THE GSFC EUV AND X-RAY SPECTROHELIOPHOTOGRAPH ON OSO-7

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Abstract. The Goddard Space Flight Center instrument carried on the pointed section of the OSO-7 satellite is described. This instrument contains: An extreme ultraviolet spectroheliograph using glancing incidence optics of Wolter's Type II to focus the Sun's light on the entrance slit of a concave grating spectrometer; an auxiliary Hα system; two X-ray spectroheliographs using mechanical collimators for spatial resolution and Ross filters to isolate spectral bands of interest, and a flare polarimeter operating in the 15–40 keV X-ray region. These subsystems may be operated in a number of modes which, when combined with the spacecraft modes, give the instrument great flexibility for making solar observations. Representative results from each of the subsystems are presented.

1. Introduction

The seventh satellite in the Orbiting Solar Observatory (OSO) series was placed in orbit on 29th September 1971. Aboard were six instruments designed to study solar and stellar radiation in wavelength regions inaccessible to ground-based observers. Two of these, the Naval Research Laboratories (NRL) white light coronagraph and XUV heliograph, and the Goddard Space Flight Center (GSFC) EUV and X-ray spectroheliograph, were carried on the pointed (or sail) section of the spacecraft so that their optical axes could be pointed accurately at regions of interest on the solar disc, or be made to scan various raster patterns over such regions.

The GSFC instrument, which is described in this paper, was designed to study extreme ultraviolet (EUV) and X-ray emission from the solar corona, in particular from active regions and flares. The following is a summary of the design goals for this instrument:

1. Simultaneous observation of a number of emission lines in the solar spectrum, representing a wide range of temperatures of formation. In particular, the instrument was designed to observe ionic species of iron from Fe IX (171 Å) up to Fe XXV and Fe XXVI (~ 1.8 Å).
2. Spatial resolution compatible with the capabilities of OSO-7 and the photon flux available from the Sun.
3. Repeated observation of a selected region in a time short compared to the lifetime of a typical solar flare.
4. Spectral resolution sufficient to assume that the radiation being recorded at any time originates in a single stage of ionization of a particular element.

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(5) An auxiliary channel which would permit direct comparison of X-ray and EUV data with ground-based observations. An Hα system was designed for this purpose.

(6) A method of monitoring the impulsive phase of an X-ray burst for correlation with soft X-ray and EUV data and also obtain, if possible, information on the polarization of the hard component of the X-ray burst. To accomplish this, a small polarimeter based on Thomson scattering of hard X-ray photons in a beryllium block was designed.

These design goals were met by an instrument which contains five subsystems: An EUV spectroheliograph operating in the region 170–400 Å; an ancillary Hα system; a soft (8–16 Å) X-ray spectroheliograph employing Ross or balanced filters for monochromatization; a harder (1.7–8.0 Å) X-ray spectroheliograph operating on the same principle; and the polarimeter mentioned above. These subsystems are shown schematically in Figure 1, and described in more detail in the following sections.

2. The EUV Spectroheliograph

Many observations of the solar EUV spectrum have been made from satellites and rockets. In fact, several of the earlier OSO satellites carried EUV scanning spectrometers (see, for example, Neupert et al., 1969). These spectrometers all accepted light from the whole Sun; they were capable of no spatial resolution. Such a lack of spatial