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Modeling non-thermal emission from SN 1987A

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The remnant of SN 1987A is the best-studied object of its kind. The rich data-set of its thermal and non-thermal emission across the electromagnetic spectrum poses a unique testbed for the elaboration of particle-acceleration theory.

We use 2D simulations of the progenitor's wind to obtain hydro-profiles for the medium around the supernova explosion. Various cones along prominent features of the ambient medium are then used in our time-dependent acceleration code RATPaC to model the evolution of the emission of SN 1987A and compare it to observational data.

We solve for the transport of cosmic rays, magnetic turbulence, and the hydrodynamical flow, in the test-particle limit. The simulation code relies on 1D profiles but the large expansion speed of the young remnant renders lateral transport unimportant.

We find that the increase in thermal X-ray emission predates the increase in the low-energy gamma-ray brightness by several years. The increase of the gamma-ray brightness at lower energies is followed by a smooth increase at the highest energies. The gamma-ray spectrum at the highest energies appears soft during the brightening but hardens as more material in the equatorial ring gets shocked. The X-ray and gamma-ray brightness remain almost constant once the SNR blast-wave passed the region of peak-density in the equatorial plane.

Keywords

SNR; SN 1987A; modeling; X-ray; gamma-ray; CSM

Collaboration

other Collaboration

Subcategory

Theoretical Results

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