THE EVOLUTION OF YOUNG SUPERNOVA REMNANTS

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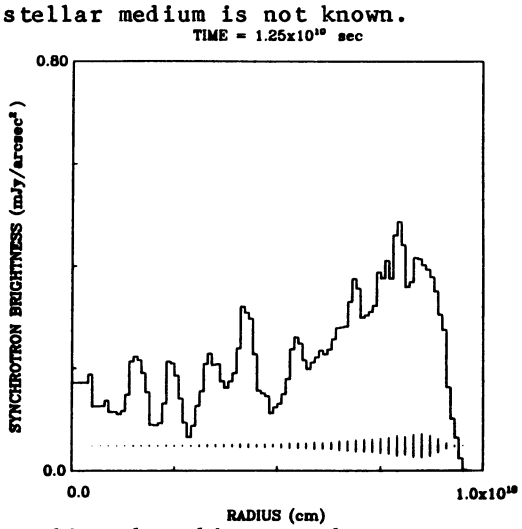
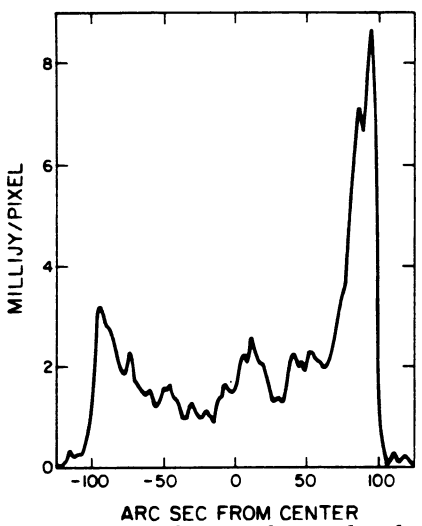
The remnants of the Kepler's and Tycho's supernovae show a thick shell structure with a sharp outer edge and significant brightness irregularities. Models of their expansion have been constructed using a one-dimensional spherical hydrodynamics code, which includes both a leading shock and a reverse shock moving back into the ejectum. The dynamics are controlled by conditions between these shocks. Synchrotron radio emission is produced by acceleration and amplification of initial relativistic particles and fields by eddy motion at the interface between the ejected and swept-up material and at the boundaries of clumps in the surroundings with a mean separation of 5×10^{17} cm, Gaussian sizes of 1×10^{17} cm and peak densities of 3.6×10^{-24} cm^{-3}. The latter was typically 10 times the mean density between clumps. A net radial orientation of the magnetic fields is attributed to stretching by Rayleigh-Taylor instabilities at the contact surfaces. To simulate true three-dimensional structure with the one-dimensional model, random contributions from four runs with varying spacings for the clumps were summed along the line of sight. The results are shown in the figure. Without clumps the observed shell is much too narrow and steep on the inside. Whether the clumpiness is a result of presupernova mass loss or a general property of the interstellar medium is not known.



Predicted radio synchrotron emission from the model type I SNR expanding into a clumpy medium. The vertical vectors near the bottom represent the polarized power in a direction corresponding to a radial magnetic field.



South-north slice through the radio emission from Kepler's SNR. A pixel represents a 1".75 by 2".75 Gaussian beam. The left side can be compared with the model.

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