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Gamma-ray morphology of SNRs and their halos

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We use our time-dependent acceleration code RATPaC to study the formation of extended gamma-ray halos around supernova remnants and the morphological implications that arise when the high-energetic particles start to escape from the remnant.

We performed spherically symmetric 1-D simulations in which we simultaneously solve the transport equations for cosmic rays, magnetic turbulence, and the hydrodynamical flow of the thermal plasma in a volume large enough to keep all cosmic rays in the simulation.

For older supernova remnants we find strong morphological differences between the hadronic and the leptonic gamma-ray intensity. At early times both - the inverse-Compton and the Pion-decay morphology - are shell-like. However, as soon as the maximum-energy of the freshly accelerated particles starts to fall, the inverse-Compton morphology starts to become center-filled whereas the Pion-decay morphology retains its shell-like structure. Escaping high-energy electrons start to produce an emission halo around the remnant at this time. There are good prospects for detecting the spectrally hard halo component with the future Cherenkov Telescope Array, likewise for detecting variations of the gamma-ray spectral index across the interior of the remnant, whereas current-generation gamma-ray observatories have insufficient sensitivity.

Keywords

SNR; particle acceleration; gamma-ray halo

Collaboration

other Collaboration

Subcategory

Theoretical Results

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