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Smoothed Particle Inference Analysis of Supernova Remnant DEM L71

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Supernova remnants (SNRs) are complex, three-dimensional objects; properly accounting for this complexity when modeling the resulting X-ray emission presents quite a challenge and makes it difficult to accurately characterize the properties of the full SNR volume. We apply for the first time a novel analysis method, Smoothed Particle Inference (SPI), that can be used to study and characterize the structure, dynamics, morphology, and abundances of the entire remnant with a single analysis. We apply the method to XMM-Newton observations of the Type Ia supernova remnant DEM L71. We present histograms and maps showing global properties of the remnant, including temperature, abundances of various elements, abundance ratios, and ionization age. Our analysis confirms the high abundance of Fe within the ejecta of the supernova, which has led to it being typed as a Ia. We demonstrate that the results obtained via this method are consistent with results derived from numerical simulations carried out by us, as well as with previous analyses in the literature. At the same time, we show that despite its regular appearance, the temperature and other parameter maps exhibit highly irregular substructure which is not captured with typical X-ray analysis methods. Interestingly, we find that SPI can be used to decipher the position of the Rayleigh-Taylor unstable contact discontinuity, consistent with that derived from the hydrodynamic simulations.

Topic

Compact and diffuse sources in galaxies and in the Galactic Center

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