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Predictions for TeV fluxes from ”Spider” Compact Millisecond Pulsar Binaries

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Black widow and redback systems are compact binaries in which a rotation-powered millisecond pulsar interacts with its low-mass companion. In such systems, an intrabinary shock can form as a site of particle acceleration and associated nonthermal emission. We model the X-ray and gamma-ray synchrotron and inverse Compton spectral components for select spider binaries, including diffusion, convection, and radiative energy losses in an axially symmetric, steady-state approach. Our new multizone code simultaneously yields energy-dependent light curves and orbital-phase-resolved spectra. Using parameter studies and matching the observed X-ray spectra and light curves, as well as Fermi Large Area Telescope spectra where available, with a synchrotron component, we constrain model parameters. This affords a more robust prediction of the expected high-energy and VHE gamma-ray flux. It also better constrains the multiplicity of electron/positron pairs that have been accelerated up to TeV energies and are necessary to power orbitally-modulated synchrotron emission components between the X-rays and MeV/GeV potentially observed in some systems. We find that nearby MSPs with hot or flaring companions may be promising targets for CTA, and that such spider binaries could contribute to the observed AMS2 energetic positron excess.

Keywords

Millisecond Pulsars; Pulsar binaries; Particle acceleration; Positrons; Pulsar winds; Termination Shock; Pulsar Nebulae

Collaboration

other Collaboration

Subcategory

Theoretical Results

Primary authors: Dr WADIASINGH, Zorawar (NASA GSFC); Mr VAN DER MERWE, Christian (North-west University Potchefstroom); Prof. VENTER, Christo (North-West University); Dr HARDING, Alice K. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, NM 58545, USA); Prof. BARING, Matthew (Rice University)

Presenter: Dr WADIASINGH, Zorawar (NASA GSFC)

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