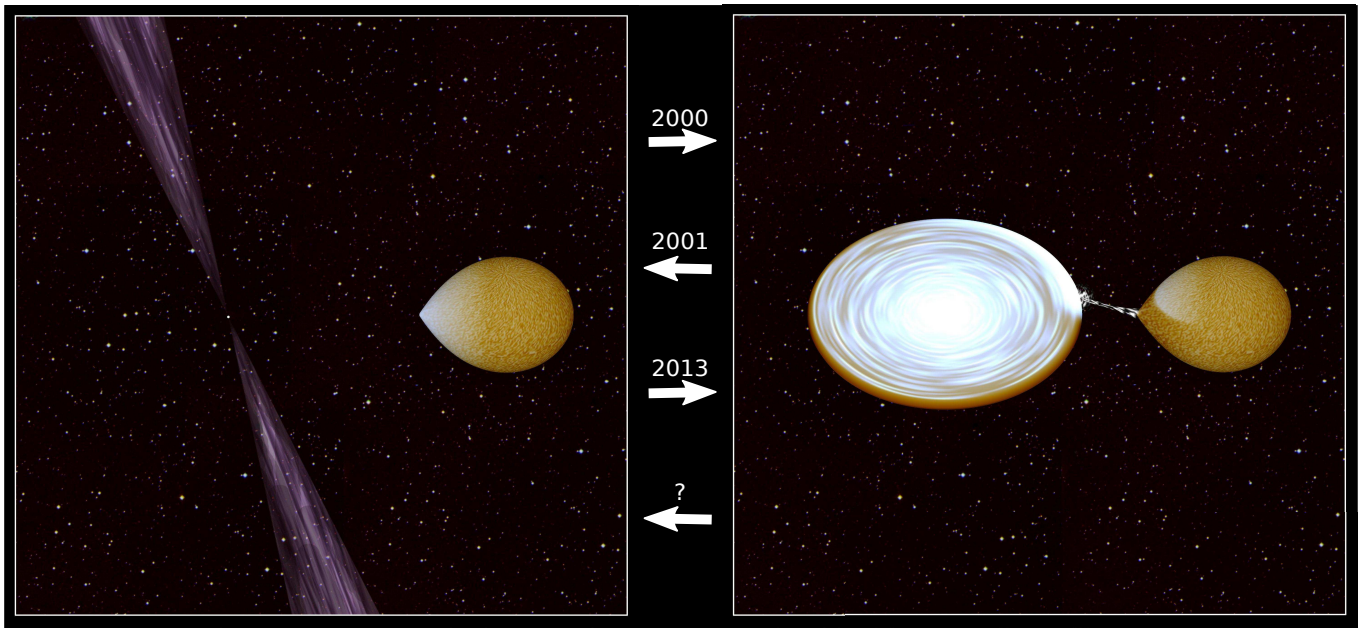
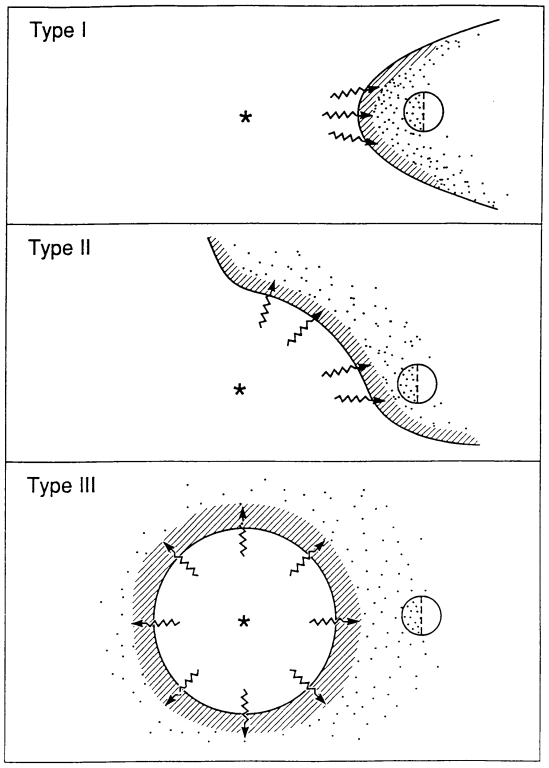
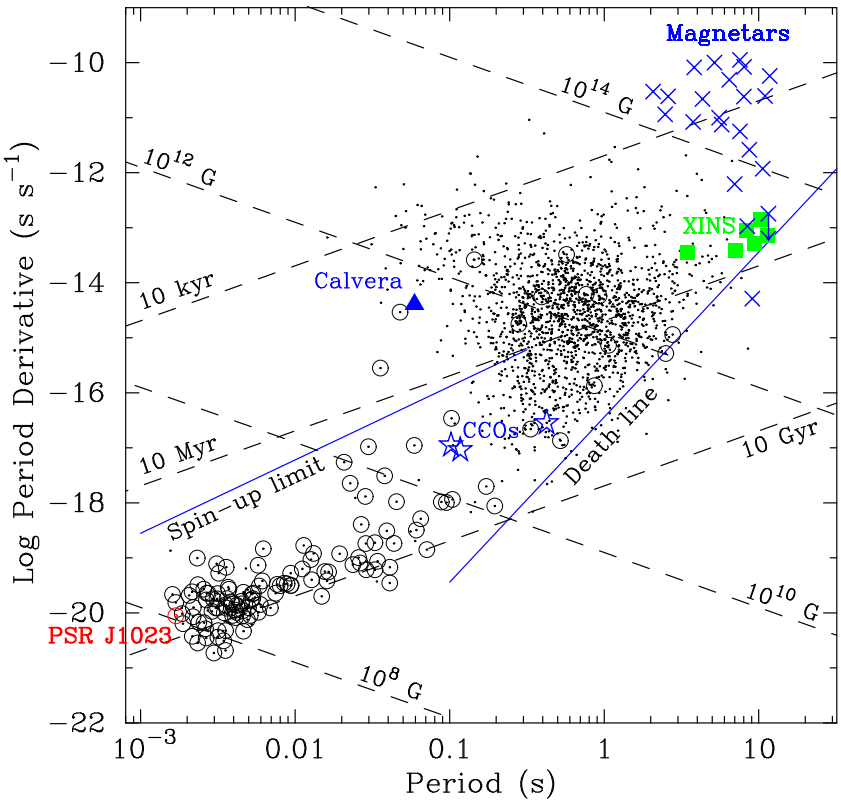
# TRANSITIONAL MILLISECOND PULSARS



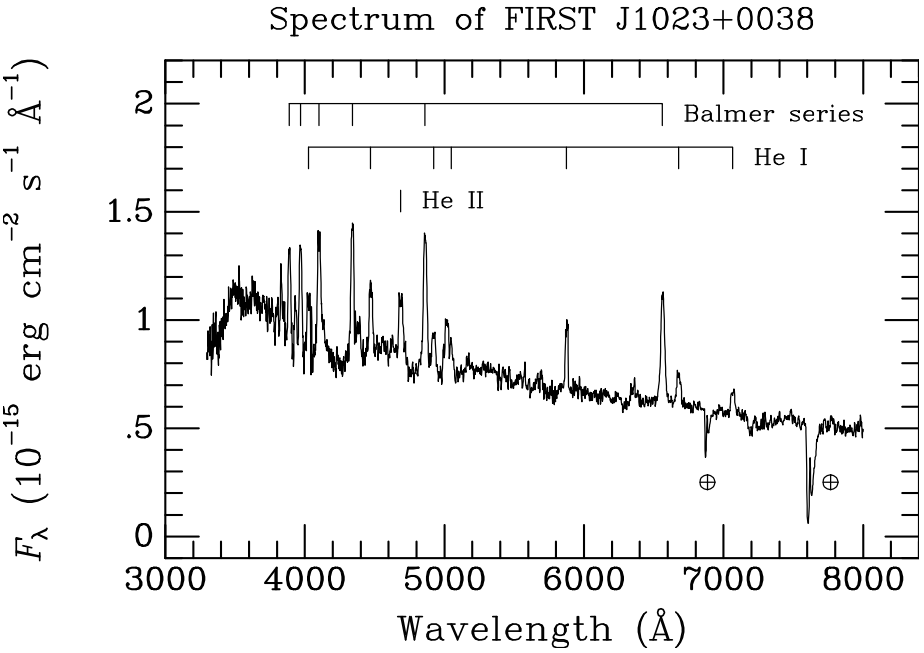

PSR J1023+0038: $P_{\rm spin} = 1.69$ ms, $P_{\rm orb} = 0.198$ d



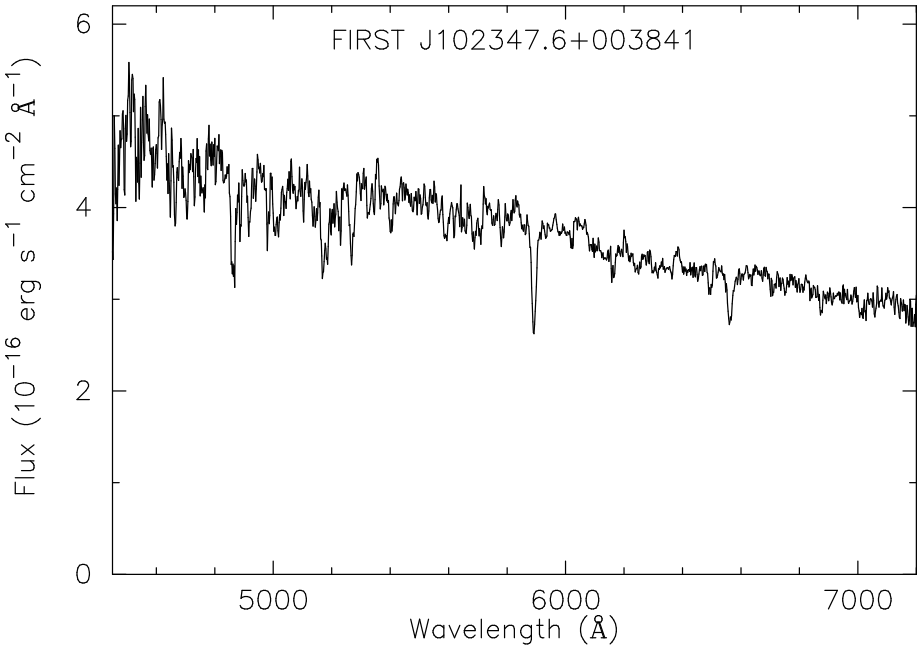




"Hidden" Millisecond Pulsars
Tavani (1991)

"The First Radio-Selected Cataclysmic Variable"
Bond, White, Becker & O'Brien (2002)

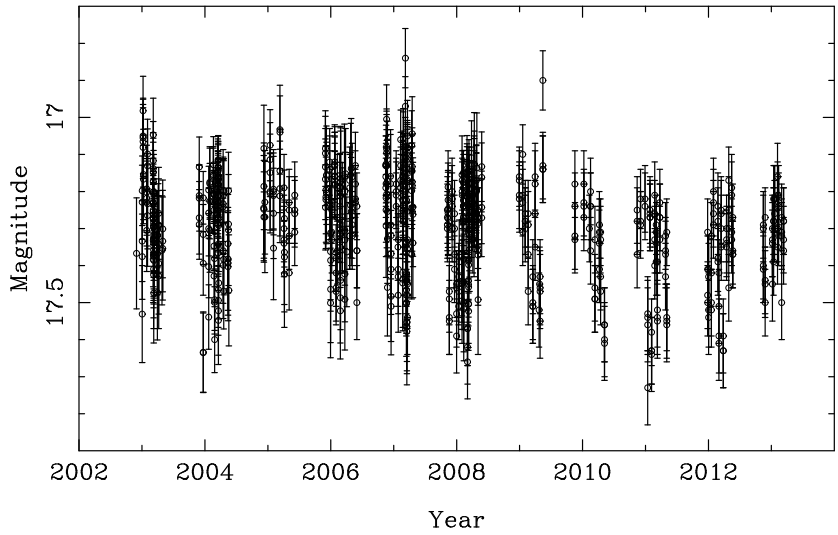


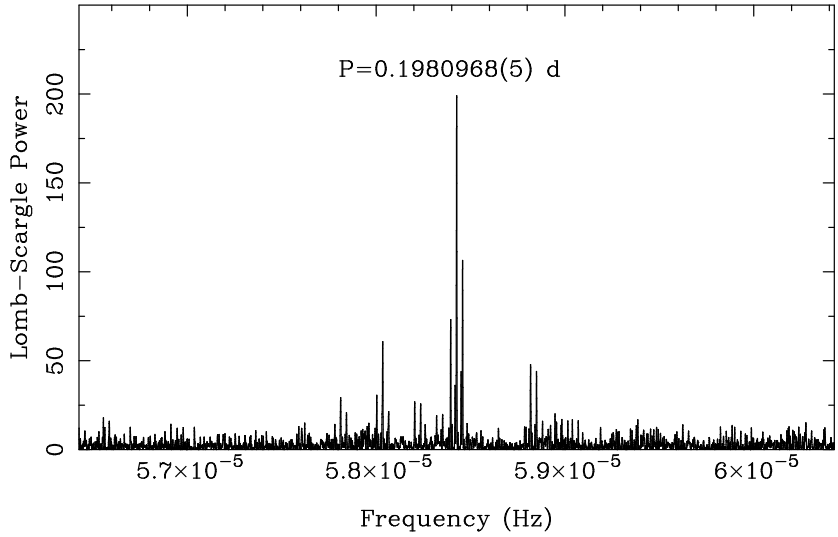

"Is FIRST J1023+0038 Really a Cataclysmic Variable?"
Thorstensen & Armstrong (2005)

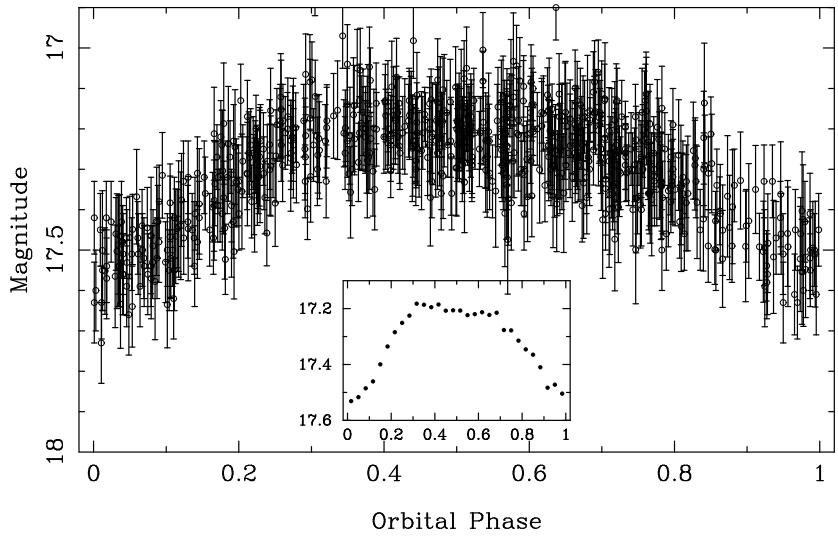



Answer: No, it's "A Radio Pulsar/X-ray Binary Link"
Archibald et al. (2009)

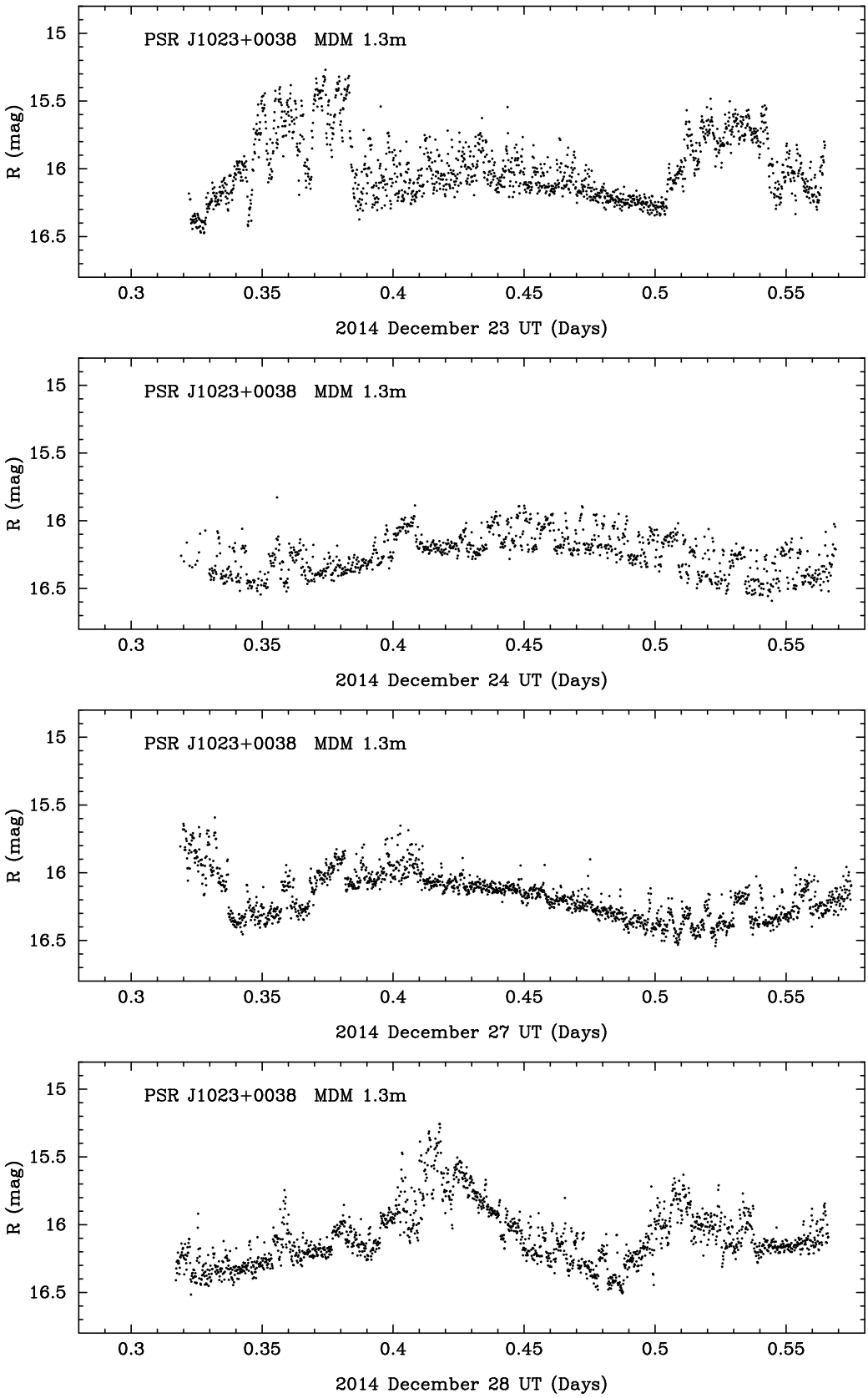
# The Radio-Pulsar Years: 2002 – 2013
# PSR J1023+0038 in LINEAR and Catalina Sky Surveys



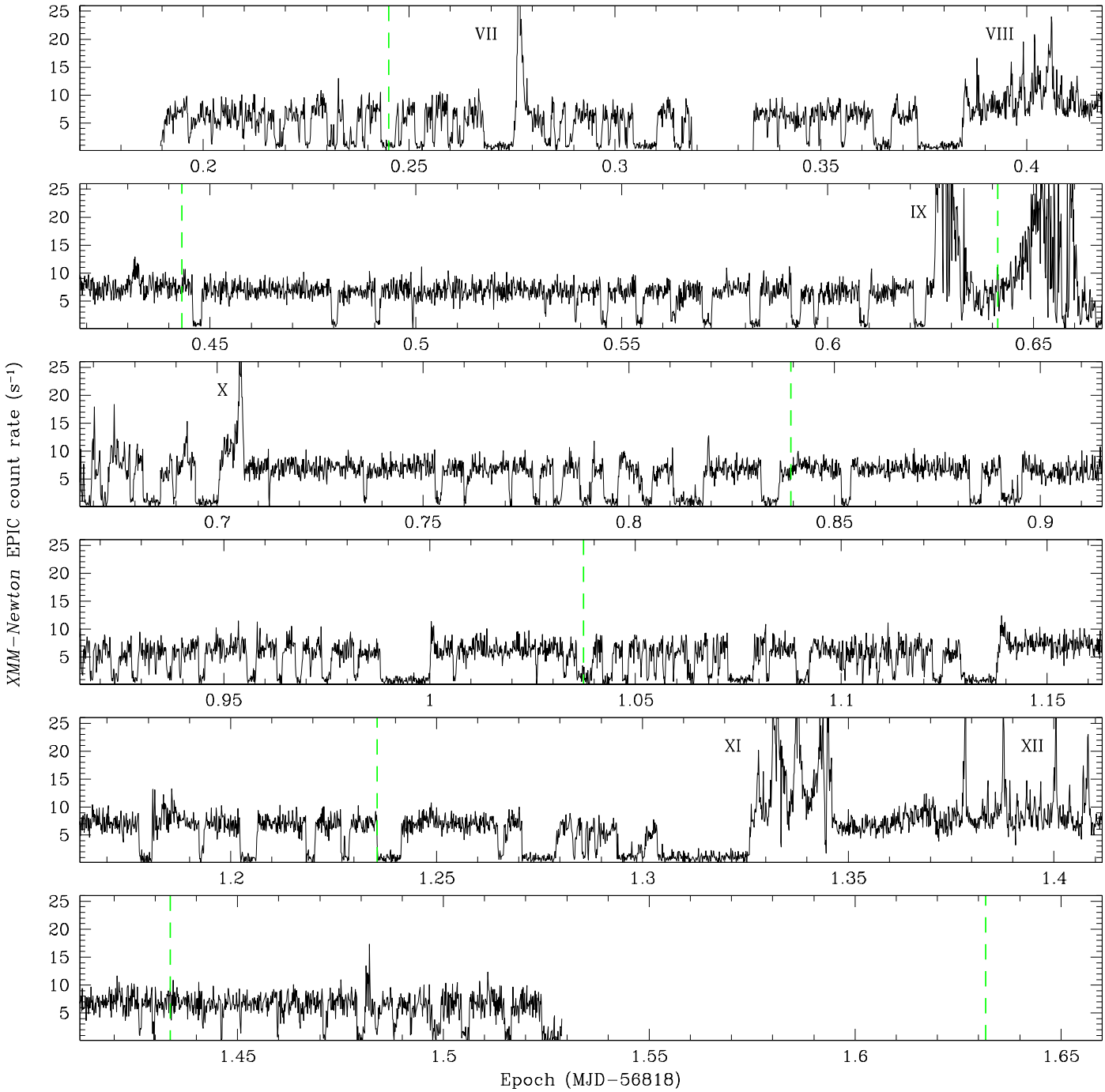



# Accretion Resumes: 2013-2015 at MDM Observatory



# X-ray Light Curve in the Accreting State
Bogdanov et al. (2015)



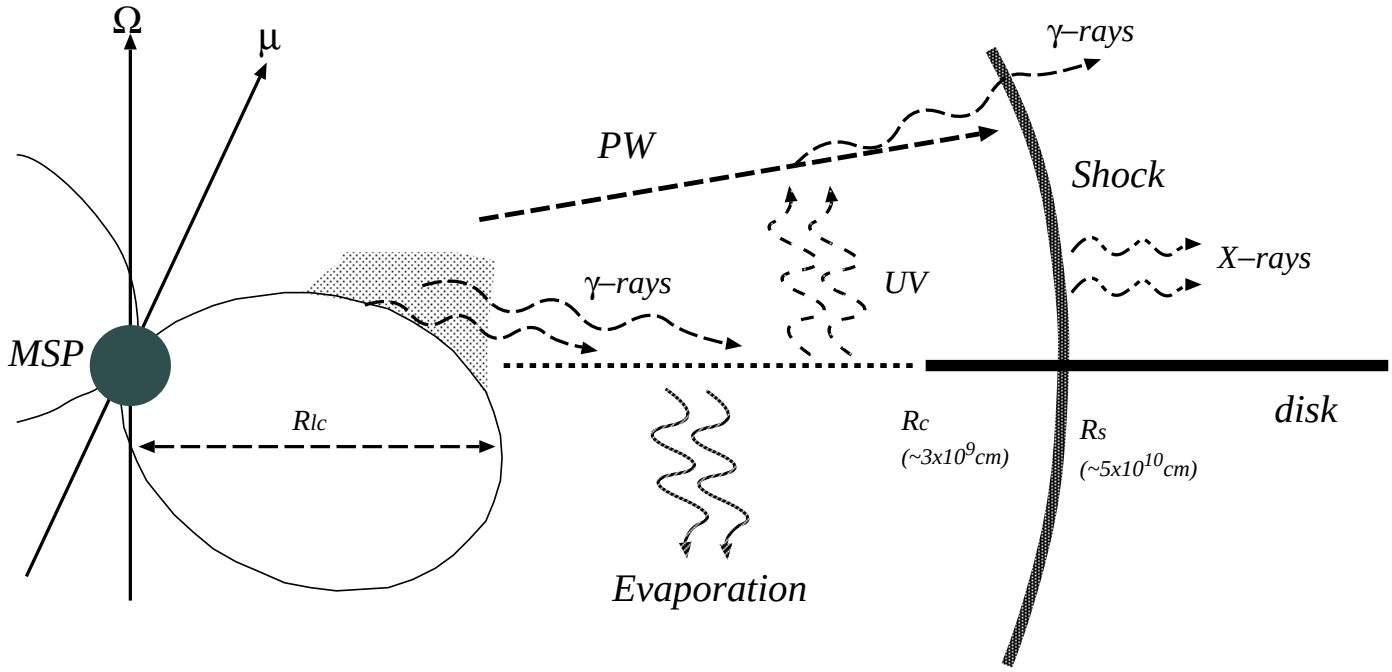

Three X-ray levels: "low", 'high", and 'flare".

$L_x \approx 3 \times 10^{33}$ erg s$^{-1}$ ($< 10^{-4} L_{\rm edd}$).

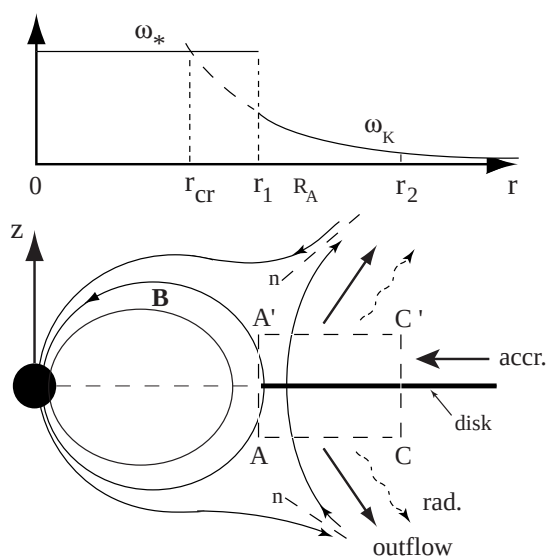
1.69 ms X-ray pulsations detected in "high" level only.

Models: Pulsar Wind Shock or Propeller Accretion?

1) Pulsar Wind Shock: Takata et al. (2014)




2) Propeller Accretion: Lovelace et al. (1999)

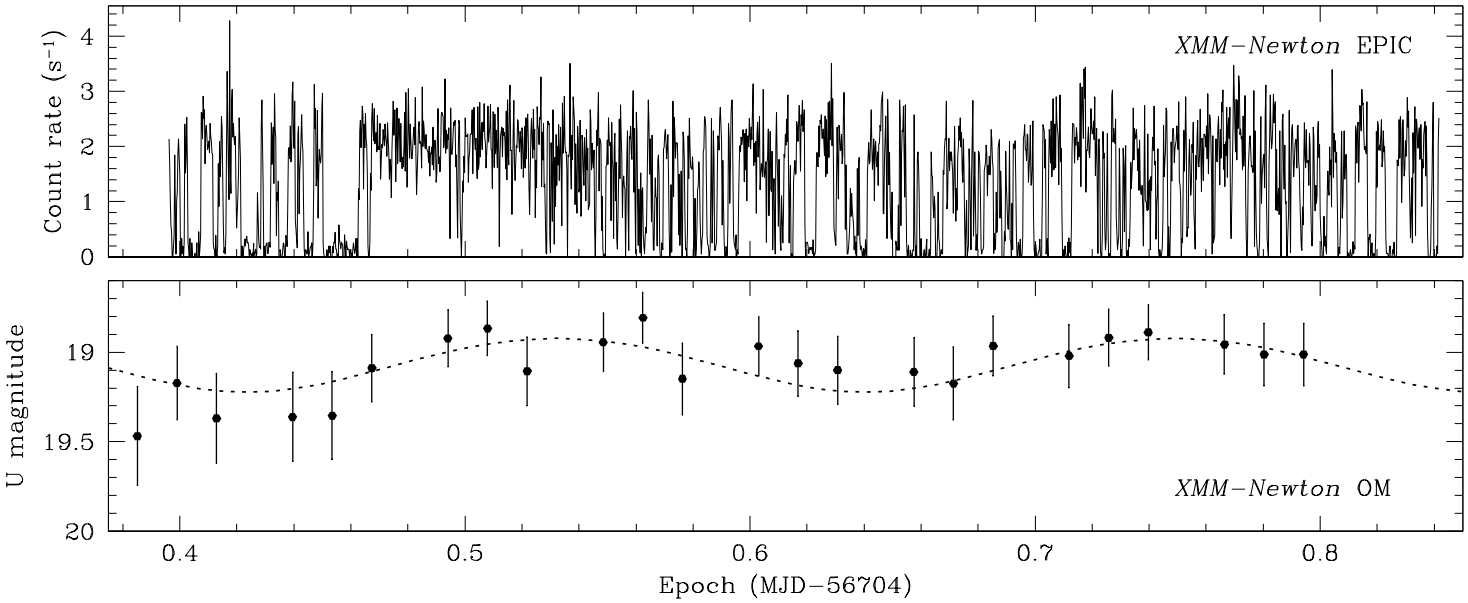


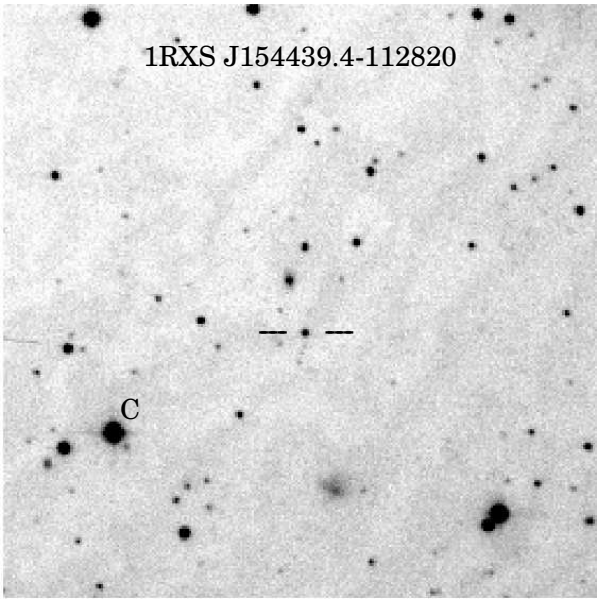

Light cylinder radius $R_{lc} = 8 \times 10^6$ cm.

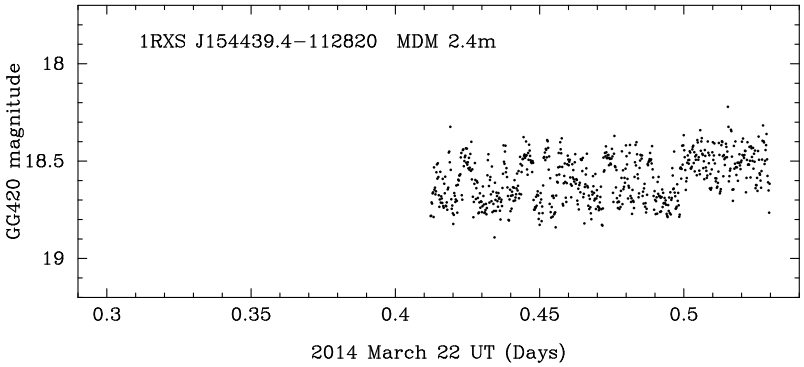
Corotation radius $r_{cr} \approx 2.5 \times 10^6$ cm.

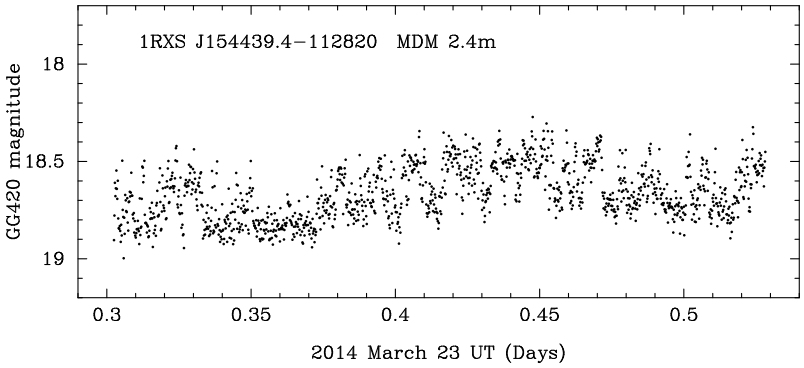
In both models $\dot{M} \sim 10^{16}$ g s$^{-1}$.

# Latest *Fermi* Accreting MSP Discovery
# 3FGL J1544.6−1125: Bogdanov & Halpern (2015)




PSR J1544−1128: $P_{\rm spin}$ and $P_{\rm orb}$ not yet known . . .