

PSR J1023+0038: The Exceptional Behavior of the Missing Link Binary Pulsar

Alessandro Patruno

NWO Vidi Fellow



**Universiteit
Leiden**

The Netherlands

ASTRON

Netherlands Institute for Radio Astronomy

*ASTRON: A. Archibald, J. Hessels,
C. Bassa, G. Janssen*

Manchester: B. Stappers, A. Lyne

Columbia: S. Bogdanov

McGill: V. Kaspi

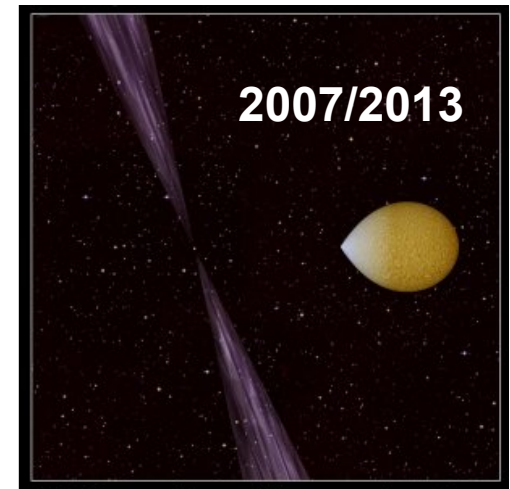
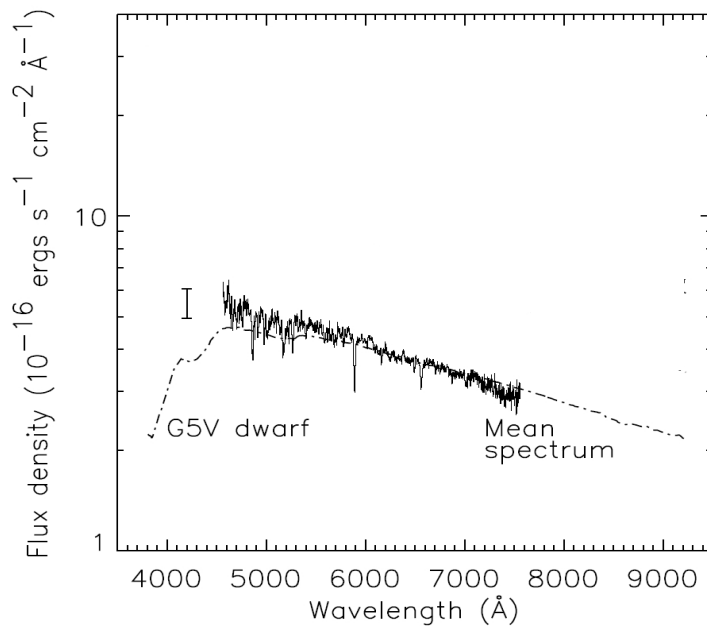
Caltech: S. Tendulkar

A Radio Pulsar/X-Ray Binary Link

PSR J1023+0038

1.69 ms spin period

4.8 hr orbital period

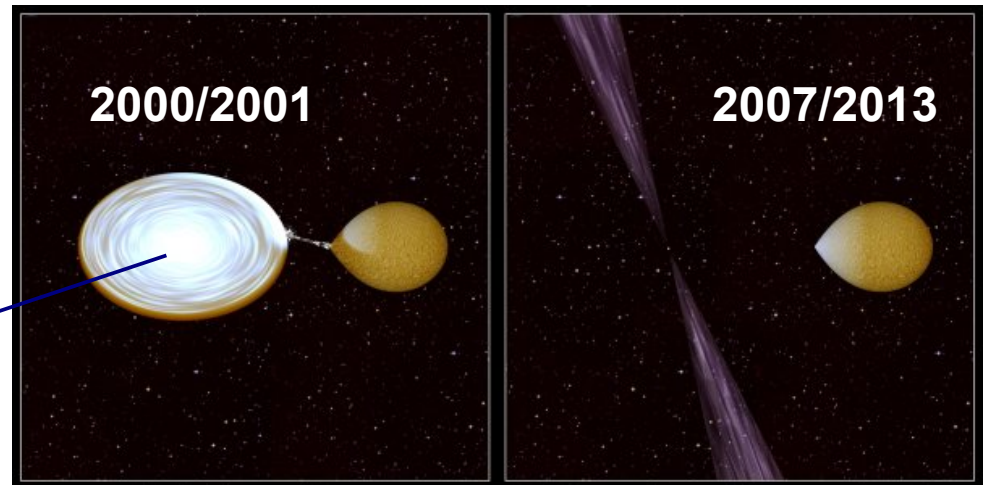
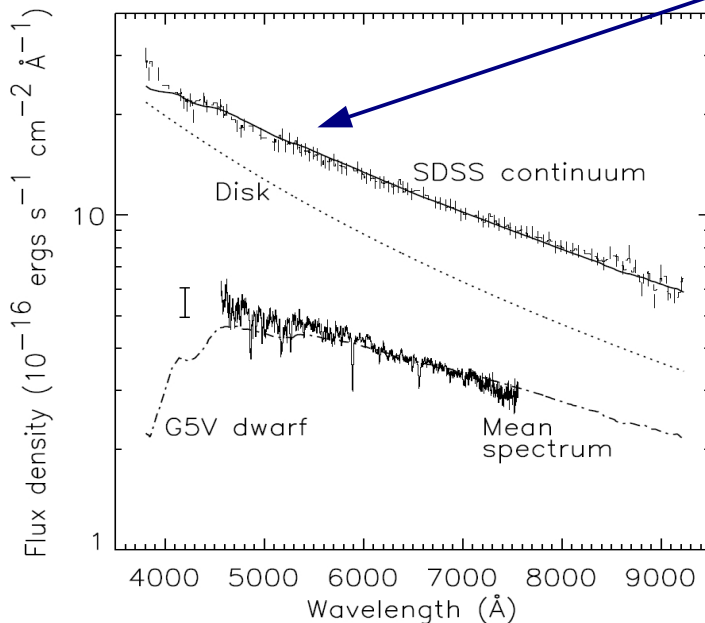


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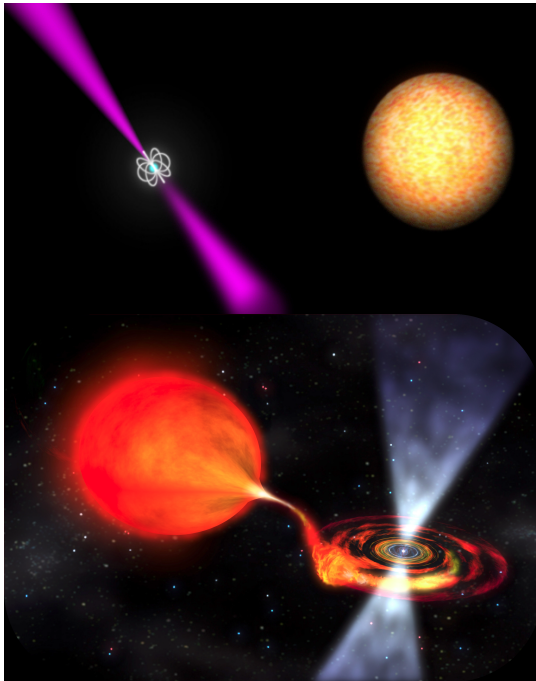
“Missing Link Binary Pulsar”

Recycling

Original Idea

(Alpar 1982, Radakrishnan & Srinivasan 1982)

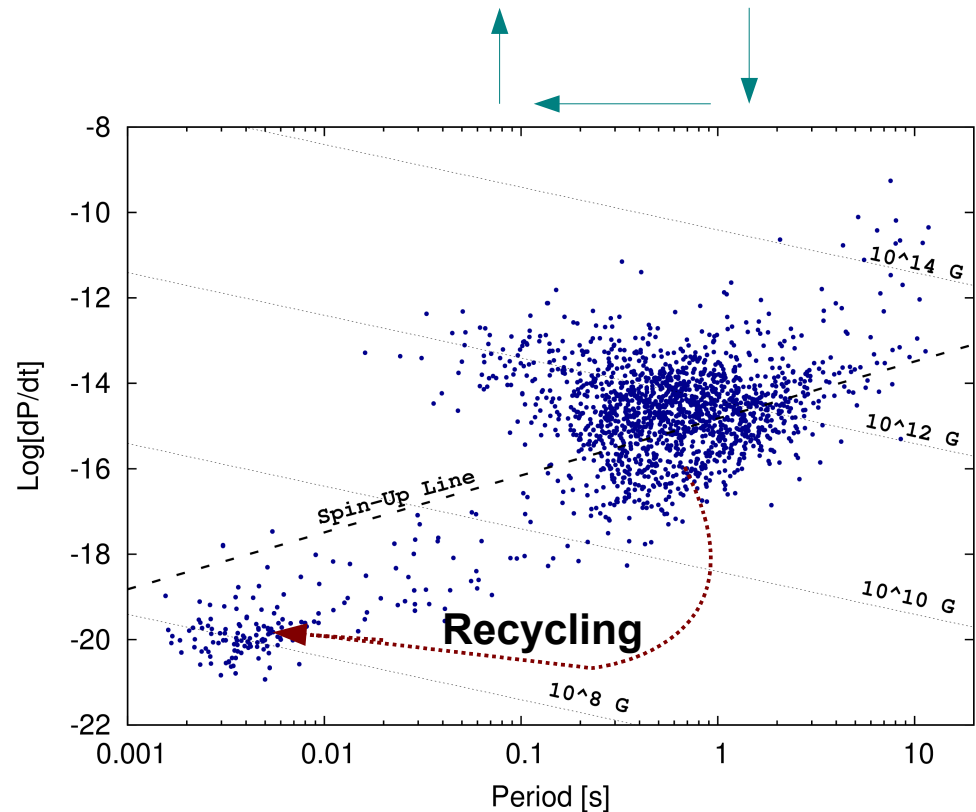
Pulsar → LMXB → ms Pulsar



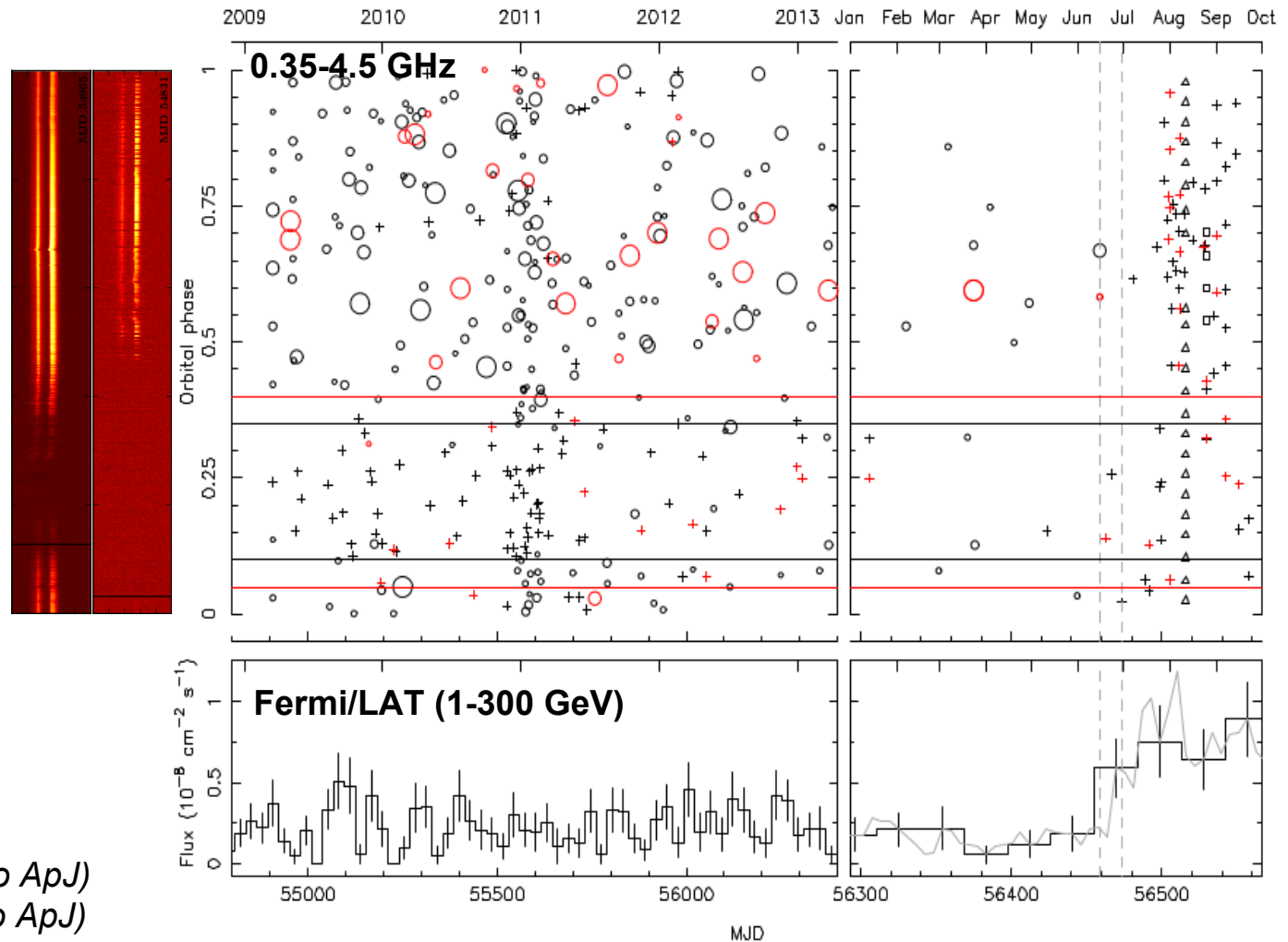
Not unidirectional process !

(Archibald+ 2009, Papitto+ 2013)

Pulsar → LMXB → ms Pulsar

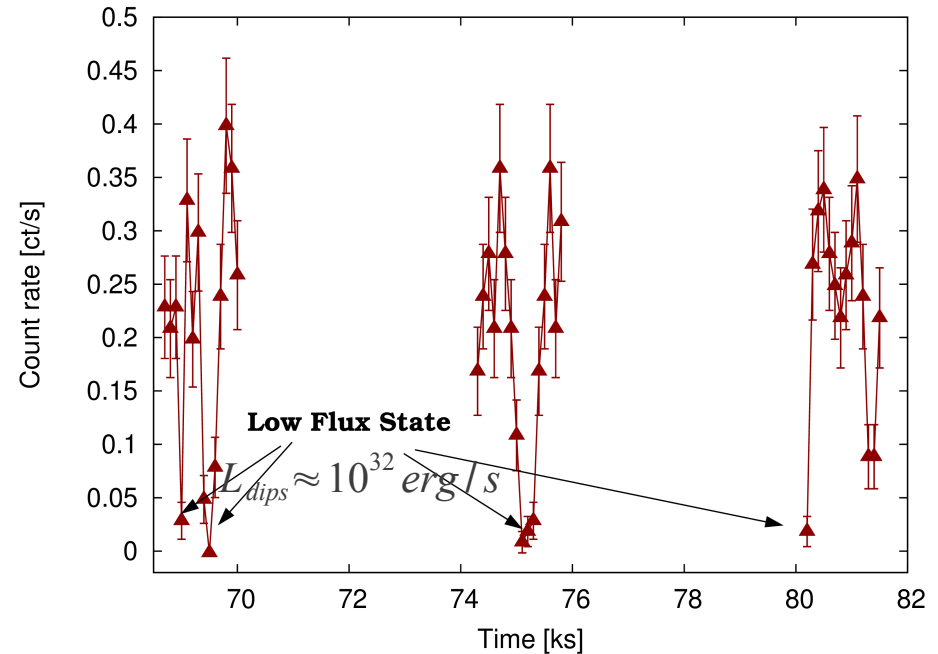
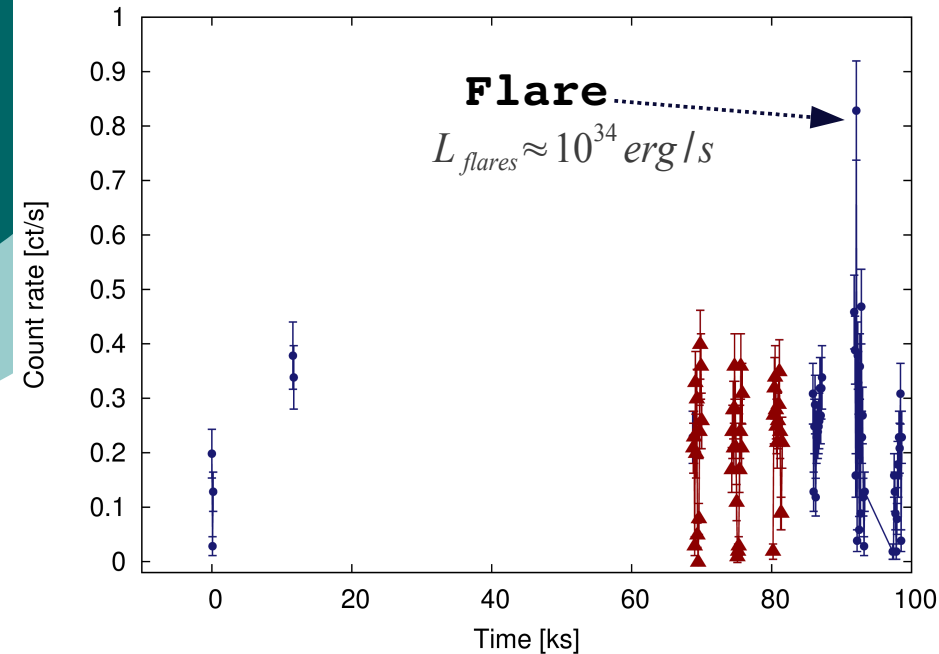


The June 2013 State Change



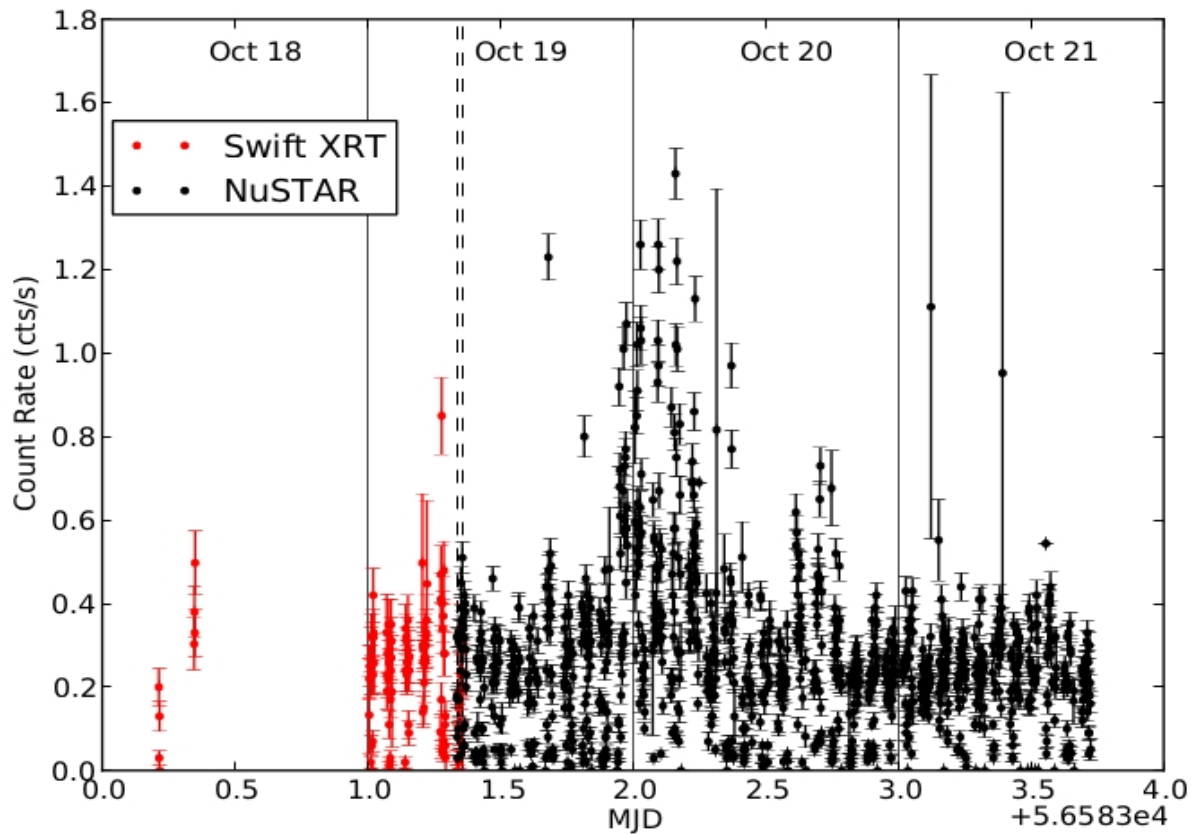
Stappers+ 2013 (subm. To ApJ)
Archibald+ 2013 (subm. To ApJ)

Swift/XRT: Dips and Flares



X-Ray Flickering: 10-1000 s timescale
Luminosity variation: 2 orders of magnitude

Hard X-Rays: NuSTAR

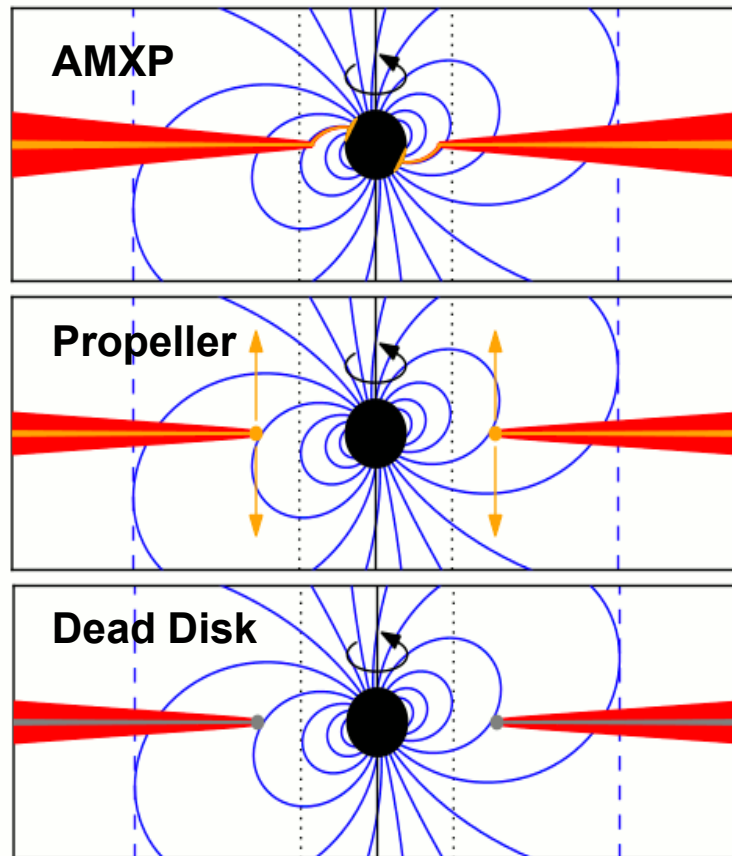
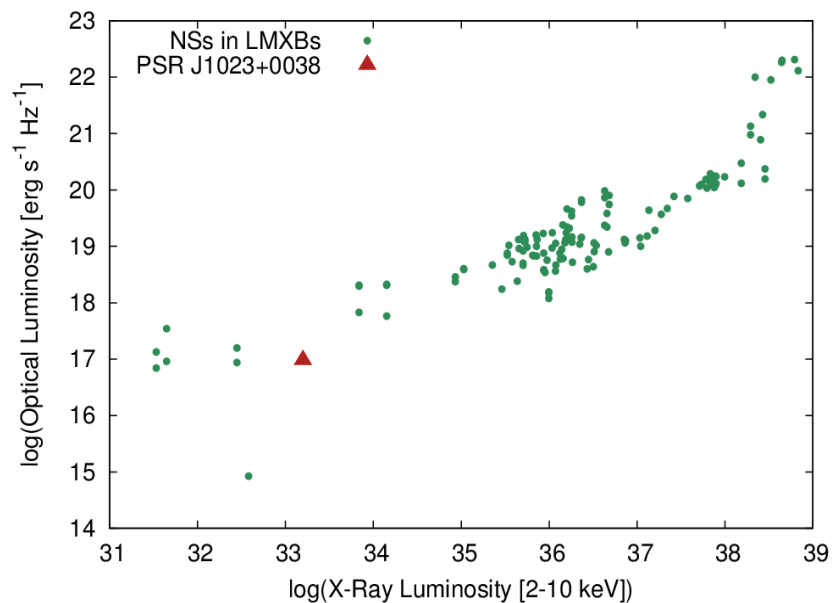


Tendulkar et al. In prep.

See also POSTER P40. (S. Tendulkar)

“NuSTAR observations of renewed accretion in LMXB-MSP transition system PSR J1023+0038”

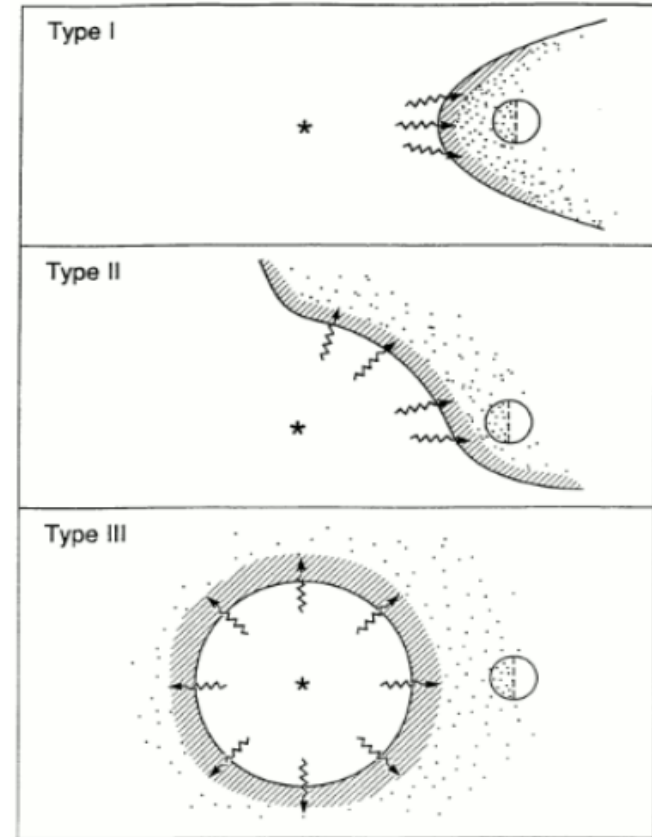
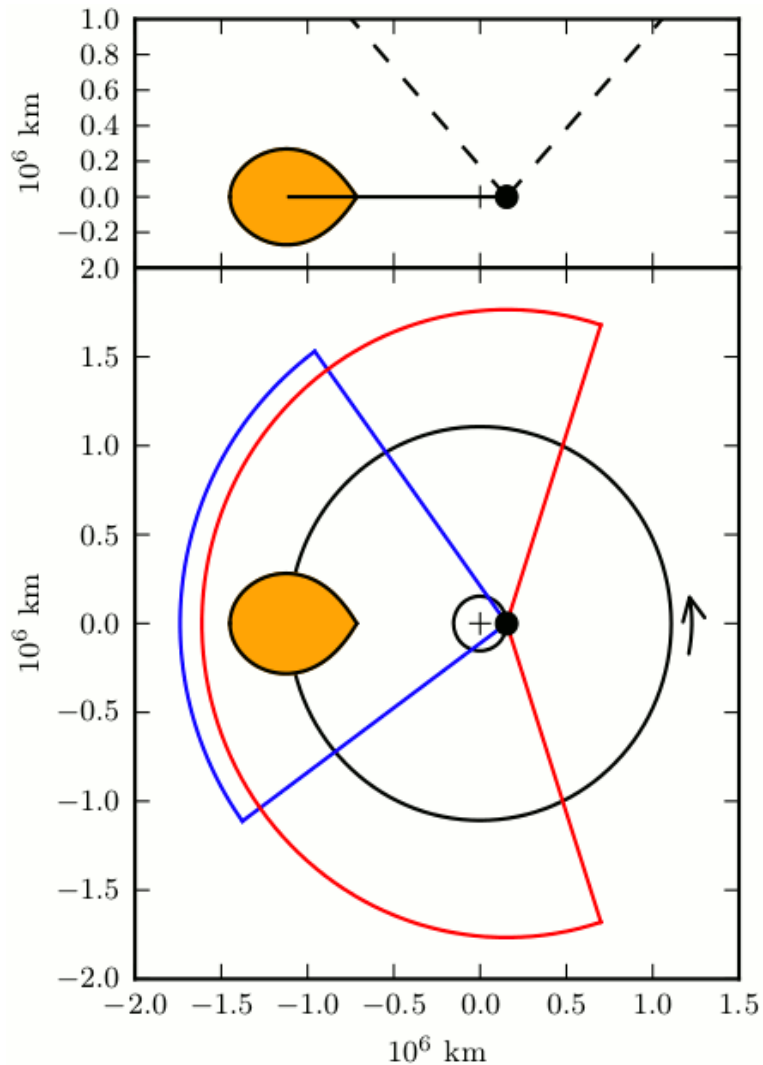
A New Accretion Disk



$$L_{acc} = \frac{GM\dot{M}}{R}$$

$$\tau_{visc} \sim 3.5\alpha^{-4/5} \left[\frac{\dot{M}}{10^{-10} M_{\odot} \text{yr}^{-1}} \right]^{-3/10} \left[\frac{\Delta R}{10 \text{ km}} \right]^{5/4} \text{ s}$$

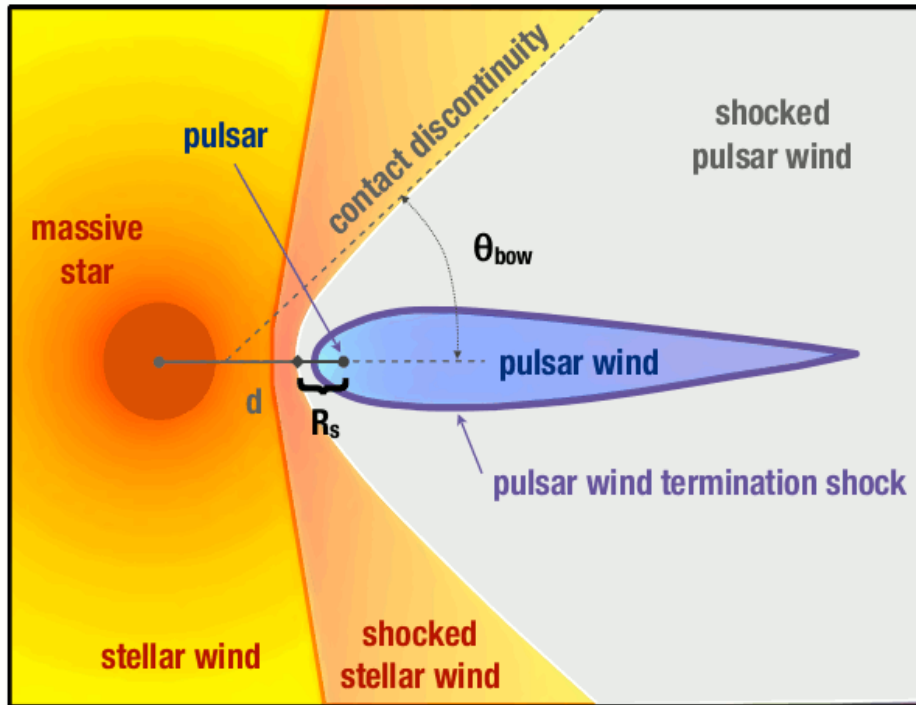
Models: an enshrouded pulsar ?



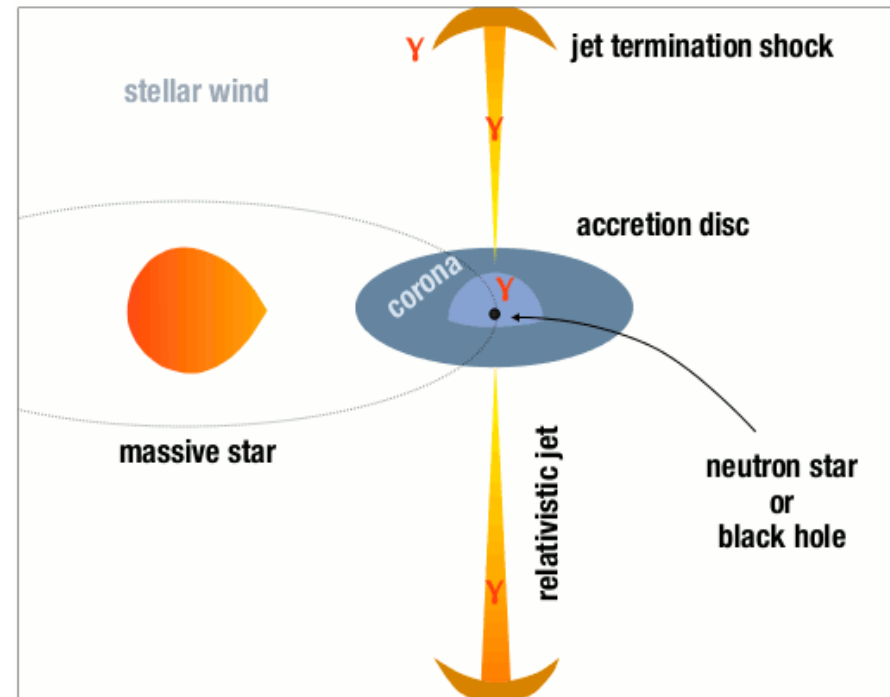
Tavani+ 1991, 1993
Archibald+ 2010, 2013
Bogdanov+ 2011

Models: a new type of gamma ray binary ?

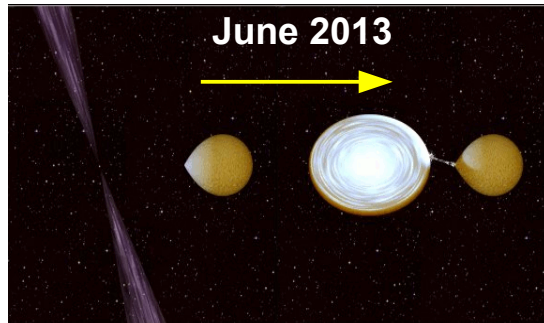
Pulsar Wind



Jet Model

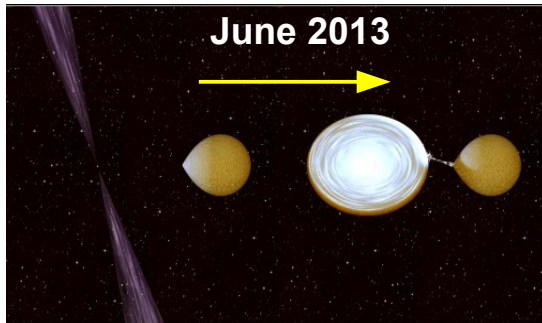


Open Questions & Conslusions

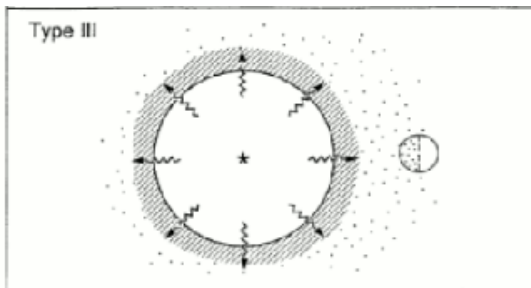


I. New LMXB phase

Open Questions & Conclusions

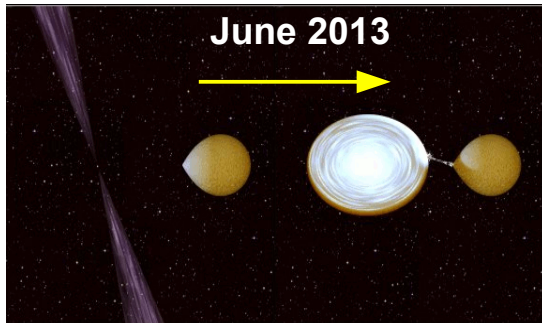


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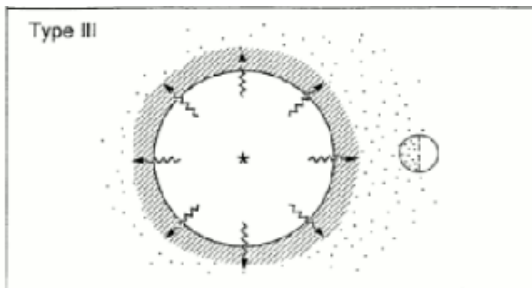


II. Strong Gamma-Ray emission
III. Very low X-ray luminosities

Open Questions & Conclusions



I. New LMXB phase



II. Strong Gamma-Ray emission
III. Very low X-ray luminosities

- ▶ PSR J1023+0038 is a new type of “compact” gamma-ray binary.
- ▶ Is the MSP still active and “enshrouded” ?
- ▶ Why is the gas not falling on the neutron star surface ?