A SOLAR EXTREME ULTRAVIOLET TELESCOPE AND SPECTROGRAPH FOR SHUTTLE/SPACELAB*

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Abstract. An instrument for advanced studies of the solar corona is described. Its optical system provides nearly stigmatic imaging of selected portions of the Sun over the spectral range from 22.5 to 44.0 nm. Both spectroheliograms and emission line profiles of coronal features will be obtained over a wide range of coronal temperatures.

This paper describes the capabilities and anticipated scientific application to solar observations of a Solar Extreme Ultraviolet Telescope and Spectrograph (SEUTS) that has been selected by NASA for definition and, it is expected, flight on a Shuttle/Spacelab mission. (The instrument was proposed in response to a NASA Announcement of Opportunity issued in June 1978 (Neupert et al., 1978)). We will summarize the scientific objectives and functional design of the instrument and then discuss how it will be applied to investigation of major questions concerning the solar corona.

The scientific investigations that will be carried out with the SEUTS address several fundamental problems of solar physics:
- The energy and mass balances in closed magnetic field regions in the corona and the processes by which these regions are heated.
- Mass and energy transport into the solar wind.
- The characteristics of the emergence and evolution of coronal active regions and their relation to flare activity and coronal holes.

Our prime scientific objectives require EUV observations with high spectral ($\Delta\lambda \approx 0.005 \text{ nm}$) and spatial ($\Delta s \approx 2 \text{ arc sec}$) resolution simultaneously over a wide range of solar temperatures ($1 \times 10^5 - 2 \times 10^7 \text{ K}$) and over an extended field of view. We intend to:

1. Observe emission line profiles and intensities over a wide range of transition zone and coronal temperatures for many types of features (active regions, quiet

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sun, coronal holes, etc.) in order to correlate turbulent and directed mass flows with the coronal conditions of electron temperature and density in which they are found.

(2) Search for periodic and aperiodic (possibly impulsive) intensity variations of spectral lines as a function of temperature that may be indicative of wave processes or other forms of energy injection into the corona.

(3) Observe coronal and transition-zone loop configurations and their changes prior to and following flares to assess the role that coronal magnetic fields and their possible instabilities play in the flare phenomenon.

(4) Observe the EUV line-emission of flares as a means of identifying the locations of impulsive components, sources of mass for the high-temperature flare plasma and processes by which energy is converted and dissipated during the flare event.

The SEUTS optical design combines a Wolter Type II grazing incidence telescope having high EUV reflectivity with an aspheric near-normal incidence grating system which produces approximately stigmatic images of the solar image at each wavelength. A slit placed at the focus of the telescope acts as the entrance aperture for the spectrograph and defines the array of spatial elements that will be refocussed, at each wavelength, in the final focal plane. The principal optical paths can be traced in Figure 1a.

Fig. 1. (a) Schematic outline of optical and detector systems currently planned in the Solar Extreme Ultraviolet Telescope and Spectrograph (SEUTS). (b) Outline of spectrograph slit configuration to be located at the focus of the SEUTS Wolter type II telescope.