

### Effect on the Lower Ionosphere of X-rays from Scorpius XR-1

SINCE early 1960 we have been recording at Ahmedabad the field strengths of radiowaves of 164 kHz transmitted from Tashkent. A pronounced minimum recurred night after night in the months April to July, the local time of the minimum shifting to earlier hours as the days advanced from April to July.

This suggested that the phenomenon might be due to increased ionization in the lower D-region of the ionosphere below the reflexion level, due to a celestial X-ray source. Further examination showed that the time of

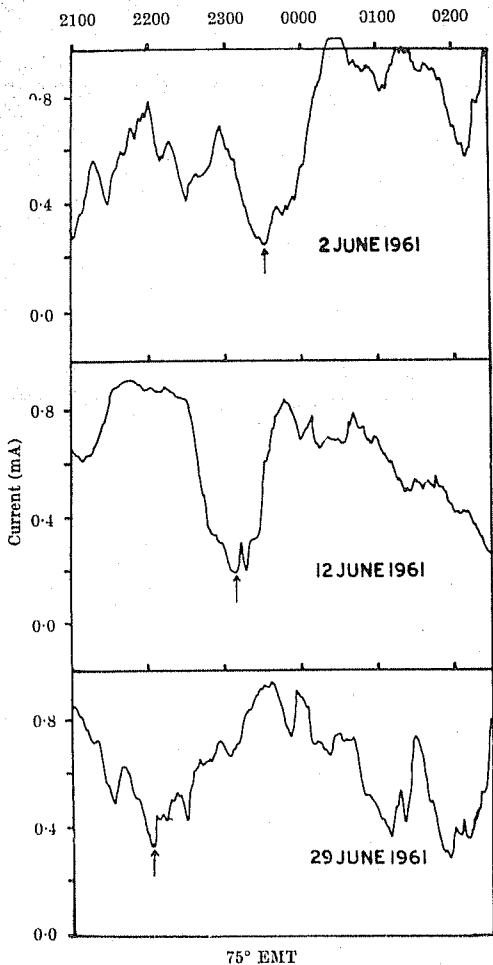


Fig. 1. Field strength of Tashkent 164 kHz observed at Ahmedabad. Arrows indicate transit of Sco XR-1.

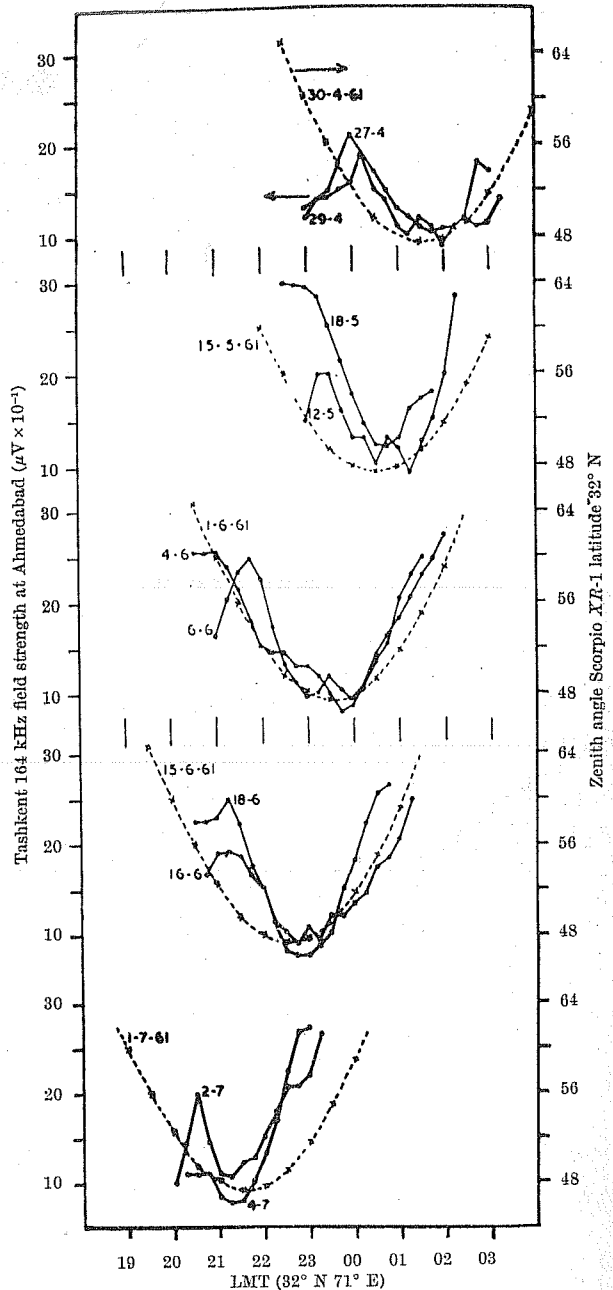


Fig. 2. Changes in times of minimum of Tashkent 164 kHz field strengths received in April to July 1961.

the minimum nearly coincided with the transit of Scorpius XR-1 across 71° E, which is the one-hop reflexion meridian of radiowaves from Tashkent to Ahmedabad (Figs. 1 and 2).

It is known from the observations of Giacconi and Gorenstein, Sandage *et al.* and of NRL scientists that the strongest X-ray source in the northern hemisphere near 32° N is Scorpius XR-1 ( $\alpha = 16 \text{ h } 17 \text{ m}$  and  $\delta = -15^\circ 31'$ ) and that it has a spectrum with maximum at 2 to 4 keV coming down to about 0.1 of the maximum value at 8 keV (G. Fritz, Spectra of Cosmic X-ray Sources, NRL Space Research Seminar, April 17, 1968).

Fig. 3 plots the times of minimum field strength of 164 kHz transmissions from Tashkent observed at Ahmedabad on individual days in May-June 1960-63 against the time of transit of Sco XR-1 at 71° E. There is striking agreement between the observed times of minimum field strength and the times of transit of Sco XR-1.

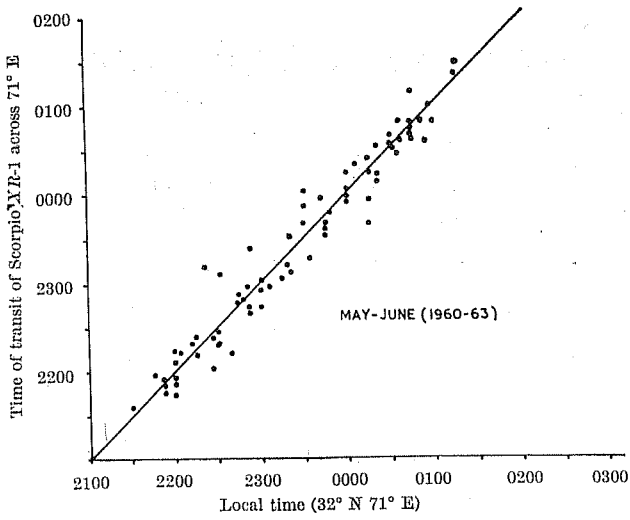


Fig. 3. Times of minimum field strength plotted against times of transit of Sco XR-1.

The Tashkent transmissions are stopped each day between 0100 and 0400 h LT. The vertical incidence critical frequency corresponding to a single-hop of 164 kHz at oblique incidence from Tashkent to Ahmedabad is about 27 kHz.

S. ANANTHAKRISHNAN  
K. R. RAMANATHAN

Physical Research Laboratory,  
Ahmedabad 9, India.

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