

Hinode mission status

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T. Shimizu (ISAS/JAXA)

Overview

- Hinode has been operated for two years after the launch on 23 September 2006 (JST).
- All the three telescopes are continuing to observe the Sun with the expected excellent performance.
- The Sun has been quiet for most of the last one year and Hinode's observations were mainly focused on the quiet Sun studies.
- Spacecraft functions are OK except for a problem in X-band downlink.
- X-band downlink problem gives a restriction to the volume of science data but we have almost established scientific operations baseline since the transition to S-band backup high-speed downlink.

Main Aims: Systems approach to understand generation, energy transfer and release of solar magnetic energy with 3 well-coordinated advanced telescopes onboard Hinode

Solar Optical Telescope (SOT)

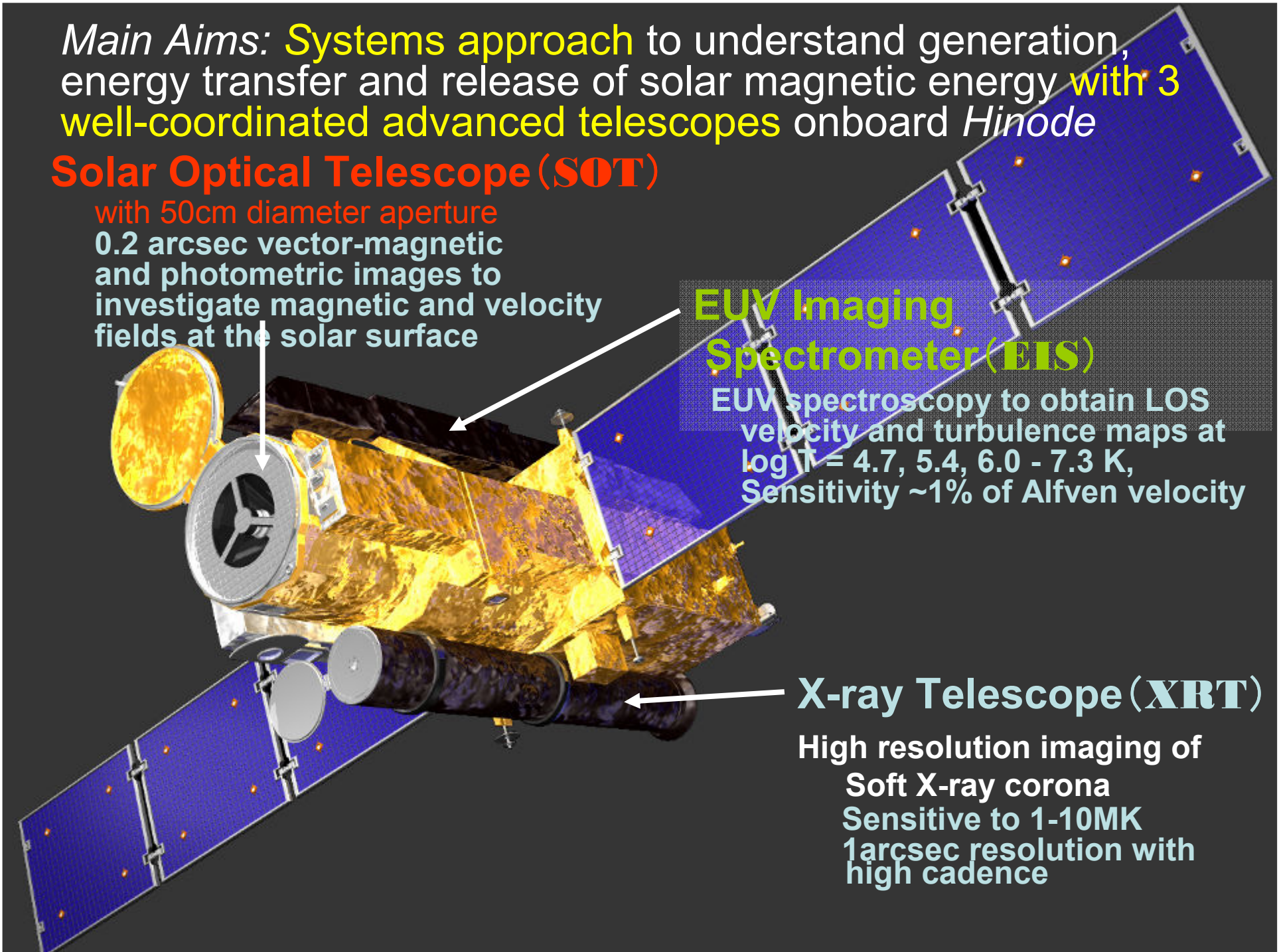
with 50cm diameter aperture
0.2 arcsec vector-magnetic and photometric images to investigate magnetic and velocity fields at the solar surface

EUV Imaging Spectrometer (EIS)

EUV spectroscopy to obtain LOS velocity and turbulence maps at $\log T = 4.7, 5.4, 6.0 - 7.3$ K, Sensitivity $\sim 1\%$ of Alfvén velocity

X-ray Telescope (XRT)

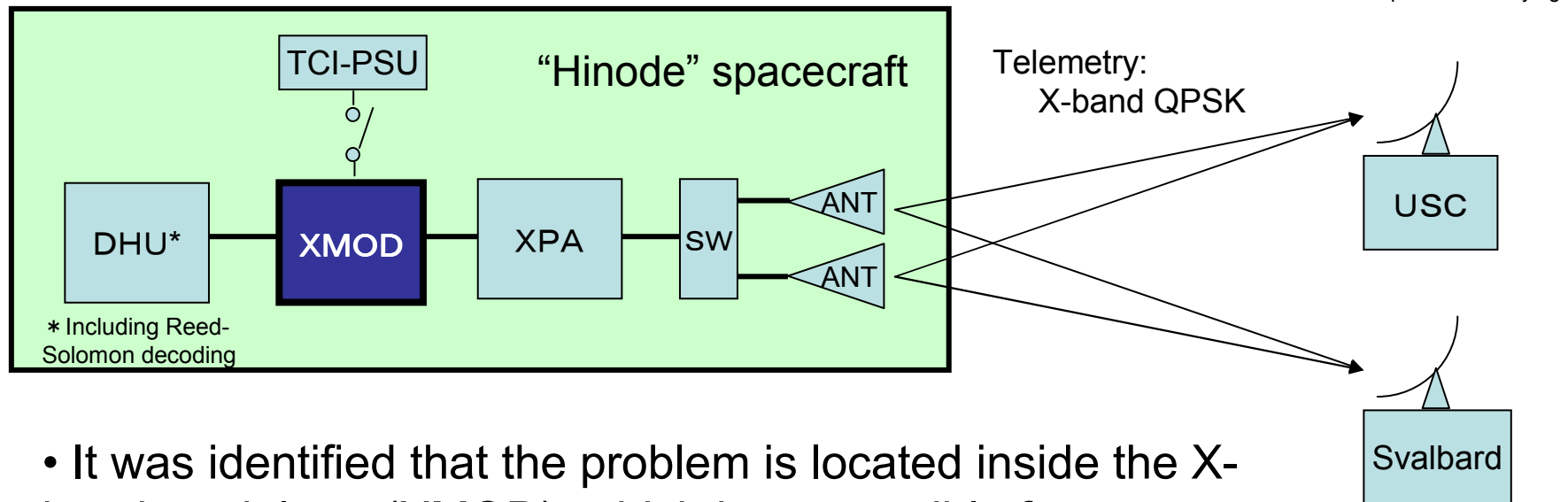
High resolution imaging of Soft X-ray corona
Sensitive to 1-10MK
1arcsec resolution with high cadence



X-band downlink problem

- Starting at the end of last year, X-band transmitter signal began to experience irregularities in the latter half of each contact with the ground stations.
- Irregular signal has caused partial and complete loss of science telemetry data.

◇ X-band data transmission system

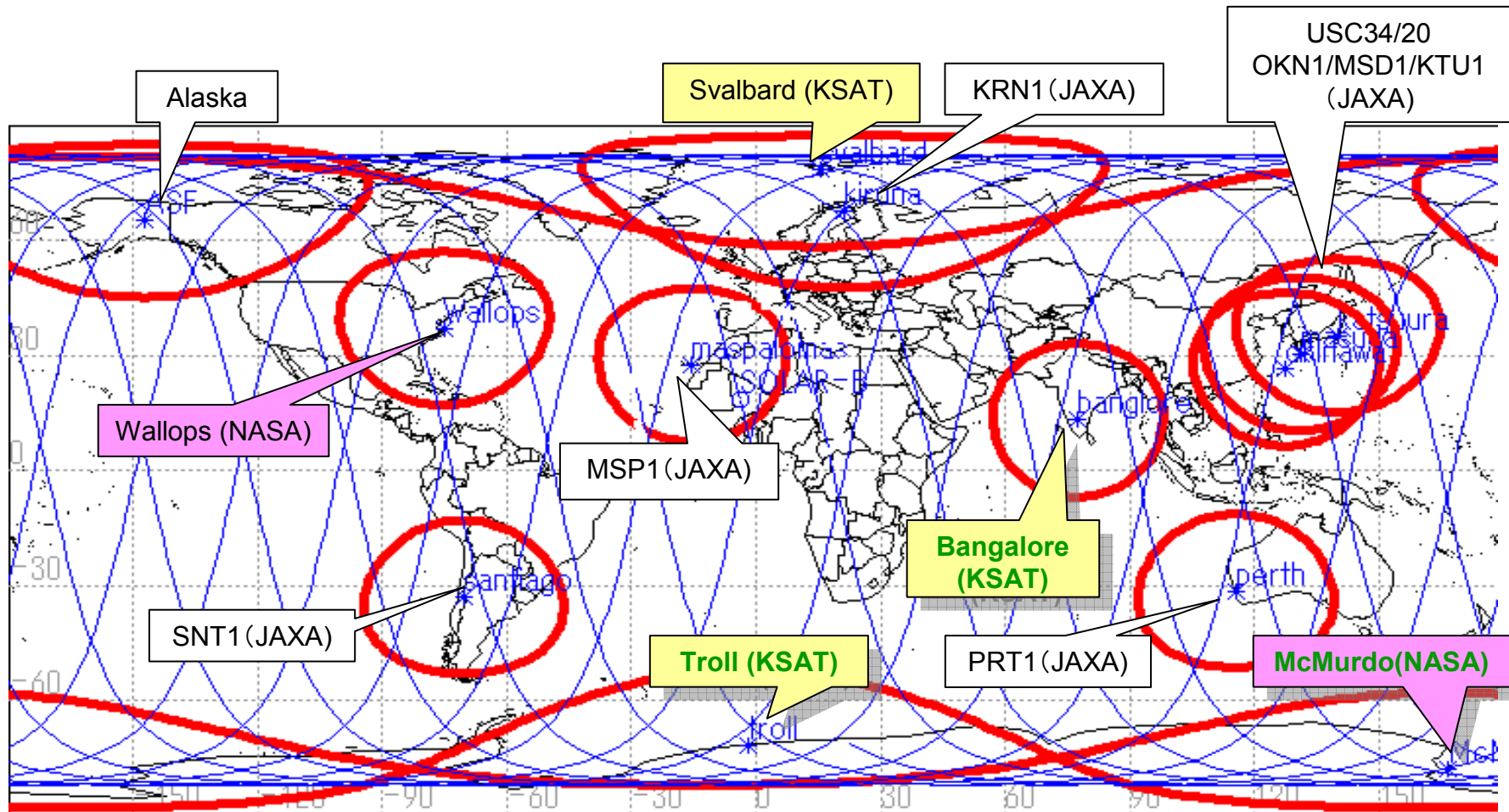


- It was identified that the problem is located inside the X-band modulator (XMOD), which is responsible for generating transmitter analog signal from digital data.

Recovery from X-band problem

- The probability that X-band full function will be back is extremely low.
- We switched the primary downlink path to S-band high-speed backup line this March.
- Downlink with S-band results in decreased downlink speed.
 - 256Kbps instead of 4Mbps in X-band
- Two major actions have been taken to mitigate the situation.
 - More efficient data compression and trade-off of less useful complimentary data (including FOV, pixel size, lines, cadence etc) have been implemented to observing sequences. (1/2 ~1/4.5 data volume reduction)
 - Working on adding downlink stations and performing science data downlinks more frequently.

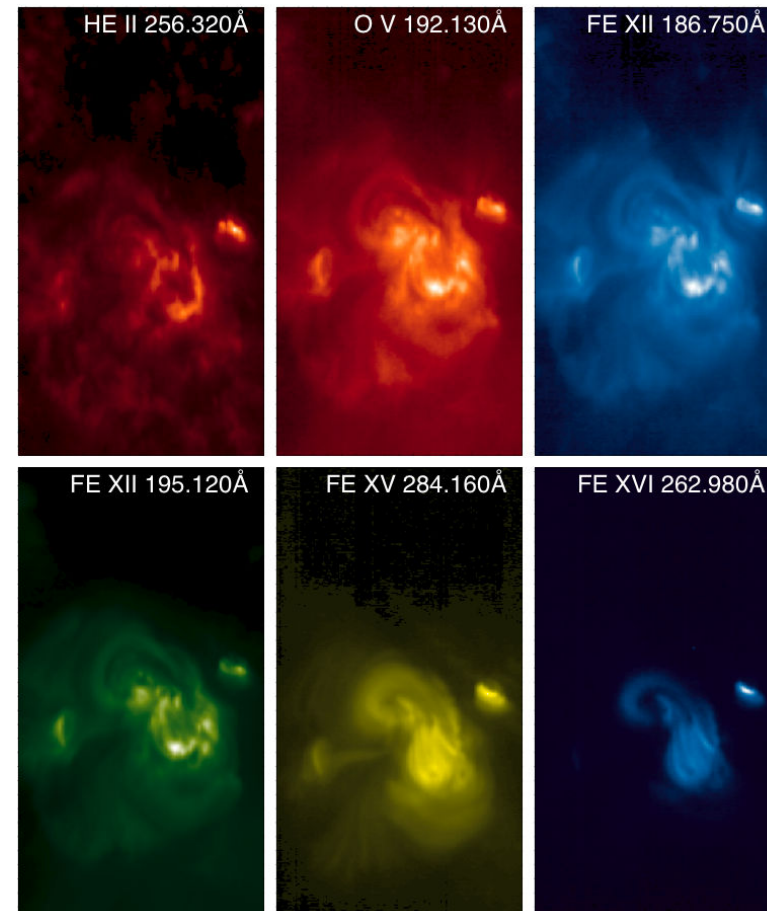
Hinode S-band downlink network



Currently more than 4 hours as the total duration of downlink in one day. Thanks to ESA, NASA, and JAXA supports, the downlink duration per day will be increasing more (→ ~6 hours).

EIS Observations since transition to S-band

- Raster scan during eclipse season, June 2008
 - covering active region 10998
 - and a neighbouring coronal hole (to the north).
- Data are a slit raster with:
 - Information on:
 - Intensity
 - Velocity
 - Line widths
 - over a broad range of T
 - $\sim 5 \times 10^4$ to 3×10^6 K
 - with density diagnostic information



(courtesy of D. Books & Williams)

Long-duration data

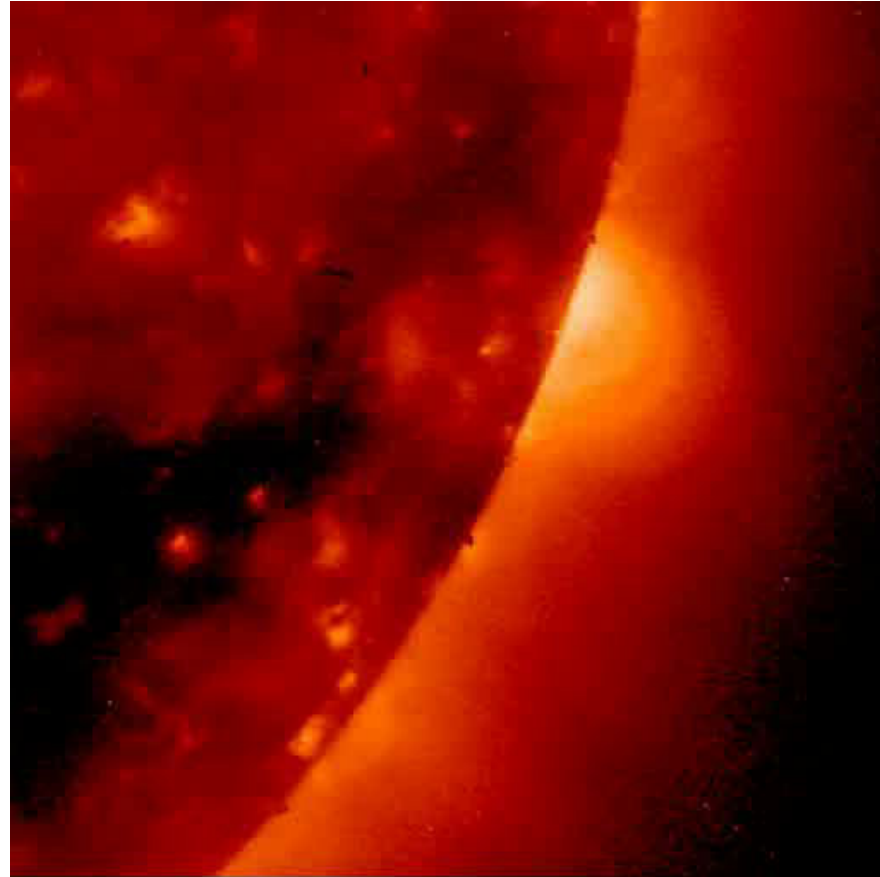
- EIS narrow-slot raster movie
 - Taken 18th September 2008
- Data show the evolution of a filament over long duration.
- Cadence 30 seconds
- Multiple temperatures covered
 - 5×10^4 to 2.2×10^6 K
- Over 7 hours' continuous data
 - Duration limited by other observations, not by volume!

QuickTime™ and a
Cinepak decompressor
are needed to see this picture.

(courtesy of D. Books & Williams)

XRT Observations since transition to S-band

- XRT made a rare and exciting observation on 9 April, 2008.
- The long-duration movie clearly shows **dynamical evolution of coronal magnetic fields during a CME**
 - The main X-ray flare source is hidden behind the limb, allowing XRT to capture dynamical evolution of faint coronal structures in details.

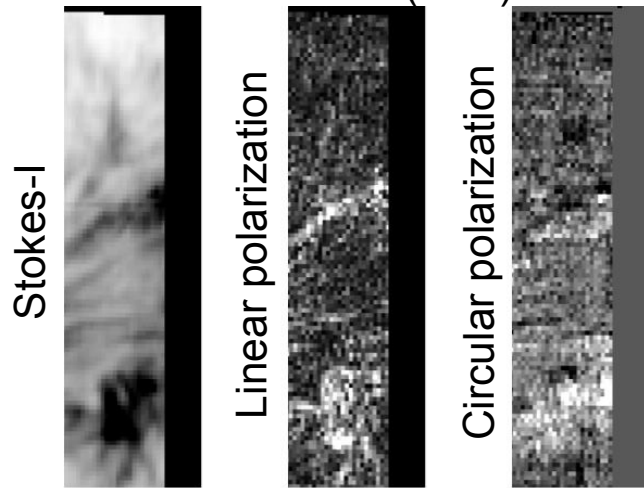


XRT movie on 9 April 2008
long-duration coverage from 4:24 to 17:32 UT)

SOT Observations since transition to S-band

Hinode-VTT coordination
on May 2008

He I 10830 (VTT)

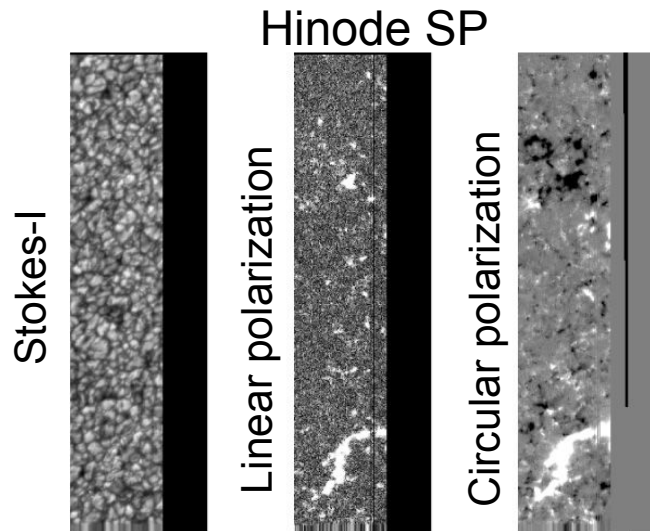
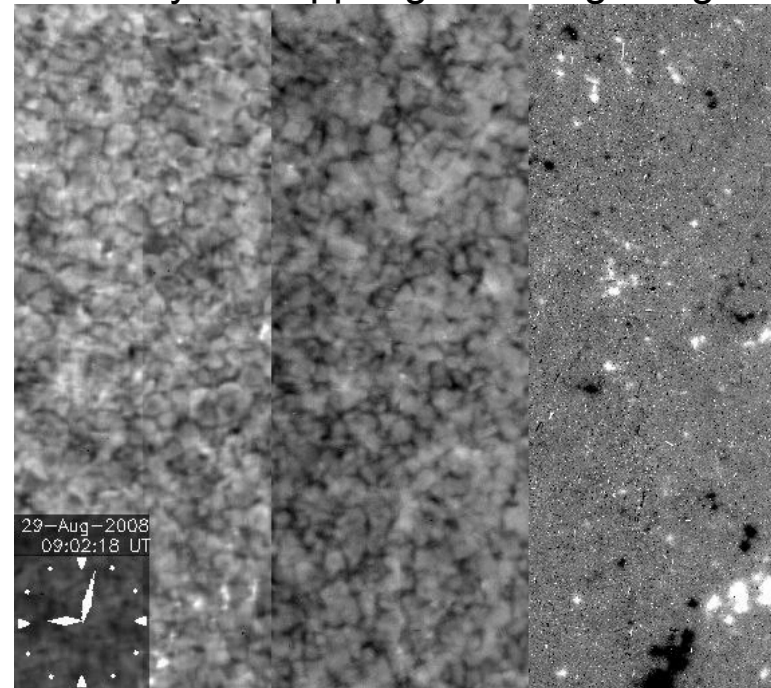


- Magnetic-field observations well coordinated with ground-based observatories have been performed for quiet Sun studies, providing valuable data for analysis.

Hinode-STT coordination on Aug 2008

NFI Mglb observation

intensity dopplergram magnetogram



(courtesy of R. Ishikawa & Y.Katsukawa)

Scientific Operations

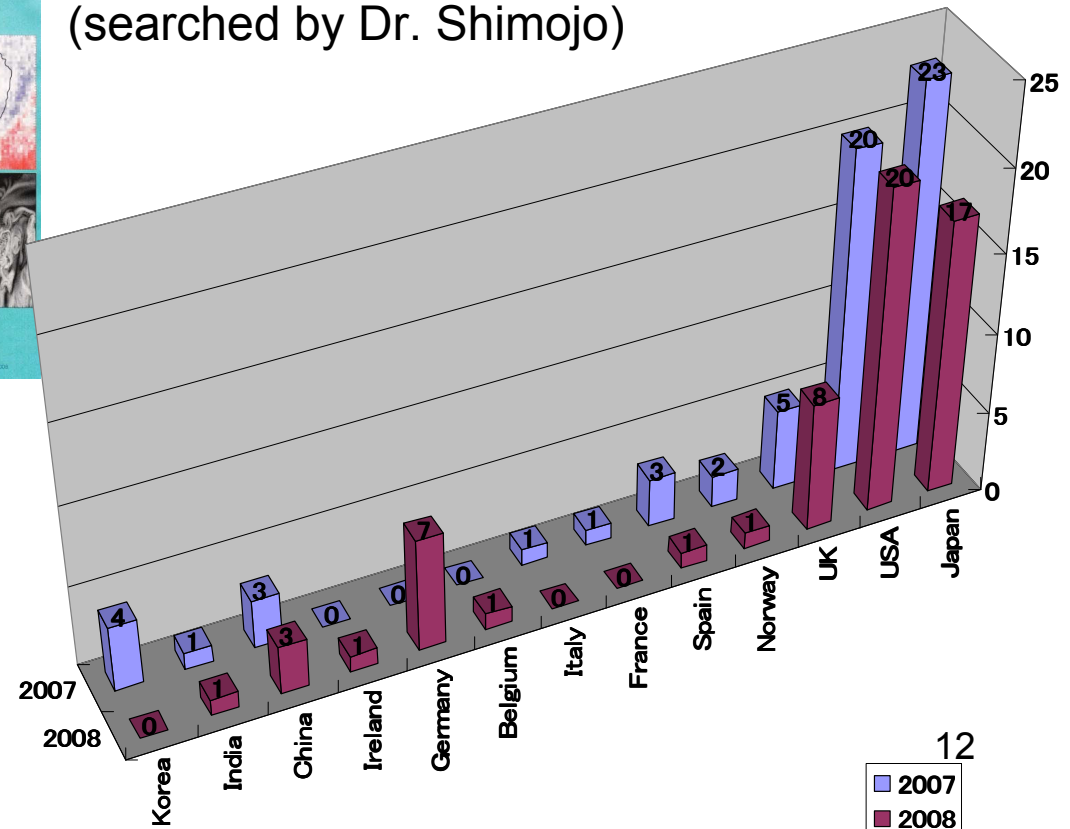
- Some updates have been made to Hinode scientific operations.
 - Currently science planning every 2 or 3 days.
 - Give more flexibility to the usage of limited telemetry resource.
 - Can be back to daily planning, by request in advance. For example, daily planning may give us target-selection flexibility, when the solar activity becomes up in the near future.
- Resumed to receive HOP proposals
 - Any scientists are encouraged to submit proposals.
 - See http://www.isas.jaxa.jp/home/solar/hinode_op/ for guidance
 - Hinode team would like to have **better observations for everyone**. Some modifications may be made to perform proposed observations under restriction of telemetry resource and coordination.
- Need further considerations
 - Hinode has been operated with “observatory” style.
 - Hinode’s observations when the solar activity is up.
 - What is the best observations for solar flares and AR long-term evolution?

Result Publications

- 124 papers have been published in refereed journals, including Hinode special issues of PASJ, Science, and A&A.
 - 63 papers in 2007, 61 papers in 2008(~Aug), not including “in press” papers.
- Data analysis over the world



Country based on the nationality of the institute of the first author (searched by Dr. Shimojo)



Final remarks

- Many thanks to all the people involved in Hinode daily operations and data analysis.
- To keep Hinode observations valuable, we continuously need huge number of ground stations supports from ESA, NASA, and JAXA.
- Keeping our Hinode research activities active encourages the agencies to continue their long-period supports.
- We expect a lot of new exciting scientific results will be presented and discussed in the following sessions.