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Origin of the very high energy gamma-ray emission from pulsar wind nebulae

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We study electron and positron acceleration at the termination shock of a striped pulsar wind by integrating particle trajectories in a prescribed model of the magnetic field and flow pattern. We find that drift motion on the shock surface maintains either electrons or positrons on Speiser orbits in a ring-shaped region close to the equatorial plane of the pulsar, where they are accelerated to very high energy by the first-order Fermi mechanism. We calculate the resulting inverse Compton emission from these electrons, and demonstrate that the observed > TeV gamma-ray emission from the Crab Nebula can be well reproduced for reasonable parameters of the Crab pulsar wind and turbulence levels in the nebula. We show that future observations of the Crab Nebula at ~ PeV energies, e.g. by LHAASO, will allow for putting relevant constraints on parameters of the Crab pulsar wind that are still poorly known.

Keywords

Particle acceleration; Pulsar wind nebulae; Gamma-rays

Collaboration

other Collaboration

Subcategory

Theoretical Results

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