# Spatial-Spectral Analysis for HETGS SNR Observations

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## Abstract

Although designed to observe point sources, the High Energy Transmission Grating Spectrometer (HETGS) on Chandra can be used to observe spatially extended sources. In general for an extended source with smooth spatial and spectral distributions, analysis of the resulting dispersed images will produce source spectra with reduced resolving power and corresponding blurring of spatial-spectral information along the dispersion direction. However, for sources such as Super Nova Remnants (SNRs) which include fine spatial structures (bright knots and filaments) and have X-ray spectra dominated by discrete emission lines (in particular of O, Ne, Fe, Mg, and Si), the "spatial-spectral space" is sparsely filled and the dispersed images retain much of the spatial-spectral information.

As part of the HETG GTO program four SNRs have been observed with the HETGS: E0102, N132D, N103B and Cas A. The observed diameters of these remnants range from $\approx 30$ to $\approx 200$ arc seconds. Analysis methods are being developed to extract useful high-resolution information from these observations. For example, differences in the composition and physical condition of individual X-ray features in N132D can be measured.

In addition, the line-of-sight velocities in SNR can be a few hundred to several thousand kilometers per second and produce measureable effects in the HETGS observed images. As an example, the HETGS data from the Ne X line in E0102 has been analyzed by fitting it to a source model represented by a spatial-velocity data cube, similar to the data structures produced by long-slit spectroscopy or narrow band (Fabry-Perot) imaging in the optical/UV. Chandra's high spatial and spectral resolution leads to a clear demonstration of a $\approx 2500$ km/s velocity variation across the $\approx 5$ arc second width of E0102's X-ray ring.

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