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**FINAL REPORT OF THE PROPOSAL "STUDIES OF EARTH
SPACE ENVIRONMENT AND SUDDEN DISAPPEARANCES OF
SOLAR PROMINENCES"**

JUNE 18, 2002 — DECEMBER 31, 2005

GRANT NUMBER: F49620-02-1-0345

PRINCIPAL INVESTIGATOR: Tian-Sen Huang

INSTITUTION: Prairie View A&M University

1. Summary

With the support from AFOSR/Minority University Program, we worked on research of Sun-Earth space environment, conducted daily solar observation program, improved solar instruments, and established and maintained an space science education program. We also worked on the preparation for transferring Big Bear Solar Observatory's 65 cm telescope to Prairie View A&M University.

2. Research performance

A. Earth's ionosphere and magnetosphere research

In the first year of the award, we have concentrated on the study of geomagnetic variation at several ground observatories approximately aligned along the same meridian (~295°). First, we investigated the monthly frequency distribution (histogram) of the measured magnetic field and examined its seasonal and yearly variations. Second, we took the 5 quietest days of each month, and separated observations according to the polarity of the y-component of the Interplanetary Magnetic Field. Using 20 years of data to cover two consecutive solar cycles allows us to cancel out the Svalgaard-Mansurov effect at high latitudes, and to isolate the typical Sq daily pattern at any station for each month. A presentation for this work was given to AGU 2002 Fall Meeting.

In the second year, we worked on two subjects: Calculation of vortex changes in the Earth magnetosphere with particle guiding center motion theory, and inference of interplanetary electric field history from the geomagnetic records. We studied for the first time the vortex changes in the magnetosphere from the point of view of particle guiding center motion and relate the temporal change of vortex to the polarization drift. In the calculation, we adopted a distorted dipole magnetic field (Stern, 1976) and used the Euler potentials in analytic form. The work was presented at AGU 2003 Fall Meeting. For the subject, inference of interplanetary electric field history from geomagnetic records, the

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long-term variation of the interplanetary electric field is inferred back to 1926 from a correlation analysis with magnetograms recorded at two polar cap geomagnetic observatories, Godhavn and Thule. We found that no evidence for a long-term trend in BV and therefore in the interplanetary electric field. A paper for this work has been published in JGR.

In the third year, we worked, in collaboration with Rice University, on the Earth ionosphere and magnetosphere coupling subject. We have created new Euler potential grids on the ionosphere of north hemisphere which has been a started point for the Rice University space science group to improve the Rice Convection Model to be one with the realistic magnetic field in the ionosphere. The work has been reported in AGU 2005 Spring Meeting and an jointed paper with Rice University has been submitted to JGR fro publication.

B. Solar activity research

For the research of solar activity, we have focused on the sudden disappearances of solar filaments and their relationship with CMEs.

Sudden disappearances of prominences/filaments have been identified from the Prairie View Solar Observatory H_{α} images and Meudon Observatory spectroheliograms for the period from January 1, 2000 to August 31, 2000. The H_{α} events have been compared with CME data from LASCO C2 and C3 coronalgrphs aboard SOHO. The association was established if the disappearance occurred in a time interval of 180 minutes centered on the onset of CME and if its position angle was located within 30 degrees of the position angle of the CME. Our study suggests that an important percentage of the observed sudden disappearances are local destabilizations produced by heating or minor rearrangements of the magnetic configuration of the filaments and do not involve CMEs. Dynamic or eruptive disappearances on the other hand are produced by a major reorganization of the magnetic structure containing the filament and are associated with coronal mass ejections. One poster presentation has been given in 2002 COSPAR Conference and one paper was published in the journal *Adv. Space Res.*, 2003.

Late, based on our observatory's H-alpha images and Meudon Observatory spectroheliograms, we studied three classes of disappearances, and presented a poster in AAS/SPD 2004 Meeting. (One student coauthored the poster.)

3. Daily solar observation program

A team, consisting of research staff and three or four students, runs the daily solar observation program at our solar observatory for the whole award period. When the weather permits, on each day the team collects several hundred H-alpha images with the 35 cm diameter principal telescope and potassium K-line images with a magneto-optical system. The collected images are saved at our data base that opens to the public. The data have been used by our group and by other research groups including NASA/MSFC (Choudhary) and Big Bear Solar Observatory (Yamazaki) for the research on solar activity.

4. Instrument improvement

In order to strengthen Prairie View Solar Observatory's observation ability, last year we worked on the upgrade of the exiting magneto-optical filter (MOF) system and complete the design of a full solar disk telescope. The full solar disk telescope that associates to a tunable filter currently is under manufacture and will be mounted on the main telescope folks.

5. Education

In each semester, we have three to five undergraduate students to participate in our solar observation and research activities. The students learned the operation of solar telescope and the data analysis, learned the basic knowledge of solar physics, and involved in the solar research project. Two students gave presentations in scientific conferences.

One graduate student worked on the space science research project in finishing his master degree.

6. Preparation for transferring the Big Bear Solar Observatory's 65 cm telescope

We have also worked on the preparation for transferring the Big Bear Solar Observatory's 65 cm telescope to Prairie View A&M University. A plan for a new observatory to host the 65 cm telescope has completed.

7. Publications

Le Sager, P., L. Svalgaard, and T. S. Huang, Main magnetic field determination and Sq-model tuning from local geomagnetic variation, *AGU 2002 Fall Meeting*.

- Pojoga, S., and T. S. Hunag, On the sudden disappearances of solar filaments and their relationship with CMEs, *2002 COSPAR Conference*.
- Huang, T. S., and P. Le Sager, Vorticity change in the magnetosphere: A study with particle guiding center motion, *AGU 2003 Full Meeting*.
- Le Sager, P., and L. Svalgaard (2004), No increase of the interplanetary electric field since 1926, *J. Geophys. Res.*, **109**, A07106, doi:10.1029/2004JA010411, 2004.
- Pojoga, S., and T. S. Huang, On the sudden disappearances of solar filaments and their relationship with coronal mass ejections, *Adv. Space Res.*, **32**, 2641, 2003.
- Pojoga, S., F. R. Crawford, T. S. Huang, Sudden disappearances of filaments and their relation with Coronal Mass Ejections, *Amer. Astron. Soc. SPD Meeting*, **204**, 38.04, 2004.
- Huang, T. S., Optimum Cross-Section of the Current Flowing Through Magnetic Field Lines, *AGU 2005 Fall Meeting*.
- Wolf, R. A., R. Spiro, S. Sazykin, F. R. Toffoletto, P. Le Sager, and T. S. Huang, Use of Euler Potentials for Describing Magnetosphere-Ionosphere Coupling, submitted to *J. Geophys. Res.*, 2005.