Numerical 3D-hydrodynamic modelling of colliding winds in massive star binaries: particle acceleration and gamma-ray emission

Klaus REITBERGER[1], Ralf KISSMANN[1], Anita REIMER[2], Guillaume DUBUS[3] & Olaf REIMER[1]
[1.] Institut für Astro und Teilchenphysik, University of Innsbruck, Austria
[2.] Institute for Astro- and Particle Physics, Innsbruck University
[3.] Institut de Planétologie et d'Astrophysique de Grenoble (IPAG)

Massive stars in binary systems (as WR140, WR147 or η Carinae) have long been regarded as potential sources of high-energy γ-rays. The emission is thought to arise in the region where the stellar winds collide, thereby producing accelerated particles which subsequently emit γ-rays.
This scenario is supported by recent observations of η Carinae with the Fermi Large Area Telescope. To address the underlying emission mechanisms in a quantitative way, numerical simulations that incorporate hydrodynamics, the acceleration of charged particles as well as subsequent γ-ray emission are necessary.
Hydrodynamical models have been presented in the past which describe the dynamics of the wind-collision region and the ensuing thermal emission up to X-ray energies. Consequently, we present a 3D-hydrodynamical model with the aim of describing high-energy γ-ray emission. Our model incorporates the line-driven acceleration of the winds, gravity, orbital motion and the radiative cooling of the shocked plasma, as well as the diffusive shock acceleration of charged leptons in the wind collision region and the subsequent γ-ray emission via relativistic bremsstrahlung and anisotropic inverse Compton radiation towards the observer. First results regarding wind structure, particle and γ-ray spectra will be shown.