Modeling of the spatially resolved non-thermal emission from the Vela Jr. supernova remnant

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Abstract

Vela Jr. (RX J0852.0–4622) is one of just a few known supernova remnants (SNRs) with a resolved shell across the whole electromagnetic spectrum from radio to very-high-energy gamma-rays. Its proximity and large size allow for detailed spatially resolved observations of the source making Vela Jr. one of the primary sources used for studies of cosmic rays from SNRs. In this study we aim for a self-consistent radiation model of Vela Jr. which at the same time would explain the broadband emission from the source and its intensity distribution. We solve the full particle transport equation combined with the high-resolution 1D hydrodynamic simulations (using Pluto code) and subsequently calculate the radiation from the remnant. Equations are solved in the test particle regime. We test two models for the magnetic field profile downstream of the shock: damped magnetic field which accounts for the damping of strong magnetic turbulence downstream, and transported magnetic field. Neither of these scenarios can fully explain the observed radial dependence of the X-ray spectrum under spherical symmetry. We show, however, that the spectral variation and the X-ray intensity profile can be explained under the assumption of the enhanced emission within a cone of a limited size.

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