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Predicting Broadband Emission from Millisecond Pulsar Binaries

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Black widow (BW) and redback (RB) systems are compact binaries in which the pulsar heats or ablates its low-mass companion by its intense wind of relativistic particles and emission. Radio, optical and X-ray follow-up of unidentified Fermi Large Area Telescope (LAT) sources has expanded the number of these systems from four to nearly 30. Orbital modulation in X-rays suggests that in many systems, an intrabinary pulsar termination shock exists as a site for particle acceleration, which in many instances wraps around the pulsar. We model the X-ray and γ-ray spectral components from nearby "spider binaries", including diffusion, convection and radiative energy losses in an axially-symmetric, steady-state approach. The code simultaneously yields energy-dependent light curves and orbital phase-resolved spectra. We constrain certain model parameters and estimate the broadband flux for various systems via data fitting, enabling us to identify the effect that different system conditions (e.g. shock orientation or stand-off distance) have on the expected emission from the two subclasses. Two sources, J1723-2837 (RB) and J1311-3430 (BW), have potentially been observed by Fermi-LAT, leading to constraints on the maximum particle energy and particle acceleration in this mini-PWNe. We find that nearby binaries in a 'flaring state'are promising targets for H.E.S.S. and the future Cherenkov Telescope Array (CTA), and that GeV photons (in the off-peak phases of the pulsar light curve) may be detectable by Fermi-LAT for optimistic parameter choices. Moreover, some of these systems will be excellent targets for future MeV missions such as AMEGO.

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