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Broadband X-ray Study of the Galactic Microquasar W50/SS433, a Galactic PeVatron Candidate

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W50/SS433 is a complex and fascinating system that represents an important test bed for many astrophysical processes. Powered by the microquasar SS 433, the W50 nebula —classified as a supernova remnant with an unusual double-lobed morphology reminiscent of a Manatee —has been proposed to be a Galactic PeVatron candidate; a scenario that has been recently revived with the detection of very high energy TeV emission with HAWC. We present the first NuSTAR and XMM-Newton observations of the inner eastern lobe of W50, combined with archival Chandra and XMM-Newton observations spanning various regions across the eastern lobe. We resolve and characterize hard non-thermal X-ray emission detected up to 30 keV, originating from a knotty, few-arcminute size, head region located ~ 29 pc east of SS 433, and constrain its photon index to 1.58 ± 0.05 (0.5–30 keV). The index gradually steepens away from SS 433 and all the way out to the radio ear (at ~ 96 pc east of SS 433) where soft thermal X-ray emission dominates. The unusually hard index and blobby structure seen from the ‘head’ of the eastern jet is similar to what is observed in pulsar wind nebulae as well as in extragalactic AGN jets, and challenges classical particle acceleration processes. We conclude with an outlook on upcoming and future modelling and observational studies of this system that continues to puzzle and fascinate a diverse range of researchers even more than 40 years into its discovery.

Collaboration name

W50 Collaboration

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