EXPERIMENT TO DETERMINE THE TEMPERATURE STRUCTURE IN THE SOLAR CHROMOSPHERE AND CORONA

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An experiment is in course of preparation at the Astrophysics Research Unit at Culham for flight on a Sun-pointing rocket. It is designed to determine the ionization temperature and electron density as a function of height in the temperature range of about 8×10^4 K to 3×10^6 K by measuring limb to disk intensity ratios of extreme ultraviolet emission lines in the 170 to 850 Å region. The work is an extension of current experiments in which normal-incidence spectrographs are used to determine the structure lower in the chromosphere-corona transition region.

The experiment employs three instruments each having a component lay-out as illustrated in Figure 1. A grazing-incidence mirror, consisting of a paraboloidal section and a hyperboloidal section, forms a solar image on the entrance slit of a grazing-incidence, grating spectrograph. The disk spectrum is recorded by two such instruments; one, fitted with an aluminium filter, covers the range 170 to 350 Å and the other, unfiltered, covers the 300 to 850 Å range. The limb spectrum is recorded by a single, unfiltered instrument; to maintain the solar limb on the entrance slit to a few arc-seconds accuracy the position of the double mirror is servo controlled. The geometrical slit width on all three instruments will be 10–15″.

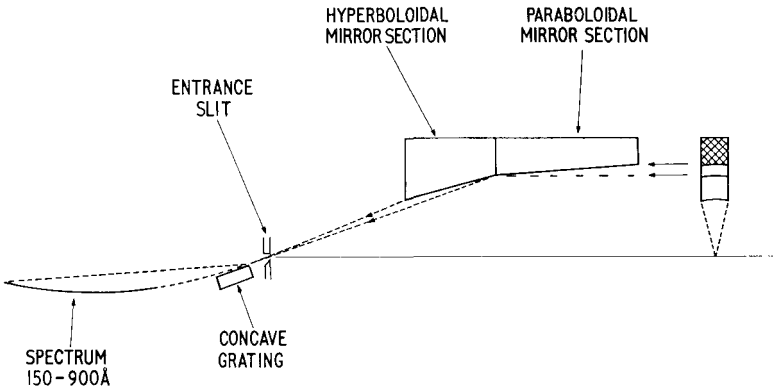

Fig. 1. Experiment to determine limb-disk line intensity ratios.

The temperature gradient should be determined over a height range of $\sim 30''$. To determine the atmospheric structure it is necessary to know the transmission function

Space Science Reviews **13** (1972) 668–669.

of the optical system in the range 170–850 Å. This will be obtained from laboratory measurements of the mirror aberrations at suitable wavelengths and measurements of the in-flight pointing noise. A relative intensity calibration between the instruments, and an absolute intensity calibration of the limb-pointing instrument by the branching ratio method, will be done using a θ-pinch source.

DISCUSSION

B. S. Fraenkel: How much intensity is lost by the two mirrors?

C. R. Negus: We have not measured the reflection efficiency of our double mirror system, although this will be done before flight. At the shortest wavelength ($\lambda \simeq 150$ Å) we would expect to lose about 50 % of the energy from the two reflections, while at longer wavelengths it should be less.

S. R. Pottasch: When will this experiment be flown?

C. R. Negus: It is expected at present that the flight will take place in about 16 months time.

B. Woodgate: What is your detection system?

C. R. Negus: The limb and disk spectra will be recorded photographically.

https://doi.org/10.1017/S0252921100089879 Published online by Cambridge University Press