HOP #140 PROPOSAL

18 May 2016
Masahito Kubo

HOP title

3D structures of magnetic field at magnetic flux cancellation sites with IBIS, Hinode and IRIS

Plan term

Date: 2016/06/02 – 2016/06/10
Time: 13:30UT – 17:00UT

Proposer

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Abstract of observational proposal

The purpose of this project is to study 3D structures of magnetic field and velocity field at magnetic flux cancellation sites from multi-line observations. The magnetic flux cancellation is a descriptive term to indicate a mutual flux loss due to the apparent collision of the opposite-polarity magnetic elements. The flux cancellation has the key to understanding the dissipation of the magnetic flux from the photosphere. We plan joint observations with the IBIS (Cavallini 2006), Hinode and IRIS. Our proposal to the IBIS has been already accepted.

Two major possible processes have been proposed to explain the observed flux cancellation (Zwaan 1987): submergence (retract) of Ω-shaped loops or emergence of U-shaped loops across the photosphere. The approaches to understanding the physical process of magnetic flux cancellation could be categorized into two types. One is to examine the motion of the photospheric horizontal magnetic field between the canceling magnetic elements from the vector field measurements. The horizontal field with the downward motion should be observed in the submerging Ω-loop model, and the observation of the emerging horizontal field is expected in the emerging U-loop model. Another approach is to investigate the relative timing of disappearance of the photospheric and chromospheric magnetic flux from a time series of line-of-sight magnetograms like Harvey et al. (1999). When the chromospheric magnetic flux disappears before the photospheric magnetic flux, some submerging activities are suggested at the cancellation site, and vice versa.

We expect two new results from our proposed joint observations. (1) We will improve the Harvey

et al. (1999) study. The cadence of their study was about 14 minutes, which was insufficient to detect the dynamic motion of magnetic field lines at the cancellation sites. The IBIS can provide us the photospheric and chromospheric magnetic flux (Fe I 637.3 nm, Na I D 589.6 nm, and Ca II 854.2 nm) with about a 40 second cadence. We can examine the relative timing of the magnetic flux disappearance from only the longitudinal fields. (2) We will also investigate the consistency between the timing of the photospheric/chromospheric (line-of-sight) magnetic flux disappearances and the motion of the photospheric horizontal fields. For this purpose, we propose the repeat scans by the Hinode/SP. The SP is necessary for the accurate measurements of the photospheric horizontal fields between the canceling magnetic elements. In addition, IRIS can provide us the timing of brightening and Doppler motions at the cancellation sites in the chromosphere or transition region. These information are also important to identify the height of magnetic reconnection and motion of plasma related to the magnetic flux cancellation.

Remark

Our primary target is mixed polarity regions in active regions. A complex active region usually has mixed polarity regions where magnetic flux cancellation is highly expected. In the case of a simple, bipolar active region, our target is the outer boundary of the moat region of the sunspot. The moat boundary is one of the major cancellation sites. We choose the target active region every two or three days and track the same region in these periods. If there is no active region on the disk, we select a region with higher magnetic activities (ephemeral regions, network fields, etc) around the disk center.

Request to SOT

Before 14:00UT

SP – Fast map, FOV=50”x122”, Q75, 1-side

→ 70 Mbits

14:00UT – 17:00UT

SP – Fast map, FOV=20”x82”, Q75, 2-side, repeat (4 min/map)

→ 570 Mbits/hour

Total = 1780 Mbits /day

Request to XRT/EIS

Standard AR programs in the active region case.
XBP programs in the quiet region case (higher cadence is better).

Request to IRIS

Either of the following programs is requested for 3 hours from 14:00UT. The program #1 is a baseline.

Program #1: OBSID: 3620254423
SG: Large coarse 4-step raster 6x120 4s, Medium line list, 2s exposure
SJ: Si IV Mg II h/k Mg II w
→ 2.1 Mbit/s

Program #2: OBSID: 3620256403
SG: Large sit-and-stare 0.3x120 1s, Medium line list, 4s exposure
SJ: Si IV Mg II h/k Mg II w
→ 1.5 Mbit/s

If you need to reduce the data rate, please use the lower data rate versions as follows:

- Program #1: 3620104423
- Program #2: 3620106403