



Lab. of Space Environment Exploration
(LSEE)
and our effort in solar EUV
observation for space weather

National space science center(NSSC),
Chinese Academy of Sciences (CAS)

September 2013

About LSEE

The earliest founded Chinese organizations in space environment exploration



aims at service for the basic research of space physics, space weather forecast, and the security of spacecrafts

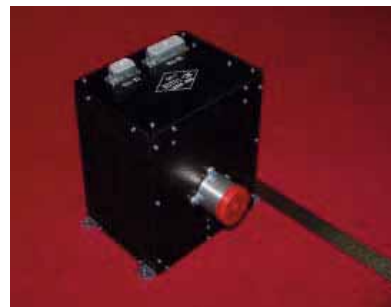
exploring scope has covered the whole solar-terrestrial system (including the solar atmosphere, the magnetosphere, the ionospheres, and the atmosphere), the deep space (such as the Moon, the Mars and etc.) and their effects on spacecrafts

High energy particle & effect Detection

- To develop particle radiation and effect payloads ensuring spacecraft safety.
 - High energy electron and proton detection
 - Heavy Ion composition detection
 - Radiation dosimeter
 - Particle LET spectra detection



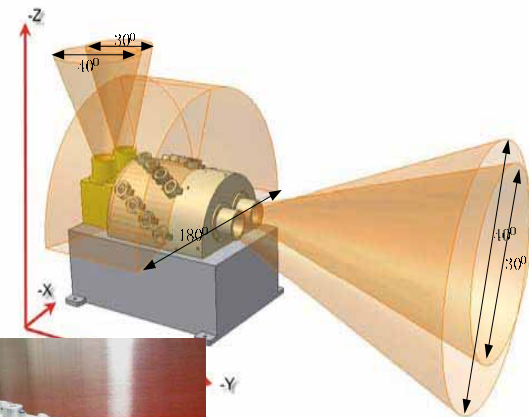
Radiation dosimeter



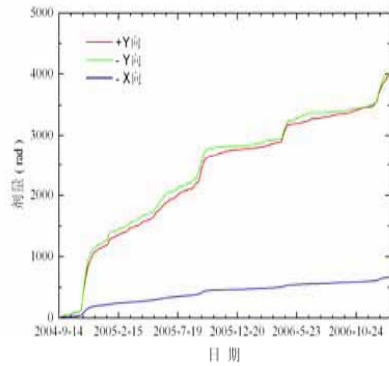
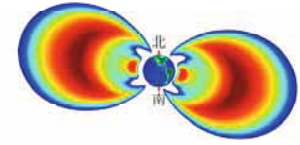
High energy particle detector



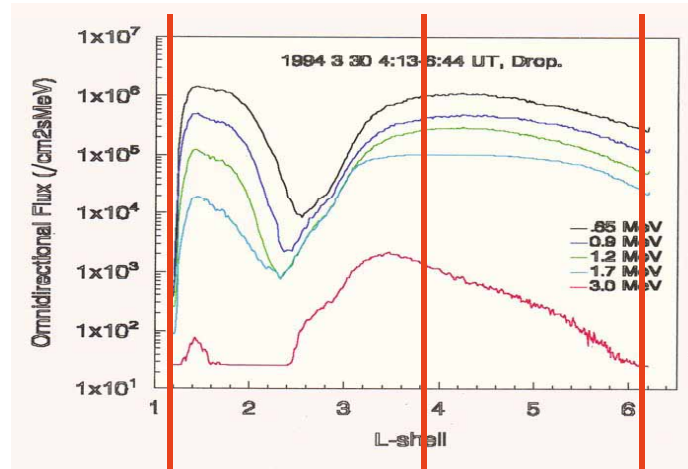
Pitch angle and spectra detector



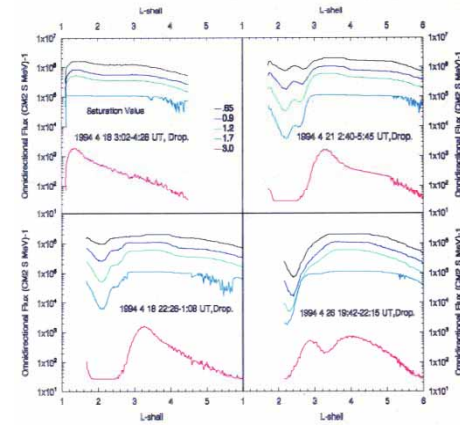
High energy particle & effect Detection



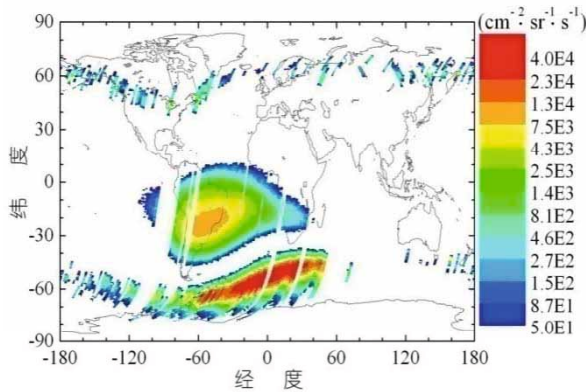
Increase of radiation dose



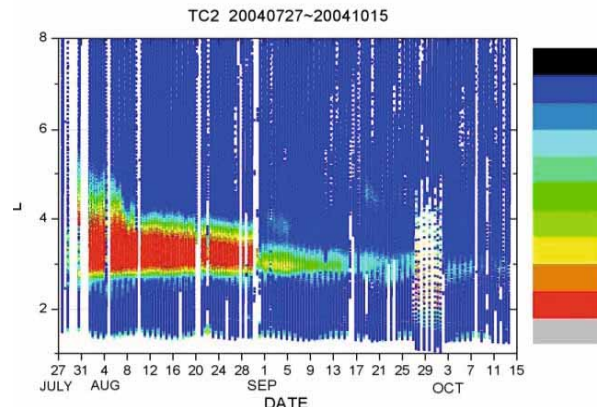
LEO MEO GEO



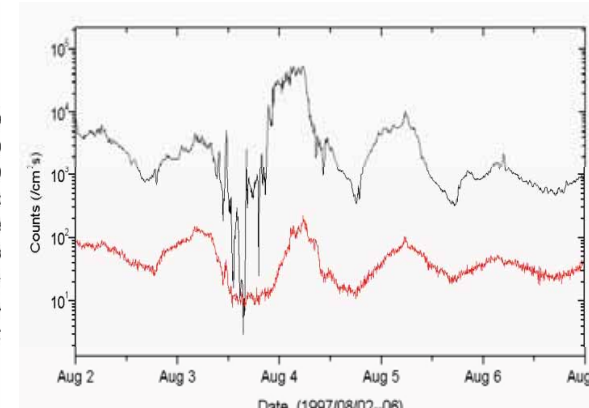
Electron fluxes disturbance due to magnetic storm



LEO Electron distribution



MEO Electron fluxes after storm



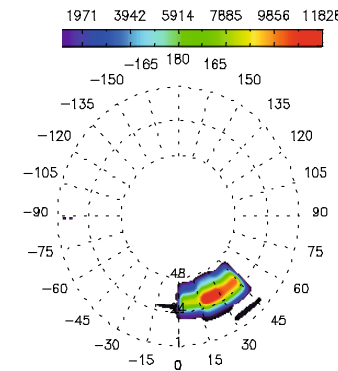
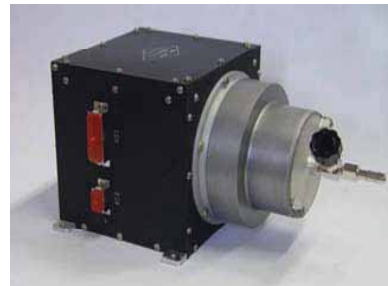
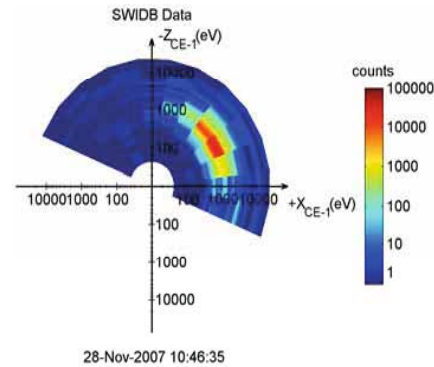
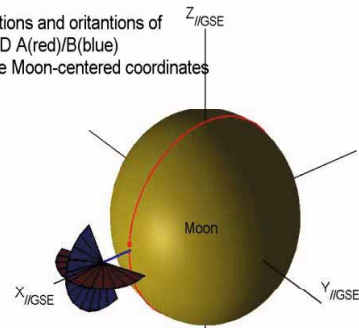
GEO Diurnal variation of electron fluxes

Plasma Probe

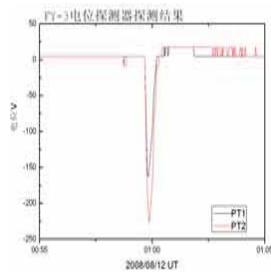
- To develop measurement techniques of space plasma
 - Electrostatic analyzer
 - Langmuir probe
 - Retarding potential analyzer
 - Charge potential

Solar wind plasma near moon
(CE-1)

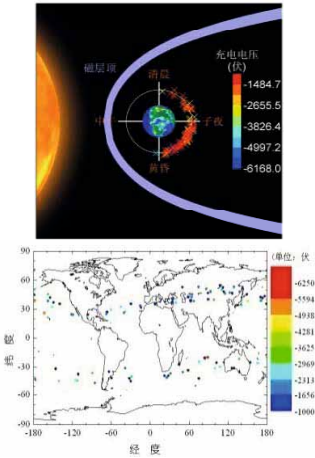
Positions and orientations of SWID A (red)/B (blue) in the Moon-centered coordinates



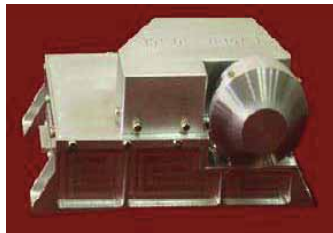
Plasma Probe Group



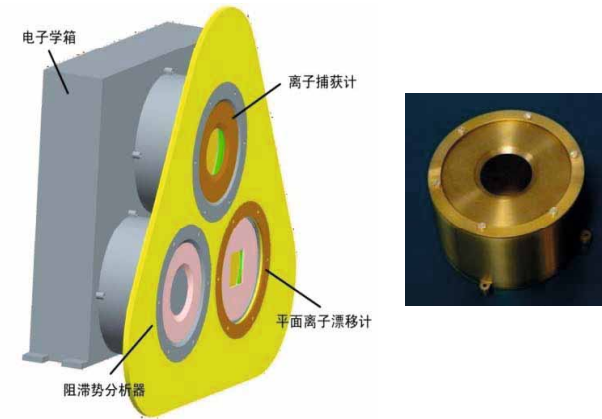
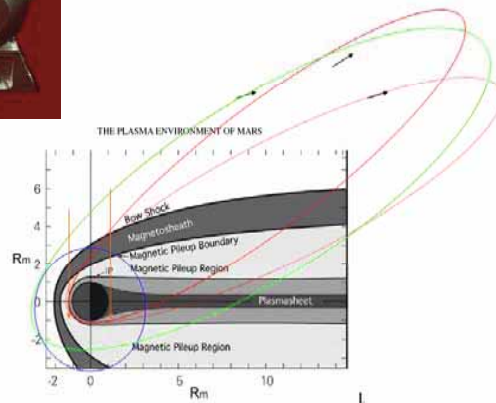
Surface charge potential monitor



Langmuir probe



Mars plasma analyzer of YH-1



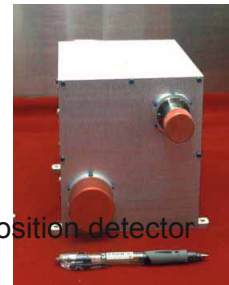
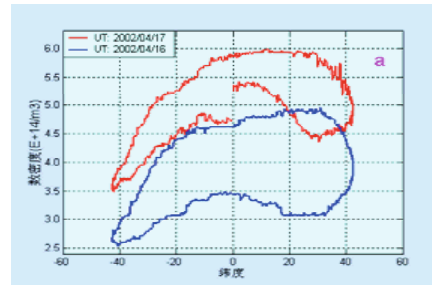
Retarding Potential Analyzer

Upper Atmosphere Detection Group

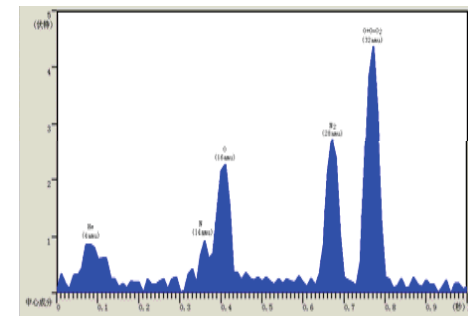
- To develop in situ measurement techniques of upper atmosphere
 - Atmosphere density
 - Atmosphere composition
 - Gas pollution of spacecrafts



Density detector



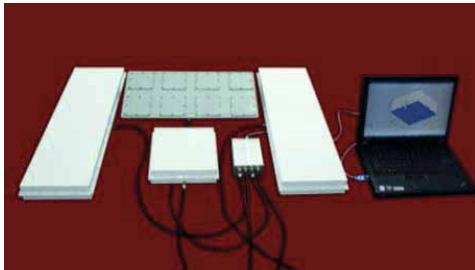
Composition detector



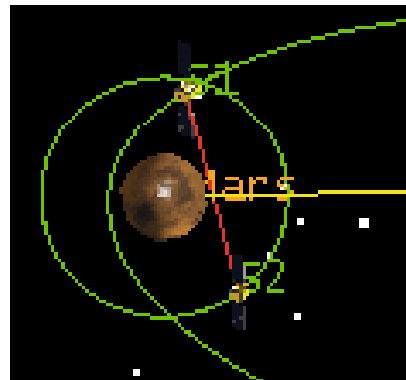
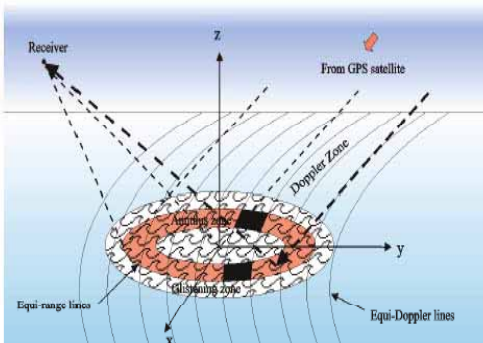
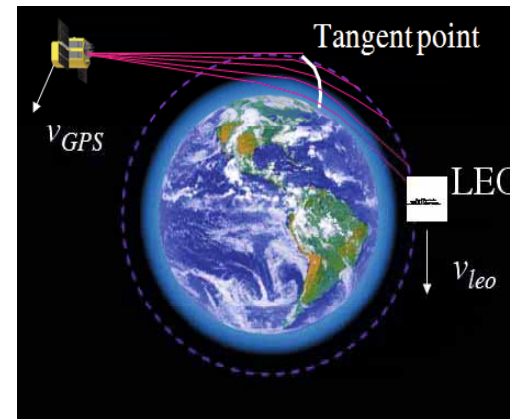
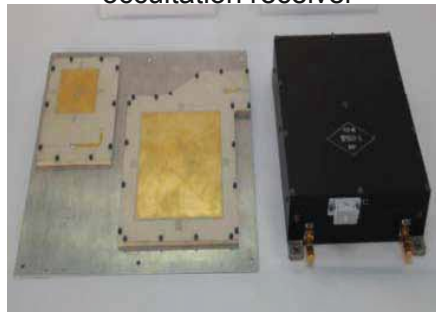
GNSS application

- To develop occultation receiver techniques measuring ionosphere, atmosphere and ocean.

GNSS-R receiver



Mars ionosphere occultation receiver



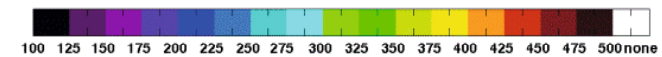
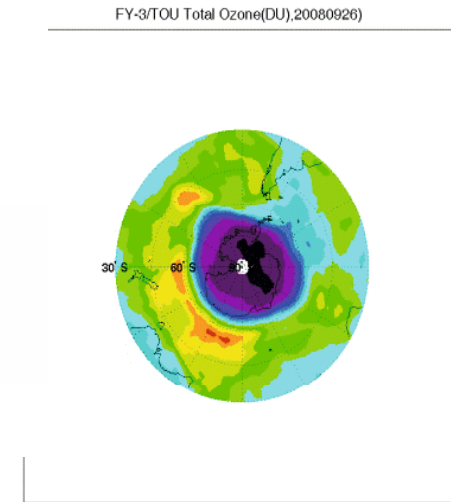
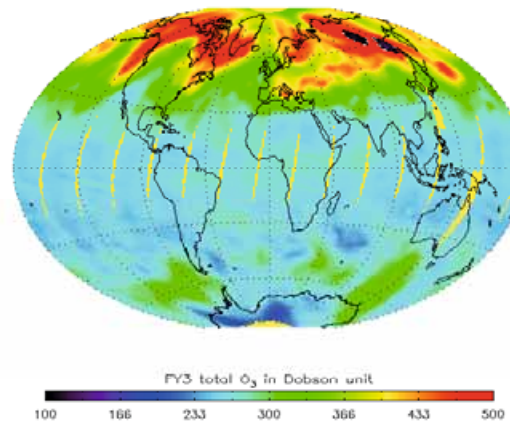
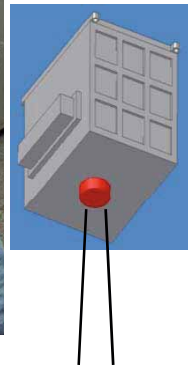
Optical remote sensing

- To develop optical remote sensing techniques of the earth's and solar atmosphere.
 - Total ozone
 - Airglow
 - Aurora

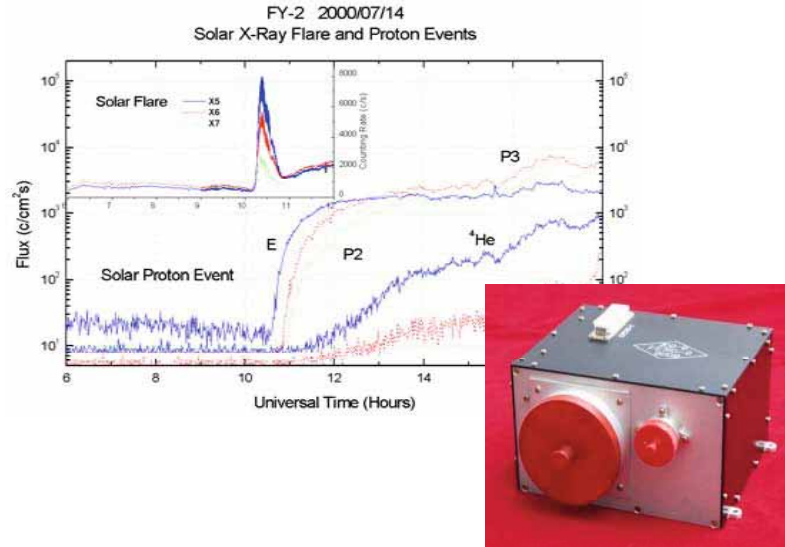
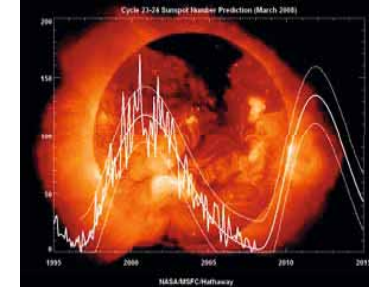
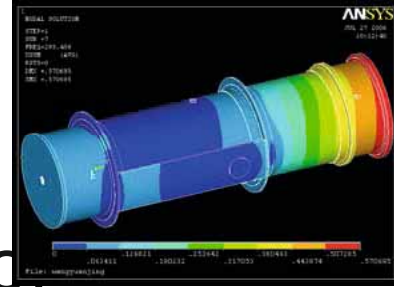


Total ozone detector (FY-3)

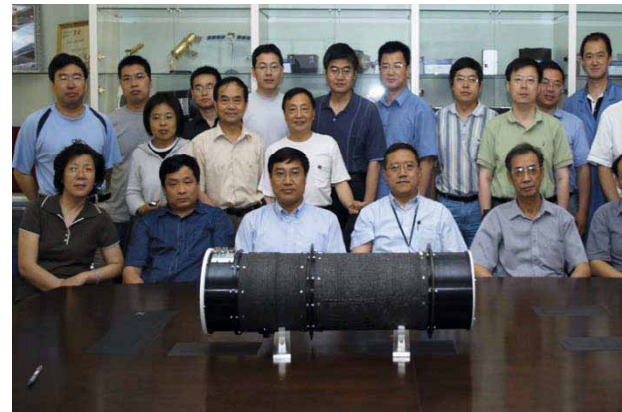
Airglow photometer



- Solar X-ray imager
- Solar EUV imager
- Solar X-ray fluxes detector
- Solar EUV imaging spectrograph



Spectral band: 0.9~10 nm and 19.5nm
 Field of view: 45 arc min
 Pixel size: 3 arc sec



Spectral band: 2~20 keV



Present Projects

- Manned Spacecraft
 - Particle pitch angle and spectra detector
 - Orbit atmosphere detector
- Meteorological Satellites

FY-3 A/B

Space environment monitor package
Total ozone imager

FY-3 C/D/E/F

Space environment monitor package
Total ozone imager
GNSS occultation receiver
Airglow photometer

FY-2 E/F

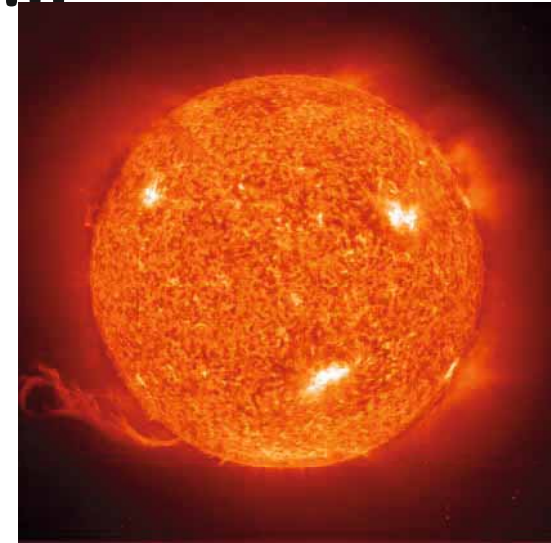
Solar X-ray detector
High energy proton detector
High energy electron detector

FY-4

Space weather monitor suite
(Particle radiation, plasma,
magnetic field, dose, charge
potential)

Projects coming soon.....

- MOSES
 - Solar EUV imager
 - Solar X-ray imager
 - White light coronagraph
 - Particle radiation, x-ray flux, and so on
- Kuafu
 - Solar EUV imaging spectrograph
 - Lalpha imager
 - Inner Coronagraph (Lalpha+WL)
 - Outer coronagraph
 - Heliospheric imager
 - Plasma, particles



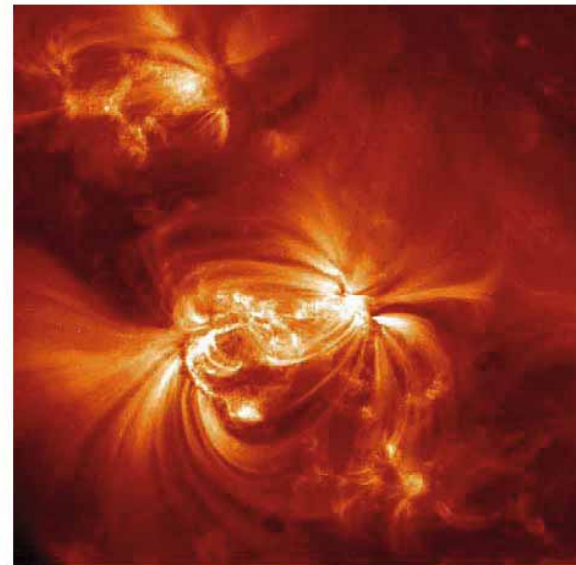
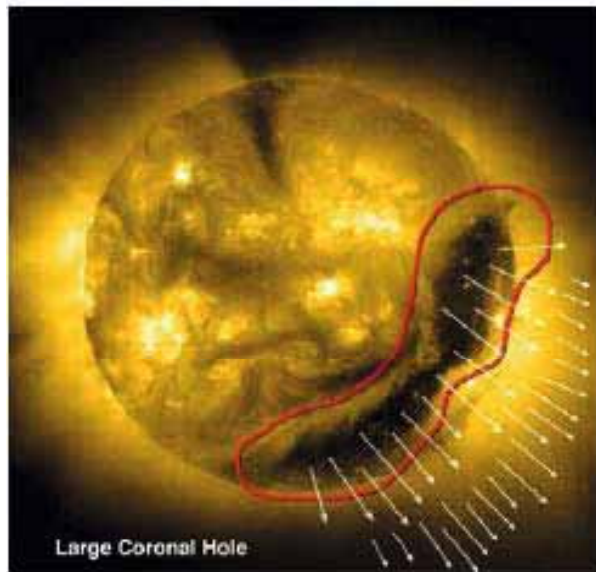
Space weather vs. solar physics

Synthesis in many missions, but are different

orbit: Real time
uninterrupted

FOV
Resolution

full disk > high resolution





Solar X-ray and EUV imager for meteorological satellite

Wavelength: X-ray 5bands 0.8-21.2nm

0.8-6.1nm

0.8-4nm

0.8-2nm

0.8-1.3nm

EUV 19.5nm

FOV: 45arcmin

CCD array: 1024X1024

Resolution: 4arcsec/pix

Weight: 24kg

X-ray

- Very high T
- Broad band

5bands by filter

Deduce EM and T

by ratio of different band
show the precursor,
sigmoid and CUSP,
as well as flare, CH

EUV

High T

Line

high resolution and
accuracy

observing dimming, EIT wave,
CH, flare and filament

Limitation of the present instruments

imagers

EUV disk imager (EIT, EUVI)

white light coronagraph

(LASCO, SECCI)

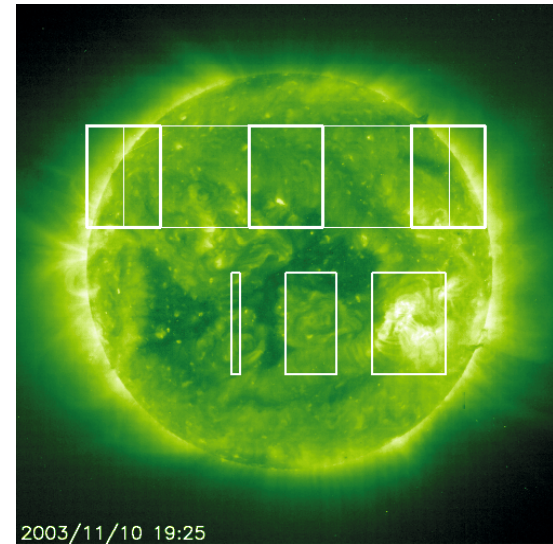


Difficult to identify the source of CME

Lack of initial acceleration information of CME

Limitation of the present instruments

**Slit spectrograph
(EVE, EIS)**



Difficult to catch eruption

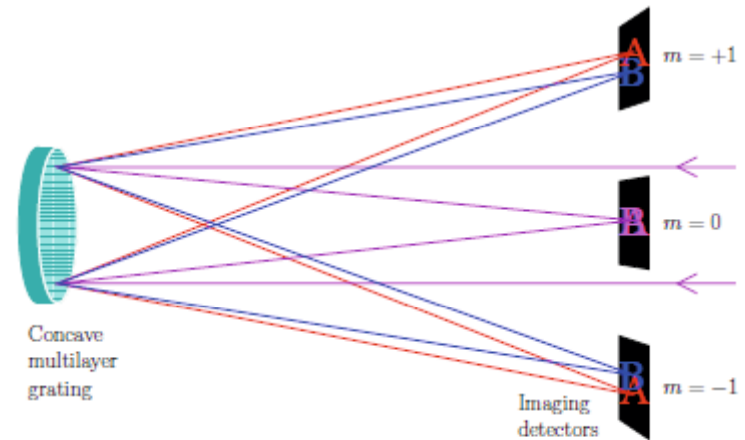
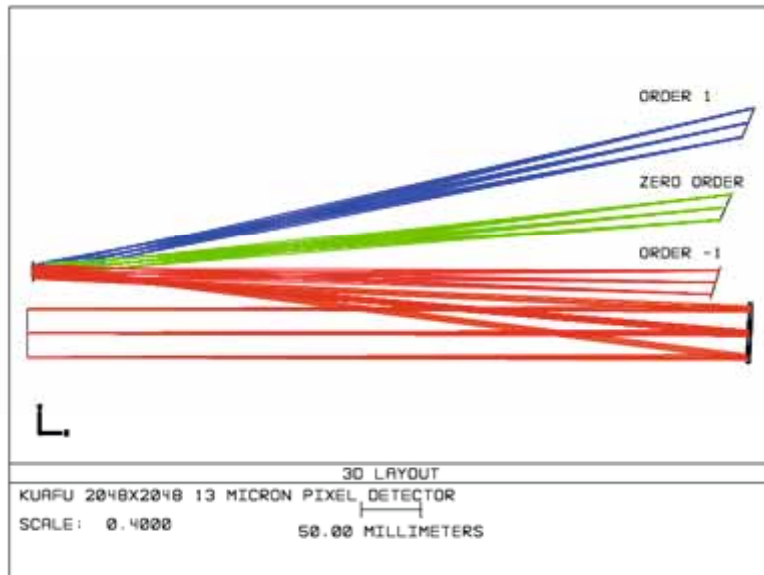
Low temporal resolution

Non synchronous in spatial and temporal information

Slitless Solar EUV imaging spectrograph

- Kankelborg, Montana State University

MOSES , sounding rocket



L.K. Harra, MSSL,
Proposal for SO, Kuafu

Full disk solar EUV imaging spectrograph

- Get the form, intensity and velocity of solar atmosphere simultaneously
- Study the flow behind the form evolution of solar activity
- Identify the source and initial acceleration of CME
- Acquire the velocity and direction of CME



Very Useful not only in solar physics
but also space weather

- Observing almost all the violent solar activities, flare, CH, EIT wave.....
- identify the CME **source, velocity and direction** by a single instrument
- Get solar disk velocity map, study the flow behind active region evolution

Now we are working on...

- Nonspherical Grating
- *Inversion* algorithm
- GT and Self Stabilization system
(stabilization requirement better than 0.35arcsec/10s)
- Multilayer and Mirror

International cooperation is welcome!

We are looking for.....

international collaborations

- To find out excellent proposals.
- To design, manufacture and calibrate the payloads.
- Scientific data will be share.
- to promote exchange of researchers

Thank you!

