NAG8-872

FNAS/Solar Flare Energetics

FINAL REPORT

April 15, 1991 - October 14, 1992

Submitted to

National Aeronautics and Space Administration
George C. Marshall Space Flight Center
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November 20, 1992

NAG8 – 872

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As noted in our last report, we have performed an extensive study of solar flare energy buildup and release, concentrating in two aspects:

a) Relationship with 3–D field topology and measured electric currents. We extended our previous studies on the characteristic topology of flaring regions, by following the evolution of an active region over three consecutive days. From comparison with flare observations in X–rays and H–alpha, we found further support for the hypothesis that flares were triggered by taking place at the separator (3–D generalization of an X–type neutral point). Furthermore, we found that emerging flux at a site within the active regions where no (or little) activity was previously observed, caused the appearance of a secondary separator and thereon continuous triggering of activity at such site. Our topology arguments were then applied to a study of sympathetic activity between two regions within an active complex. Here again we found that interacting field structures along separators and separatrices, which act as pathways for recurrent flaring to spread between the regions, could be used to understand how activity spread to potentially explosive sites with the complex. Although research in this topic has not been exhausted, a summary paper of our progress to date was presented at the Solar–Terrestrial Energy Program (STEP) Symposium.

b) We also finished our study of flare onset characteristics as determined from combined X–ray and ultraviolet observations. Using a quasi–static modeling approach, we find that this phase is characterized by a relatively low level of energy release, 10^{26-27} erg s^{-1}, which is sufficient to produce "gentle" evaporation, a shift in the location of the transition zone as compared to pre–flare conditions, and an increase in the temperature and density of coronal loops. All these changes have profound implications on the observed signatures of impulsive phase phenomena, which had been neglected in the past. During the time elapsed since our last report we finished the paper which is now ready to be distributed to the co–authors, for final review prior to submission to the journal. As a follow–up of this investigation we now plan to apply our results to the interpretation of high–sensitivity spectroscopic and hard X–ray data currently being gathered by the Yohkoh and Compton Gamma–Ray Observatory satellites.

PUBLICATIONS.

Evidence for Magnetic Reconnection in Large Scale Magnetic Structures in Solar Flares.
C.H. Mandrini, M.G. Rovira, P. Demoulin, J.C. Henoux, M.E. Machado and L.K. Wilkinson. Astronomy and Astrophysics, submitted.

Interactive Flare Sites in an Active Region Complex.
G. Poletto, G.A. Gary and M.E. Machado. Solar Physics, in press.

Flare Onsets: Characteristics and Effects.
M.E. Machado, J. Rodriguez, M.G. Rovira, L.E. Orwig and E. Reichmann. Solar Physics, to be submitted.

Understanding Transient Solar Phenomena: A New Approach.
M.E. Machado, P. Demoulin, G.A. Gary, J.C. Henoux, C.H. Mandrini, G. Poletto and M.G. Rovira. Proc. STEP Symposium (Pergamon Press), in press.

Research Needed to Improve Solar Flare and Particle Forecasting.
M.E. Machado and J.M. Davis. To be published in Advances in Space Research.

Relationship Between Magnetic Field Shear and Flare Sites in AR6659.
B. Schmieder, P. Demoulin, M.J. Hagyard, M.E. Machado, A. Guoxiang, L.Z. Kai and F. Qijun. To be published in Advances in Space Research.