



Contribution ID: 39

Type: **Oral contribution**

On the X-ray features associated to some bow-shock pulsar wind nebulae

Tuesday, 6 September 2022 15:00 (20 minutes)

Elongated X-ray features have been detected in association to some bow-shock pulsar wind nebulae, among which those of PSR B224+65 (the Guitar Nebula), PSR J1101-6101 (the Lighthouse Nebula), PSR B0355+54, PSR J1135-6055, PSR J1509-5850, PSR J2055+2539, PSR J1809-1917 and more recently the outstanding filament associated to PSR J2030+4415.

Distinctive properties of these features are: a very elongated structure, in some cases very straight and narrow; a direction uncorrelated with the pulsar proper motion (incompatible with the hypothesis of a pulsar tail); a very hard non-thermal X-ray spectrum, which does not show any clear softening with distance from the pulsar; the presence in some cases of a counter-feature.

Both semi-analytic and numerical analyses converge to outline a scenario in which the highest-energy electrons may escape from the head of the pulsar bow shock, leak in the ISM, flow along the ambient magnetic flux tubes, emit X-ray synchrotron, and to some extent contribute to amplify the field itself. However, there are some aspects of their nature, structure, and involved micro-physics that are still rather controversial and puzzling.

We will mainly discuss here the way in which the highest energy electrons flow / diffuse in ambient magnetic field (this by focusing on possible effects of a pitch-angle anisotropy), and whether these structures are dynamically passive, or rather real jets (this by introducing a statistical analysis of their curvatures).

Collaboration

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Session Classification: Galactic Astrophysical Accelerators