Solar-B

Report from Kyoto 8-11 Nov
Meeting organized by K. Shibata
Kwasan and Hida Observatories of Kyoto University
The mission overview

Japanese mission as a follow-on to Yohkoh. Collaboration with USA (NASA), UK (PPARC), and ESA

Launch date September 2006. Lifetime 3 years - Solar Minimum

Polar, Sun-synchronous orbit - 24 hour obs.
Instruments

3 Instruments – focused on extending Yohkoh

• XRT (X-ray telescope). Full Sun soft X-ray images at 2” resolution.

• SOT (0.5 m solar optical telescope). High res., high cadence filtergrams, vector magnetic field of the Sun at 0.2-0.3” spatial resolution.

• EIS (EUV imaging spectrometer). Doppler velocity data for coronal plasma flows at 2” resolution.

All on schedule
XRT

XRT full and partial disk coronal images.

Temperature range: $6.1 < \log T < 7.5$

Angular resolution: 2"

Temporal resolution: cadence=2s (reduced FOV), exposure time: min=4ms, max=10s

FOV: Full disk (>30 arc min)
EUV

log T \sim 6.2

Soft X-ray

log T \sim 7.0
Shibata Introduction

Key topics:
Plasmoid ejection
CME and flare initiation
X-ray and H-alpha Jets
X-ray downflows
Solar Optical Telescope

Very complex instrument. Designed to observe single active region.

1. Broad Filter Imager
2. Narrow Filter Imager
3. Spectro-polarimeter

Resolution 0.1-0.2"

**Broad** - transverse motion & temperature – cadence <10s

**Narrow** – tunable around central wavelength
  - Doppler (12s), longitudinal (21s) and vector magnetic field

**Spectro-Polarimeter** – vector magnetic field raster images
  - 164” slit,
  - fast 1.6” map 18s → normal 160” map 83 min
# Filter Spectral Lines

## Narrowband

<table>
<thead>
<tr>
<th>Line</th>
<th>Wavelength (Å)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mg I b</td>
<td>5172.7</td>
<td>Low chromosphere magnetograms, dopplergrams, Stokes vectors</td>
</tr>
<tr>
<td>Fe I 5247.1</td>
<td></td>
<td>Secondary photospheric magnetic line.</td>
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<tr>
<td>Fe I 5250.2</td>
<td></td>
<td>Used with 5247 line for ratio analyses.</td>
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<tr>
<td>Fe I 5250.6</td>
<td></td>
<td>“</td>
</tr>
<tr>
<td>Fe I 5576.1</td>
<td></td>
<td>Photospheric dopplergrams</td>
</tr>
<tr>
<td>Fe I 6301.5</td>
<td></td>
<td>Secondary photospheric magnetic line</td>
</tr>
<tr>
<td>Fe I 6302.5</td>
<td></td>
<td>Primary photospheric magnetic line.</td>
</tr>
<tr>
<td>Ti I 6303.8</td>
<td></td>
<td>Sunspot umbral magnetogram line</td>
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<tr>
<td>HeNe 6328.1</td>
<td></td>
<td>Laser alignment and testing line</td>
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<tr>
<td>H I 6563</td>
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<td>H-alpha chromospheric filtergram and dopplergram</td>
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</table>

## Broadband

<table>
<thead>
<tr>
<th>Line</th>
<th>Wavelength (Å)</th>
<th>Description</th>
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<tbody>
<tr>
<td>CN I 3883.5</td>
<td></td>
<td>Magnetic Network Imaging</td>
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<tr>
<td>Ca II H 3968.5</td>
<td></td>
<td>Chromospheric heating</td>
</tr>
<tr>
<td>CH I 4305.0</td>
<td></td>
<td>Magnetic elements</td>
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<tr>
<td></td>
<td>blue continuum 4504.5</td>
<td>Temperature</td>
</tr>
<tr>
<td></td>
<td>green cont. 5550.5</td>
<td>Temperature</td>
</tr>
<tr>
<td></td>
<td>red cont. 6684.0</td>
<td>Temperature</td>
</tr>
</tbody>
</table>

## Spectro-Polarimeter

Fe lines at 6301.5 and 6302.5 nm
Bruce Lites comments

Advantages
Continuous uniform dataset
Good temperature coverage
High angular resolution

Need ground collaboration
Small field-of-view for coronal field extrapolation
Chromospheric fields - He I 10830
Resolution from ground is better

Simulations of magneto-convection impressive and on time.
EIS
EUV Imaging spectrometer

Wavelength range: 170-210A and 250-290 A

Angular resolution: 2".

Four slit/slot positions: 1" & 2" slit, 40" & 266" wide and 360" long

Spectral/Velocity resolution: 3km/s for Doppler velocities, 20km/s for line widths

Temporal resolution:
   In spectrosocopy mode: < 1s in dynamic events ~ 10s in active regions

   In imaging mode: monochromatic imaging of an active region in 3s for dynamic events, 10s otherwise.

FOV: 360"x512"
EIS lines

Many lines in log T 6-7 range. Some key ones are

He II 256 – transition region
Fe VIII, Si VII, Mg VII – upper transition region
Fe IX-Fe XV - corona
Fe XVII, XXI-XXIV - flares
EIS Studies

Flare Waves
Flares - Mass Motions in Coronal Lines
Flare trigger - role of emerging flux
Chromospheric Evaporation in Flares
Flares - Coronal Reconnection
CME onset studies

Active Region Cool Loop Dynamics
Active Region Heating
Active Regions Science
Active Region hi-res motions
Active Region line broadening

Coronal Loop Variability - Time Dependent Diagnostics
Coronal Loop Variability - Propagating Oscillations
Longitudinal waves in EUV coronal loops

Quiet Sun Limb Brightening
Heating of the Quiet Sun
Dynamic Events in the Network

Coronal Holes
Coronal hole boundary

Diffuse Corona - Streamer Dynamics

Activation process of prominence

Abundance Anomalies
X-ray loop oscillations
Standing sound waves?

Hot coronal loop oscillations
Left: The active region corona over 12 hours. Bottom: Typical FeXIX Doppler shift oscillations. Right: The SXT loops and Doppler shifts oscillations.

Do the loops move? Simultaneous high cadence, high resolution images of both limb and disk loops.

Does the trigger come from footpoint or corona? Spectral images.

Do loops of all sizes oscillate with a period twice the sound crossing time? Observe different loop sizes in active regions, bright points and trans-equatorial loops.
Parallel Solar Missions

• SOLAR-B Sept 2006 – Sept 2008
• SOHO til 2007?
• TRACE til 2007?
• RHESSI til ?
• Stereo April 2006 – April 2008
• SDO April 2008 + 5 years
• Sunrise 2008 +..
Reconnectio Obs.
Longcope et al Apj 2005
Reconnection obs.

Most of the reconnection occurs in a 3-6 hr interval whose onset is delayed by approximately 24 hr following the onset of flux emergence.

Nothing in the photospheric flux evolution at that time that could be construed as a trigger for this event.

The reconnection episode is somehow triggered from the corona after roughly 24 hr of relatively quiet evolution.

Some reconnection does occur during the quiet buildup phase, since at least eight different interconnecting loops are visible, the first with incontrovertible connection appearing only 7 hr after the onset of emergence. But the reconnection rate during this period is evidently very low.

Solid curve – area of coronal loops
dashed – interconnecting flux in potential field model