

**3FGL J1544.6-1125:
Radio Imaging
Analysis of the
Newest Transitional
Millisecond Pulsar**

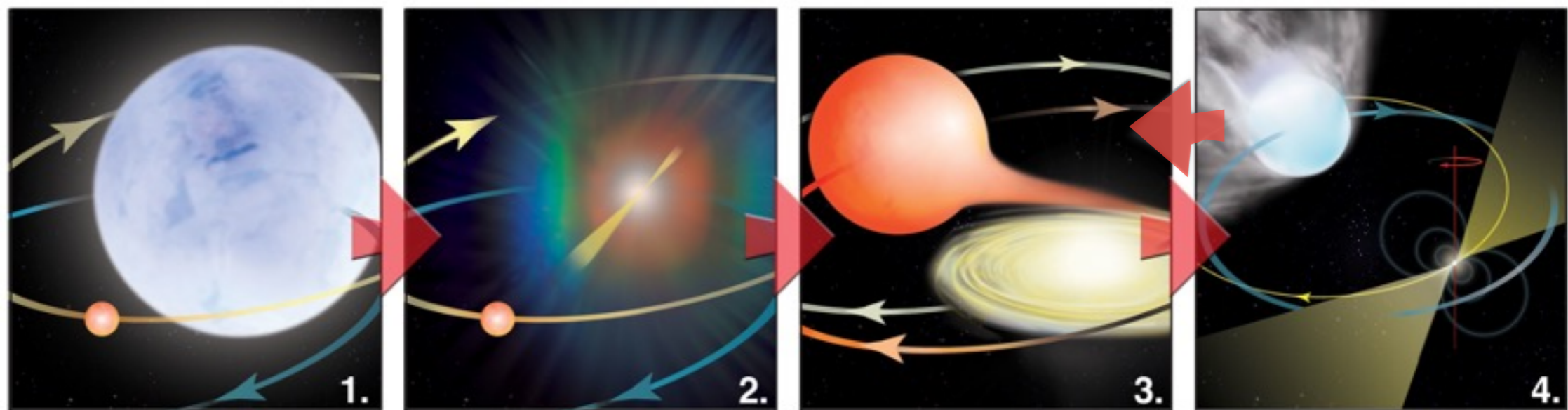
**Texas Symposium, Binaries,
Session 15
16th Dec. 2015**

Amruta Jaodand

**Adam Deller, Jason Hessels, Anne Archibald,
Slavko Bogdanov
Alessandro Patruno, Caroline D'Angelo,**

Pulsar Recycling

- **PSR J1023+0038**, (1.69 ms) Archibald et al. (2009)
- XSS J12270–4859, (1.69 ms) Bassa et al. (2014)
- PSR J1824–2452I (3.9 ms) Papitto et al. (2013)
- 3FGL J1544-1125 (?? ms) Bogdanov & Halpern (2015)



Binary

SN

X-Ray Binary

Radio MSP

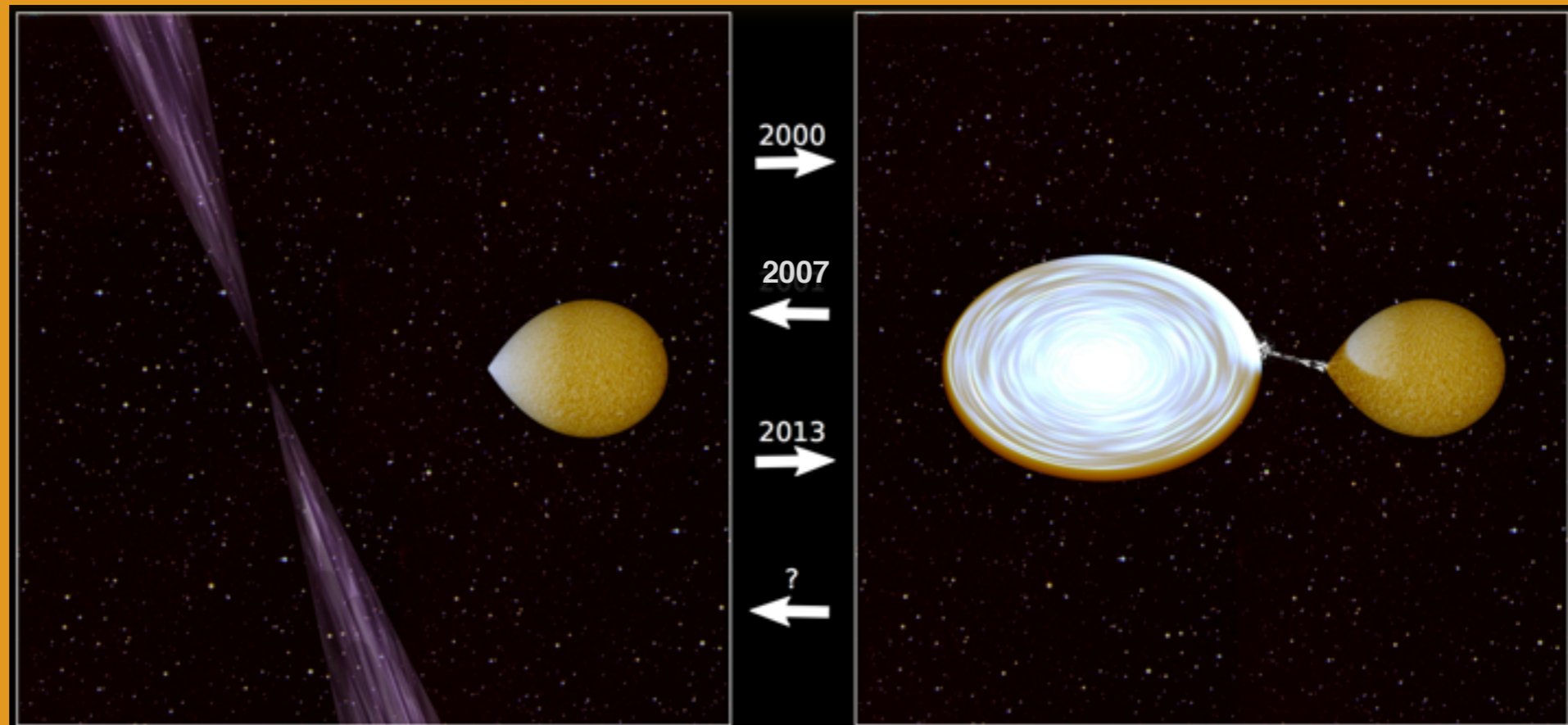
Alpar et al. 1982,
Radhakrishnan & Srinivasan 1984

Why
tMSPs??

- Probe low-level accretion
- Jet mechanism
- Accretion flow
- Pulsar winds

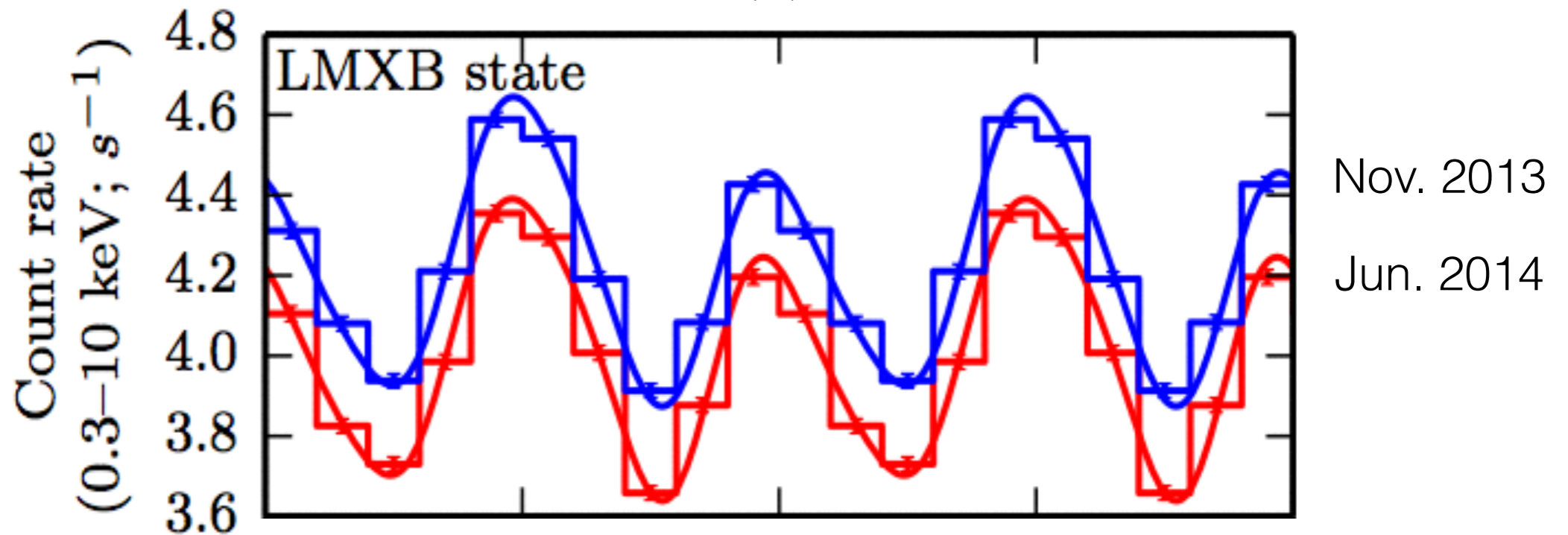
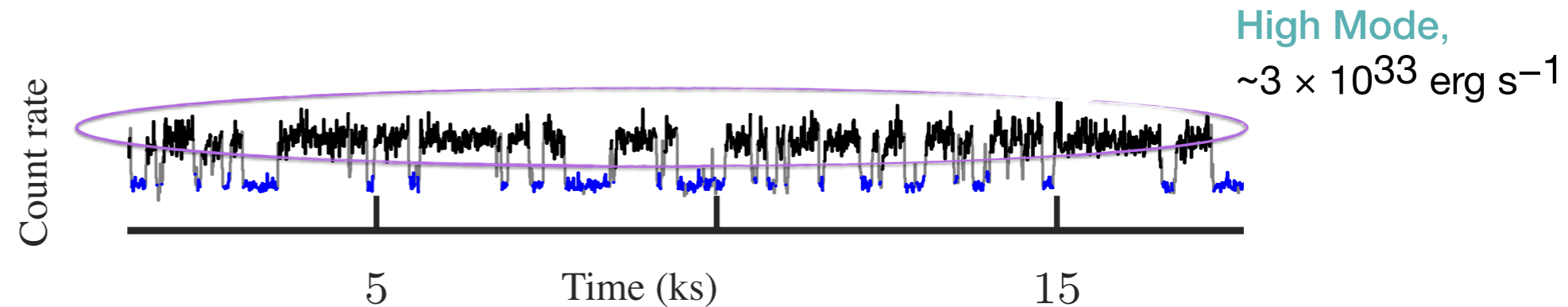
RMSP

LMXB



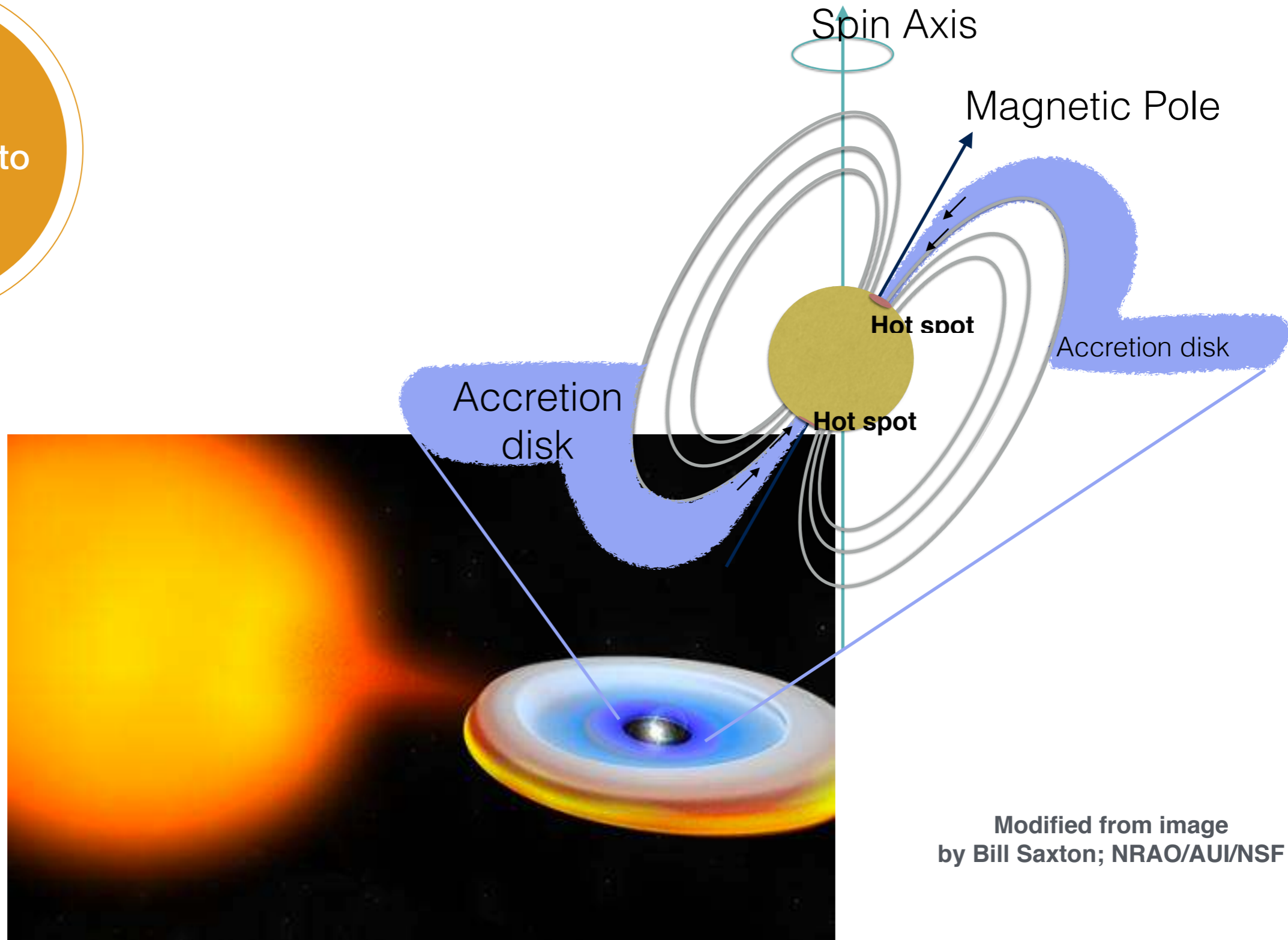
PSR J1023+0038

Incoherent X-ray Pulsations



Archibald et al. (2015), Bogdanov et al. (2015)
Papitto et al. (2015)

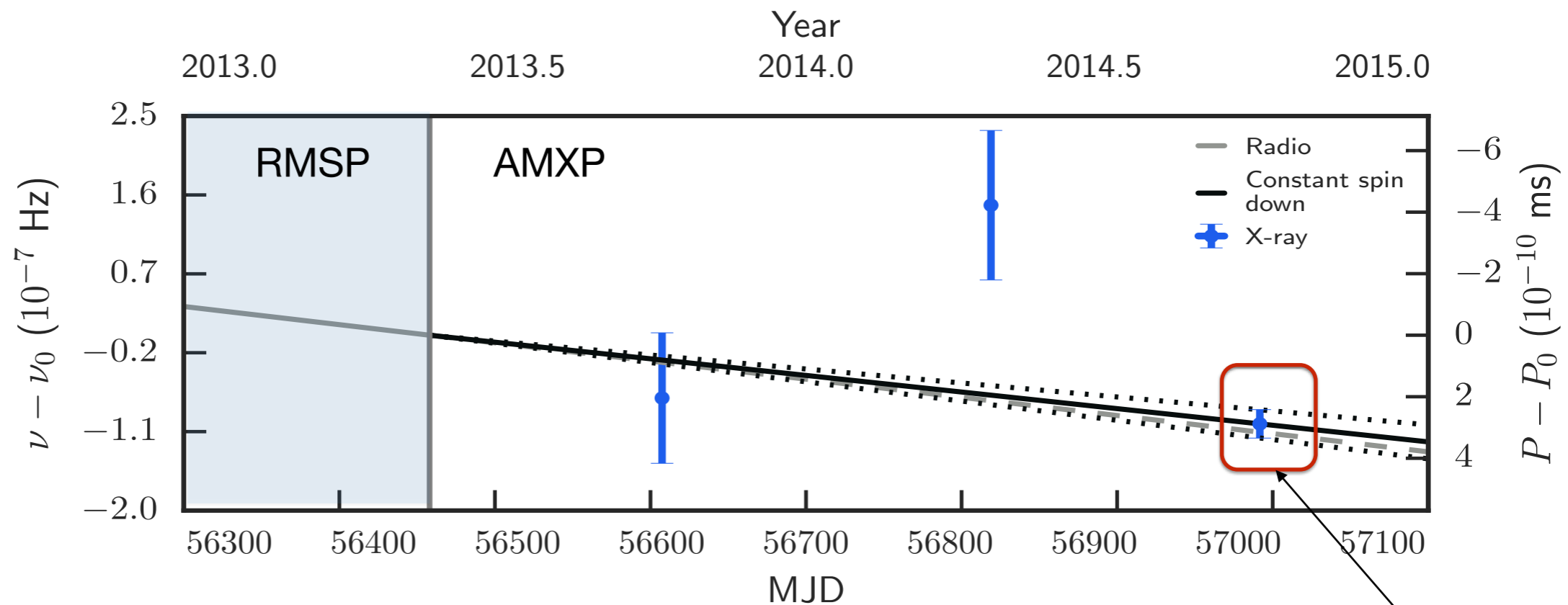
Accretion onto NS



Modified from image by Bill Saxton; NRAO/AUI/NSF

Archibald et al. (2015), Bogdanov et al. (2015)
Papitto et al. (2015)

Timing results



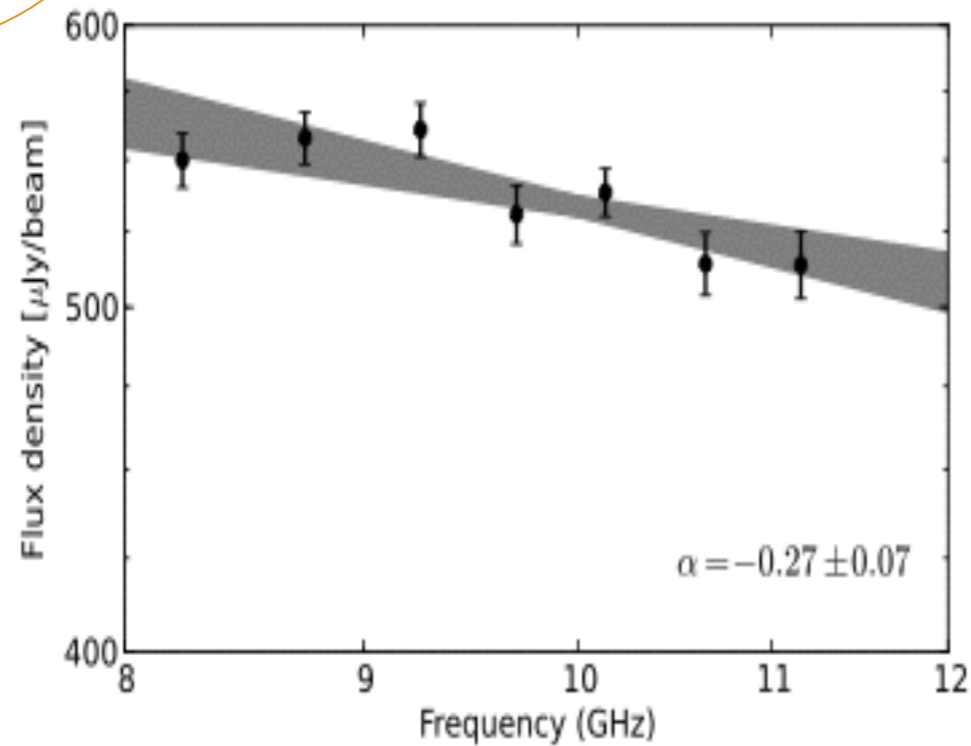
Four observations phase connected over a month

$$\dot{P}_{LMXB} = \dot{P}_{RMSP} (0.91 \pm 0.15)$$

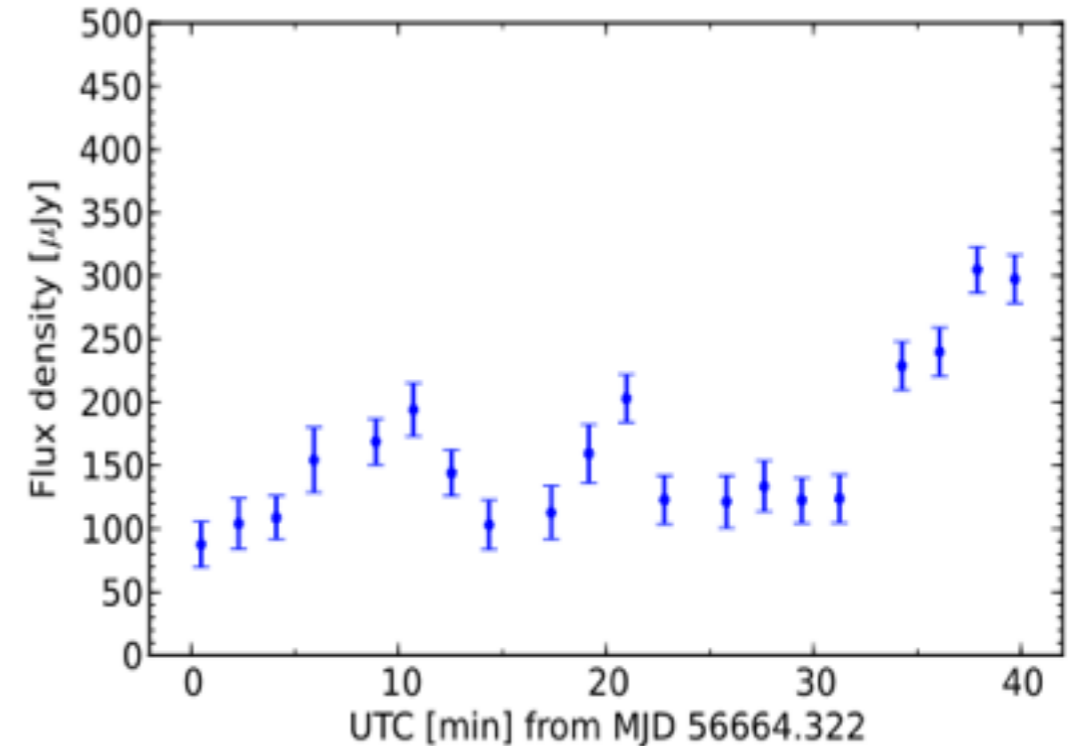
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Radio Imaging

Spectrum



Lightcurve



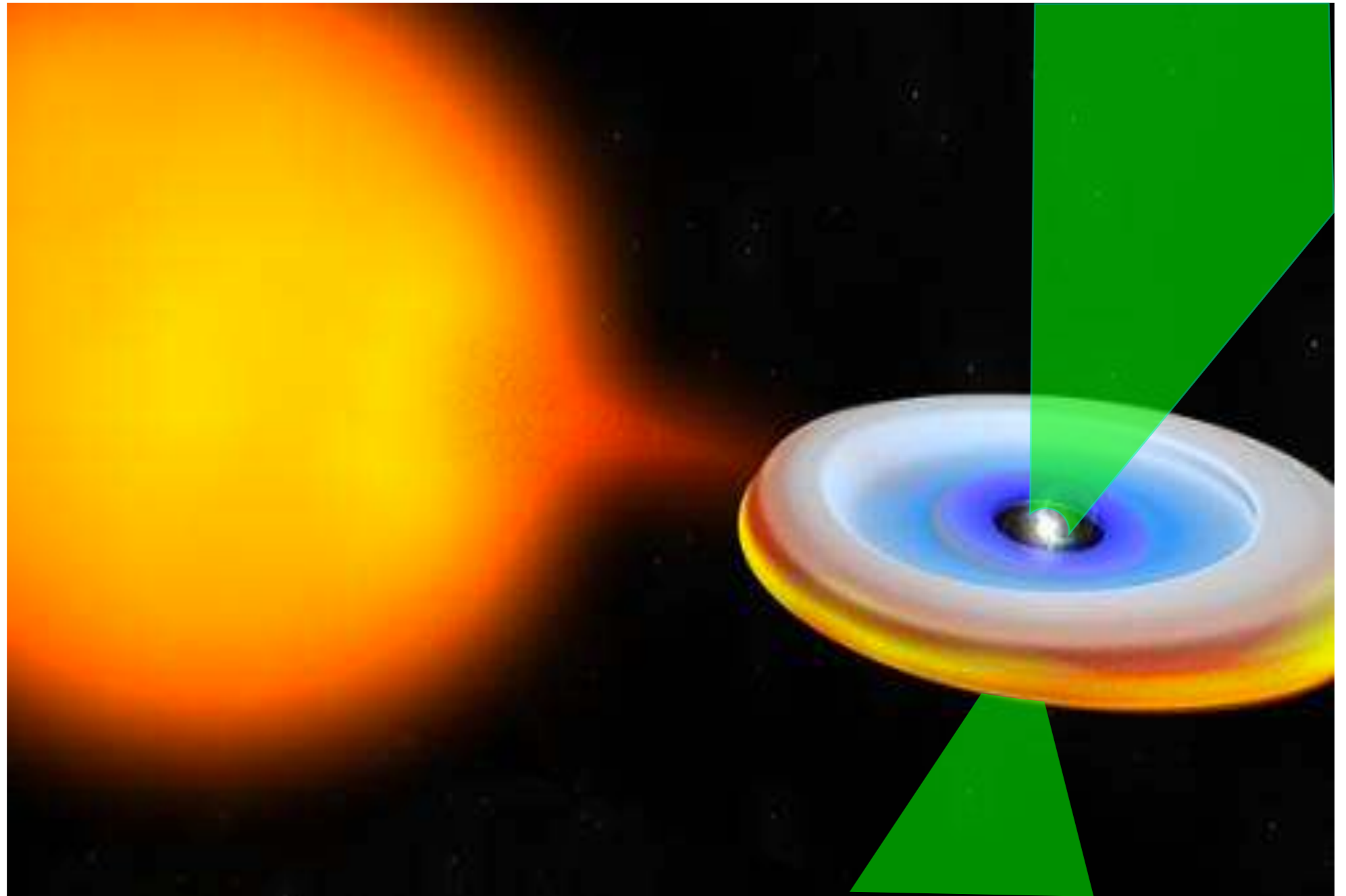
Deller et al. (2015)

Spectral Index: (-0.3,0.3)

Flat Spectrum continuum radio emission

Collimated outflow

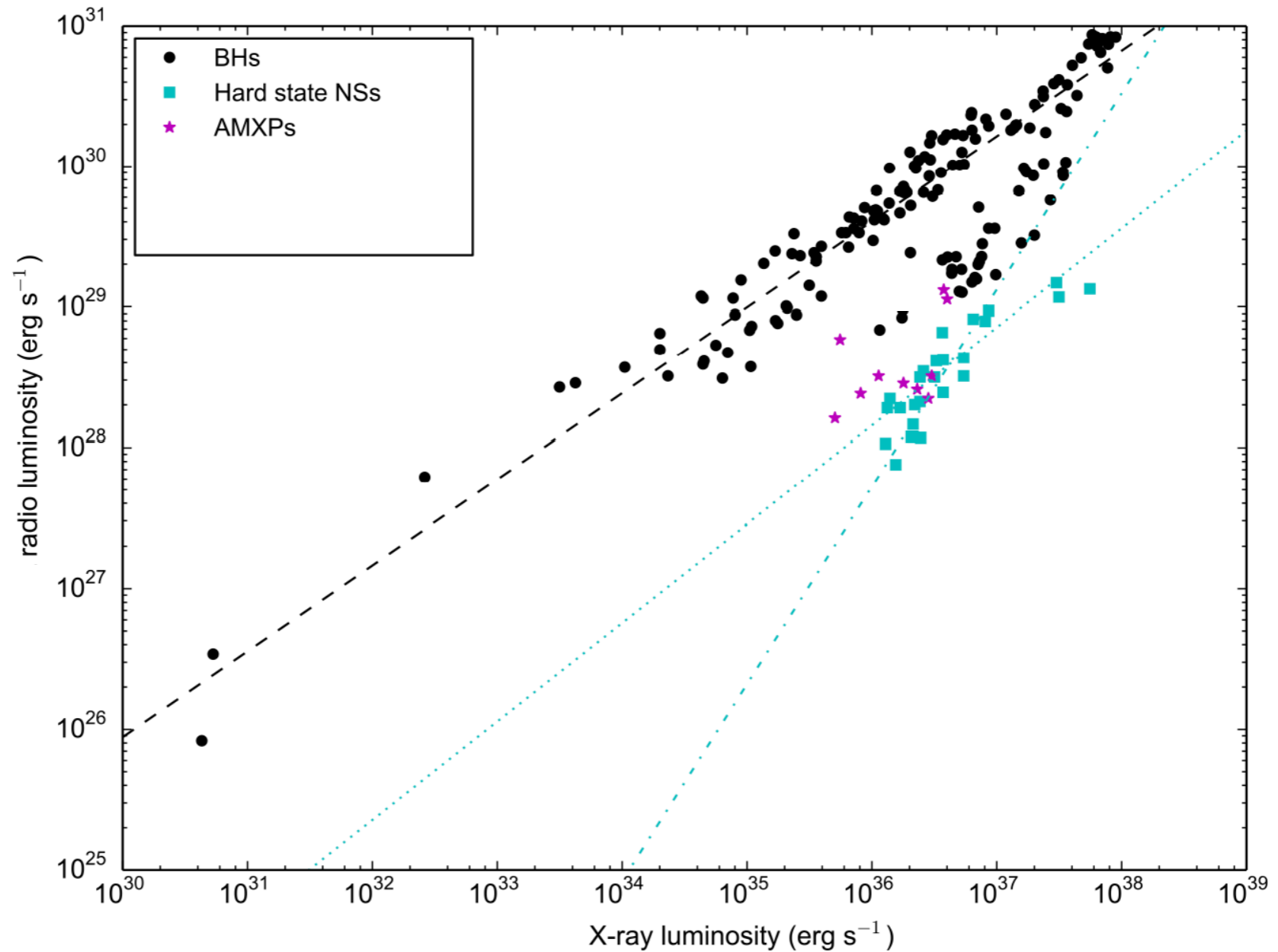
Jets



Modified from image by Bill Saxton; NRAO/AUI/NSF

LMXBs: L_R/L_X

Outflows and jets

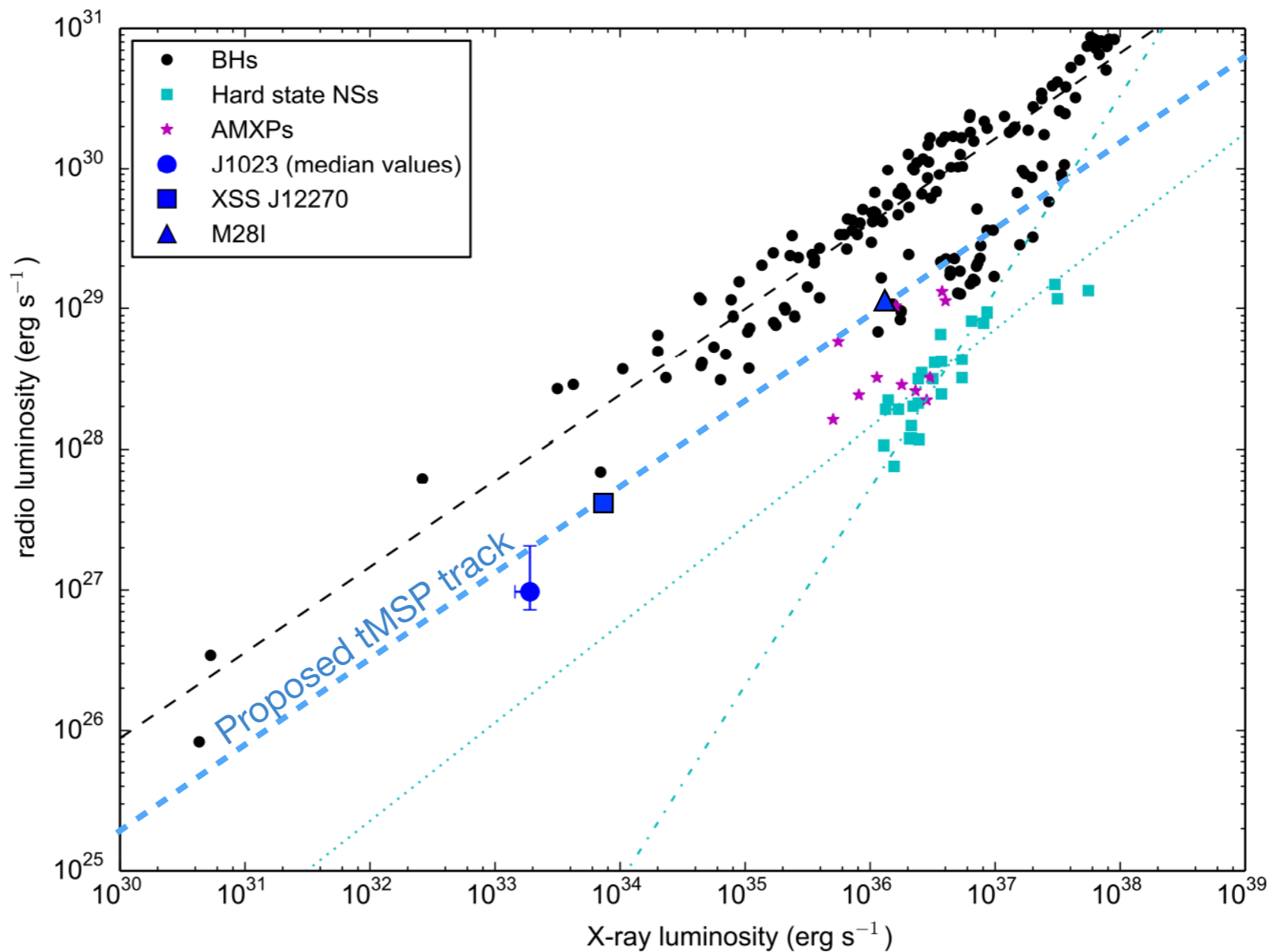


LMXB jet
luminosity:
 $L_R \propto L_X^{1.4}$

BH Jet
luminosity:
 $L_R \propto L_X^{0.7}$

PSR J1023+0038

Radio Imaging Result

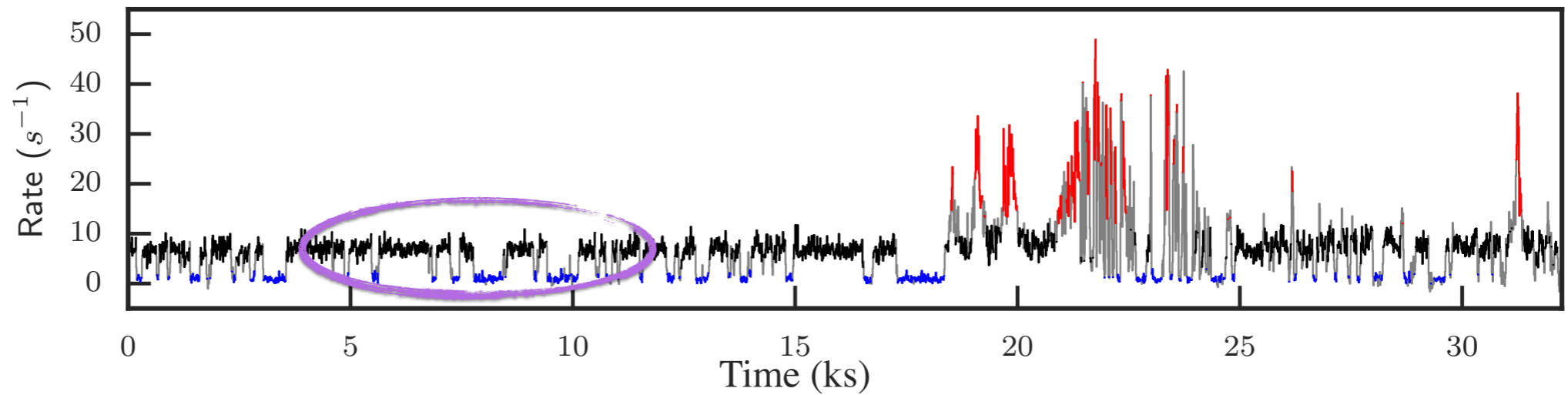




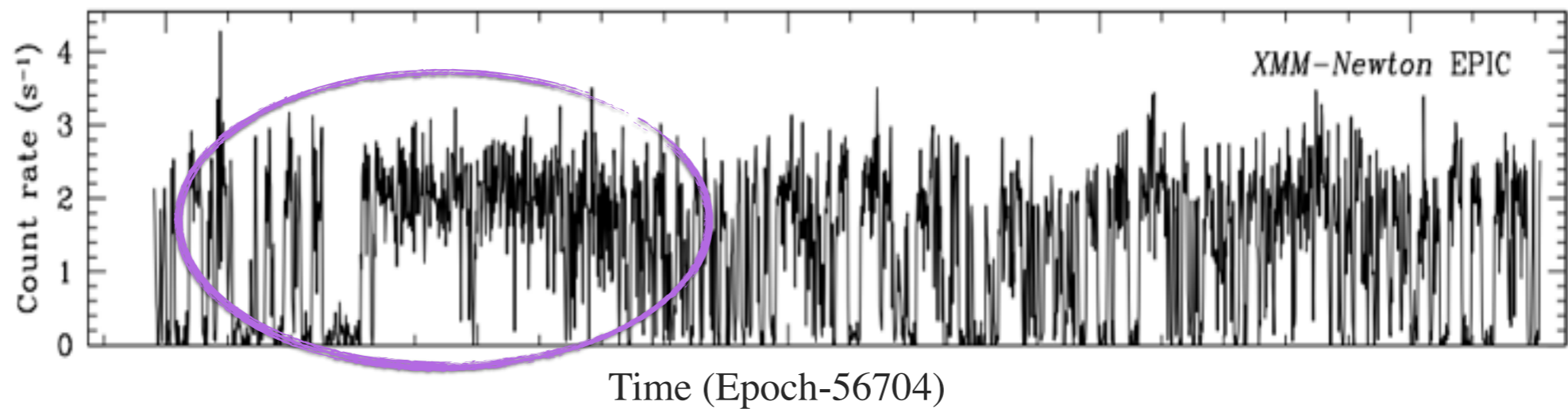
Typical for tMSPs??

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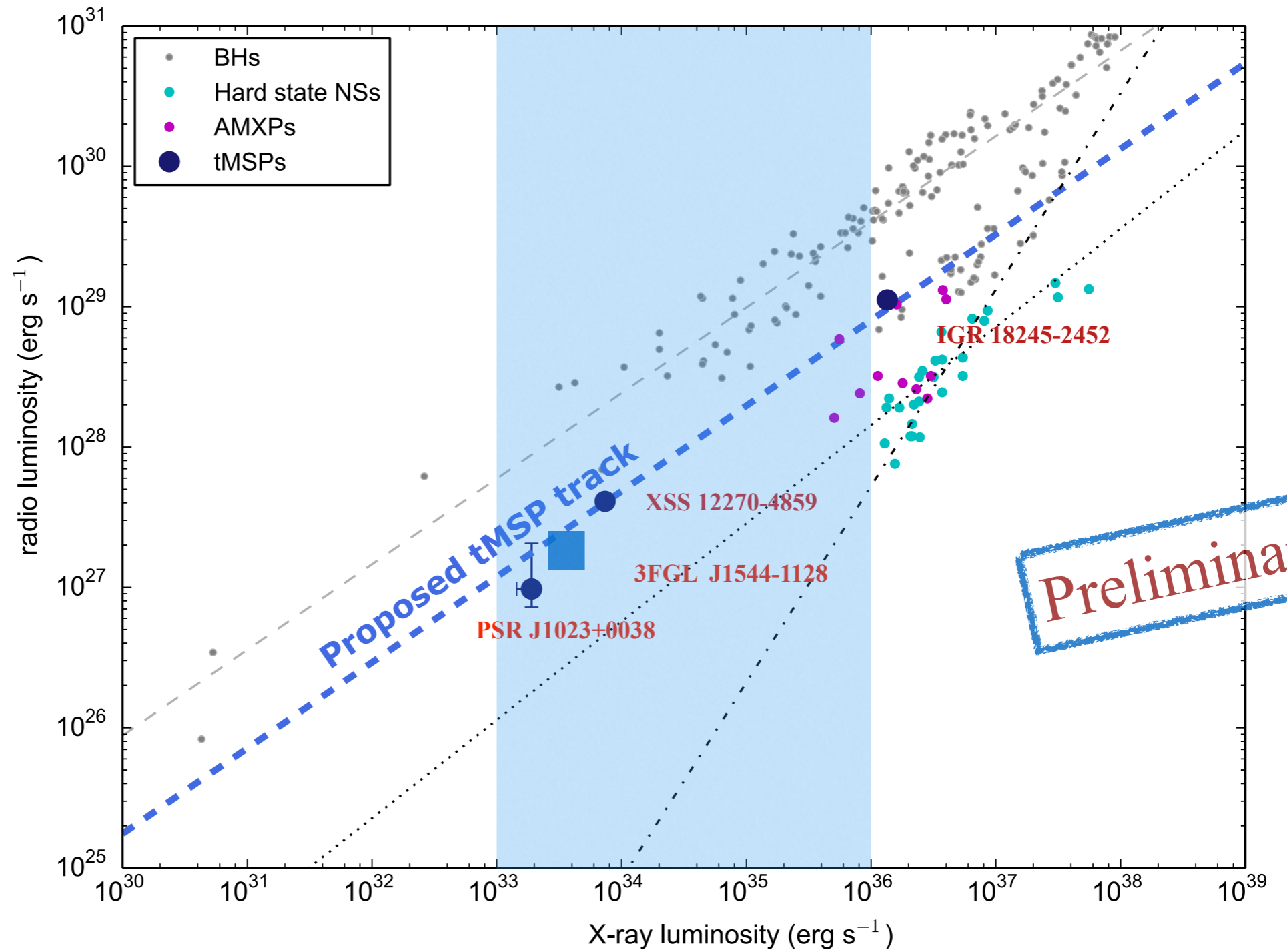


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Bogdanov & Halpern (2015)
Bogdanov (2015)

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Black Hole parallel track

$$L_R \propto L_X^{0.7}$$

Summary, Future

- **tMSPs show flat spectrum continuum radio emission in the LMXB state**
- **Collimated outflow**
- **Radiatively inefficient accretion**
- **Timing constraints on accretion models**
- **Baseline extension for timing**
- **Campaigns to compare radio vs. X-ray variability**
- **Find more sources!**