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Modelling the very high-energy gamma-ray emission from accreting neutron stars in X-ray binaries: a theoretical framework for future observations

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The search of gamma-ray emission from accreting pulsars in X-ray binaries (XRBs) has been ongoing for some time. Recent marginal detections in high-mass X-ray binaries (HMXBs) have sparked renewed interest in this area. Anticipating future advances in gamma-ray telescopes like the Cherenkov Telescope Array (CTA), we investigate the expected emission above 10 GeV from XRBs using an enhanced Cheng & Ruderman model. This model incorporates Monte Carlo simulations to account for cascade development inside and outside the accretion disc, including pair and photon production processes that involve interaction with nuclei, X-ray photons from the accretion disc, and the magnetic field. Our results yield a wide range of gamma-ray luminosities (up to ~1E35 erg/s) and spectra, with some exhibiting emission below ~100 GeV and others extending to 10-100 TeV. We compare our findings with existing Fermi/LAT and VERITAS data for two HMXBs, and look forward to more comprehensive comparisons with forthcoming, more sensitive instruments.

Primary authors: DUCCI, Lorenzo (Istituto Nazionale di Astrofisica (INAF)); Dr ROMANO, Patrizia (Istituto Nazionale di Astrofisica (INAF))

Co-authors: Prof. SANTANGELO, Andrea (University of Tuebingen); Dr VERCELLONE, Stefano (Istituto Nazionale di Astrofisica (INAF))

Presenters: DUCCI, Lorenzo (Istituto Nazionale di Astrofisica (INAF)); Dr ROMANO, Patrizia (Istituto Nazionale di Astrofisica (INAF))

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