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

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Abstract content

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 (> 100 GeV) gamma-rays. The proximity and large size of the remnant allow for detailed spatially resolved studies of its emission and spectrum. Detection of thin bright filaments at X-ray energies places constraints on particle acceleration models and magnetic field structure in the remnant. High-resolution X-ray observations also reveal softening of the spectrum toward the interior of the remnant further constraining existing models. 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, its intensity distribution and spectral variations. 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 softening of the spectrum and the X-ray intensity profile can be explained under the assumption that the emission is enhanced within a cone of a limited size.

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