1. Relationship between movements of magnetic features and mass outflow in funnels

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Short title: Mass outflow in funnels

List of instruments and spacecraft:

TRACE, XRT/HINODE, SOT/HINODE, EIS/HINODE, SUMER/SOHO, MDI/SOHO

Science case:

The blue shifts of EUV lines (such as Ne VIII and Mg X) formed in the upper transition region and lower corona have been observed both in the quiet Sun and coronal hole. In the coronal hole, the blue shift is considered to be a signature of solar wind origin (e.g. Peter, 1999, ApJ, 516, 490; Hassler et al. 1999, Science, 283, 810; Tu et al. 2005, Science, 308, 519). While in the quiet Sun, large Ne VIII blue shifts were also found in the network lanes and considered to indicate the sources of the solar wind (Hassler et al. 1999, Science, 283, 810) or just mass supply to quiet coronal loops (He et al. 2007, A&A, 468, 307; Tian et al. 2008, A&A, accepted). It is suggested that magnetic fluxes (in the form of small loops) are transported by supergranular convection to the network lanes, where reconnections occur and produce outflows along the field lines (Axford et al.1999, Space Science Reviews 87, 25; Tu et al. 2005, Science, 308, 519).

However, the connection between moving magnetic fluxes and outflows has not been established through observation. In this study, we aim at investigating this relationship through a combination of magnetic field, spectroscopic and imaging observations. Joint observations of SOHO/HINODE/TRACE are required. SUMER should use several lines with different formation temperatures to scan a coronal hole (equatorial hole or polar hole but the former is better) and a quiet Sun region with the size of about 160” × 300”. And the step size is 1”, which is the same as the pixel size along the slit direction. For the EIS part, besides the three key lines (He II (256.32A), Fe XII (195.12A) and Ca XVII (192.82A)), we suggest taking Fe XII (186.88A), S XI (190.49A), Fe X (184.54A), Fe XIII (202.04A), Fe XIV (274.20A), Fe XV (284.16A), Si X(258.37A), and Si X (261.04A) to scan the same area (a reduced area is also acceptable) by using the 2” slit. In order to obtain the detailed information of the moving magnetic loops (their magnetic field strength and direction of motion) at a high temporal and spatial resolution, high-rate MDI magnetograms and vector magnetograms of SOT/SP are required. The magnetic field data can also be used for extrapolation and will reveal the structures of coronal funnels in coronal hole and quiet coronal loops in the quiet Sun region. The high-temporal-resolution G-band and Ca II H data obtained by SOT can be used for a comparison with the extrapolation result. They can also be used to study the links between magnetic features and granulation motions. The context images are provided by XRT. The high temporal and spatial resolution images of TRACE are also required. The data of C IV and continuum will be used to study the chromospheric response of the moving magnetic structures. And images of Fe XII and Fe IX can help us identify coronal loops and can be compared with the extrapolation result.

Observational details:

(1) Target: a coronal hole (equatorial hole or polar hole but the former is better) and a quiet Sun region near the center of solar disk. The size of each region should be about 160” × 300”. The observation time for each of the two targets can be set as 4 hours.

We suggest this observation be included in the joint observation of SOHO/HINODE this April. The observation date can be after 16th of April.

(2) TRACE: in order of decreasing priority

1700 A time series at high S/N

1550 A time series at high S/N

171 A time series at high S/N

195 A time series at high S/N

(3) XRT/HINODE:

Context full-Sun images

(4) SOT/HINODE:

Broad-band imager: time series of 430.5 nm G-band and Ca II H images

Vector magnetograph: time series

(5) EIS/HINODE:

Set window heights as 304”, exposure (delay) time at 45 s (1 minute). Use the 2” slit to scan the same regions (reduced areas are acceptable, e.g. if the number of pointing positions is set as 80, then the size of the scanned area is about 160”×304”) by using the following lines:

He II (256.32A) , width=40 pixels, Total Counts for Exposure (per pixel)=360

Fe XII (195.12A) , width=40 pixels, Total Counts for Exposure (per pixel)=3000

Ca XVII (192.82A) , width=40 pixels, Total Counts for Exposure (per pixel)=400

Fe XII (186.88A) , width=40 pixels, Total Counts for Exposure (per pixel)=175

Fe X (184.54A) , width=40 pixels, Total Counts for Exposure (per pixel)=500

Fe XIII (202.04A) , width=40 pixels, Total Counts for Exposure (per pixel)=500

Fe XIV (274.20A) , width=40 pixels, Total Counts for Exposure (per pixel)=60

Fe XV (284.16A) , width=40 pixels, Total Counts for Exposure (per pixel)=25

Si X (258.37A) , width=40 pixels, Total Counts for Exposure (per pixel)=175

Si X (261.04A) , width=40 pixels, Total Counts for Exposure (per pixel)=125

(6) SUMER/SOHO

Use the slit 2 to scan each of the target twice. The increasing step size is set as 1”. The exposure time is set as 45 s. One scan of a region with the size of 160” × 300” needs 2 hours.

O II (834.4 A)

O IV (787.7 A)

O IV (790.2 A)

Ne VIII (770.4 A)

Mg X (624.9 A)

(7) MDI/SOHO

Time series of magnetograms (1 minute cadence)