

X-RAY SPECTRUM OF THE TYCHO SUPERNOVA

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ABSTRACT

Uhuru satellite data combined with Wisconsin rocket data suggest that the X-ray spectrum of the Tycho supernova remnant is composite and includes a thermal as well as a nonthermal component, the latter being an extension of the radio spectrum. Attempts have been made to fit the low-energy observations (thermal component) with the Tucker and Koren calculations for the solar corona.

Subject headings: supernova remnants — X-ray sources

I. INTRODUCTION

We report here X-ray spectral data on the Tycho supernova remnant (SN 1572, 3C 10, 2U 0022+63). The Wisconsin observations were made in a 10-second sighting during a rocket flight 1969 December 5 (Bunner *et al.* 1969) and provide data of reasonable quality below 3 keV. The *Uhuru* observations reported here were made as part of the *Uhuru* survey from data sets beginning with orbits 441, 1468, and 1518 and provide data of reasonable quality in the range 2–10 keV. The two sets of data therefore overlap and provide together a somewhat better picture than if each were published separately.

II. THE DATA

Taken alone, the *Uhuru* data are inconsistent with any of the usual power-law, free-free, or blackbody spectral functions. The spectrum is significantly steeper in the region 2–3 keV than it is above 4 keV and is satisfactorily fitted by the functions

$$\begin{aligned} I(E) &= 2.4 E^{-4.3} \quad , \quad 2 < E < 4 \text{ keV}, \\ &= 0.094 E^{-1.6} \quad , \quad 4 \leq E < 10 \text{ keV}, \end{aligned} \quad (1)$$

where $I(E)$ is the differential energy flux in keV $(\text{keV cm}^2 \text{ s})^{-1}$ and E is in keV. These two functions are shown in figure 1.

The prescription for displaying the data in this figure requires explanation. The assumed spectrum was folded through the proportional-counter response functions and the results integrated between appropriate pulse-height intervals to give predicted rates of detection. These predicted rates were then compared with the measured rates and the “data points” with associated errors plotted in figure 1 as assumed (input) intensity \times (measured rate/predicted rate). The figure therefore provides an honest basis for judging the compatibility of the assumed spectrum but no other.

The *Uhuru* spectrum is in reasonable agreement with the Wisconsin rocket data in

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