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Estimating the Modulated Inverse-Compton Flux Level from a Black Widow System

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The Fermi Large Area Telescope has detected more than 200 gamma-ray pulsars. Many of them are in binary systems, and a subset of these comprise the “spider binary” class, including black widows and redbacks. The latter systems consists of energetic pulsars and companion stars that are in tight binary orbits. The two stellar winds interact with each other, forming an intrabinary shock and leading to particle acceleration. Observed double-peaked X-ray light curves from these systems are attributed to Doppler-boosted synchrotron emission by relativistic particles flowing out along the shock. Additionally, radio eclipses reflect the presence of the shock enshrouding the companion in the black-widow case. Although energetic arguments suggest that these systems may be detectable by ground-based Cherenkov telescopes, detailed calculations remain to be done rigorously. Given the non-trivial geometry and particle dynamics, we first attempt a simple approach to estimate the level of inverse Compton flux that should result from nearby black-widow systems. We normalise the injected particle spectrum to the pulsar current and spin-down luminosity and approximately take into account the processes of diffusion, convection, and radiative energy losses in an axially-symmetric, steady-state approach. Future work will build on these first estimates and will include more detailed particle transport in a relativistic 2D approach.

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