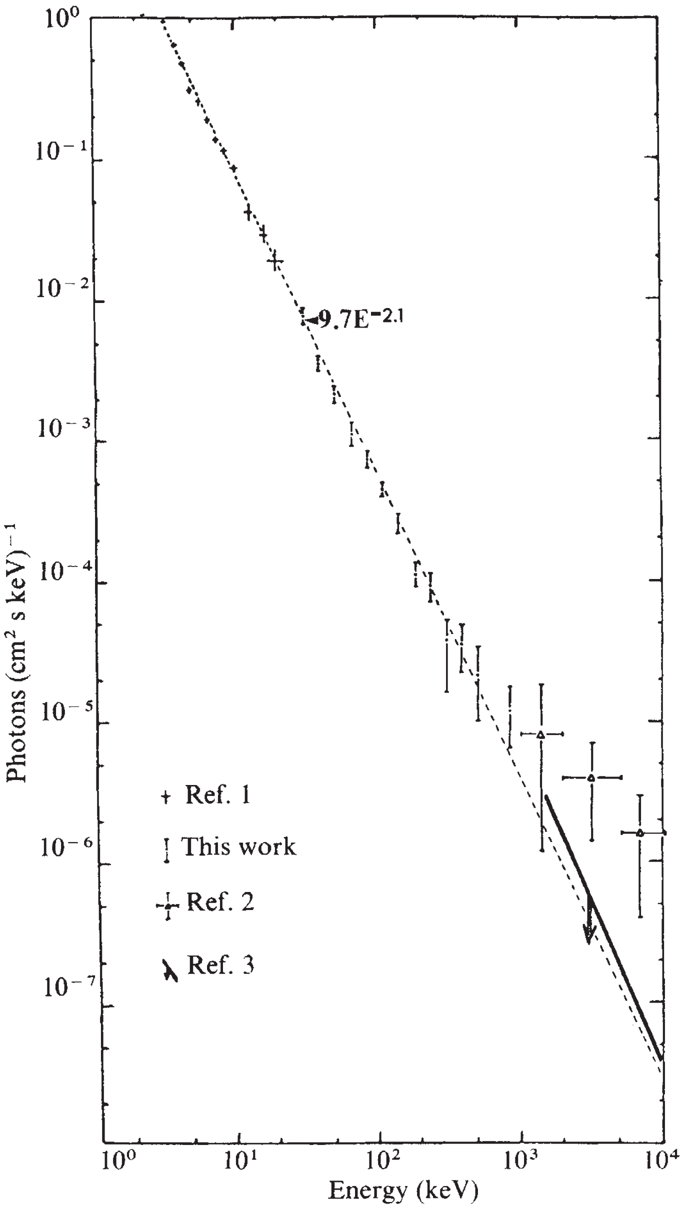
New X-ray measurements of the Crab spectrum in the range 26 keV–1.2 MeV

THE Imperial College scintillation detector on Ariel V made measurements of the X-ray spectrum of the Crab Nebula in 1975 April and September. The detector consists of an 8 $cm^2 \times$ 4 cm CsI(Na) crystal actively collimated to 8° FWHM, and measures X rays in 15 logarithmically spaced energy channels in the range 26 keV–1.2 MeV. The detector axis is inclined 3° to the spacecraft spin axis, which in turn is normally offset by ~ 3° from the source being viewed. Source counts are thus spin modulated, allowing the background to be subtracted. A residual modulation is further removed by changing the direction of the offset to the source and observing the resulting phase change in the modulation. This observational technique ensures all sources of background are eliminated, the modulation characteristics having been previously determined by laboratory calibration.

Counting rates were then deconvolved from the detector response by considering the effects due to window thickness, crystal dead layer and K shell X-ray escape, as well as the various statistical processes that occur in the detection sequence from the incident photon to the phototube output.

Fig. 1 Observations of the Crab Nebula from 1 keV to 10 MeV.



The 1975 observations of the Crab Nebula were first analysed separately, but as no significant variation was observed they have been combined in Fig. 1. Error bars represent 1σ counting statistics, which we believe dominate any other systematic errors. Also plotted on this figure are data below 20 keV obtained from a rocket flight by Toor and Seward[1] in 1970, and results above 1 MeV from balloon flights by Baker *et al.*[2] in 1972 and Schonfelder *et al.*[3] in 1974.

Though there have been many studies of the Crab Nebula by balloon and rocket experiments observing at < 100 keV (see ref. 2) and some limited observations above 1 MeV, there has previously been a noticeable lack of any accurate observations between these two ranges.

The dotted line shown in Fig. 1 is the best fit given by Toor and Seward to all available data and extrapolated from their limit of ~ 50 keV up to 10 MeV. As can be seen, the fit to the Ariel V results is excellent up to 500 keV and lies within one s.d. of the final point at 840 keV. Our results are thus consistent with a power law extrapolation to beyond 1 MeV, and hence with Schonfelder's upper limits. On the other hand, if Baker's results are correct, this would imply a rather abrupt hardening of the spectrum at about 800 keV, with a consequent softening above 10 MeV to bring the spectrum into agreement with spark chamber measurements by Kniffen *et al.*[4] at 50–100 MeV.

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4 Kniffen, D. A., *et al.*, *Nature*, **251**, 397 (1974).

Meteor radar rates and the solar cycle

A WORLDWIDE increase in meteor echo rates in 1963 was observed in New Zealand[1], Canada and Sweden and has been widely discussed in the literature[2–8]. From radar observations in 1953–66 I reported[9] a long term variation in the echo count rate with a peak occurring in 1963 near the solar minimum. Those observations also showed that the height of first appearance of meteors from a given shower had remained nearly constant at ~ 110 km, whereas the average endpoint height had risen by ~ 11 km from 1956 to 1963. It was thus evident that the 1963 peak in the meteor echo count rate was of atmospheric origin. We report here further observations, and propose that the phenomenon can be explained by a solar controlled variation of the atmospheric density gradient at the meteor ablation level, probably caused by a variation in the solar X-ray flux.

My observations were made at the Onsala Space Observatory in the period 1953–72. Visual and radar recordings of meteors have been regularly made in August since 1953. A radar control run in September was operated intermittently from 1953 to 1959 and has been regularly performed since 1962. The radar equipment records echoes of duration ⩾ 0.02 s corresponding to meteors brighter than about fifth zenithal magnitude. The experimental technique has been described elsewhere[5,10].

Figure 1*a* depicts the mean night-time hourly rate of meteor radar echoes of all durations, as observed from 1953 to 1972 (1954 is missing and 1971 not yet reduced). A long term variation in the August meteor rate curve is evident. The operational run in August includes the period of maximum activity of the Perseid meteor shower, but the length of the run is such that