A TWO-COMPONENT THERMAL
MODEL OF X-RAY BURST SOURCES

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Abstract. A semi-empirical model of the soft X-ray source associated with solar flares is presented, based on the results of the two temperature analysis of OSO-5 data obtained by Herring and Craig (1973). The model makes use of a jet of plasma rising from the solar surface as the basic origin of the soft X-ray emitting region, and gives rise to a cool region caused by randomisation of the jet, and a hot region caused by a shock front. Two different geometries are examined, and the model allows flow velocities and electron densities to be calculated.

1. Introduction
It was shown by Herring and Craig (1973) that a number of soft X-ray bursts, observed in the wavelength region 2.6–10 Å with the University College London/Leicester University X-ray spectroheliograph aboard the OSO-5 satellite, could be explained as resulting from a source consisting of two regions at temperatures of about $2 \times 10^6$ K and $15 \times 10^6$ K, each with a rapidly rising and slowly falling emission measure. The observations consisted of seven-channel proportional counter histograms obtained at 46 s intervals during the bursts, and the analysis, performed on each of these histograms, compared it with a calculated histogram, consisting of the sum of two histograms generated artificially by the use of the known instrument parameters and the line and continuum spectra computed by Landini and Fossi (1970a, b). The shape (a function of temperature) and total count for each of these two artificial histograms were selected to give a minimum $\chi^2$ fit to the data, thus ascribing two temperatures and two emission measures to each measurement during the burst. The $\chi^2$ values showed that a statistically acceptable fit was obtained, which was not the case when a single histogram (representing an isothermal source) was used to fit the data at each point.

While this does not necessarily mean that such a two temperature model is the final answer, but only that it cannot be disproved with the data used, it is interesting that a number of flares have shown a good fit in this way, whereas attempts to fit active region data in a similar fashion have not resulted in an equally good improvement in the $\chi^2$ value over a one temperature fit. A number of authors have in fact dealt with active regions as embodying a continuous distribution of temperature, e.g., Batstone et al. (1970), Landini and Fossi (1971), Chambe (1971), Acton et al. (1972) and Parkinson (1973).

Bearing the above in mind, a semi-empirical model of the source of an X-ray burst...
Fig. 1. Results for the two component analysis of an X-ray burst on 15 September 1969. The lower \( \chi^2 \) plot was obtained from a single component model not shown. The expected \( \chi^2 \) value is 3 in the two component and 5 in the single component case.