OBSERVING TIME PROPOSAL FORM FOR

THEMIS-SOHO-Hinode - 2009

SCIENTIFIC PROPOSAL

1 General Information

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Title of Project:

JOP157 Activity of magnetic features in the solar atmosphere (emergence, shear, dispersion)

Specify the observation modes: **MTR** [X] **IPM** [ ] **MSDP** [X]

Number of days requested: September 23 to October 10 2009

2 Proposed programme

A - Scientific rationale

Concise scientific background of the project, pertinent references; previous work plus justifications for present proposal.

The Scientific Objectives and justification are the following:

Emerging magnetic flux and reconnection

Young Active Regions and new emerging magnetic flux produce MMFs associated with Ellerman Bombs (EBs). The models of emerging flux tubes assuming an Omega-shape are commonly accepted (observations of Arch Filament Systems, coronal loops). However, the balloon Flare Genesis Experiment launched in 2000 over the Antarctica pointed out that the flux does not emerge with such shape of loops, but more as fragmented elements with more or less horizontal serpentine field lines (Pariat et al, 2004). This was only observed for one active region (NOAA 8844). Hinode gets impressive movies of emergence of magnetic flux. The aim is to observe such features in other emerging active regions. THEMIS showed already its capability for such a program (Pariat et al 2007). With the new solar cycle arriving, it is a very promising program.

Hα/Ca II 8542 profiles indicate different features at different levels:
In the line center Arch Filament Systems are observed, the models proposed to interpret dopplershifts of AFS are still uncertain: rising up of loops or Bald Patches (field lines tangent to the photosphere, noted BPs). Hα surges are also associated with EBs and parasitic polarities (Rust 1968, Kurokawa and Kawai 1993, Asai et al. 2001).
Far in the wings, there are emission excess called Ellerman bombs, with short lifetimes (15 mn) and small areas ($1,8 \times 1.1\,\mathrm{arcsec}^2$) (Georgoulis et al, 2002). Are they due to bombardments of the low chromosphere by energetic particles (Hénoux et al 1998)? Pariat et al. (2004) used extrapolation techniques in linear force-free field approximation and explained the EBs by reconnections at the loci of BPs.

Emerging flux tube close to other magnetic structures (filament channel, active region) leads to flares and filament eruption (Schmieder, Török and Aulanier 2008).

Decaying active regions and faculae

Frequently the decay of active region is correlated with the expulsion of moving magnetic features (MMFs). They were named moving magnetic features by Harvey and Harvey (1973). They consist of small magnetic dipoles surrounding commonly the trailing sunspot. They cancel as they reach opposite polarities (Deng et al 2002). These MMFs are also correlated with Hα surges. The morphological and evolutionary characteristics support their physical origin , i.e., magnetic reconnection between the MMF and the pre-existing coronal fields (Kurokawa and Kitai 1993).

Some active regions cannot form at the beginning of solar cycle and only plages or faculae can be observed. It is a good time to understand the filling factor of these regions (Guo Yang, Schmieder, Bommier submitted 2009) .

B - Immediate objectives

Immediate objective of the proposal: state what is actually going to be observed, what shall be extracted from the observations, so that the feasibility becomes clear.

New active regions or faculae will be observed in multi wavelengths: vector magnetograms from the photophere to low chromophere, the photospheric velocity field, the fine structures in the chromosphere, the corona transition-region loops. Heating of the corona is one of the goal of this program.

C - Strategy for observing
Brief description of the observation method

The long list of co-investigators shows the extensive work that could be produced during this campaign. The complementary expertise of each member of the team should lead to important progresses in this field. In order to achieve our four objectives we will adopt the following method according to the instruments involved in this campaign.
We will use alternatively the two modes of THEMIS: MSDP and MTR. The mode MSDP provides vector magnetograms in one line Ca I, magnetic field in different altitudes with Na D1 line and images in Hα at different wavelengths. It is a raid way to explore a large field of view and a fast mode for small field of view (less than 30s). The mode MTR provides vector magnetograms in multi lines that can be used to resolve the 180 degree of ambiguity using a differential method.
For achieving the goals, observations with high polarimetry sensitivity (THEMIS, SOT) associated fine structures are suitable. We would like to cross-check the weak magnetic field of emerging flux observed by THEMIS and SOT aboard Hinode.
Can we see signatures of magnetic reconnection prior to the emergence i.e. brightenings in the photosphere, in the transition region and corona ? For this study Hinode (XRT , EIS), SOHO (CDS, EIT, 195 Å, THEMIS (Hα or Ca II) should be used. STEREO SECCHI/EUVI and LASCO would provide information about consequent CME after eruptions.

Ca II H observations and spectro polarimetry data with SOT would be very suitable for such studies. MDI on SOHO is also strongly recommended to analyze the differential rotation on a long time scale and detect shearing motion and flows before emergence..

SUMER (if it is available during the campaign) is well designed to observe the Lyman lines, THEMIS the Hα line, EIS the 256 Å 2nd resonance line of He II, CDS the 584 Å of He I, EIT the 195 Å.

Ground based instruments will support our campaign:
Hida Domeless Solar Telescope DST, SMART (Japan- Kitai)
Huairou magnetograph (Deng)
Nanjing multi line spectrograph (Li Hui)
Ondrejov new multi line spectrograph (Heinzel, Kotrc)
Bialkov MSDP spectrograph (Berlicki)

This campaign is requested during **two weeks**.
we would like to have Hinode/EIS and XRT and hopefully SOT. Cross-check would be great between these different instrument measurements and very valuable and particularly for THEMIS and SOT to ensure of their spectropolarimetry capability , for CDS and EIS and EIT. He lines (CDS, EIS) and Hα spectra (THEMIS);

We get the principle agreement of the PIs of each instrument and should advertise them as soon as we know exactly the week for final agreement.

OTHER OPPORTUNITY PROGRAM

As back up we can run the JOP178/HOP 111 program. We need to observe a filament (not too far from the center), on the East side of the Sun at the beginning of the campaign. A filament in a region of low-medium magnetic field (100 to 400 G). A prominence is a possible target. but

E. RESULTS OF PREVIOUS CAMPAIGNS

1. Active region and emerging flux

Data of 2003

1. Berlicki A., Mein P., Schmieder B., **2006**, THEMIS/MSDP magnetic measurements, Astron. and Astrophys. J., 445, 1127

2. Li Hui, Schmieder B., Aulanier G., Berlicki A., **2006**, Is pre-eruptive null point reconnection required for triggering eruptions?, Solar Physics, 237, 85

3. Schmieder B., Mandrini C.H., Démoulin P., Pariat R., Berlicki A., DeLuca E.E., **2006** Preevents of the X 17 flare on 28 October, 2003, 2006, Adv.Space Res. 37, 1313

Data of 2004

4. Pariat E.,Schmieder B., Berlicki A., Deng Y.Y., Mein N., Lopez Ariste A., Wang S., **2007**, Spectrophtometric analysis of Ellerman bombs observed with THEMIS and TRACE, Astron and Astrophys., 473, 279

Data of 2005

5. Li Hui, Schmieder B, Song, M.T., Bommier V., **2007**, Interaction of magnetic field systems leading to an X1.7 flare due to large scale flux tube emergence Magnetic topology favoring a double X ray flare, Astron and Astrophys., 475, 1081

6. Schmieder B., Mandrini C.H., Démoulin P., Berlicki, A., Li Hui, Aulanier G., **2007**, Roll of Null points in flares?
Advances in Space Research, 39, 1840

7. Canou et al Pre-eruptive twisted tube emergence
2009, ApJ, in press

2. Filaments

Data of 2004

8. López Ariste,A., Aulanier G., Schmieder B. and Sainz Dalda A., 2006, First observation of bald patches in a filament channel, and at a barb endpoint, Astron. and Astrophys. J., 456, 725

9. Schmieder B., Aulanier G., Mein P, López Ariste, A., 2006, Evolving photospheric flux concentrations and filament dynamic changes, 2006, Solar Phys., 238, 245

10. Rondi , Roudier T., Molodij G. Bommier V., Malherbe J.M., Meunier N.,.. Schmieder B., 2007, Photospheric flows around a quiescent filament, 2007, Astron.Astrophy. , 467, 1289

11. Dudik J., Aulanier G., Bommier V., Roudier T., 2007, Magnetic topology of a filament with dips, 2008, Solar Physics 248, 29

12. Roudier,T., M. Swanda, N. Meunier, J. M. Malherbe, G. Molodij, S., Keil, B. Schmieder and V. Bommier, 2007, Large scale flows field effects on the filament for its destabilization, 2008, A et A, 480, 255

Data of 2006

13. Schmieder B., Bommier V., Kitai R., Golub L., Magnetic causes of a filament eruption, 2008, A et A, 480, 255
2008, Solar Phys., 247, 321

3. Faculae (Data of 2008)

14. Su Yingna, Schmieder B., van Ballegooijen A., Guo Yang, Berlicki A.
3D modelling of a filament , **2009**, ApJ submitted
15. Guo Yang, Schmieder B., Bommier V., Gosain S.
Magnetic field structures in a facula region by THEMIS and Hinode
2009, Solar Physics, submitted
16. Gosain S., Schmieder B., Chandra R., Artzner G.
How plasma diasppears from a filament in 3D in STEREO?
2009, Solar Phys., submitted

3 Scheduling and support

B.Schmieder will be at THEMIS and will benefit of the help of the THEMIS team (A. Lopez). BS will coordinate the campaign with the planners of Hinode, SOHO (CDS) and the Meudon group by emails three days for Hinode and one for SOHO before the observations as it was done during the previous years.

SOHO:
MDI:
For a target inside the HR FOV: hr-t2-ve-fe-me
(Doppler grams, magnetograms and Igrams in 1 min cadence)
Otherwise a full disk 3 variable program in 1 min cadence or 96 min
CDS -:

ARCONT1 lines: He I 584, OIV 554, OV 629, Mg X 625, Ca X 558, Si XII 521 pixel size 4"x3.4"

ARCONT2 lines He I 584, OIV 554, OV 629, Mg X 625, Ca X 558, Si XII 521 narrower slit and pixel size 2"x1.7"

EIT 195 A

Hinode XRT successive multi wavelength observations
EIS
Support from the EIS spectrometer for our observations. the three core lines He II 256.32, Fe XII 195.12, and Ca XVII 192.82. In addition we would like to observe other lines: 269.00 or 270.40 Mg VI, 192.9 OV and the He II continuum below 210 A (TBD)
SOT NFI 2x2summed magnetograms and high spectro polarimetry spectra, BFI longitudinal magnetic field and CaII H to map magnetic motions and the chromospheric fibrils