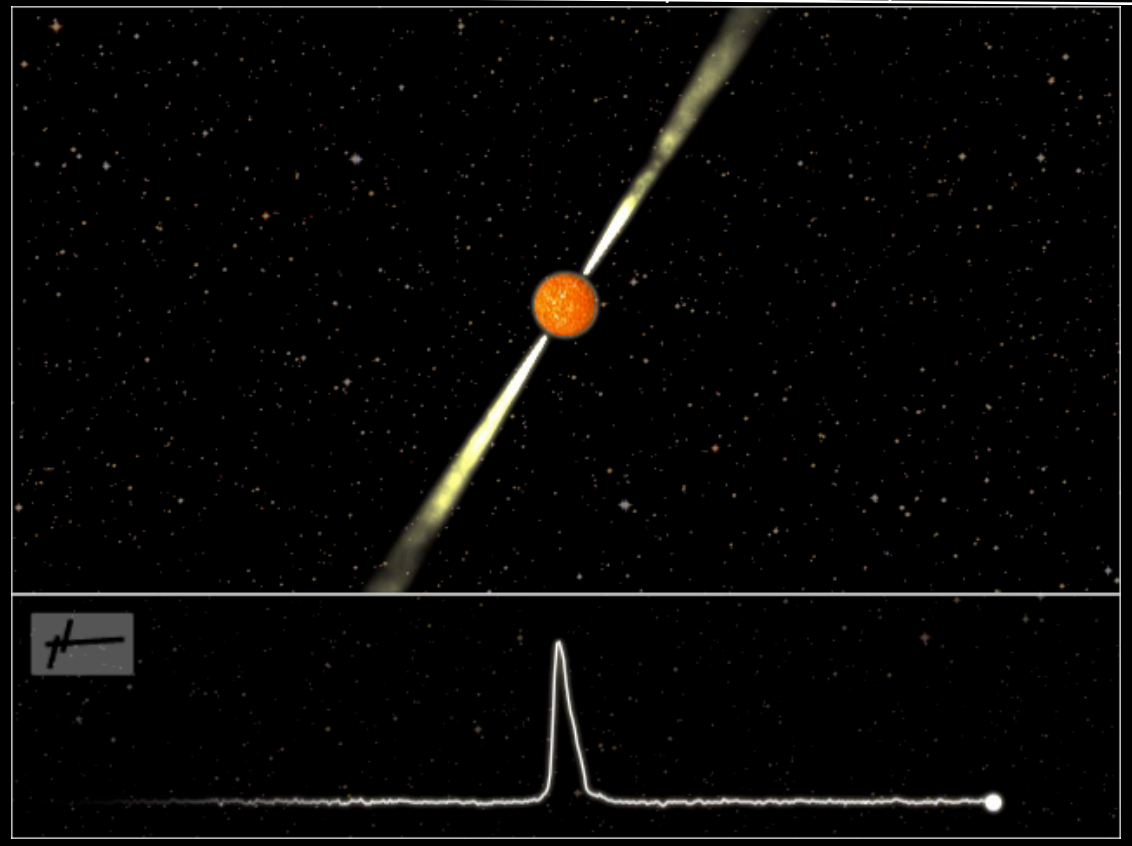
Pulsar Searches and Stuffs

SIRAPRAPA SANPA-ARSA (TUCK)

NATIONAL ASTRONOMICAL RESEARCH INSTITUTE OF THAILAND (NARIT)

Targeted Pulsar Search (for MSPs)

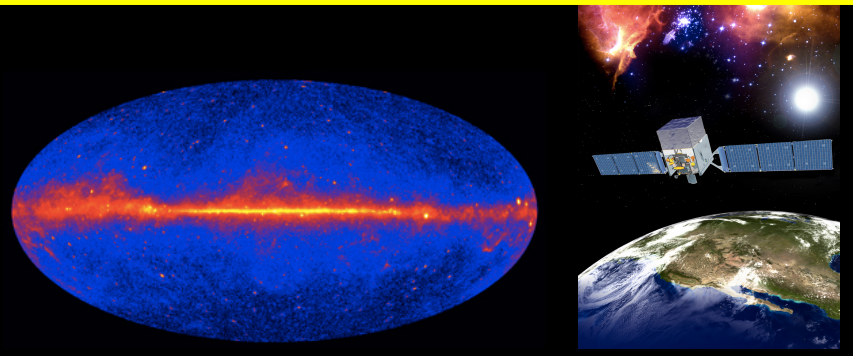
Credit:http://www.astron.nl/pulsars/animations



Pulsar is a highly magnetized, rotating neutron star that emits a beam of electromagnetic radiation.

"Physicists' playground"

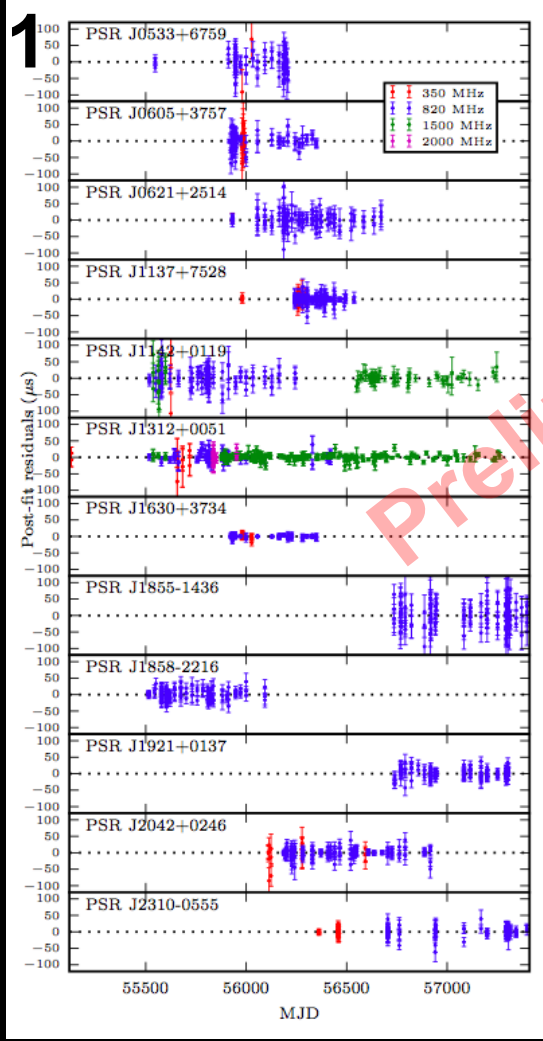
Pulsar is a radio source. The most efficient way to search for new pulsar is to use **single-dish radio telescopes**

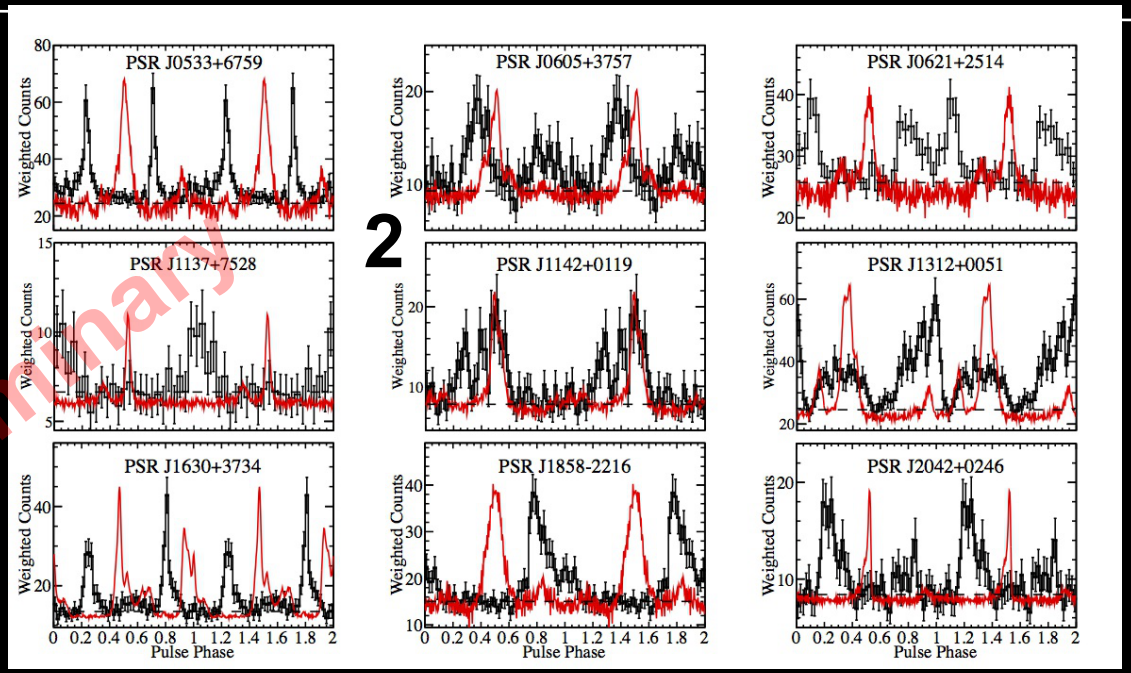


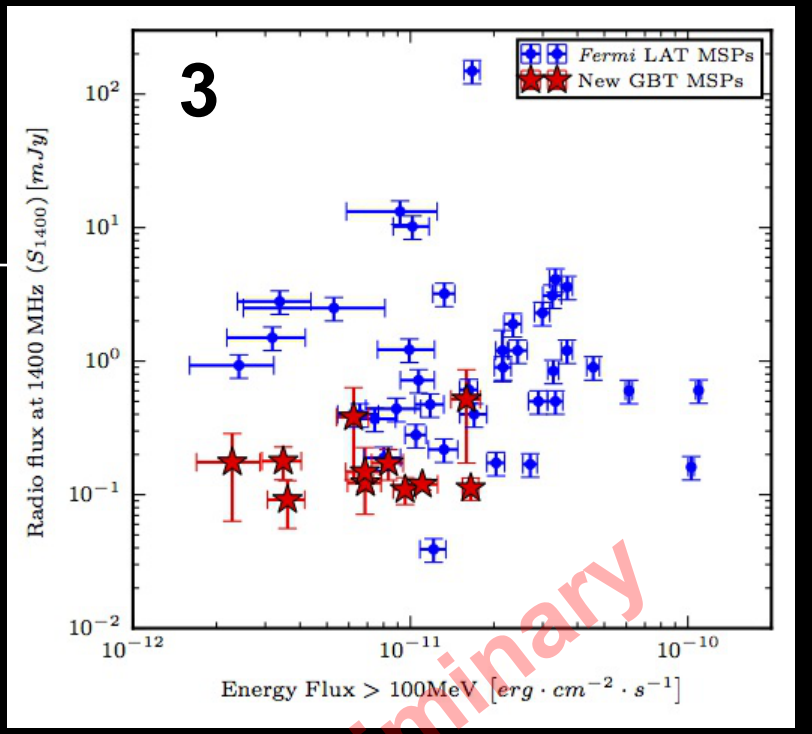
Credit: NASA/DOE/Fermi LAT Collaboration

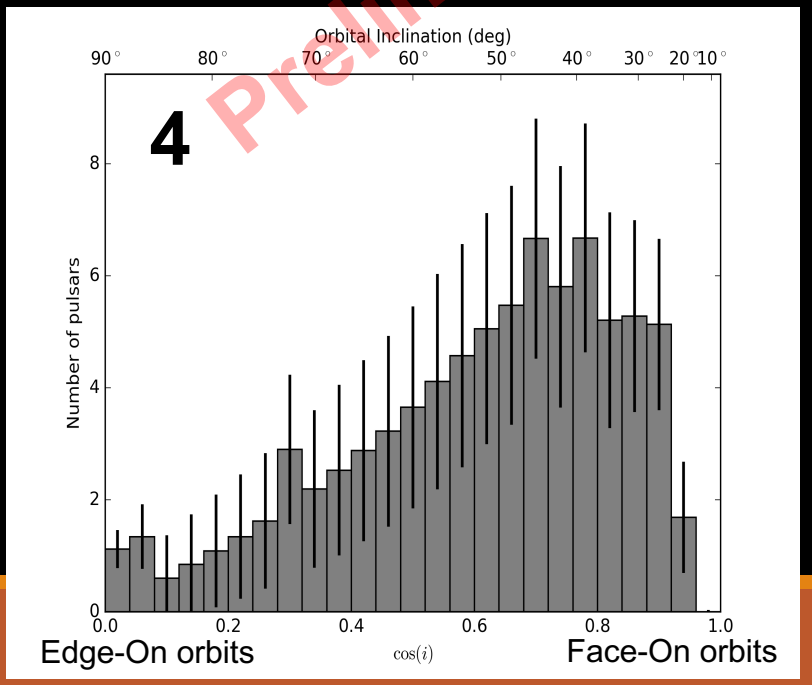
Millisecond pulsars (MSPs) emit gamma-ray.
Fermi is the most sensitive gamma-ray telescope; hence,
***Fermi* sources are the best MSPs sources**

Result: “Normal MSPs”









1. Timing solutions for all 12 MSPs (GBT)
2. Every MSPs show gamma-ray pulsations
3. No correlation between radio and gamma-ray flux densities
4. P_b– M_{com} Analysis: Distribution of cos(i) is not flat => we are more likely to observe MSPs with face-on orbit

Result: “Normal MSPs”

Typeset using LaTeX **twocolumn** style in AASTeX62

Discovery of Twelve Millisecond Pulsars in *Fermi* LAT Unidentified Sources with the GBT telescope

S. Sanpa-arsa,[1] S. M. Ransom,[2] F. Camilo,[3] P. S. Ray,[4] T. Johnson,[5] E. C. Ferrara,[6] L. Guillemot,[7] M. S. E. Roberts,[8] M. DeCesar,[9] and M. Kerr[4]

[1] *University of Virginia, Charlottesville, VA 22904, USA*
[2] *National Radio Astronomy Observatory (NRAO), Charlottesville, VA 22903, USA*
[3] *SKA South Africa, Pinelands, 7405, South Africa*
[4] *Space Science Division, Naval Research Laboratory, Washington, DC 20375, USA*
[5] *College of Science, George Mason University, Fairfax, VA 22030, USA*
[6] *NASA Goddard Space Flight Center, Greenbelt, MD 20771, USA*
[7] *Laboratoire de Physique et Chimie de l'Environnement et de l'Espace - Universit d'Orlans/CNRS, 45071, Orlans Cedex 02, France*
[8] *Eureka Scientific, Oakland, CA 94602, USA*
[9] *Physics Department, University of Wisconsin-Milwaukee, 1900 East Kenwood Boulevard, Milwaukee, WI 53211, USA*

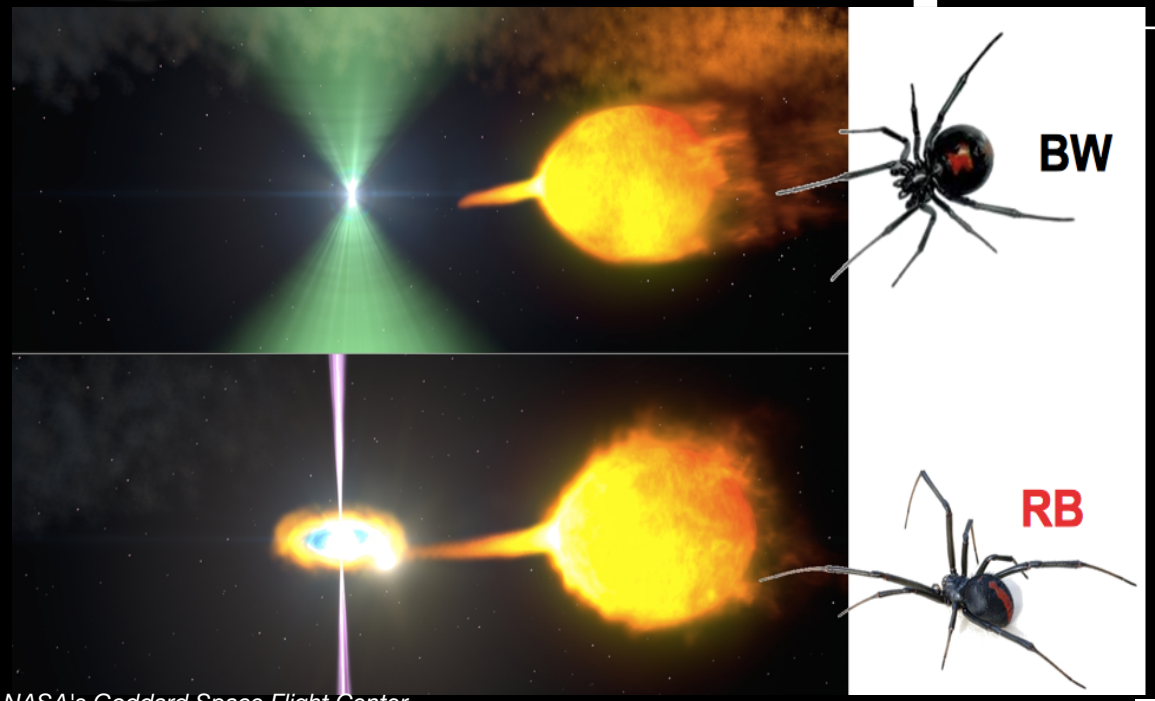
in prep

ABSTRACT

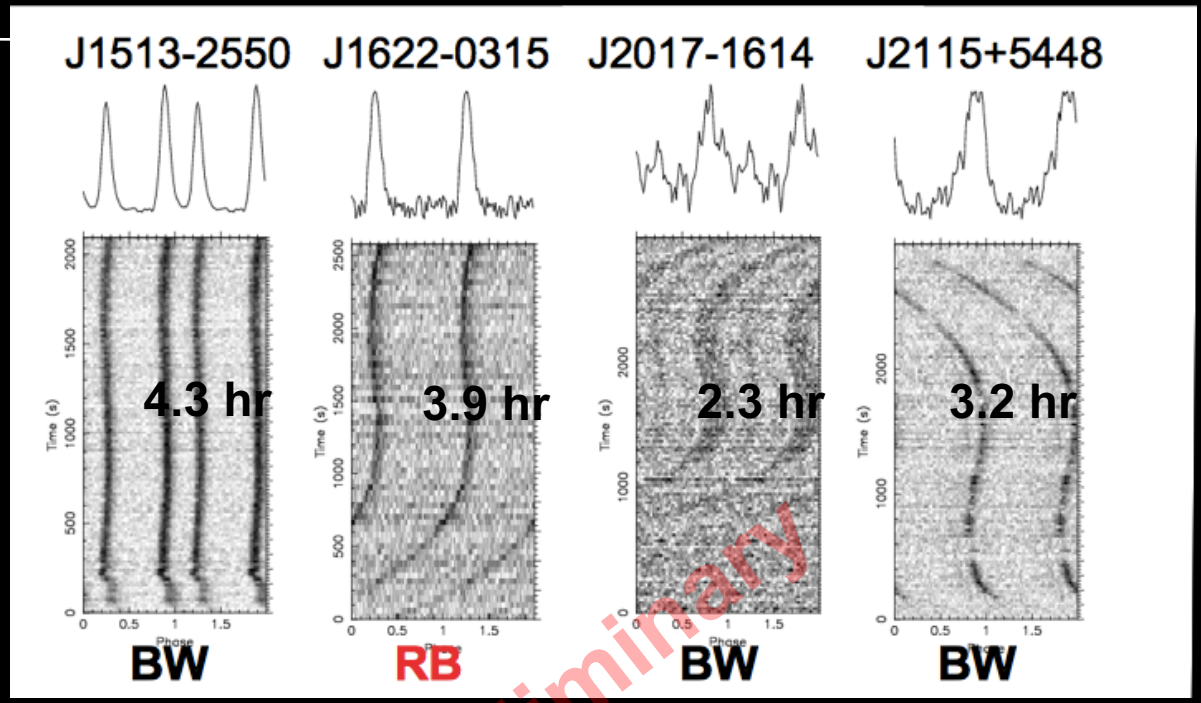
We report the discovery and initial timing solutions of twelve millisecond pulsars (MSPs) from radio searches in the direction of 198 unidentified *Fermi* LAT sources, conducted with the Green Bank Telescope (GBT) at 350 MHz, 820 MHz and 2 GHz. All MSPs (except for the isolated J0533+6759) are in binary systems with likely degenerate He-core white dwarf (He-WD) companions. All twelve of the pulsars are shown to have γ-ray pulsations after folding LAT events using our radio ephemerides. Combining the γ-ray and radio data for all *Fermi* LAT MSPs detected in the radio band, we find that there is no correlation between γ-ray and radio flux densities. We also examine the assumption that the inclination angles (i) of the orbital planes of MSPs with He-WD companions are distributed randomly. Using the orbital period-companion mass relation together with Monte Carlo simulations, we find that the distribution of $\cos i$ of 92 such systems is not flat, but favors higher $\cos i$ (i.e. more face-on orbits).

FAST: Pulsar search on *Fermi* sources (Spring 2019)

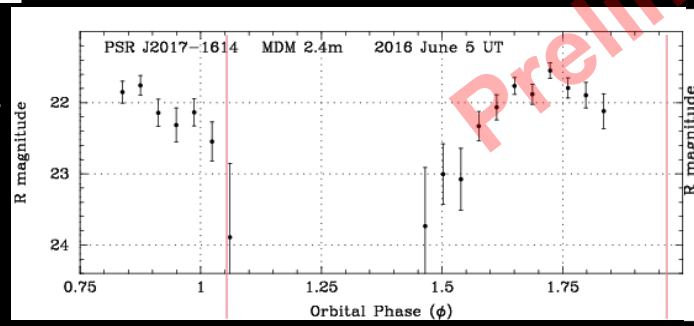
Result: “Spiders”

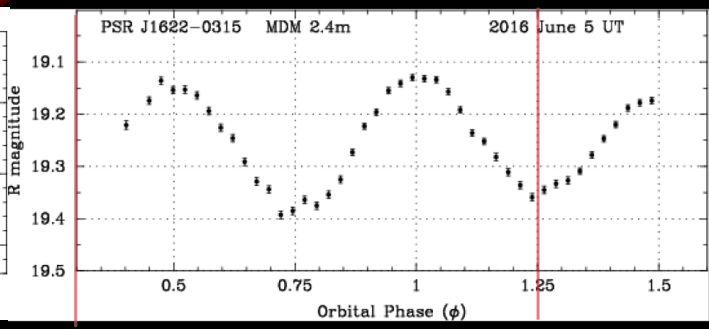


NASA's Goddard Space Flight Center



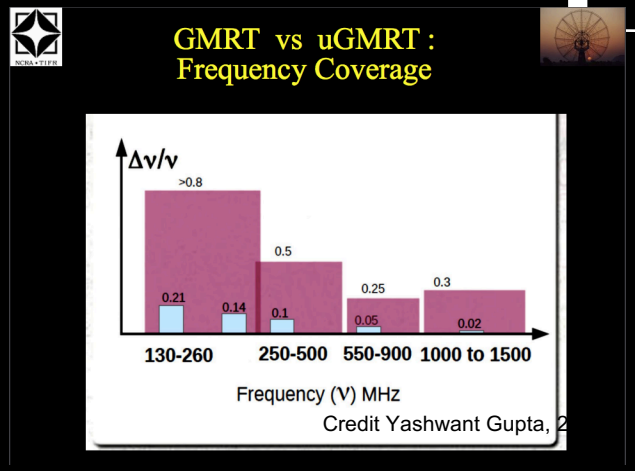
- **Spider: A MSP in a compact orbit (<u>orbital period < 1 day</u>).**
- Black Widow (BW): Extremely small companion mass (~0.01 $M_\odot$). Ablating away the companion.
- Redback (RB): Non-degenerated companion. Accreting mass from the companion.

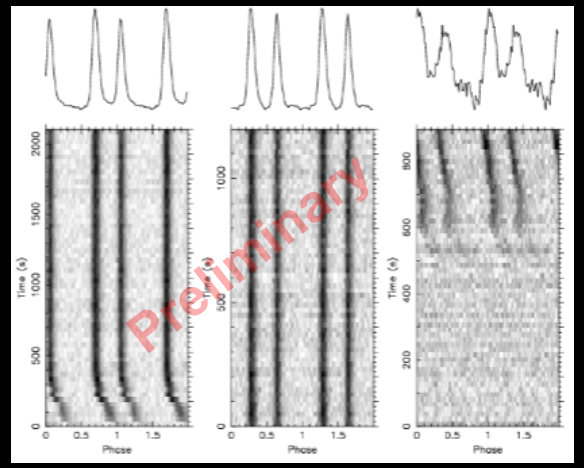




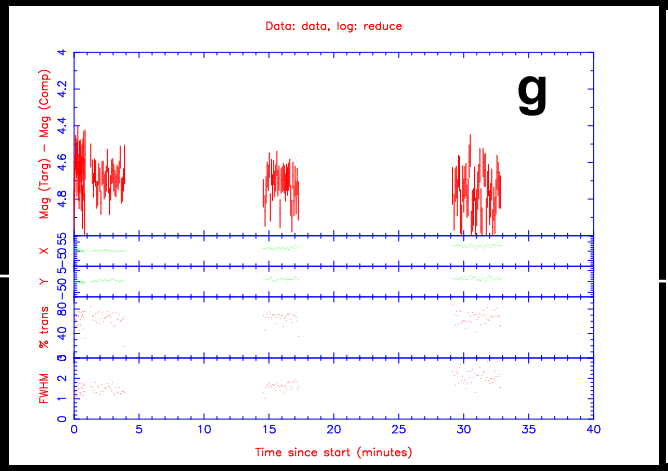
Optical counterparts with the Hiltner 2.4m Telescope

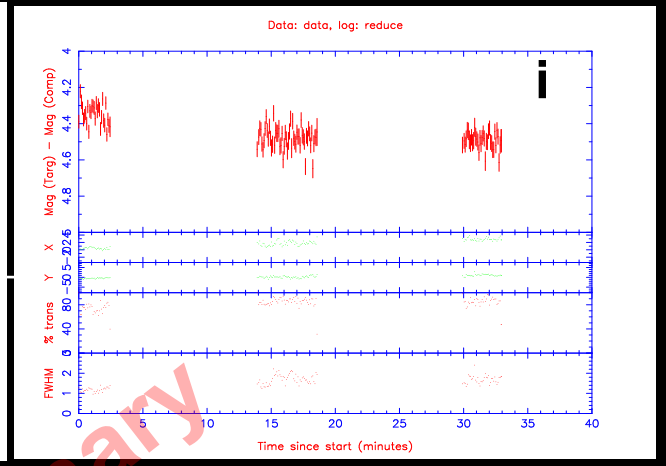
Result: "Spiders"

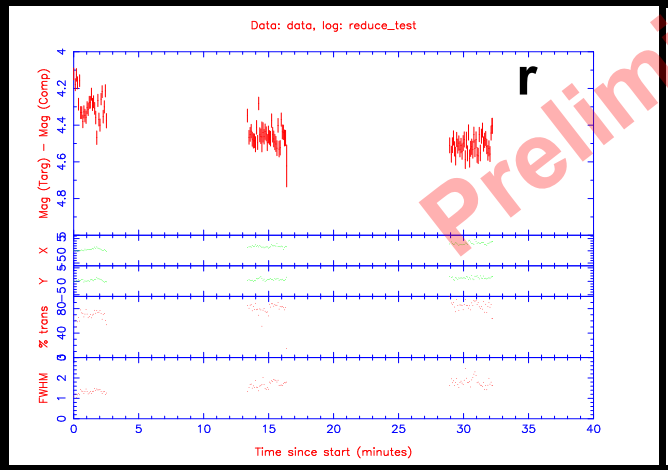


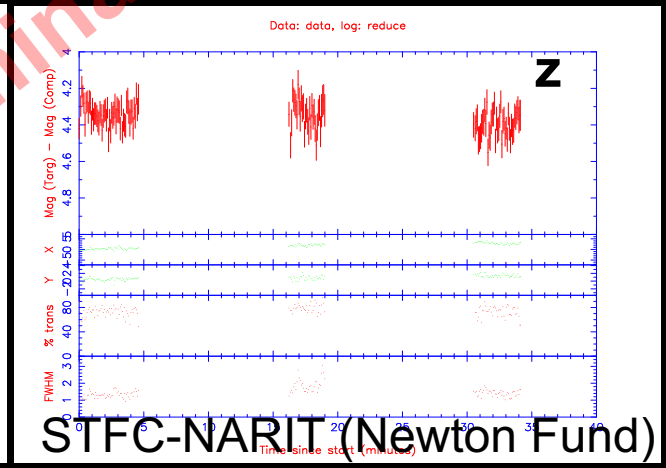


- **Observing 4 new eclipsing spiders with the uGMRT with multiple Bands**









Preliminary

STFC-NARIT (Newton Fund)

- **Long term monitoring PSR J2129-0429 with the 2.4m Thai National Telescope (TNT) using ULTRASPEC**
- PSR J2129-0429 is a BW with a flux variability over a long period of time (~10 years) (Breton+2013)
- Data from November 2017 (4 filters) taken by Dr. Puji Irawati

Result: “Spiders”: Pt5m data of J2129-0429

Rene Breton, U. of Manchester
Vik Dhillon, U. of Sheffield

STFC-NARIT (Newton Fund)