X-RADIATION STUDIES OF THE CORONA

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ABSTRACT

The coronal X-ray emission has been studied in a series of sunpointed Skylark-rocket flights over the period August 1964 to August 1967. Two types of instrument have been used, namely, an array of pinhole cameras, to study the distribution of X-ray sources across the solar disk, and a set of Bragg crystal spectrometers, to examine the detailed spectrum of the emission.

Six rocket flights in all (Skylarks 301, 302, 303, 306, 307, and 406) have provided solar X-ray photographs, covering the wave-band 12–60 Å. The main conclusions of this work may be summarised as follows:

(1) Of over twenty separate calcium-plages areas, all those having an area-intensity product greater than 300 were associated with enhanced coronal X-radiation, this 'threshold' being merely a function of X-ray camera sensitivity.

(2) The plages studied were of from 1st to 4th rotation, indicating the enduring nature of the local coronal X-ray enhancement.

(3) Crude spectral analysis, derived from different filters used in a given camera array, showed an increasing contrast between the active region and disk emissions below 25 Å, indicating the probability of the active region coronal material being rather hotter.

(4) Photographs of regions on the disk and on the limb showed a typical coronal active region to produce more than 50% of its total X-ray flux from a region within 1 arc minute cube. Electron densities up to 10 times the normal coronal values are required by the measured X-ray brightness of the larger regions.

(5) The major part of the emission above 20 Å arises from the (cooler) background corona. Examination of this coronal disk emission revealed strong limb brightening, polar darkening (particularly in the 1964–65 photographs) and a band of slightly enhanced X-radiation near latitude 35 °N. The latter observation was noted on successive flights, in October 1965 and February 1966, and clearly followed the tilt in aspect angle of the solar disk.

Skylarks 304 and 305 were equipped with uncollimated Bragg crystal spectrometers. The former payload, flown in May 1966, revealed strong line emission down to the scan limit at 11 Å. Emission lines of O VII and VIII, Ne IX and X, Fe XVII and XVIII and Ni XIX have been identified. All but the O VII series were found to have dominant components arising from a large active region on the solar disk, and an analysis has shown that the complete active-region spectrum is consistent with an electron temperature of 3 million degrees. Intercomparison of the different emission lines indicated coronal abundances of iron, nickel and neon comparable to those derived earlier by Pottasch from an analysis of the solar UV spectrum.

Provisional analysis of the latest flight (Skylark 305 in August 1967), employing crystals of beryl and EDDT in addition to the KAP flown on Skylark 304, has shown strong emission lines of the helium-like ions Mg XI and Si XIII, with weaker but significant intensity in Lyman-α of Mg XII (8·4 Å) and Si XIV (6·2 Å), the latter emission requiring the presence of active region material at a temperature of near 10^7 °K.

DISCUSSION

Newkirk: Does your emission measure $N_e^2\, V \sim 2 \times 10^{48}$ refer to the high or low ionization lines?
K. Evans: High ionization.

Kiepenheuer (ed.), Structure and Development of Solar Active Regions, 431. © *I.A.U.*

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