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Precessing relativistic jets and dynamic shocks powered by an accreting neutron star

Circinus X-1 is a peculiar neutron star X-ray binary system (XRB) which defies conventional classification despite being studied for over 50 years. Surrounded by its natal supernova remnant aged at ~4600 years, Circinus X-1 is the youngest known XRB. However paradoxically, it displays many features common to older, low mass, low magnetic field neutron star XRBs. This provides a unique laboratory to test our knowledge of accretion, jets, and jet interactions with surrounding media.

We present the results of an intensive radio campaign on Circinus X-1. We use the excellent sensitivity of the MeerKAT telescope combined with the improved resolution of the new S-band receivers to produce the most detailed images to date of the jets and the surrounding radio nebula. We show that the jets of Circinus X-1 are able to propagate relativistically to parsec scales, and we identify a curved S-shape jet morphology. We observe drastic swings in the jet axis over time, over a total range of 110 degrees on the sky. Both of these features can be explained by extreme precession of the jet launch axis. Furthermore, using over 20 years of archival radio data we have found dynamic large scale, polarised, decelerating relativistic shocks being driven into the ambient medium, and identify them as a potential site of PeV particle acceleration. These results all illustrate that Cir X-1 is the southern, younger analogue of the famous microquasar SS 433.

Contribution

Oral talk

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