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SOLAR CORONAL NON-THERMAL PROCESSES
(Solar Maximum Mission)

Final Report

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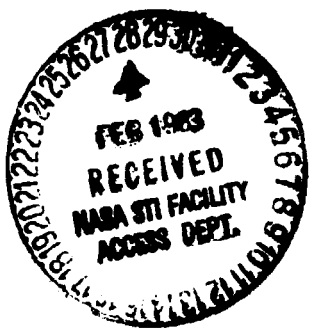

Abstract

The Solar Maximum Mission provided an opportunity to study solar coronal phenomena in hard X-radiation, since its instrument complement included the first solar hard X-ray telescope. This research effort aimed at discovering phenomena related to those discovered previously from OSO-5 and OSO-7 observations. Lack of limb-pointing data resulting from insufficient interaction between the guest investigator and the SMM planning resulted in null results. The brevity of the Guest Investigator program also contributed to this. Interesting theoretical ideas did emerge, however.

Related Publications (attached)

Hudson, H.S., Lin, R.P., and Stewart, R.T., 1982, *Solar Phys.* 75, 245.

Bai, T., 1982, *Astrophys. J.*, 259, 341.

Hudson, H.S., and Dwivedi, B.N., 1982, *Solar Phys.*, 76, 45.

Bai, T., Hudson, H.S., Pelling, R.M., Lin, R.P., Schwartz, R.A., and von Rosenvinge, T.T., 1982, *Astrophys. J.* (to be published).

Bai,T., 1981, Second-Phase Acceleration Versus Second-Step Acceleration in Solar Flares, Gamma-Ray Transients and Related Astrophysical Phenomena AIP Proceedings, number 77, p. 409.

Hudson, H.S., 1981, High Energy Observations of Stellar Flares: Comparison with the Sun, Gamma Ray Transients and Related Astrophysical Phenomena AIP Proceedings, number 77, p. 383.

Introduction

The OSO-5 hard X-ray spectrometer discovered a very interesting solar hard X-ray burst originating in a flare beyond the solar limb as viewed from the Earth (Frost and Dennis, 1971). This circumstance virtually guaranteed that the hard X-ray source was in the corona at a great altitude above the photosphere. Subsequently, Hudson (1978) and Hudson, Lin and Stewart (1982) identified two other examples from OSO-7 observations.

The Solar Maximum Mission afforded an ideal opportunity to study these objects, since its instrument complement emphasized high-energy flare observations and in particular included the first hard X-ray imaging instrument. This Guest Investigation dealt with the problem of observing such sources with SMM and carrying out the interpretation of the observations.

Observations

The Principal Investigator spent approximately ten weeks at the Goddard Space Flight Center during the winter and spring of 1981. Unfortunately the spacecraft fine pointing system had already failed at that time, and so new observations dedicated to the specific problems proposed for study could not be carried out. The responsibility for this mistake rests partly on the SMM Principal Investigators, for not giving earlier emphasis to this important investigation, and partly on the Principal Investigator of this effort for not demanding prompt attention.

Of course, none of the participants expected the untimely demise of the fine pointing system.

Faced with the lack of a dedicated observing program, the investigation had to rest upon accidental observations and theoretical progress. A search of the existing limb data failed to reveal any interesting items worth further study in this context. Subsequent to the conclusion of this grant, one potentially good example, that of 1980 October 18, may have been discovered by the SMM experimenters.

Results

The SMM observations of disk flares, not specifically part of the proposed investigation, did disclose the existence of a new coronal X-ray component. Examples were observed on 1980 March 30 (Lantos et al., 1981); 1980 21 May (Svestka et al., 1982a); and 1980 November 6 (Svestka et al., 1982b). These sources appear to consist of giant arches containing essentially thermal coronal sources; they exist in very nearly the same geometrical configuration noted for the over-the-limb hard X-ray sources. The relationship between these types of source is presently unknown, but observations with the hard X-ray imager on the Hinotori satellite (e.g. Tsuneta et al., 1983) may help to clarify this point.

Otherwise the results to which this program contributed are essentially theoretical. A scheme for Monte Carlo calculation of electron transport was set up (Bai, 1982); this method can be used for following the

motions of the non-thermal electrons composing the sources to be studied. A second activity resulted in the identification of the "second step" acceleration in the impulsive phases of flares producing gamma-radiation (Bai, 1981; Bai et al., 1983). This second step acceleration may be produced by first-order Fermi acceleration in flare loops. A similar mechanism may be involved in the coronal hard X-ray sources unsuccessfully sought in the SMM data.

References

Bai,T., paper presented at Workshop on Gamma-ray Transients at La Jolla, August, 1981.

Bai, T., Hudson, H.S., Pelling, R.M., Lin, R.P., Schwartz, R.A., and von Rosenvinge, T.T., 1982, *Astrophys. J.* (submitted).

Bai, T., 1982, *Astrophys. J., 259*, 341.

Frost, K.J., and Dennis, B.R., 1971, *Ap. J., 165*, 655.

Hudson, H.S., 1978, *Ap. J., 224*, 235.

Hudson, H.S., Lin, R.P., and Stewart, R.T., 1981, *Solar Phys., 75*, 245.

Lantos, P., Kerdraon, A., Rapley, C.G., and Bentley, R.D., 1981, *Astron. Astrophys., 101*, 33.

Svestka, Z., and 14 co-authors, 1982a, *Solar Phys., 75*, 305.

Svestka, Z., and 6 co-authors, 1982b, *Solar Phys., 78*, 271.

Tsuneta, S., and 9 co-authors, paper presented at U.S.-Japan Seminar on Solar Flares, Tokyo, October, 1982.