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INVESTIGATION OF CORONAL LARGE SCALE STRUCTURES UTILIZING SPARTAN 201 DATA

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Two telesecopes aboard Spartan 201, a small satellite has been launched from the Space Shuttles, on April 8th, 1993, September 9th, 1994, September 7th, 1995 and November 20th, 1997. The main objective of the mission was to answer some of the most fundamental, unanswered questions of solar physics—What accelerates the solar wind and what heats the corona? The two telescopes are 1) Ultraviolet Coronal Spectrometer (UVCS) provided by the Smithsonian Astrophysical Observatory which uses ultraviolet emissions from neutral hydrogen and ions in the corona to determine velocities of the coronal plasma within the solar wind source region, and the temperature and density distributions of protons and 2) White Light Coronagraph (WLC) provided by NASA's Goddard Space Flight Center which measures visible light to determine the density distribution of coronal electrons within the same region.

The PI has had the primary responsibility in the development and application of computer codes necessary for scientific data analysis activities, and instrument calibration for the white-light coronagraph for the entire Spartan mission. The PI was responsible for the science output from the WLC instrument. PI has also been involved in the investigation of coronal density distributions in large-scale structures by use of numerical models which are (mathematically) sufficient to reproduce the details of the observed brightness and polarised brightness distributions found in SPARTAN 201 data.

PI's work on the four Spartan missions has produced a lot of papers with new scientific results such as:

1. For the first time polar plumes were established as large-scale coherent structures that extended into the inner heliosphere (Science

News, August, 15, 1995, page 89) which resulted in a renewed research interest in these structures and their contribution in the coronal heating and solar wind outflow processes.

2. For the first time solar wind model, using the white-light density constraints was able to show that the proton temperature in the inner corona is much hotter than the electron temperature which was later verified by observations from SOHO UVCS.

3. Spartan 201-03 WLC observations of the corona for the first time set a value (not an upper limit) in the coronal hole density estimate which matched Ulysses in situ particle observations at 2.3 AU. This result has tremendous implications for solar wind modeling ..... showing that the solar wind accelerates much closer to the Sun (5 solar radii) than had been thought before.

4. The steady-state 2-D, MHD behavior of the corona and the heliosphere was modeled using constraints from Spartan, SOHO and Ulysses observations which for the first time agreed with observations both at the corona and at 1 AU.

Recent Relevant Publications

1. Coronal Streamers and Fine Scale Structures of the Low Latitude Corona as Detected with Spartan 201-01 White Light Coronagraph. M. Guhathakurta and R. Fisher. Geophysical Research Letters, July 15th, 1995.

2. Physical Properties of Polar Coronal Rays and Holes as Detected with SPARTAN 201-01 Coronagraph. R. Fisher and M. Guhathakurta. Astrophysical Journal Letters, 447, 2, 139, 1995.

3. Flow properties of the solar wind derived from a two-fluid model with constraints from white light and in situ interplanetary observations. S.R. Habbal, R. Esser, M. Guhathakurta and R. Fisher. Geophysical Research Letters, 22, 12, 1465, 1995.

4. Guhathakurta, M., Holzer, T.E. and MacQueen, R.M., The large scale density structure of the solar corona and the heliospheric current sheet, Ap. J., 458, 817, (1996).

5. Guhathakurta, M., Fisher, R.R., and Strong, K., Temperature structure of the high-latitude corona, Ap. J. Lett., 471, L69, 1996.

6. Guhathakurta, M. and Fisher, R.R., Importance of white-light observations of the extended corona, Robotic Exploration Close to the Sun: Scientific Basis, AIP Conference Proceedings, 385, 121, 1996.

Ko, Y-K, Fisk, L, Geiss, J., Gloeckler, G., Guhathakurta, M., An empirical study of the electron temperature and heavy ion velocities in the south polar coronal hole, Sol. Phy., 171, 345, 1997.

7. D. Dobrzycka, L. Strachan, M. P. Miralles, J. L. Kohl, L. D. Gardner, P. L. Smith, S. R. Cranmer, M. Guhathakurta, R. Fisher, Comparison of SPARTAN and UVCS/SOHO Observations, Poceedings to the 10th Cambridge Workshop on "Cool Stars, Stellar Systems and the Sun", 1997, accepted for publication.

8. Guhathakurta, M. and Fisher, R., 'Solar wind consequences of a coronal hole density profile: Spartan 201-03 coronagraph and Ulysses observations from 1.15R to 4 AU', 499, L215, 1998.

9. Guhathakurta, M., Fludra, A., Gibson, S.E., Biesecker, D., and Fisher, R., 'Physical properties of a coronal hole from CDS, Mark III and LASCO observations during the Whole Sun Month', accepted for publication in JGR Whole Sun Month issue, 1998.

10. Guhathakurta, M., Sittler, E., Fisher, R., McComas, D., and Thompson, B., 'Coronal magnetic filed topology and source of fast solar wind', submitted to ApJL, 1998.

11. Sittler, E. and Guhathakurta, M., Semi-empirical 2D MHD model of the solar corona and interplanetary medium, submitted to ApJL, 1998.

12. Esser, R., Fineschi, S., Dobrzycka, D., Habbal, S., Edgra, R., Raymaond, J., Kohl, J. and, Guhathakurta, M:, accepted for publication, ApJ, 1998.