SUPERNOVA REMNANTS WITH COMPACT X-RAY SOURCES

A. MSH 15-52

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B. The Crab Nebula

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A. MSH 15-52 : A SUPERNOVA REMNANT CONTAINING TWO COMPACT X-RAY SOURCES.

Einstein observations show two small-diameter, bright X-ray sources within the shell of the Galactic radio supernova remnant (SNR) MSH 15-52. X-ray spectra and optical extinction indicate that both compact sources are at least as distant, 4.2 kpc, as the diffuse emission from the shell. There is also enhanced, diffuse emission in the vicinity of both compact sources, as well as coincident with the radio shell. The source closest to the middle of the remnant is hard, unresolved by the HRI, was previously detected as 4U1510-59, and shows strong regular X-ray pulsations with a period of 0.150 s. The second source is associated with a collisionally-excited, high-density, optical knot within the Hα nebula RCW 89 close to the northwestern rim of the SNR.

CCD observations with the Anglo-Australian Telescope yield possible reddened candidates for 4U1510-59 and map the optical knot. Infrared spectral lines at 1.6μ of [FeII] appear in the knot. This is the first time these lines have been seen in an SNR; they are at an intensity comparable to the Balmer emission. UK Schmidt

J. Danziger and P. Gorenstein (eds.), Supernova Remnants and their X-Ray Emission, 417–419.

Telescope photographs of RCW 89 show new filaments which extend into MSH 15-52 and support the hypothesis that the Hα nebula is part of the whole SNR.

It is difficult to incorporate the apparently young pulsar (characteristic age ~ 1600 years), the apparently old SNR (> 10,000 yr), and the bright knot into a single consistent system. We discuss the following possibilities: the interaction of the supernova ejecta with the interstellar medium producing the X-ray, optical, and radio appearance of the nebula; the ages of the pulsar and the SNR being less discrepant than they first appear; and a second pulsar powering the knot and RCW 89.

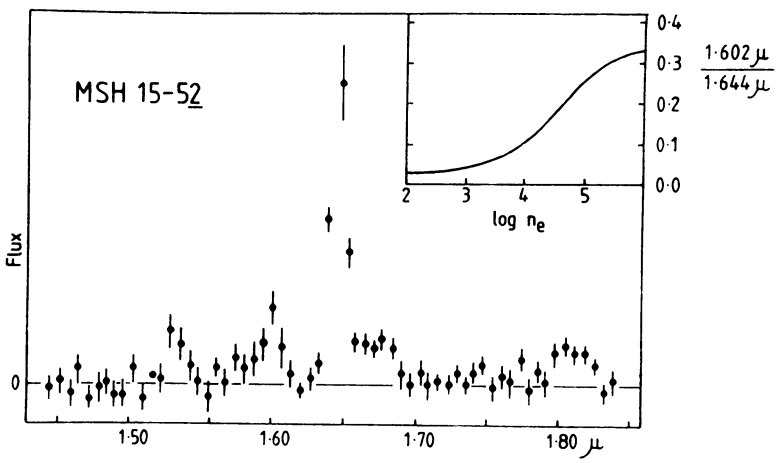

Figure 1: Infrared spectrum around wavelength 1.6 microns of the northern bright knot in MSH 15-52, showing emission lines of [FeII]. This is the first time such lines have been reported in a supernova remnant; in total they are of intensity comparable to the Balmer emission. Inset is the density dependence of the line ratio 1.602μ /1.644μ. In this object a high density, log n_e ~ 4.7, is indicated.

B. THE THREE DIMENSIONAL STRUCTURE OF THE CRAB NEBULA

More than 3000 radial velocity observations across the face of the Crab Nebula are used to investigate its 3-dimensional properties. In the standard model it consists of a thick hollow shell with synchrotron emission from within. We show that the thick shell is composed of bright inner and faint outer components

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surrounded by a higher velocity halo. Filaments are generally circumferential, but radial "spokes" link the inner and outer shells. There are spectral differences between the two extremities of the thick shell. The Crab Nebula's synchroton emission is confined within the shell system with a sharp discontinuity in brightness at the bright inner shell.

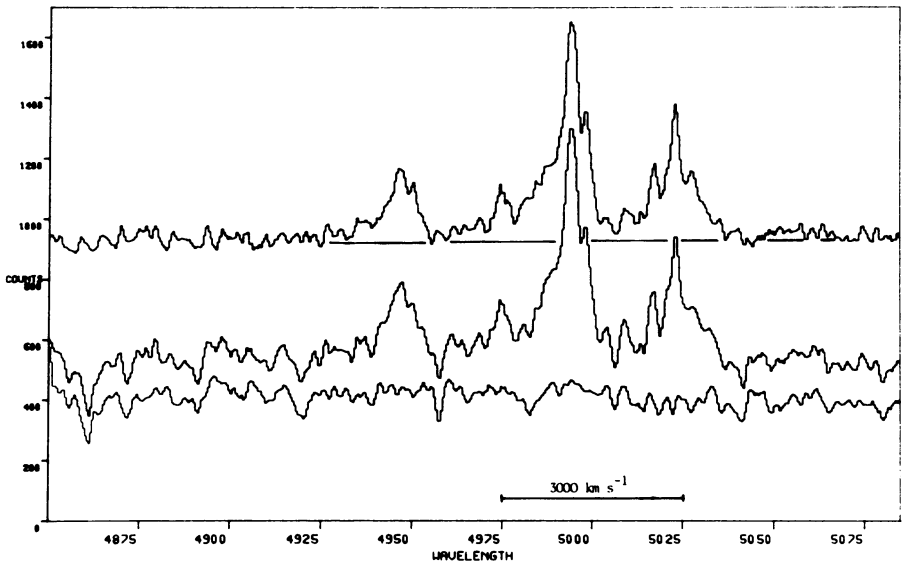

Figure 2: The middle spectrum represents the sum of many increments of a long slit spectrum through the Crab Nebula and centred on the pulsar. The lower spectrum is formed from an equal area of sky. The difference between the two (offset by 800 counts) is displayed at the top and represents filamentary emission on the synchrotron continuum. Interpolating from assumed continuum positions at about 4910Å and 5075Å gives the base level shown. Filamentary emission extends to 5065Å (+3600 km s^{-1} if identified with λ5007) and 4920Å (-2400 km s^{-1} for λ4959).

The full texts of these papers will appear in Astrophysical Journal and Monthly Notices respectively.

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