

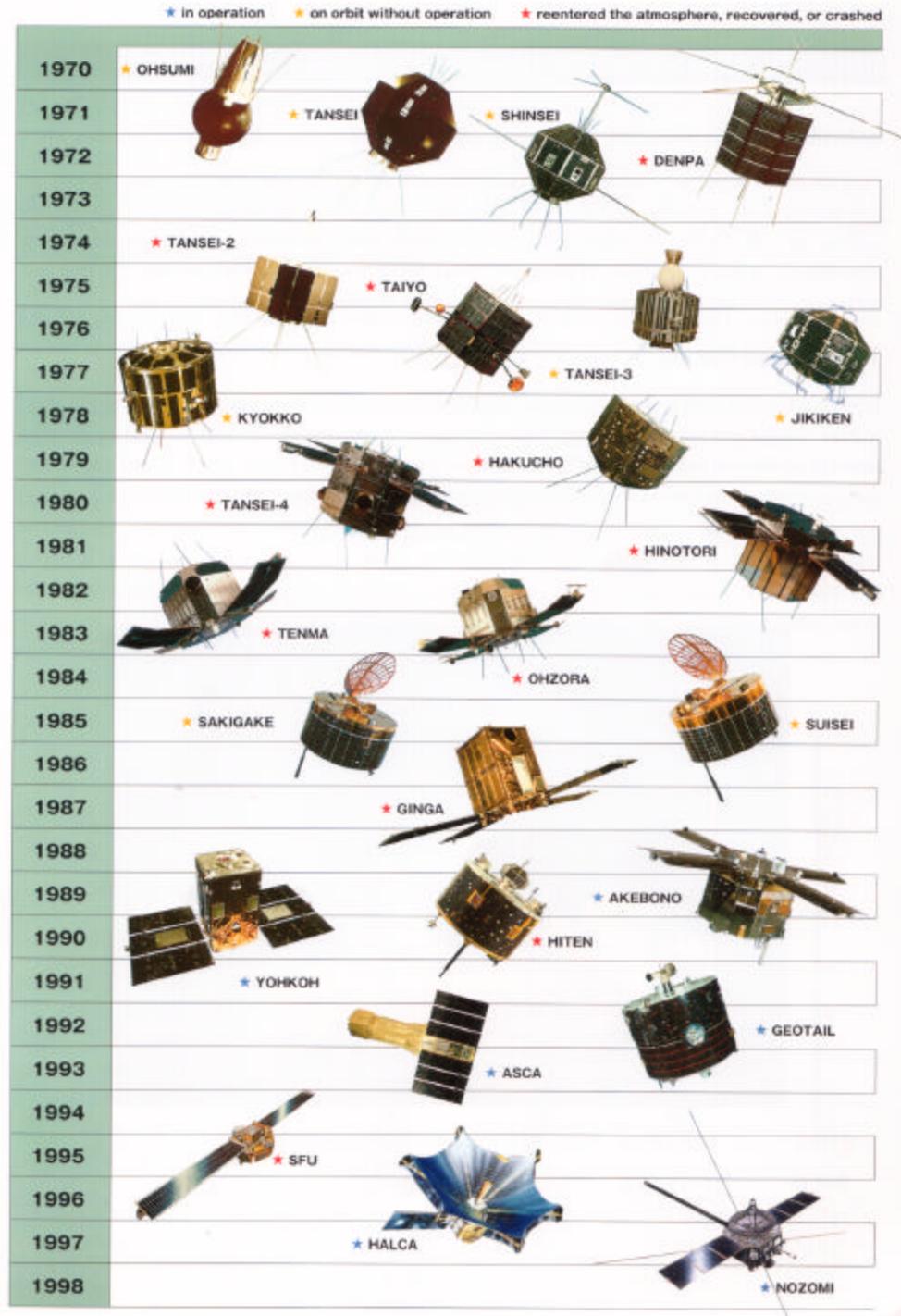
ILWS Kickoff Meeting; 4 Sep. 2002



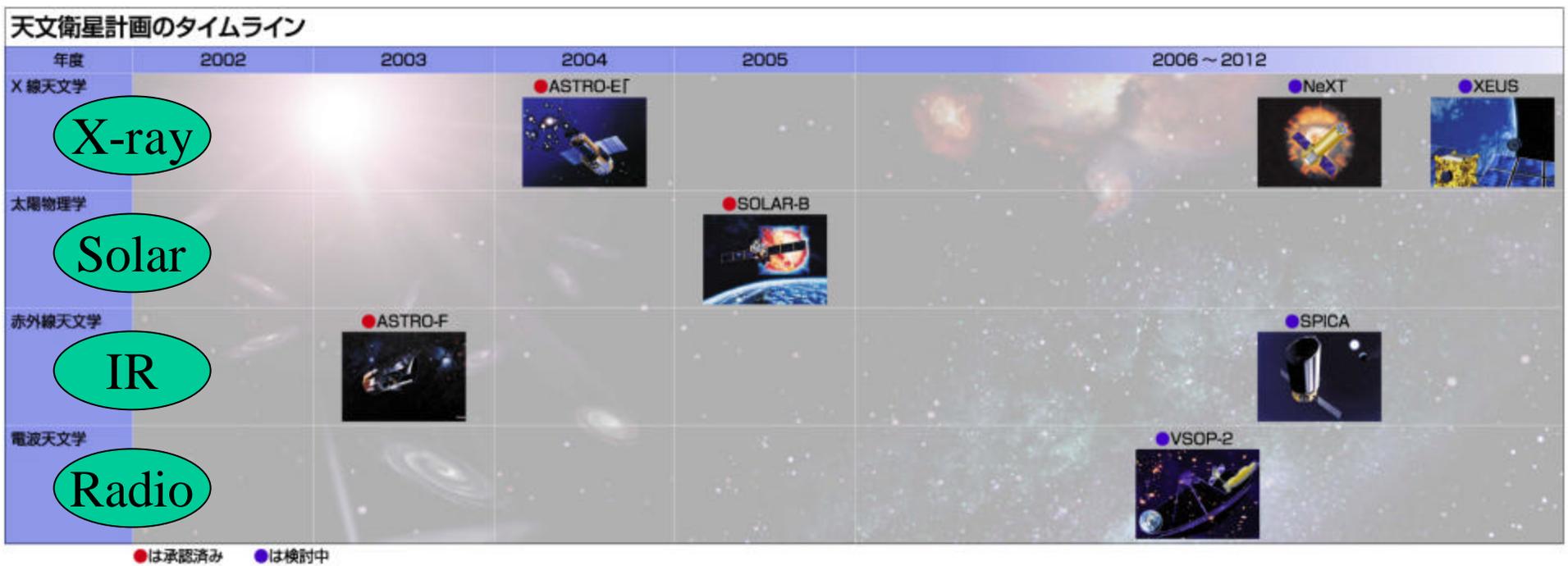
**Solar-B and other ILWS-
related Space Programs
in Japan**

T. Kosugi & K. Maezawa, ISAS, Japan

ISAS SATELLITES AND SPACECRAFT



SPACE ASTRONOMY PROGRAMS



X-ray

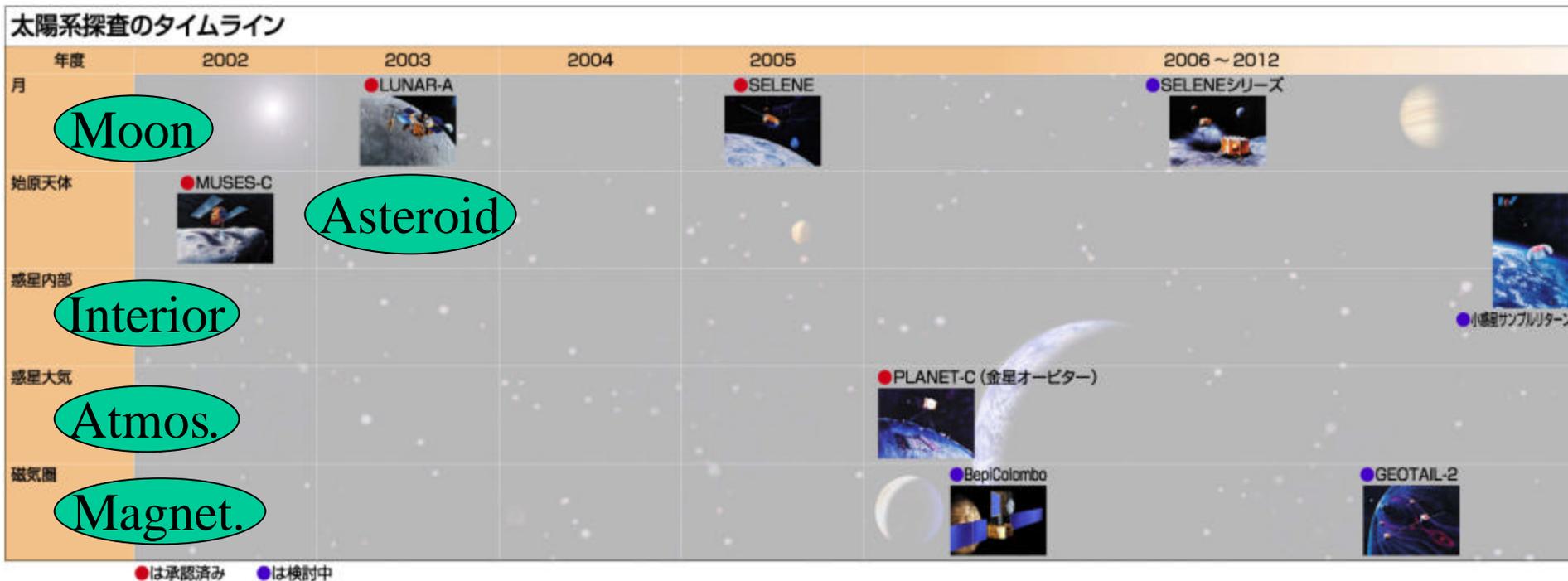
Solar

IR

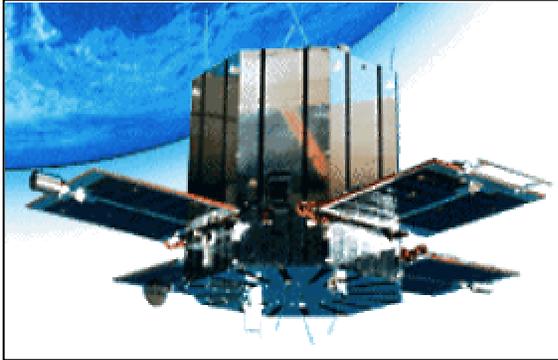
Radio

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SOLAR SYSTEM EXPLORATION



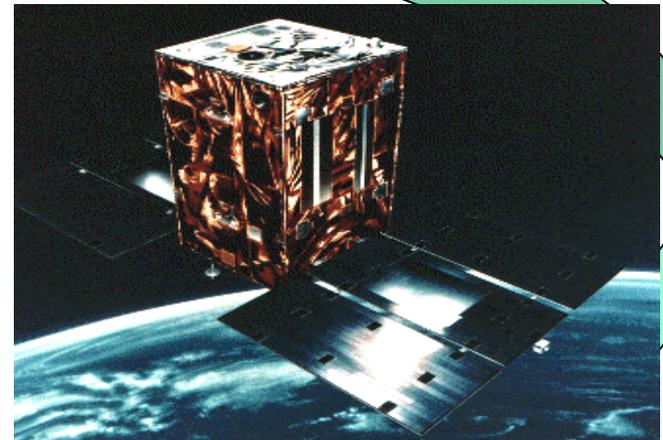
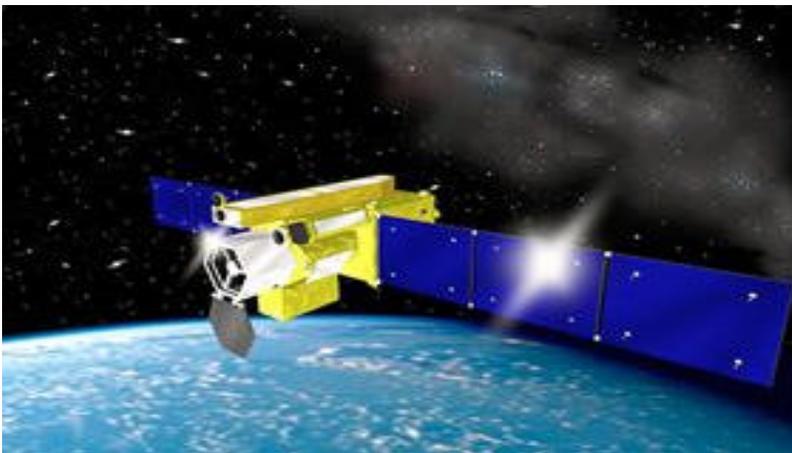
ISAS Solar Physics

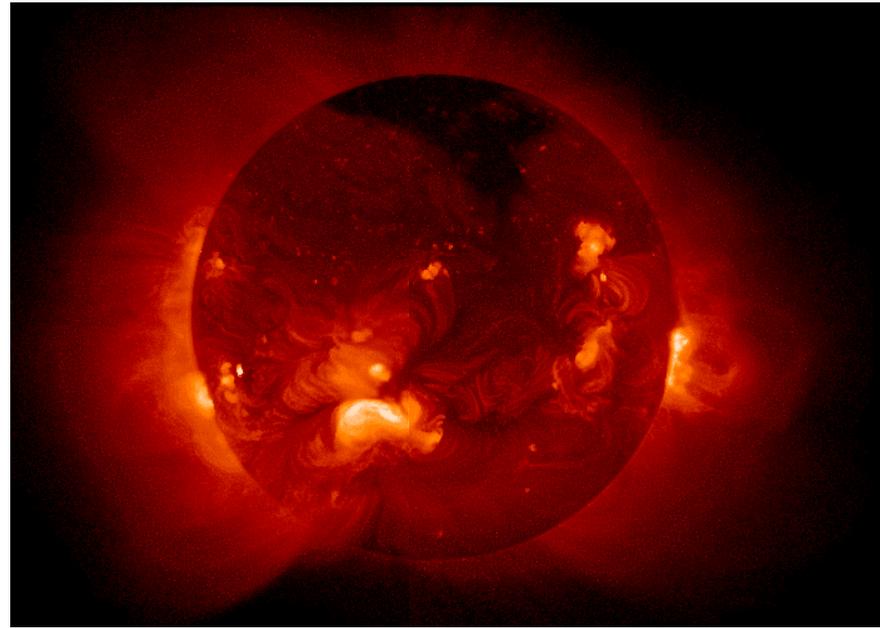


Hionotori (1981-1982)

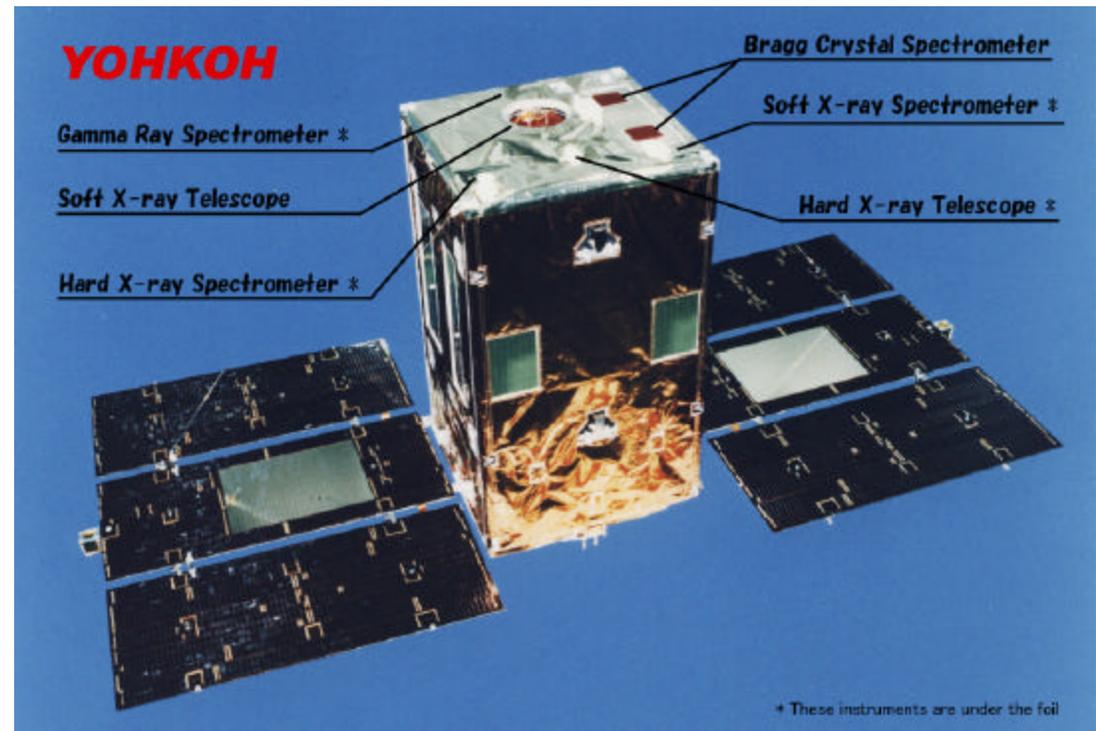
Yohkoh (1991-2001)

SOLAR-B (2005)





Yohkoh (1991-2001)



Yohkoh (1991-2001)

YOHKOH
A DECADE OF DISCOVERY

LOOKING MARTIN

Yohkoh Launch
The Yohkoh ("sunbeam") satellite was launched on August 31, 1991, as a collaborative science mission between Japan, the US and the UK to explore high energy phenomena on the Sun. In its first ten years of operation Yohkoh has significantly advanced our knowledge of the solar atmosphere, solar flares, and the Sun's star. As shown in this poster, Yohkoh has observed almost an entire solar activity cycle, with the distribution of solar eruptions (images) closely following the sunspot cycle (curve). An important ingredient in attempting to understand a complex astrophysical body like the Sun is the close collaboration between the various solar observatories, both on the ground and in space. The success of Yohkoh over the last ten years has been possible, in part, because of this close collaboration. Yohkoh provides unprecedented coverage of the hottest parts of the solar atmosphere yielding information about the most energetic processes on the Sun. Some of the scientific highlights of Yohkoh's "Decade of Discovery" are presented here.

Magnetic Reconnection
Large cusped structures, stretching more than 10⁶ km in height, are continuously observed to form in large solar flares. These structures display a shape which suggests that the magnetic field is undergoing a dramatic change, releasing vast amounts of energy into the Sun's atmosphere and heating it to over 20 million degrees. This interplay between the Sun's magnetic field and the plasma it contains is also believed to be responsible for the production of high energy particles and radiation which can impact the space around the Earth, causing temporary changes in the upper levels of the Earth's atmosphere and glitches in Earth-orbiting spacecraft.

Reshaping the Corona
Massive solar eruptions can significantly disturb and restructure large regions of the solar atmosphere. These solar storms can reach speeds of over five million kilometers per hour and create major electrical disturbances on the Earth. These solar storms are known to result in blackouts in North American cities and to cause permanent damage to instruments on board Earth-orbiting telecommunications satellites.

Coronal Hard X-rays
Hard X-rays indicate where high energy electrons are depositing their energy. Yohkoh has revealed sources of hard X-ray radiation in the coronal portion of solar flares. These Yohkoh observations give some of the first direct indications of the location where the energy of a solar flare is being released.

Coronal Depletions
The eruption of large volumes of the solar corona may indicate the early stages of a solar storm. As the plasma erupts from the Sun it leaves behind a depleted volume in the low corona.

Coronal Temperature
Temperature is the key observational parameter for the investigation of the solar atmosphere. Yohkoh's unique capabilities allow us to measure the variation of temperature with height above the solar surface.

Waves in the Corona
The disturbance of the solar atmosphere caused by a solar flare can send waves traveling out through the atmosphere like ripples on a pond. These waves are extremely difficult to detect. This image (400,000 km wide) shows an arc propagating rapidly to the north and is suggestive of a flare-induced wave.

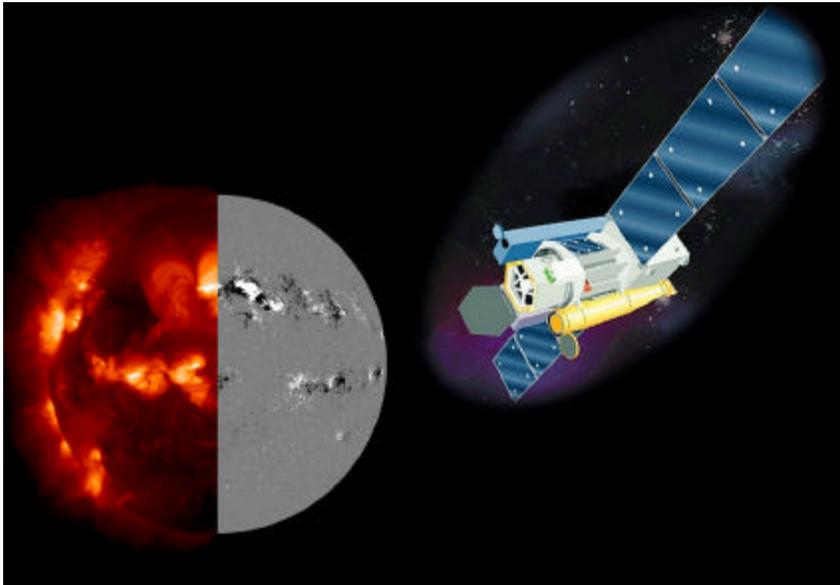
Snapping Magnetic Fields
One of the expected consequences in the production of a solar flare is the relaxation of the magnetic field after being stretched out and restructured. Only recently have we seen evidence for newly-created fine structures "snapping back" to the Sun, like stretched rubber bands, during solar flares. These observations have raised in my question about how well we understand the production of these energetic solar phenomena and underline their three-dimensional nature.

The Future
The past ten years of Yohkoh observations have been fruitful in our quest to understand the physical processes occurring in the atmosphere of the Sun. After a decade in orbit, the Yohkoh spacecraft is in good health and the instruments in good working order. Yohkoh continues to provide a unique view of the solar atmosphere and works in concert with other solar observatories, in space and on the ground, to expand our knowledge of our neighborhood star. As we move into a new solar cycle, a flotilla of spacecraft and a network of advanced ground-based telescopes are scrutinizing the Sun in ever increasing detail, encouraging us to look forward a new and exciting decade of discovery.

1991 OSO Launch (April 1991) **System 201-01 Deployed** (April 1993) **Ulysses South Polar Flypast** (August-September 1994) **System 201-02 Deployed** (September 1994) **Wind Launch** (November 1994) **Ulysses North Polar Flypast** (August-September 1995) **System 201-03 Deployed** (September 1995) **SOHO Launch** (December 1995) **ACE Launch** (August 1997) **TRACE Launch** (April 1998) **OSO Decommissioned** (June 2000) **Orbiter II Launch** (July 2000) **2001**

Science

- Coronal heating
- Coronal structure / dynamics
- Elementary processes in Magnetic Reconnection



SOLAR-B

Launch Date:

Summer 2005,
with ISAS M-V-7

Orbit:

Sun synchronous
altitude ~ 600 km

Weight: ~ 900 kg

Mission instruments

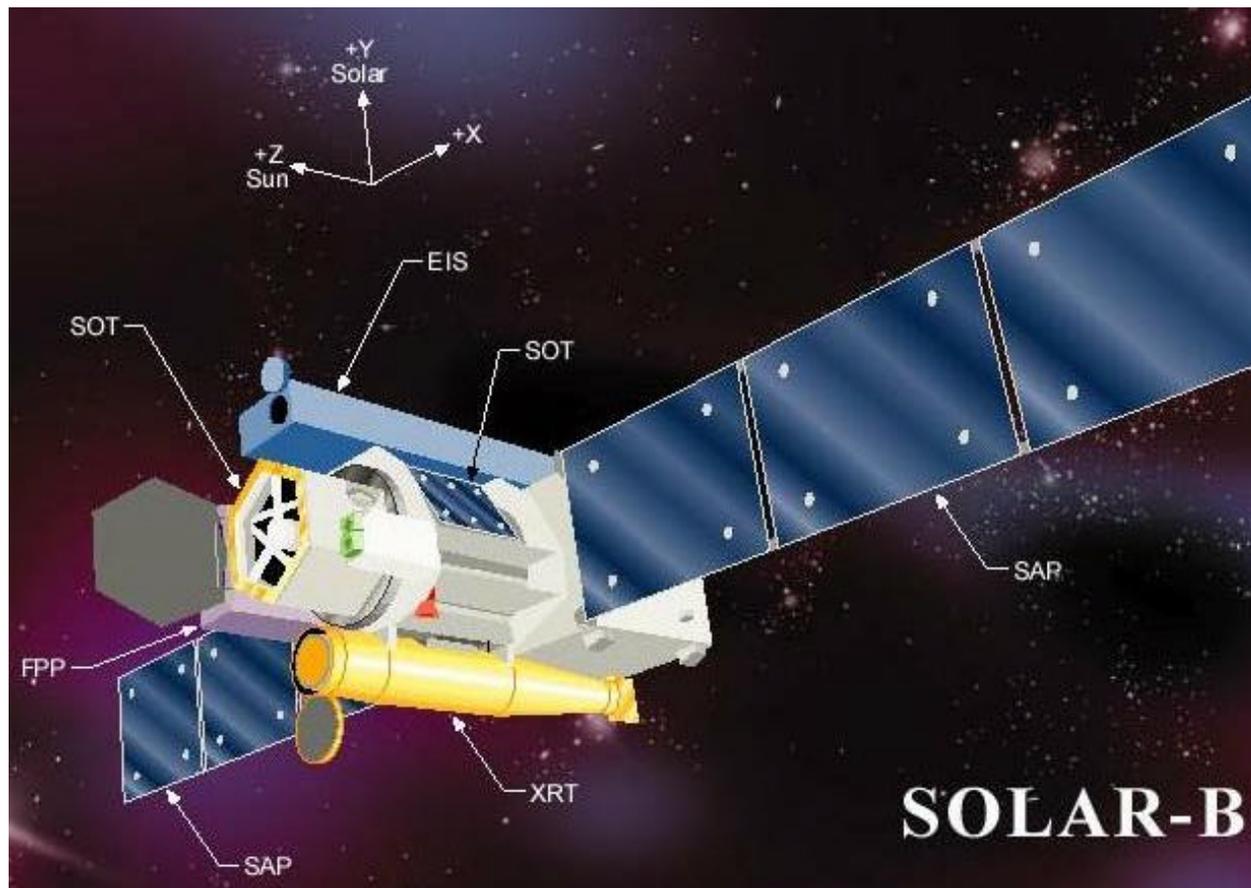
- Optical Telescope / Vector Magnetograph (**SOT**)
- X-ray Telescope (**XRT**)
- EUV Imaging Spectrometer (**EIS**)

SOLAR-B

Solar Optical Telescope (SOT)

X-ray Telescope (XRT)

EUV Imaging Spectrometer (EIS)

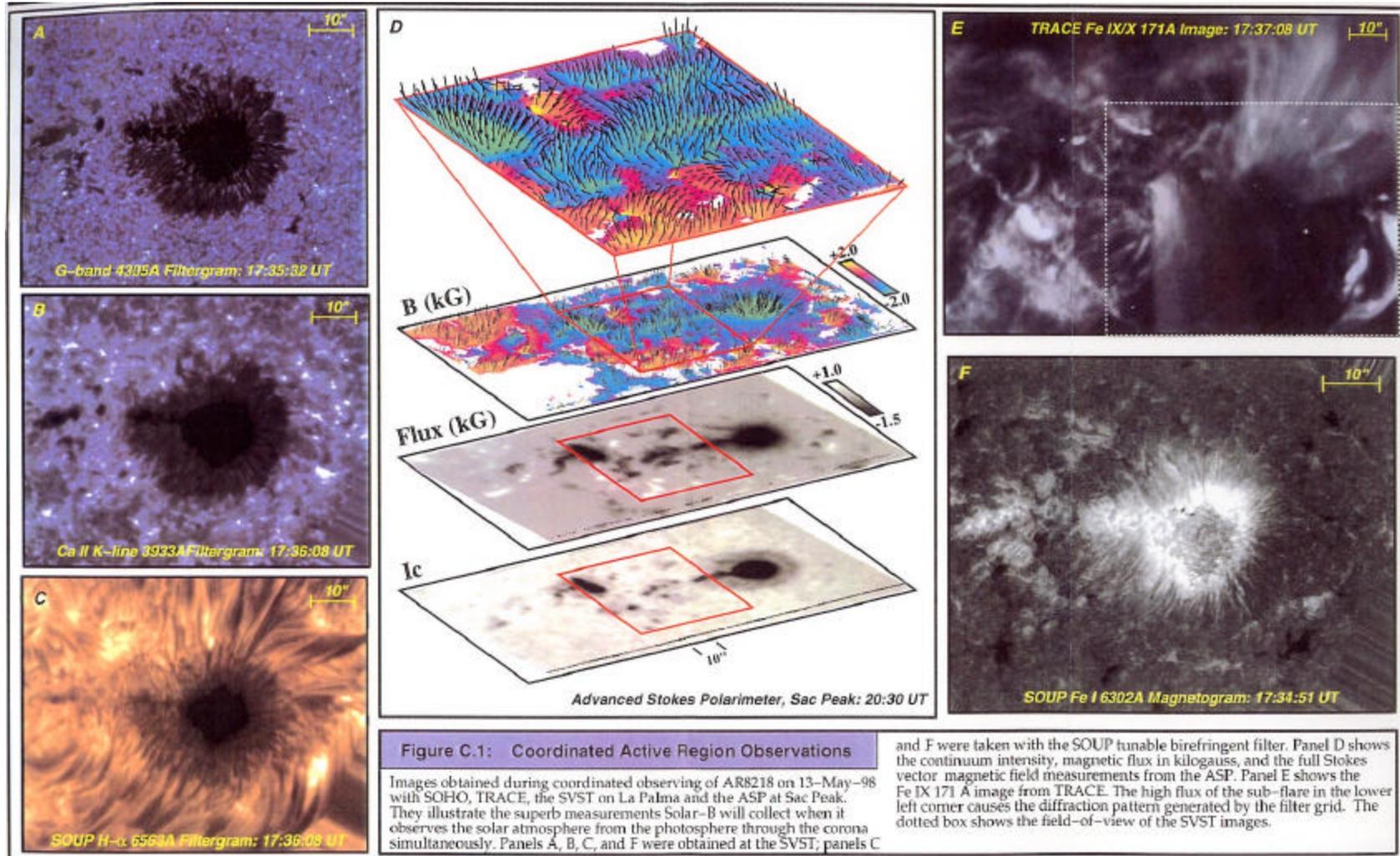


SOLAR-B

A Coordinated Set of Mission Instruments

- ***Solar Optical Telescope (SOT)***
 - 50-cm diameter telescope for the vector magnetic-field observations:
 - Optical Telescope Assembly (OTA) [J]
 - Focal Plane Package (FPP) [US]
- ***X-Ray Telescope (XRT)***
 - Grazing-incidence X-ray telescope with a 2Kx2K CCD camera covering the full Sun
- ***EUV Imaging Spectrometer (EIS)***
 - Grating spectrometer for coronal velocity and temperature diagnostics

Structure of the solar atmosphere



Lower atmosphere (Photosphere/Chromosphere) governs the dynamics of the upper atmosphere (Corona) via magnetic field lines

International Collaboration

SOLAR-B

ISAS (Japan): Integration of S/C; Launch & Operation

Mission Instruments:

SOT (optics), XRT (camera), EIS (I/f to S/C)

NASA (US):

SOT (focal plane package), XRT (optics / mech.),

EIS (optics components), NASA polar station(s)

PPARC (UK): EIS (structure, detectors & electronics)

ESA: Polar station(s) for data downlink

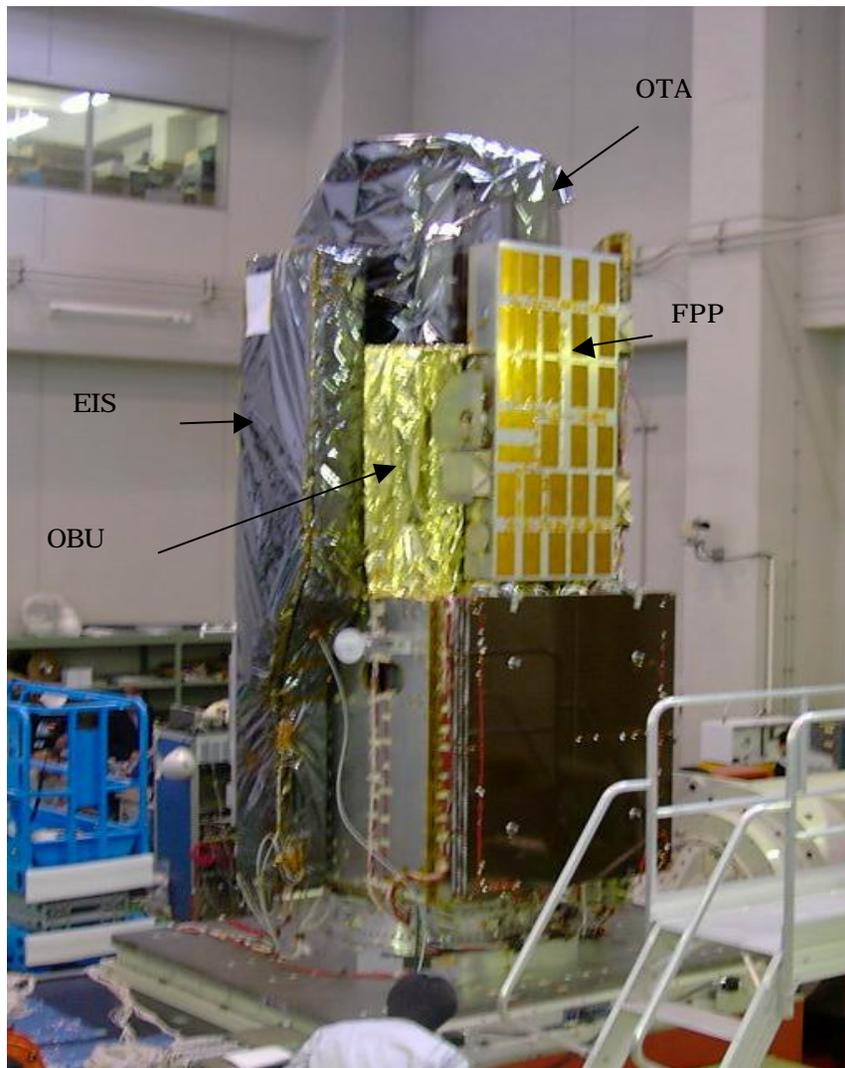
Joint Operations and Data Analysis

System Schedule

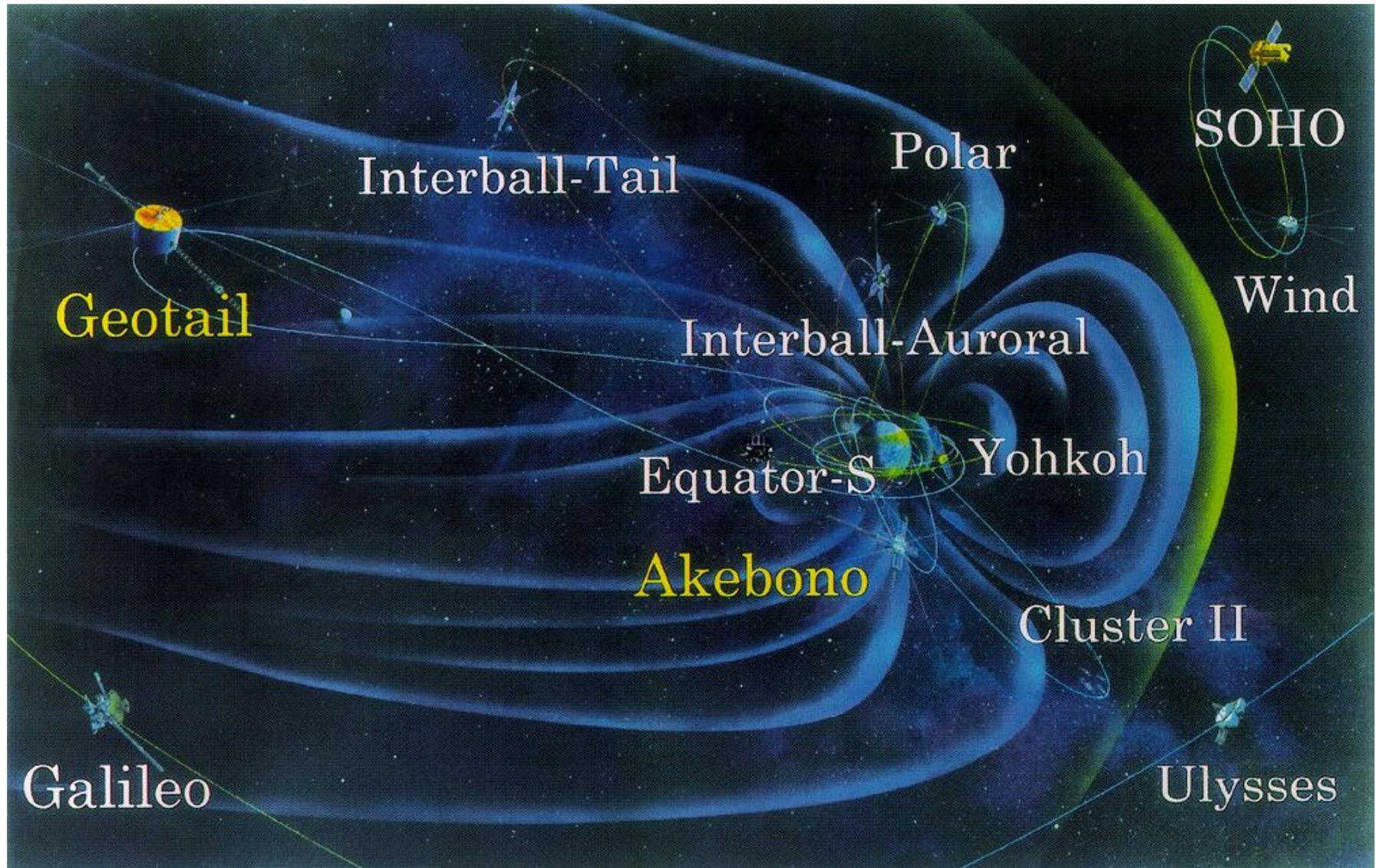
- 2001 : PM Electric I/F Test
Subsystem MTM/TTM Fabr. & Test
- 2002 : System MTM Test
System TTM Test
- 2003 : Subsystem Flight Model Fabrication
- 2004 : System Integration & I/F Test
System Final Checking
- 2005 Aug / Sep : Launch Operation

MTM Test (2002 May)

SOLAR-B

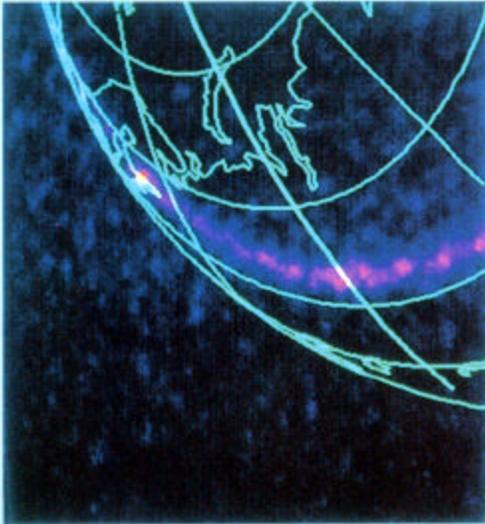


Solar Terrestrial Plasma

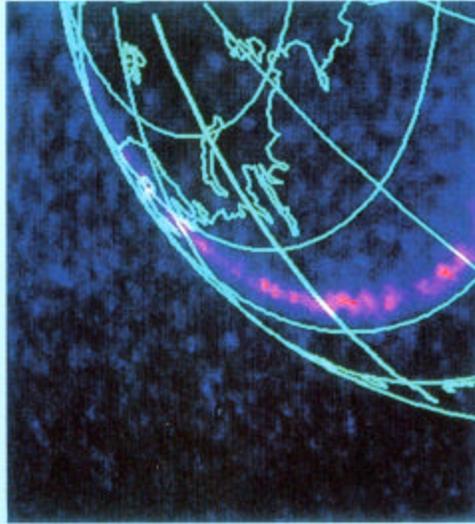


Aurora observe by AKEBONO

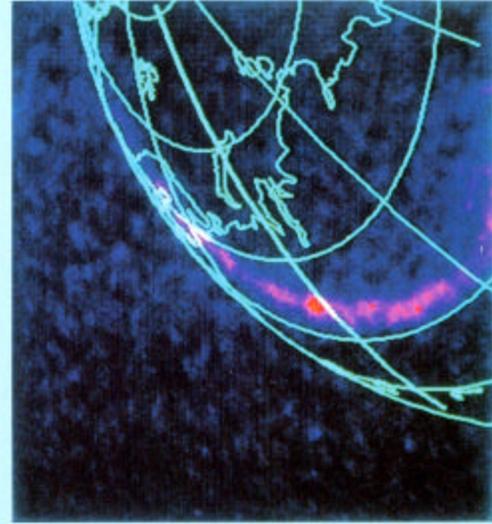
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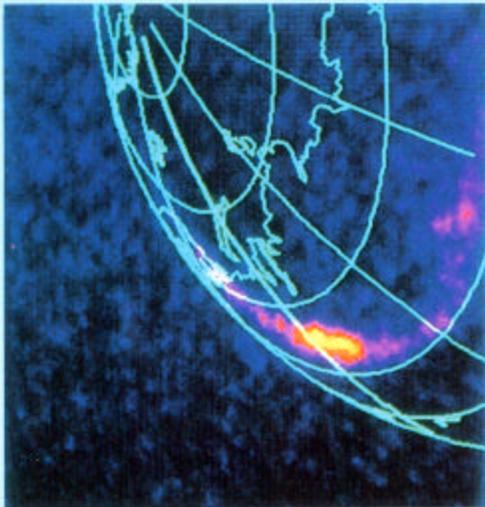
19:18:38 UT Nov.17,1989



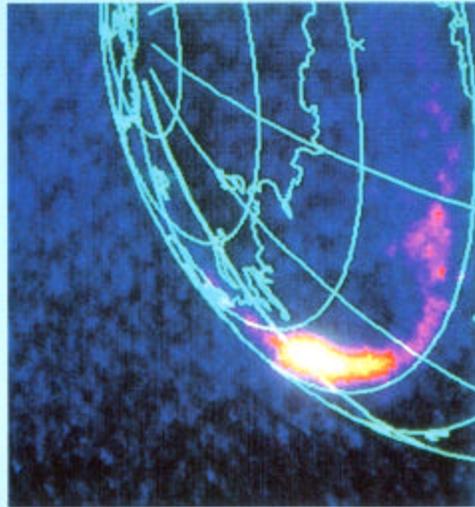
19:19:26 UT Nov.17,1989



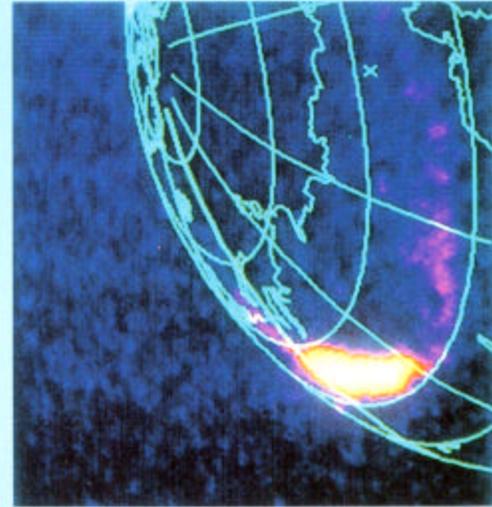
19:23:35 UT Nov.17,1989



19:26:00 UT Nov.17,1989



19:27:44 UT Nov.17,1989



Nozomi (Mars Orbiter)



Science targets

- Upper atmosphere
 - Solar wind interaction
 - Atmosphere escape
 - Magnetic field
- Moons and dust
- Surface and sub surface

Launched : July, 1998
Mars Orbit Insert : January, 2004

•Future mission: Bepi Colombo Mission (Mercury Exploration)

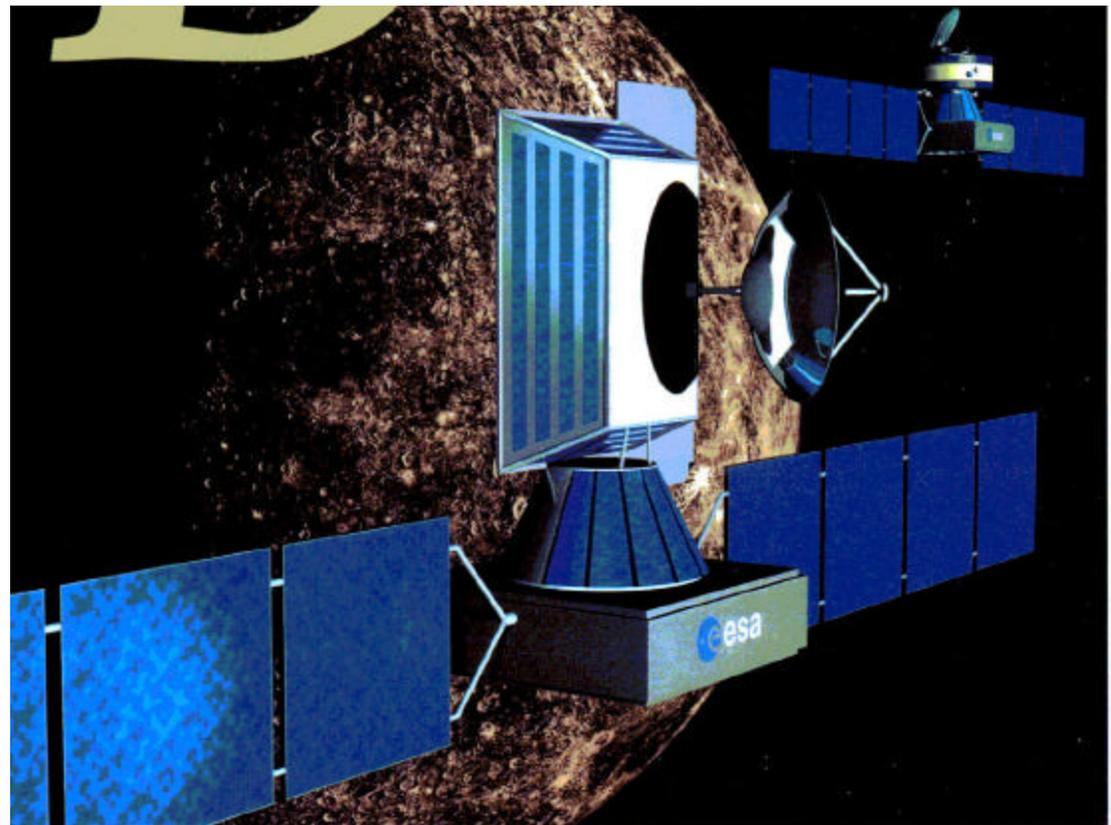
Comprehensive study of Mercury

global mapping
magnetism
atmosphere
magnetosphere

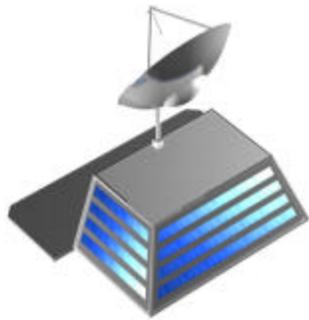
Under study in WG

collaboration with ESA

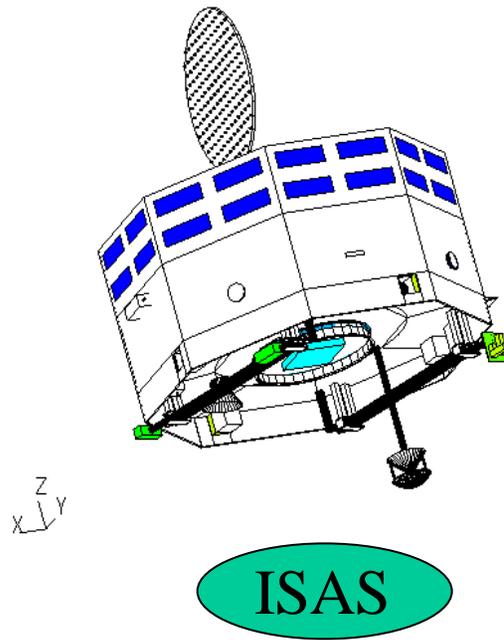
Launch :
2009
Arrival :
2012



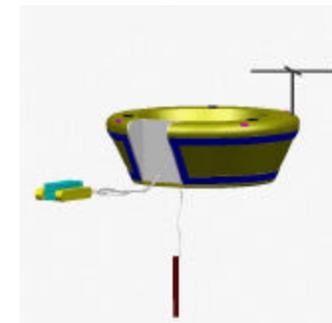
Collaboration with ESA



MPO(ESA)
400km x 1500km



MMO(ISAS)
400km x 12000km



MSE (ESA)
Lander at 85° lat.