THE SOLAR WIND GENERATION EXPERIMENT FOR SPARTAN MISSION 201

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The Solar Wind Generation Experiment consists of a UV Coronal Spectrometer (UVCS) provided by the Harvard-Smithsonian Center for Astrophysics and a White Light Coronagraph (WLC) of the High Altitude Observatory. The instruments are similar to those flown together on three sounding rocket flights [1,2,3] but they have enhanced capabilities to take advantage of Spartan's 27 hour observing period. The two instruments comprise a payload for Spartan 2, which is a self-contained instrument carrier that provides on-board data storage, power, thermal control, sun pointing and an observing program sequencer. Spartan is launched and deployed by the Shuttle and spends about 27 orbits in a detached mode before it is recovered and returned to the ground for data tape retrieval and post-flight instrument calibration.

A major scientific objective of the Spartan Mission 201, which is planned for mid-1986, is to discover the coronal source region of the "slow speed" solar wind. A new spectroscopic diagnostic technique which utilizes observations of the O VI lines at $\lambda 1032$ and $\lambda 1037$ and the polarization and brightness of visible light [4,5] will be used to measure slow speed ($\geq$ 30 km s^{-1}) outflows in helmet streamers, the boundaries of coronal holes, the quiet corona, and active region streamers. The instruments will also determine electron densities and proton kinetic temperatures in such regions [6]. Another major objective is to obtain a more complete description and understanding of the physical processes operating in broad polar coronal holes which are believed to be a source of high speed polar wind streams. The high outflow velocities in such regions will be determined from Doppler dimming of H I Lyman-α [6] and from the observed ratio of O VI $\lambda 1032/\lambda 1037$ [5]. The UVCS will also be used to assess the feasibility of determining coronal electron temperatures from measurements of the spectral line profile of electron scattered H I Lyman-α [6].

Spartan Mission 201 is intended to make a significant step toward achieving an understanding of the nature of the unknown sources of non-radiative energy flux that enters the corona from lower atmospheric layers and interacts with the coronal plasma to produce its high temperature and its acceleration to supersonic flow as the solar wind. The basic nature of the non-radiative energy flux and its mode of interaction with the coronal plasma, neither of which is understood, should be reflected in the measured temperature, density, and velocity structures of the corona.

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An instrument similar to WLC has been described by MacQueen et al. [7]. The WLC for Spartan 2 is equipped with a CCD detection system which facilitates simultaneous polarization and brightness measurements of the electron-scattered white light radiation from a 270° segment of the corona between 1.5 and 6 $R_\odot$. The spatial resolution is 25" x 25". The wavelength band measured is 4400-5400 Å.

The occulting system for the UVCS has been described by Kohl, Kirkham and Reeves [8]. The instrument for Spartan 2 has a dual telescope-spectrometer system and two detection systems. One of the two separate optical systems is optimized for measurements of H I Lyman-α and the other for O VI λ1032 and λ1037. A discrete anode microchannel array detector simultaneously observes 42 spectral elements across the H I Lyman-α line profile and also detects the electron scattered H I Lyman-α profile with 2 Å resolution elements between λ1175 and λ1260 Å The O VI lines are each detected with channel electron multipliers (CEM) with CsI photocathode coatings. The CEM's are protected from contamination by a vacuum valve that is opened during observations to provide an open path for the EUV radiation.

The spectral resolution is 0.3 Å for observations of the resonantly scattered component of Lyman-α, 2 Å for the electron scattered component and 2.5 Å for observation of O VI λ1032/λ1037 Å. The spatial resolution elements are 0.53' x 5' for the resonant Lyman-α profile, 4' x 5' for the electron scattered Lyman-α profile and 2.6' x 5' for the O VI λ1032/λ1037 Å intensities. The instantaneous field-of-view is illustrated in Figure 1. At any instant, both the resonantly scattered Lyman-α profile and O VI intensities are observed at one spatial height (represented by the X in Fig. 1) and the electron scattered Lyman-α profile is measured at a point (represented by the O in Fig. 1) which is displaced by 9.5' in the solar tangential direction. Using internal telescope mirror rotations, these elements can be scanned along a given radial direction between spatial heights of 1.5 $R_\odot$ and 3.5 $R_\odot$. The instrument field-of-view can be rotated through 360° about suncenter using the Spartan 2/Attitude Control System (Spartan 2/ACS). Offset pointing by Spartan 2/ACS will permit the instrument to view the solar disk (represented by the triangle in Fig. 1). For this observation, which is used to normalize the coronal intensities to a composite of disk intensities, a shutter mask mechanism places 14 µm pinholes in front of the entrance slits.

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References

1. J.L. Kohl, H. Weiser, G.L. Withbroe, R.W. Noyes, W.H. Parkinson, E.M. Reeves, R.M. MacQueen and R.H. Munro, Astrophys. J. 241, L117 (1980).

2. R.H. Munro, J.L. Kohl, H. Weiser and G.L. Withbroe, Bull. Amer. Astron. Soc. 13, 912 (1982).

3. J.L. Kohl, H. Weiser, G.L. Withbroe and R. H. Munro, Bull. Amer. Astron. Soc. 14, 976 (1982).

4. J.L. Kohl and G.L. Withbroe, Astrophys. J. 256, 263 (1982).

5. G. Noci and J.L. Kohl, in preparation (1984).

6. G.L. Withbroe, J.L. Kohl, H. Weiser and R.H. Munro, Space Sci. Rev. 33, 17 (1982).

7. R.M. MacQueen, J.T. Gosling, E. Hildner, R.H. Munro, A.J. Poland and C.L. Ross, Proc. S.P.I.E. 44, 207 (1974).

8. J.L. Kohl, E.M. Reeves, and B. Kirkham, in New Instrumentation for Space Astronomy, eds. K. van der Hucht and G.S. Vaiana (Oxford and New York: Pergamon Press, 1978).

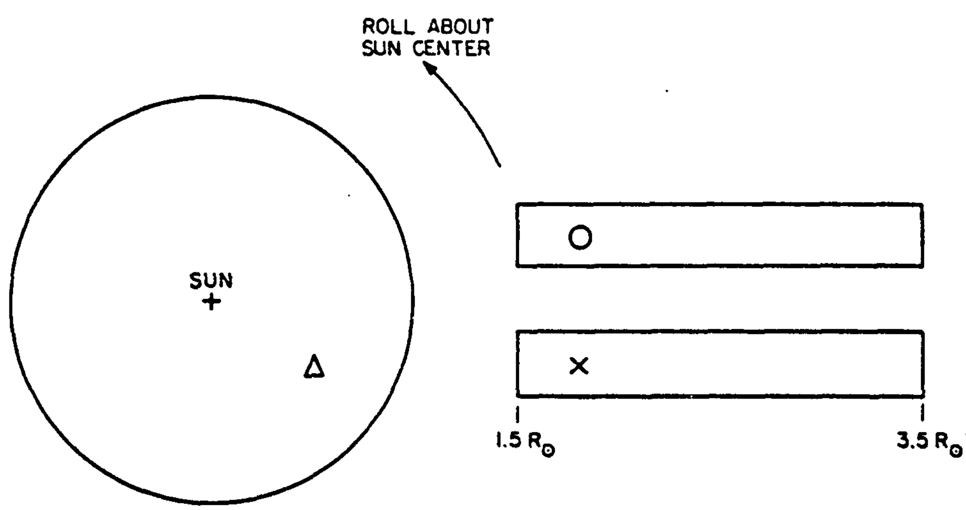

Fig. 1. Instantaneous Field-of-View of UVCS/Spartan 2.

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