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Complexities of a Mid-Life Crush: A Study of the Pulsar Wind Nebula Vela X

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The Vela supernova remnant is a canonical example of a middle-aged composite system in which the SNR reverse shock has disrupted the central pulsar wind nebula, Vela X. Due to a non-uniform ambient medium, the shock has propagated asymmetrically, crushing the northern part of the PWN. The result is a complex structure characterized by nonthermal X-rays from the pulsar wind, thermal X-rays from ejecta mixed into the nebula, and gamma-ray emission in both the GeV and TeV bands, for which the morphology shows striking differences. Here we report on an XMM Large Project to study Vela X. We study variations in the spectral index of the nonthermal X-ray emission, along with the distribution and thermal properties of the shocked ejecta, and correlate these with the gamma-ray properties of the PWN. We evaluate these properties using hydrodynamical simulations in the context of the evolution of PWNe in composite SNRs, with a view to the ultimate fate of the relativistic particles produced in these systems.

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