STUDYING THE SOUTHERLY ECLIPSING MILLISECOND PULSAR J1748-2446A USING MEERKAT

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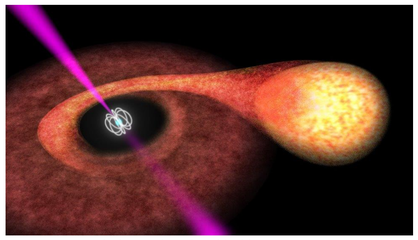
AfAS African Astronomical Society

RADIO PULSARS

Radio pulsars are highly magnetized rotating neutron stars that emit radio emission. Some pulsars are found in close binary systems called spider binaries where they accrete material from its companion. The two main types of spider binaries are redbacks and black widows.



An artist impression of a spider binary system.

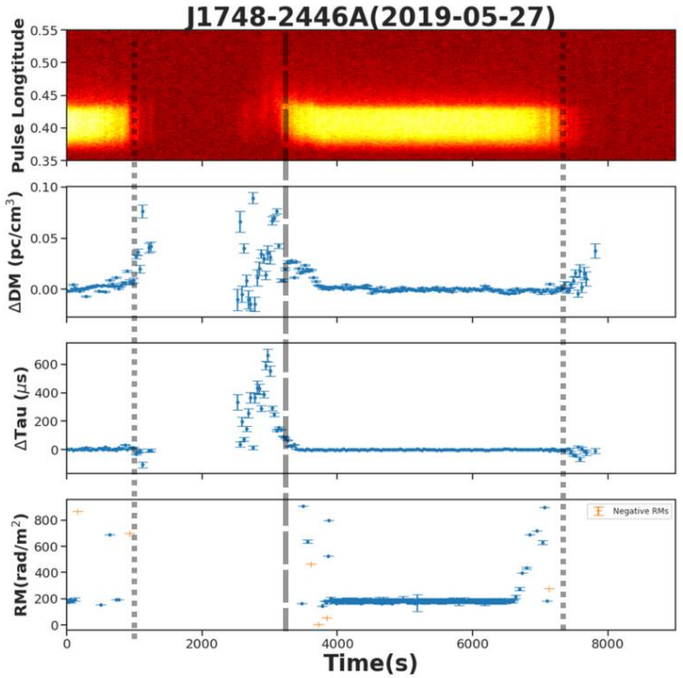
TERZAN 5A

- PSR J1748−2446A (Terzan 5A) is an eclipsing redback millisecond pulsar in the globular cluster Terzan 5.
- It has an 11.56 ms spin period and a very tight 1.8 hr orbit with a low-mass companion ($\gtrsim$0.085 M$\odot$).
- The companion outflow forms a dense, magnetised plasma that eclipses and distorts the pulsar signal.

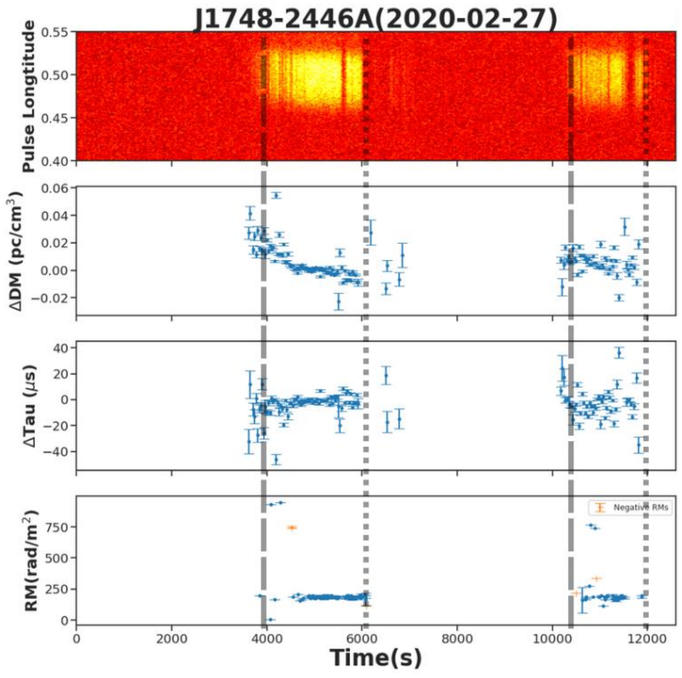
OBSERVATIONAL INFORMATION

Description	Observation 1 2019-05-27	Observation 2 2020-02-27
Number of pulse phase bins	1024	1024
Number of frequency channels	768	1024
Number of polarizations	4	4
Number of subintegrations	1126	1576
Observation duration (s)	9002	12593

OBSERVATIONS



Observation 1's ΔDM , RM and Δτ 's comparisons across time. We observe an increasing trend in the eclipse ingress (dotted lines) and egress (dashed line) where higher electron densities, stronger magnetic fields, and inhomogeneities exist.



Observation 2's ΔDM , RM and Δτ 's comparisons across time. While not as prominent as in Observation 1's data, we do observe changes in these quantities during the eclipse ingress (dotted lines) and egress (dashed lines) where higher electron densities, stronger magnetic fields, and inhomogeneities exist.

RESULTS & CONCLUSIONS

•We record a maximum DM change of 0.09 pc cm^{-3} in Observation 1 and of 0.055 pc cm^{-3} in Observation 2 which are both consistent with the 0.1 pc cm^{-3} variations from You et al. (2018). This means that there are variations in the electron density along the line of sight, due to dynamic changes in the companion's outflow.

•We measured scattering changes and this is the first time these changes have been measured for PSR J1748-2446A. We measured a maximum change of 661.41 μs and a minimum of 0.018 μs for Observation 1. For Observation 2 we measured a maximum change of 36.17 μs and a minimum of 0.11 μs. The companion outflow has irregularities and inhomogeneities, it is dynamic as we measure up to 8 times our pulse period.

RESULTS & CONCLUSIONS cont...

- We measured extreme RM variation of +/-900 rad m^{-2} during the ingress and egress phases for both Observation 1 and Observation 2, these are a big contrast to the +/-5 rad m^{-2} variations observed by You et al. (2018). We also measure a maximum rate of change in RM of over 20 rad m^{-2} s^{-1}, significantly higher than previously observed.
- These extreme change suggests that the companion's outflow is highly magnetized. So we were able to estimate the companions outflow magnetic field strength to be 57 ± 4mG.

FUTURE WORK

1. Investigate the rate of RM and DM changes on shorter time by using single pulses.
2. We also would like to look at the MeerKAT S-band, to study the magnetic fields and to investigate the polarisation properties of Terzan 5A.
3. We briefly worked with Simon Ho from Swinburne University. By providing him with the exact timestamps associated with ingress and egress for Observation 1, he was able to find approximately ten single pulses close to eclipse with SNR > 10. This indicates that they are likely magnified single pulse worth further investigation so that will be one of the next steps.