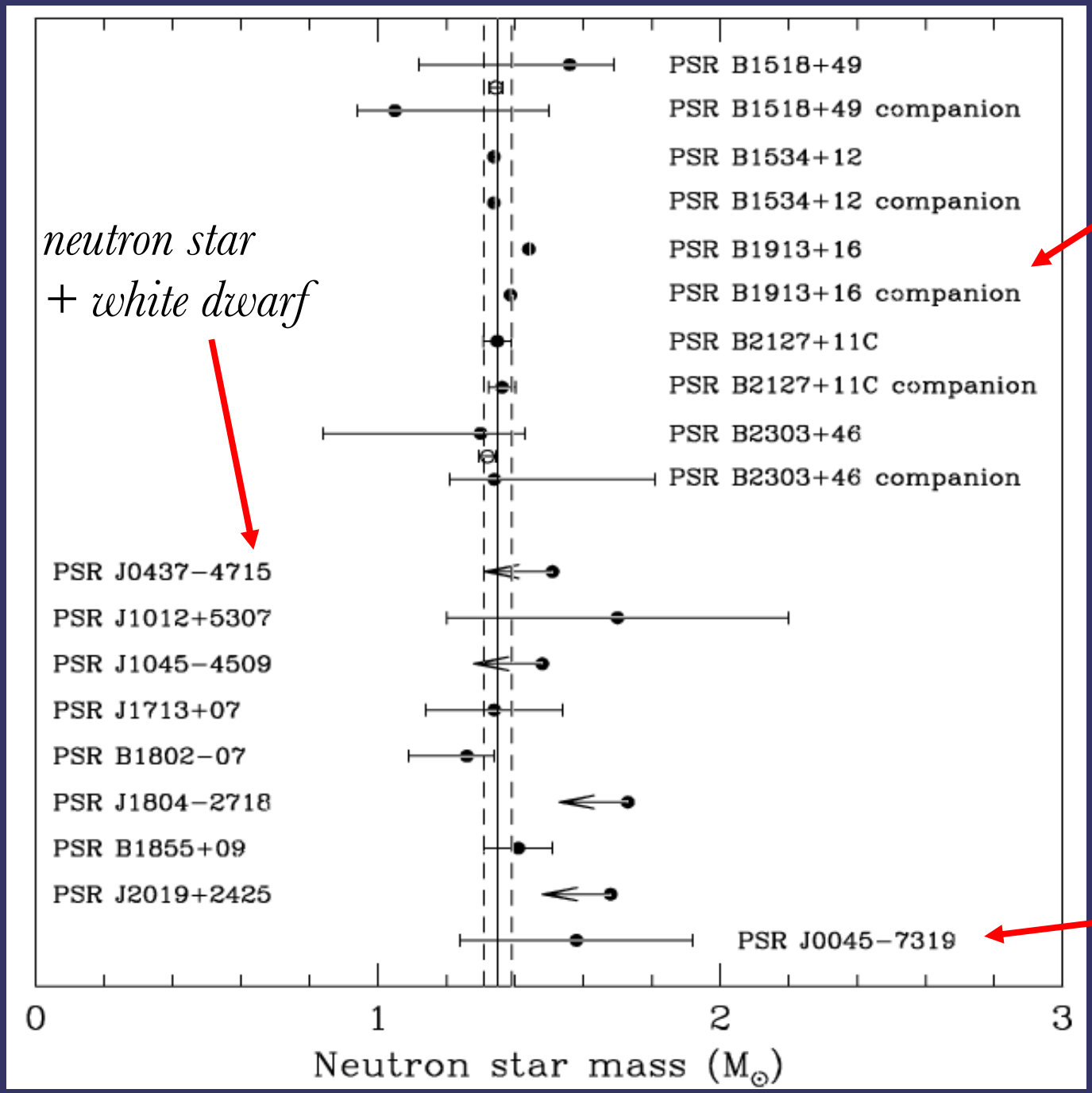


Adapted from Eisenstein et al. 2006

- *DR4 catalog: 9300 WDs; 6000 are new!*
- *~ 0.5%: $M < 0.3\ M_{sun}$*

MSP J1012+5307

IV. Conclusions



neutron star + white dwarf

neutron star + neutron star

neutron star + normal star

Provides very tight constraints on NS mass, from sample of 26 stars:

$1.35 \pm 0.04\ M_{sun}$

Thorsett & Chakrabarty 1999

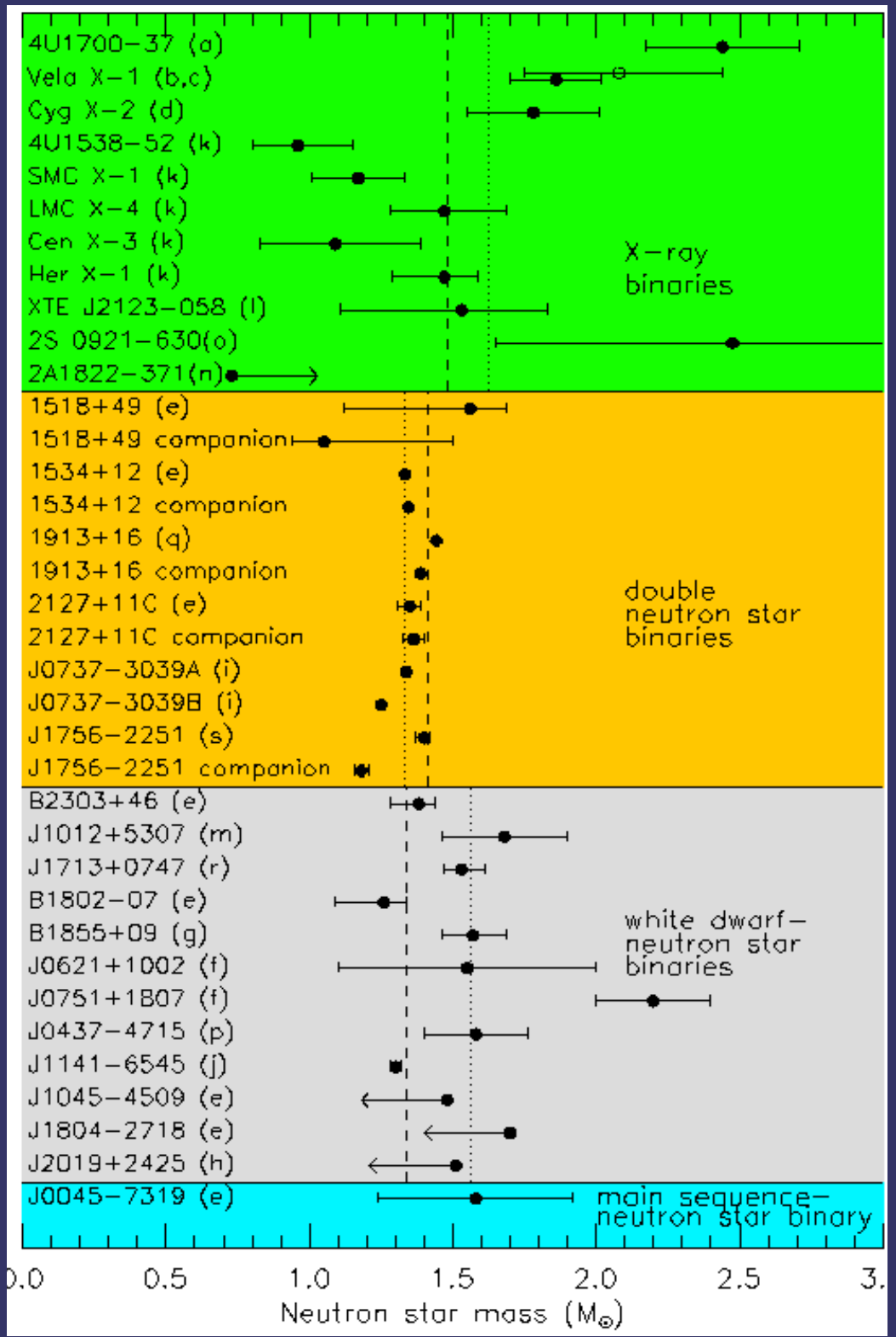
THE (New) Plot?

Importance of evolutionary scenarios?

$M = 1.62\ M_{sun}$

and $M = 1.33\ M_{sun}$

and $M = 1.56\ M_{sun}$



Lattimer & Prakash 2005

Questions?