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Gamma-rays and positrons from colliding wind binaries

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Fermi-LAT and HESS detection of η Carinae confirm that diffuse shock acceleration occurs in the complex geometry of the wind collision zone. Hydrodynamic simulations provide a convincing match with the observations if a few percent of the wind mechanical energy dissipated in the shock goes into particle acceleration. The intrinsic π_0 decay spectrum is a complex convolution of the maximum energy, luminosity, particle drift and obscuration. Accelerated particles cool down mainly via inverse-Compton, synchrotron radiation, and photo-pion production. If the final spectra of accelerated electrons from primary side and secondary side overlap significantly and have similar luminosities, the final γ-ray spectra will not present the observed two bumps. High-energy γ-rays interact also with the pool of anisotropic UV photons emitted by both luminous stars, creating $e^{\pm}$ pairs and strongly modifying the observed spectrum. Quick variations of the optical depth are expected along the orbit, due to changes in shape, position, and gas density of the shocked region. Various CTA simulations confirm that flux variabilities down to few days timescale could be detected above 30 GeV. These variations will disentangle the intrinsic particle spectral cut-off from that related to γ-γ opacity and determine the flux of relativistic protons and positrons injected in the interstellar medium, the geometry of the colliding wind region and the magnetic field configuration, as well as the geometrical orientation of the binary system. CTA will also enlighten the nature of the high-energy component, the mechanisms and the percentage of kinetic energy channelled into particle acceleration.

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