Contribution ID: **79** Type: **poster**

Modelling the X-Ray Emission from the Magnetar Wind Nebula around Swift J1834.9-0846

The extended X-ray emission around Swift J1834.9-0846 observed with XMM-Newton was recently identified to be the first magnetar wind nebula. The high X-ray efficiency of this nebula indicated that it may not be predominately powered by rotational energy of magnetar, but its internal magnetic energy released during burst activities. Similar to the case of rotation-powered pulsar, the energetic particle outflow injected from the magnetar propagates downstream of the termination shock and produces non-thermal radiations through interactions with the interstellar medium. The observed photon index softening towards the outer nebula was attributed to the cooling of relativistic electrons, which could provide useful information about particle transport in this nebula. In this work, we reanalyzed the XMM-Newton observations taken in 2014, and then developed a spatially dependent model to simulate the X-ray emission from the magnetar wind nebula. The fitting results favor the magnetic origin of the magnetar wind nebula. We also found that the observations could be well explained by the model without particle diffusion, indicating advection dominates particle transport in this nebula.

Summary

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