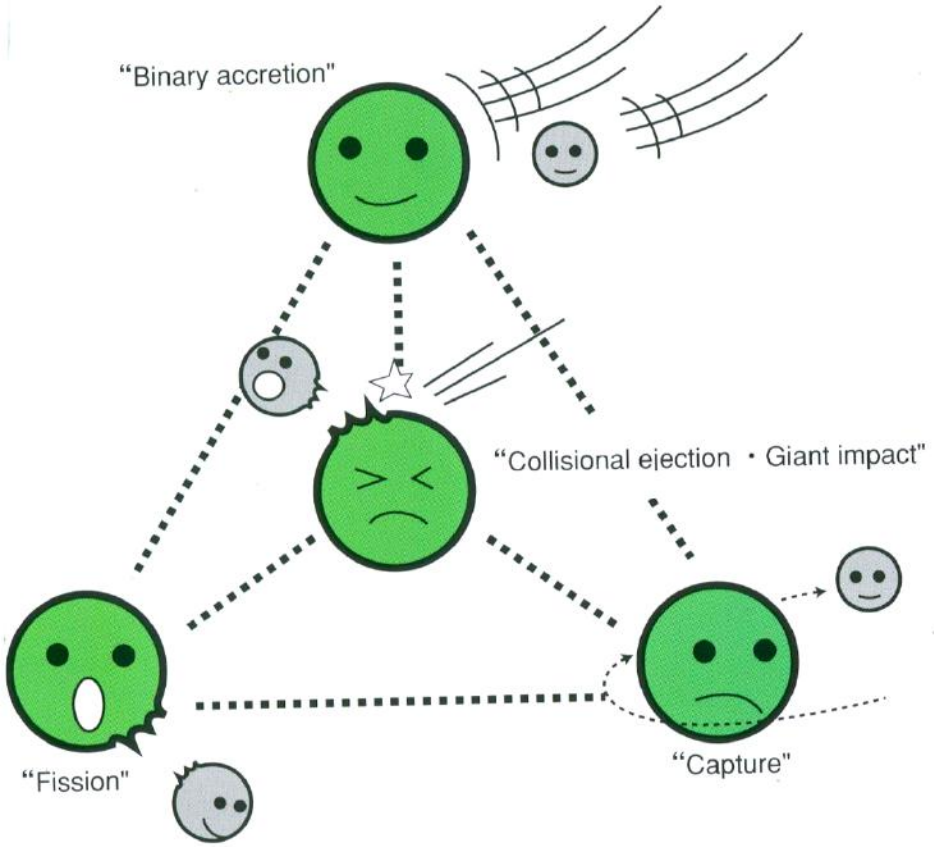
KAGUYA(SELENE) Science Mission

June 2008

JAXA
宇宙航空研究開発機構

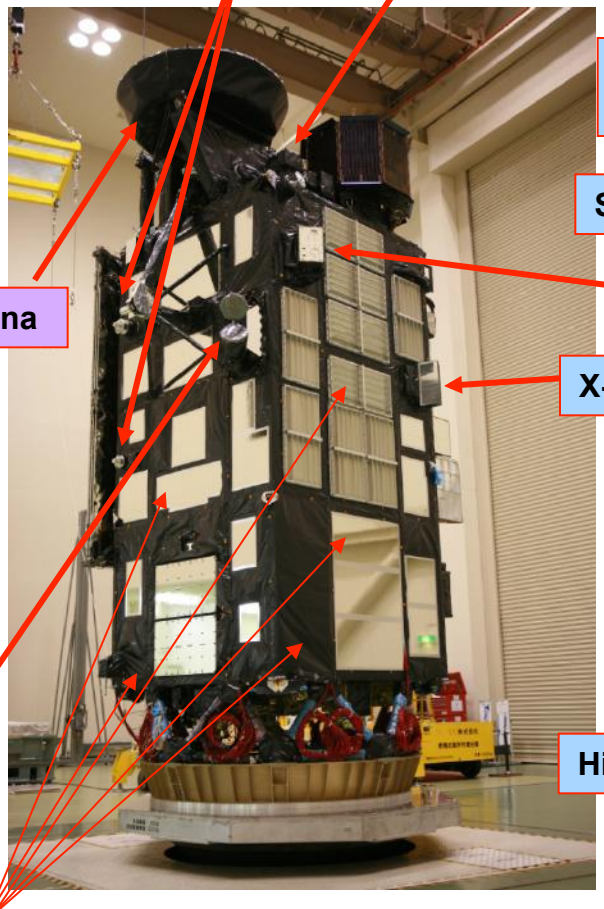
Science Objectives

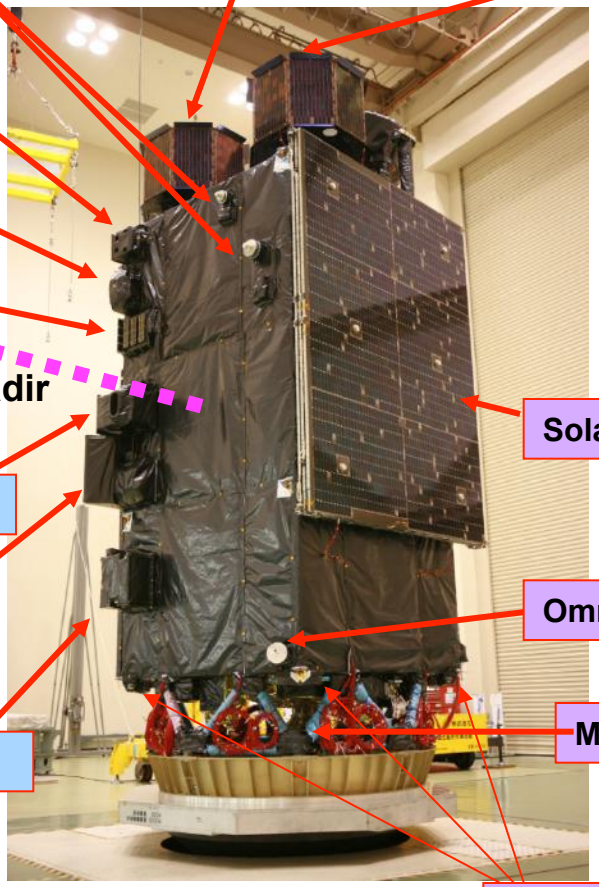
1. Science of the Moon
   - Study of origin and evolution of the Moon
2. Science on the Moon
   - In-situ measurement of lunar environment
3. Science from the Moon
   - Observation of solar-terrestrial plasma environment
   - Site search for future astronomical observation



Major Models

Flight Configuration





PACE

UPI

PACE

VRAD Satellite

Relay Satellite

Tarrain Camera
Multi-band Imager

Spectral-profiler

CPS

High Gain Antenna

X-ray Spectrometer

nadir

Solar paddle

Laser Altimeter

Gamma-ray
Spectrometer

Omni Antenna

Star Tracker

High Definition TV Camera

Main engine

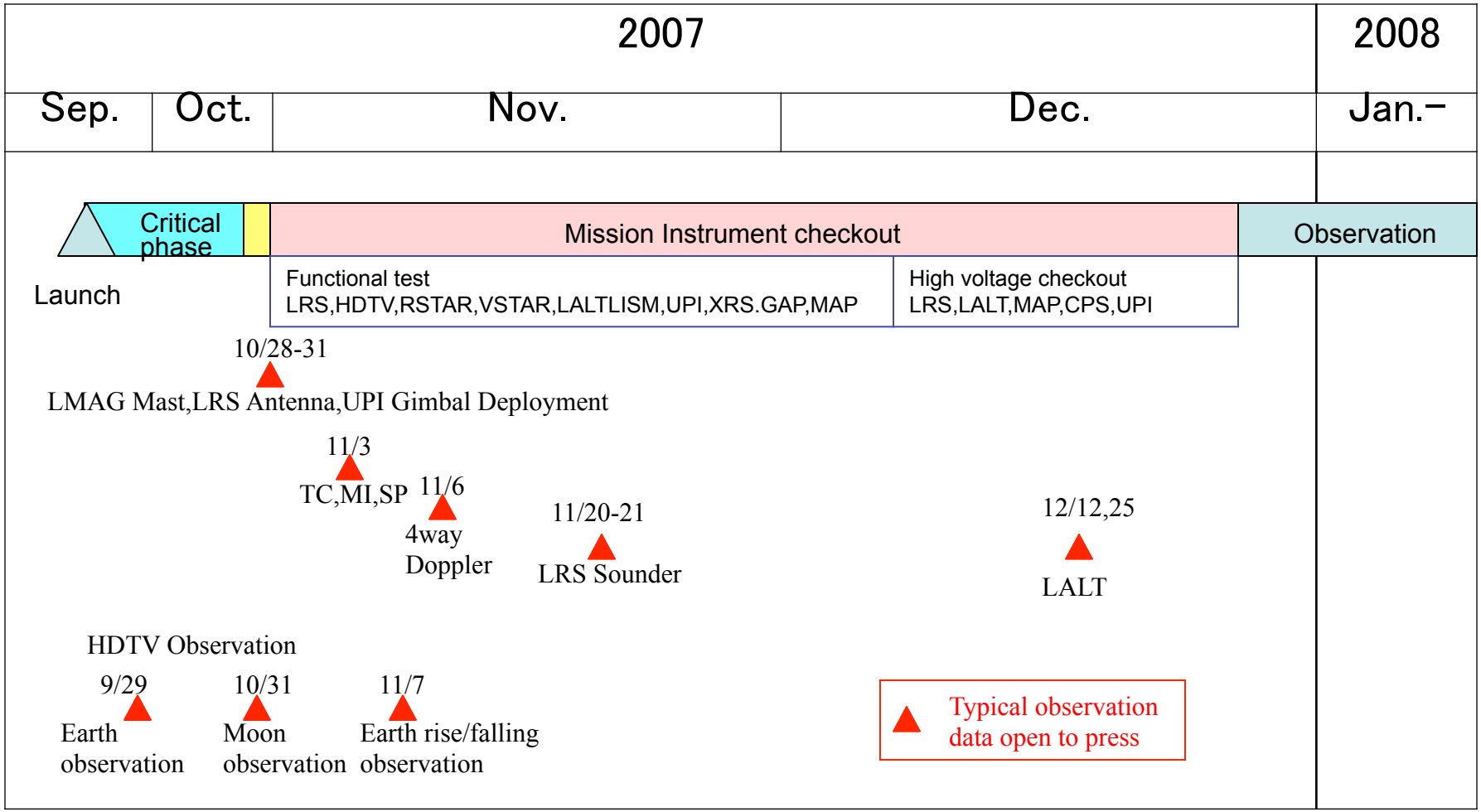
Thermal
Radiator

Thrusters

Mission
instrument

Bus sub-system

Initial-Phase Mission Operation

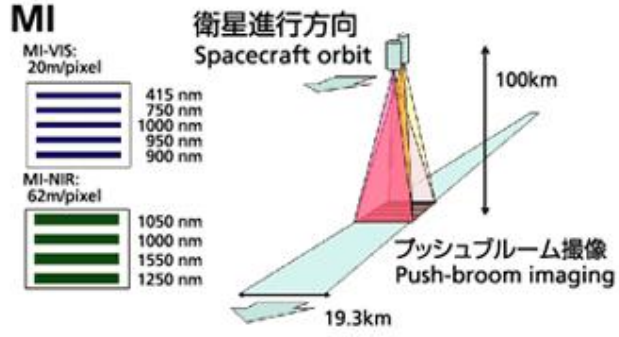


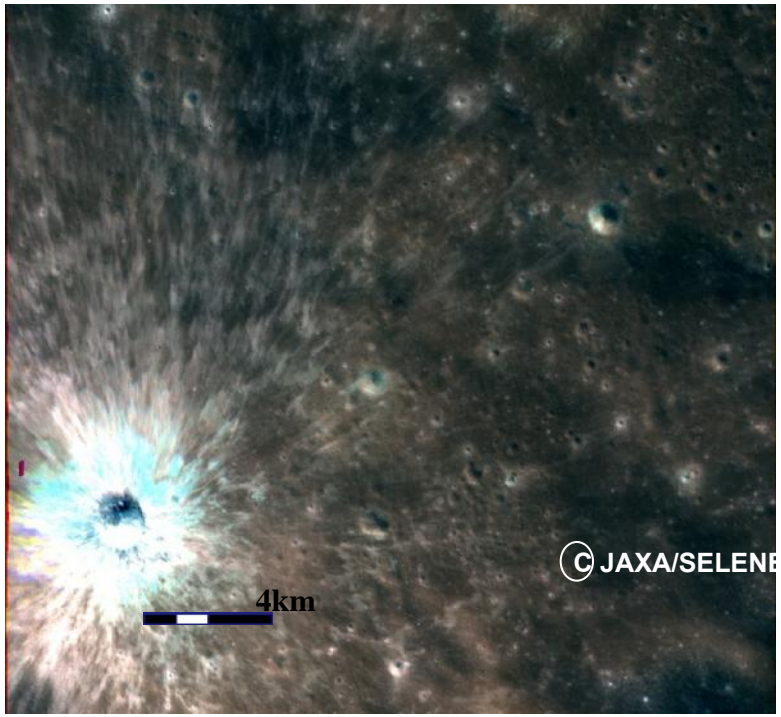
Mission Instruments

Category	Observation	Instrument	Measurement
Science of the Moon	Element Abundance	X-ray Spectrometer(XRS)	Al, Si, Mg, Fe, etc.
		Gamma-ray Spectrometer(GRS)	U, Th, K, H etc.
	Mineral Composition	Multi-band Imager(MI)	mineral distribution
		Spectral Profiler(SP)	mineral composition
	Topography, Geological Structure	Terrain Camera(TC)	geographical features
		Lunar Radar Sounder(LRS)	subsurface structure
		Laser Altimeter(LALT)	topography
	Gravity Field	Differential VLBI Radio Source(VRAD)	lunar gravity field
		Relay Satellite(RSAT)	far side local gravity field
Science on the Moon	Magnetic Field	Lunar Magnetometer(LMAG)	magnetic field
		Electron Energy Analyzer(part of PACE)	surface magnetic field
	Crustal Activity	α-ray spectrometer of CPS	α particles
	Radiation Environment	Charged Particle Spectrometer(CPS)	energetic particles
	Plasma Environment	Plasma Energy Angle and Composition Experiment(PACE)	electrons and ions
	Ionosphere	Radio Science(RS)	ionospheric electrons
Science from the Moon	Solar-Terrestial Plasma Environment	Uppe-Atmosphere and Plasma Imager(UPI)	earth magnetosphere, aurora
		Wave Receiver(part of LRS)	planetary radiations
Publicity	Earth and Moon	High Definition TV(HDTV)	high-definition movie

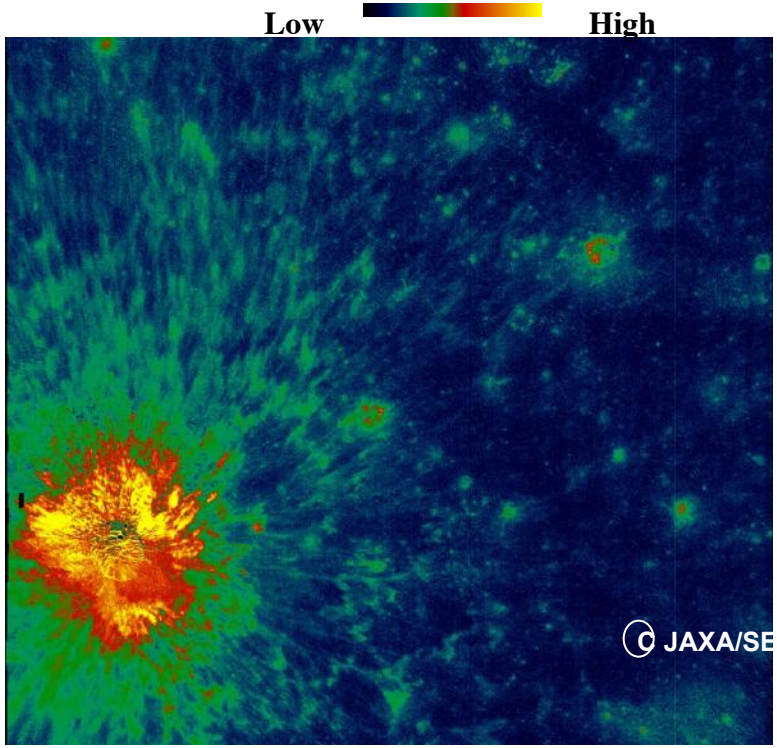
1. Multi-band Imager

UV-VIS-IR imager
Spectral bandwidth ranging from 0.4 to 1.6 μm,
9 filters(bandwidth 10-30 nm)
Spatial resolution 20m

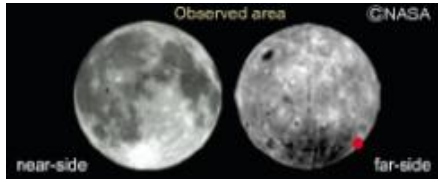




Pseudo-color image using 3 lines, showing an existence of ejectors(900nm→red, 750nm→green, 415nm→blue)



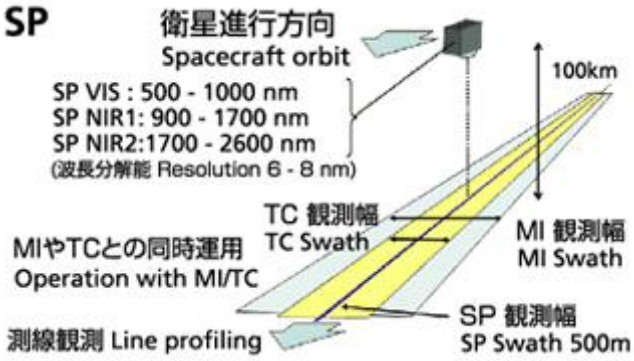
Color-ratio image, 750nm/1000nm, characterizing ejected material from the crater.

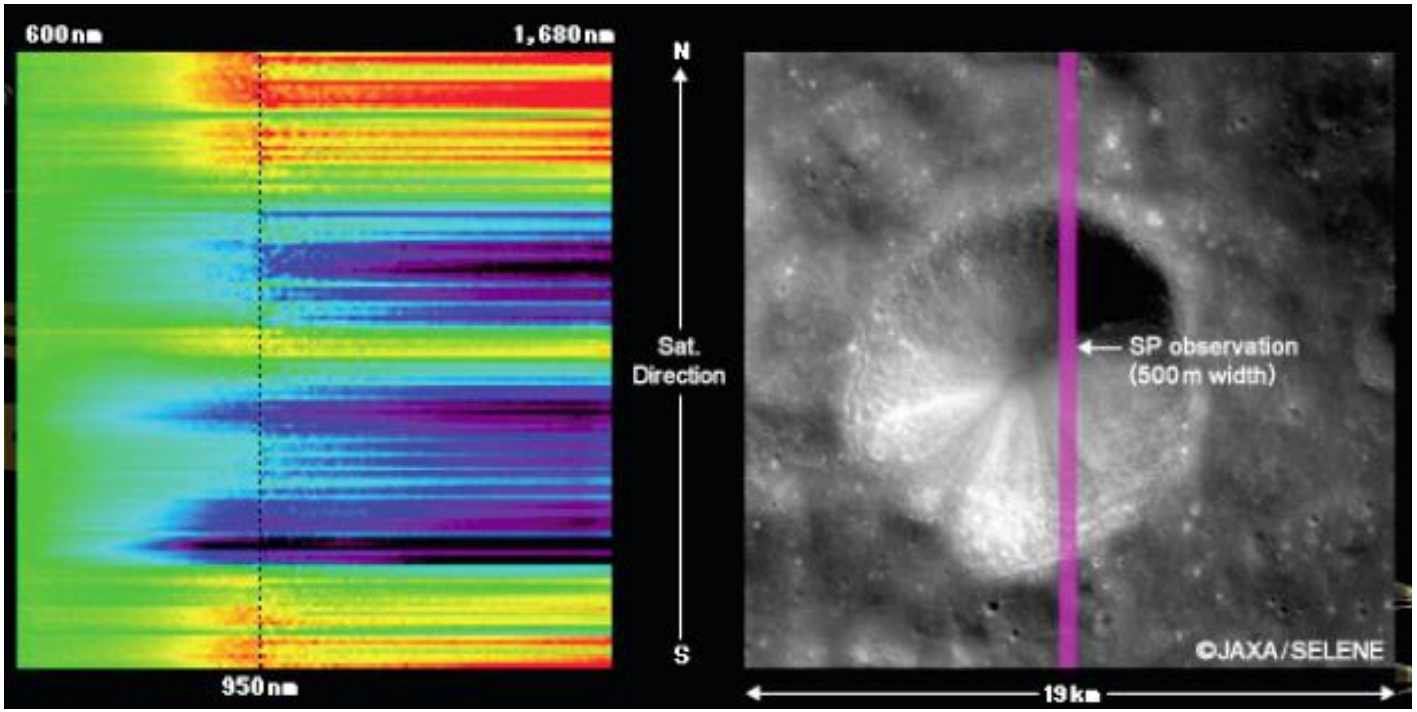


- observation spot
  about 1000km south-west of the Orientale Basin

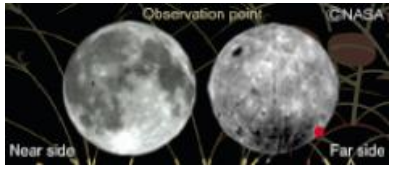
2. Spectral Profiler

Continuous spectral profile ranging from 0.5 to 2.6μm(spectral sampling 5nm)
Spatial resolution 500m





Spectral-Profiler (SP)

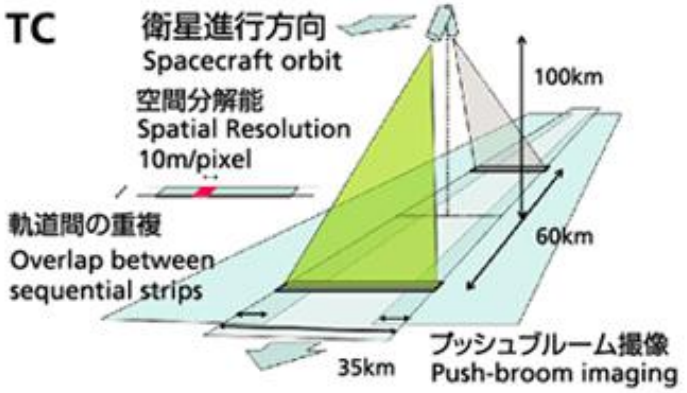


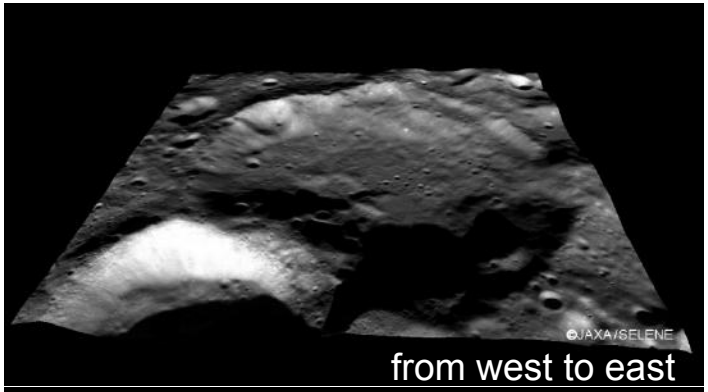
- observation spot

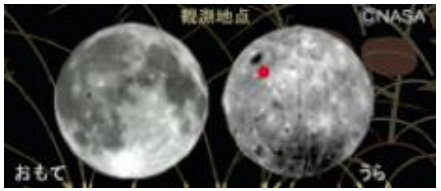
Spectral profile shows fresh rock and soil existing inside the crater, while other area experienced the space weathering effects.

3. Terrain Camera

Stereo camera
Spatial resolution 10m





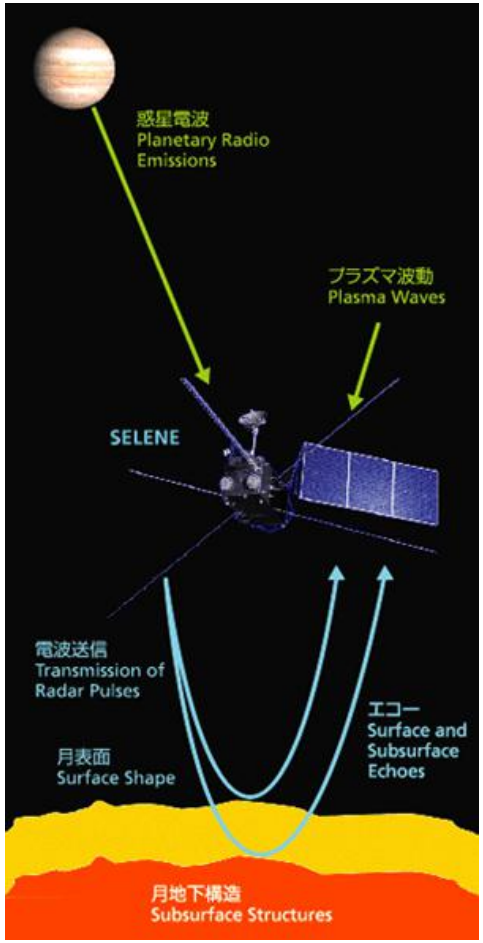


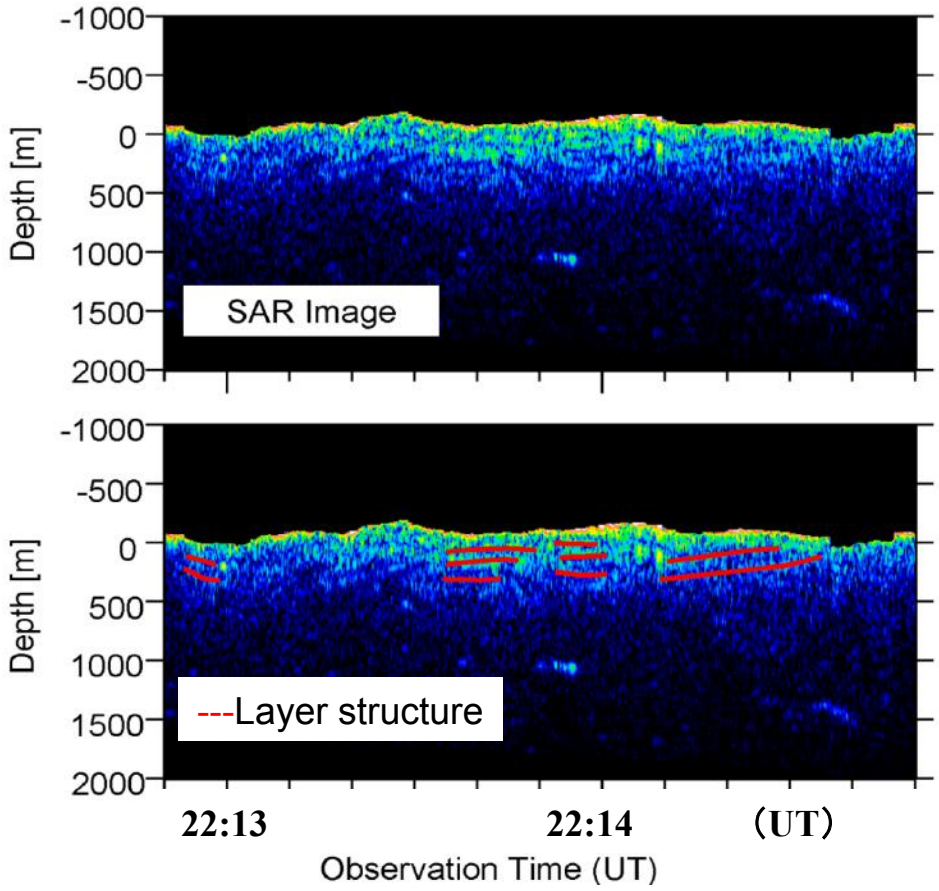
• observation spot

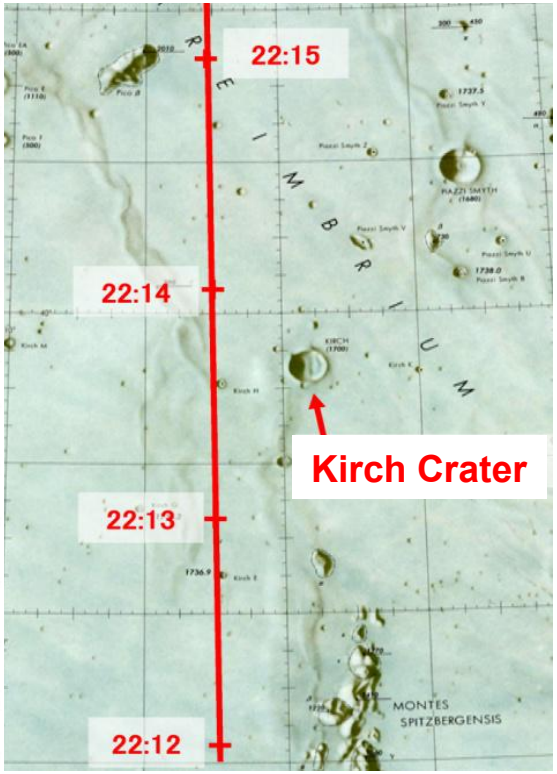
Three dimensional image of Nagaoka Crater (19.4N, 154.0E)

4. Lunar Radar Sounder

Mapping of subsurface structure using active sounder (frequency 5 MHz)
Depth 5 km(resolution 100m)



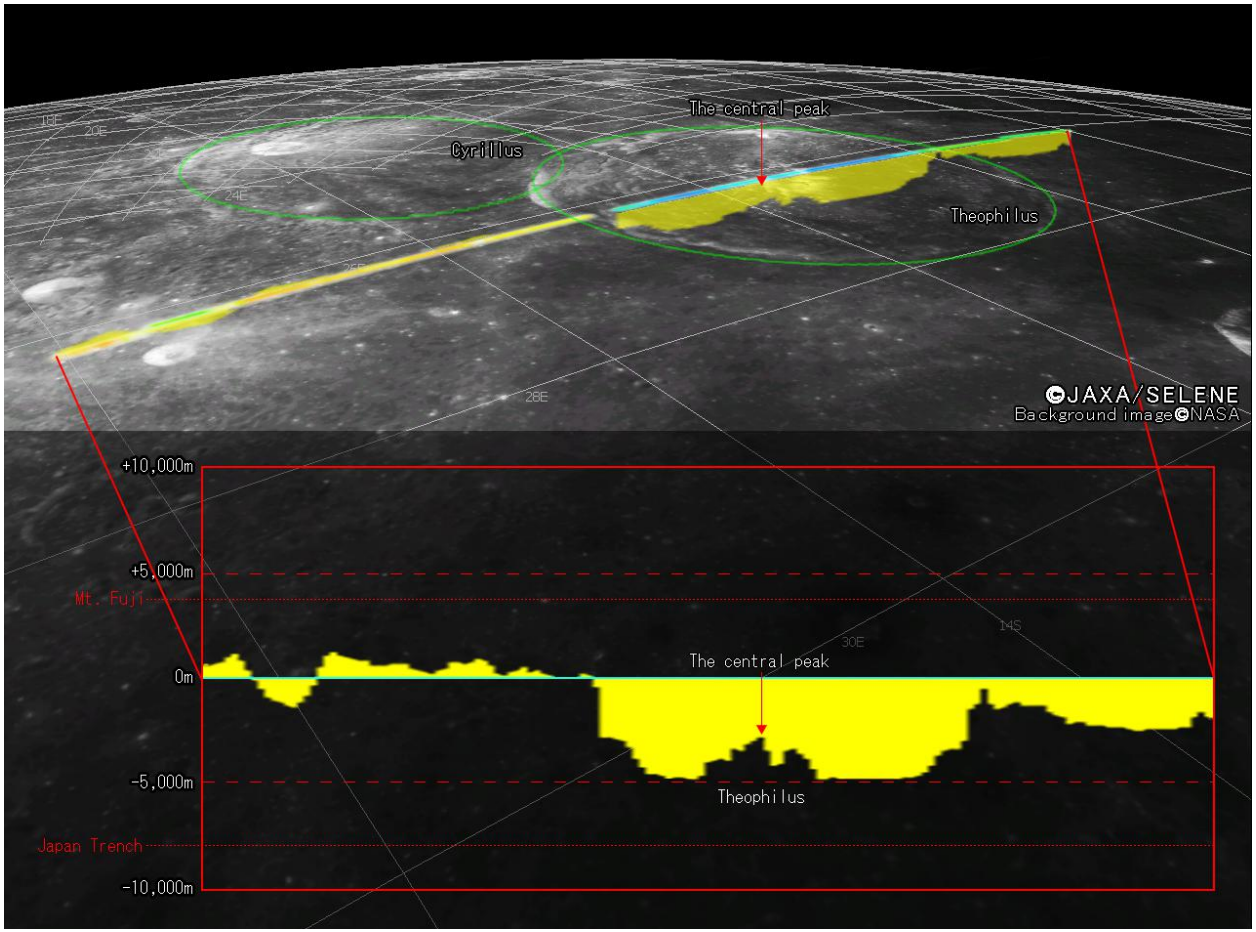




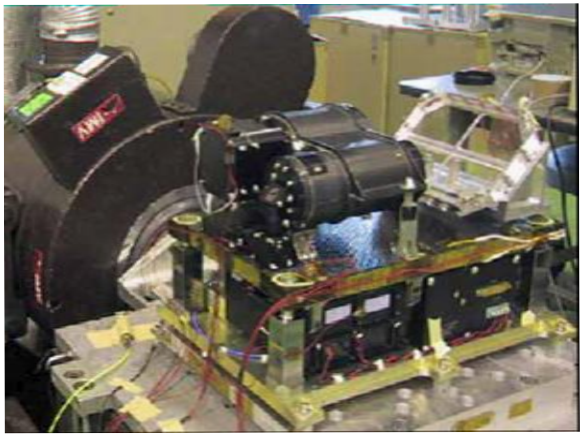
Synthetic Aperture Radar (SAR) image and strata identification of the north-eastern part of the Mare Imbrium near the Kirch crater (39.2N, 5.6W, 11 km dia.)

5. Laser Altimeter

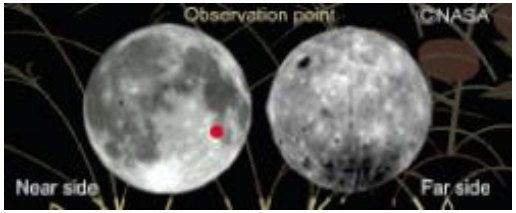
Nd:YAG+ADP laser altimeter, Footprint 30m, Height resolution 5m, Spatial resolution 1600m (pulse rate 1Hz)



Cross section of the Theophilus Crater
Depth of crater: 5000 m, Height of central peak: 2000 m

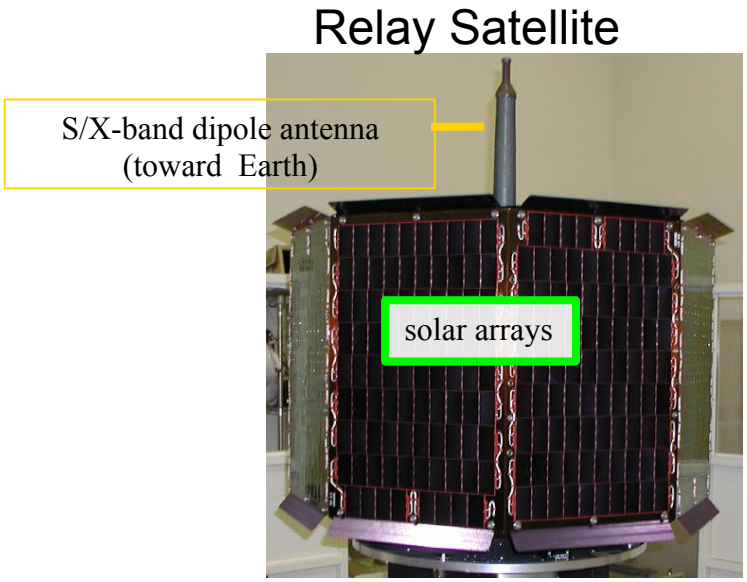


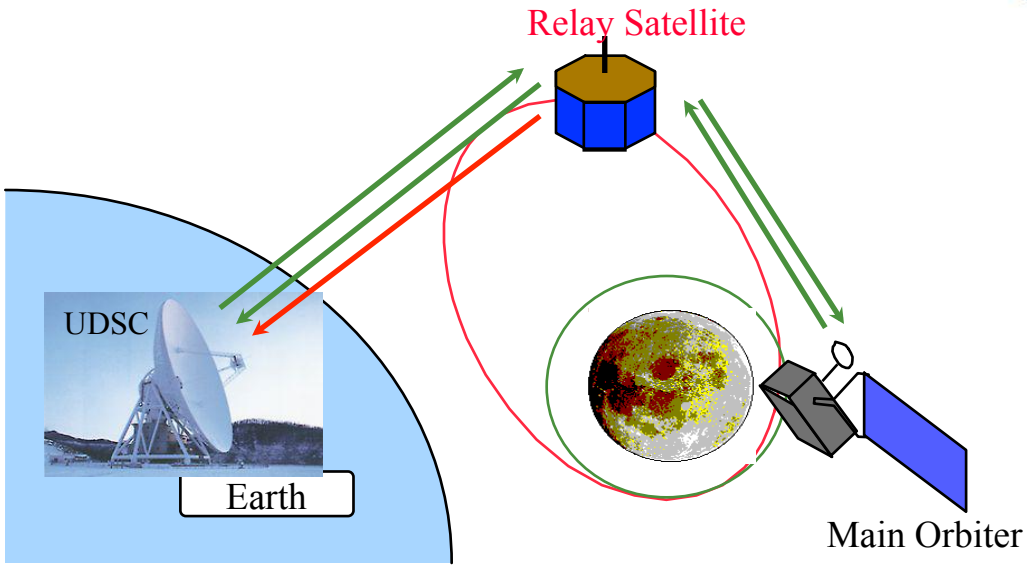
Laser Altimeter Flight Model

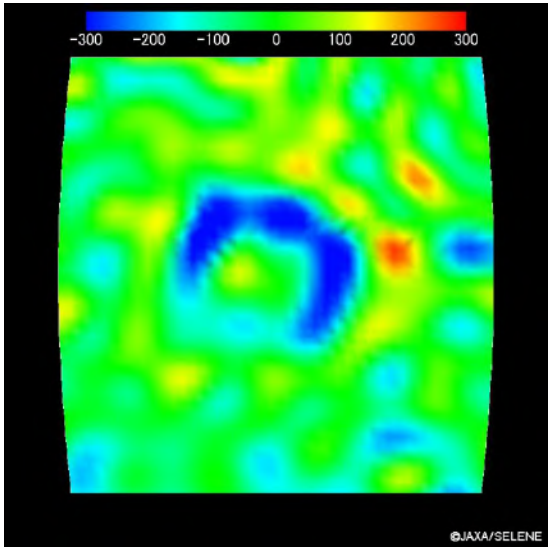


- observation spot

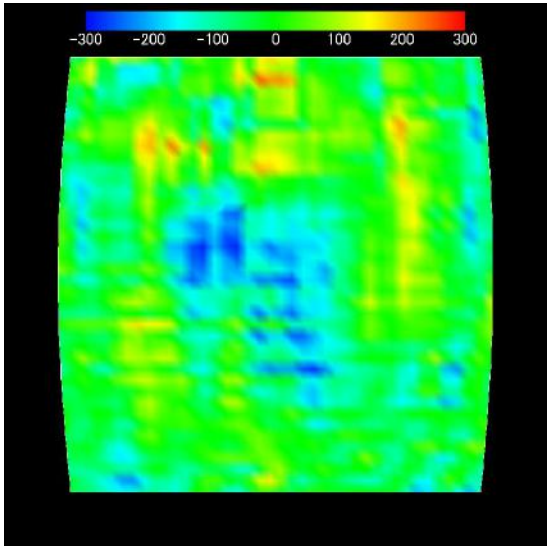
6. Observation of Gravity Anomaly in the Far Side



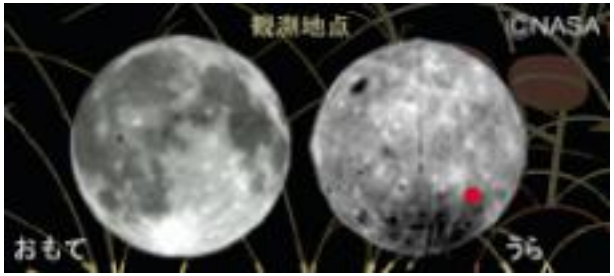




Observation by Kaguya



Previous Model (LP165P)

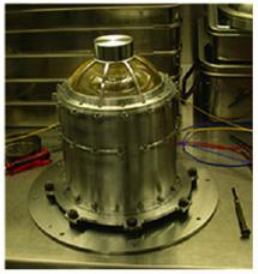


- observation area
  Apollo Basin

7.Plasma Energy Angle and Composition Experiment

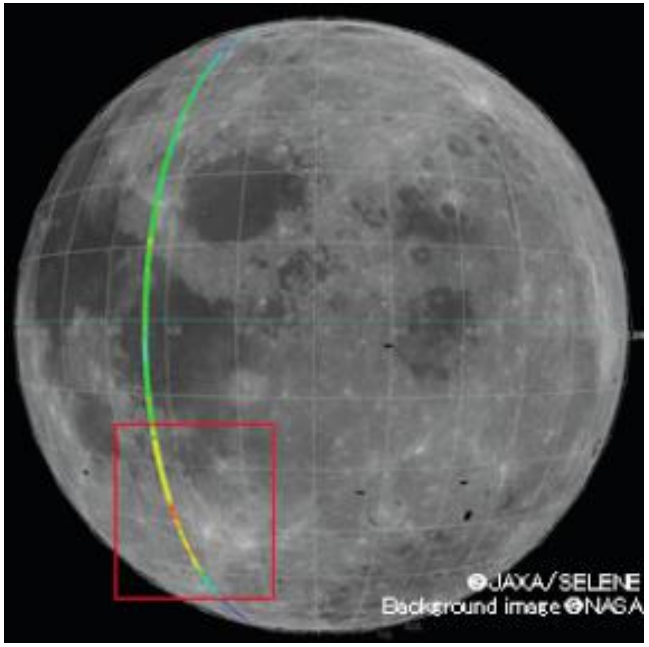
Electron energy analyzer 5 eV-15 keV
Ion energy analyzer 5 eV/q-28 keV/q
Ion mass/energy analyzer 1-60 AMU

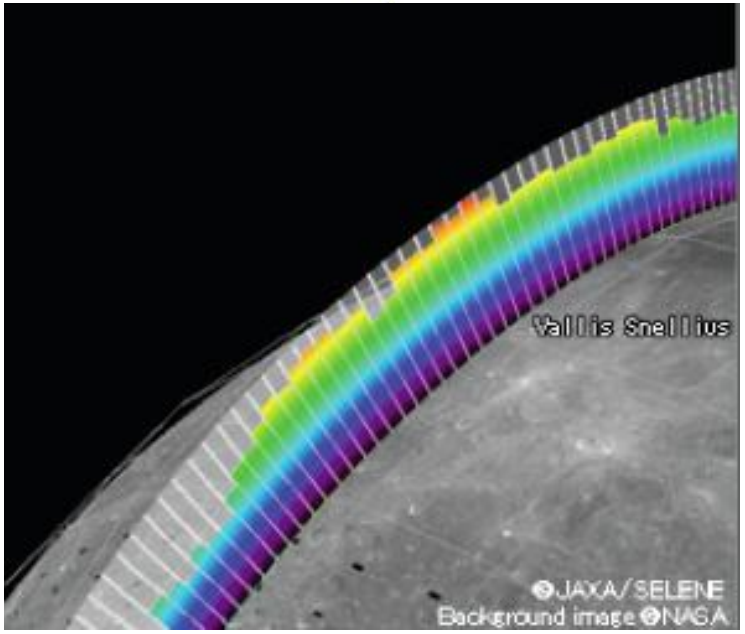
ESA-S

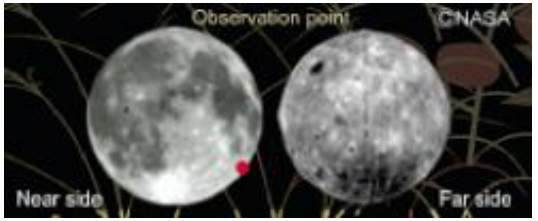


IEA-S

IMA-S



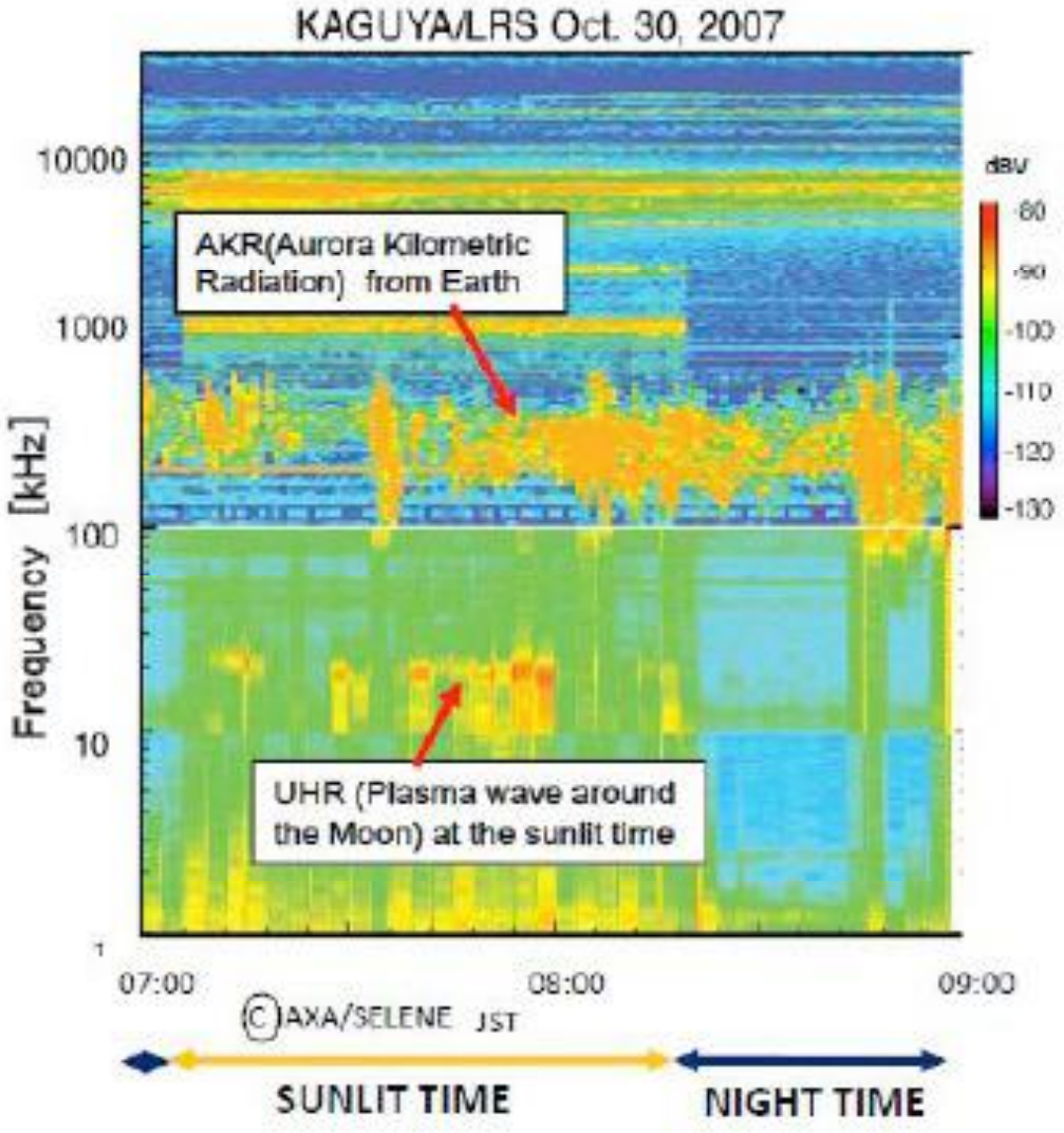




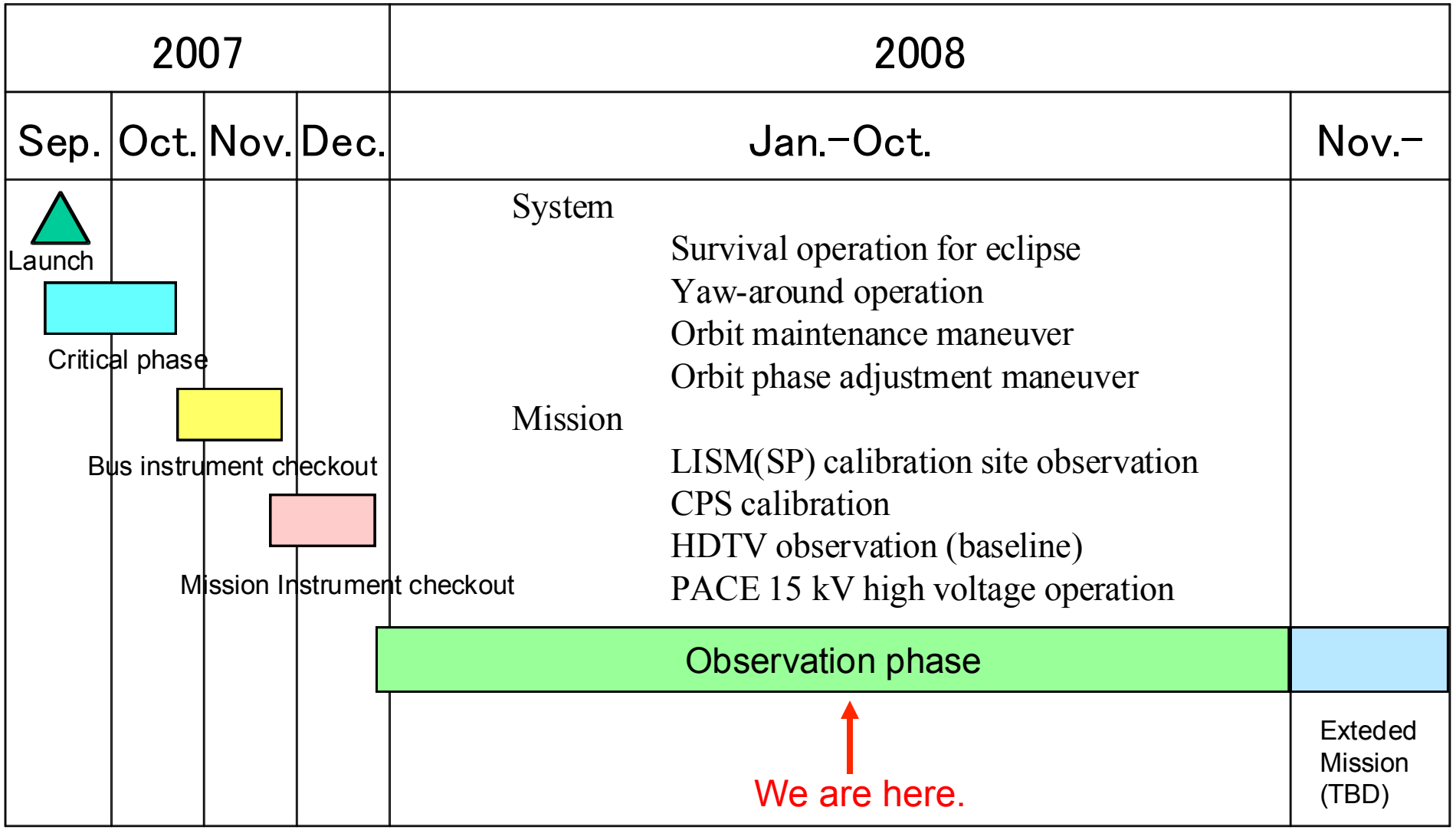
• observation Location

Count number of solar wind ion at an altitude of 100 km (Dec.14, 2007)

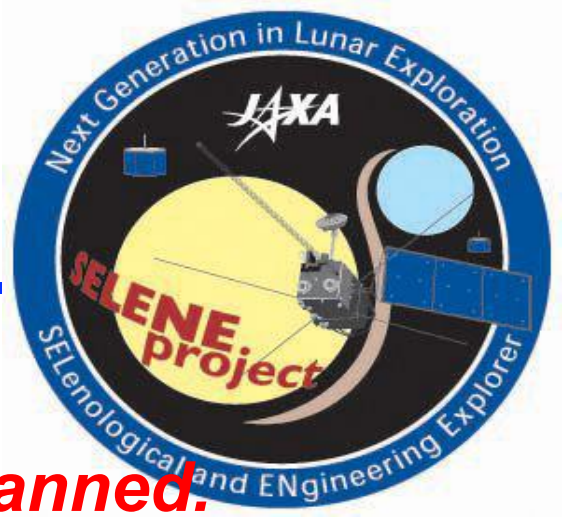
8. Observation by LRS Wave Receivers



Mission Operation Plan



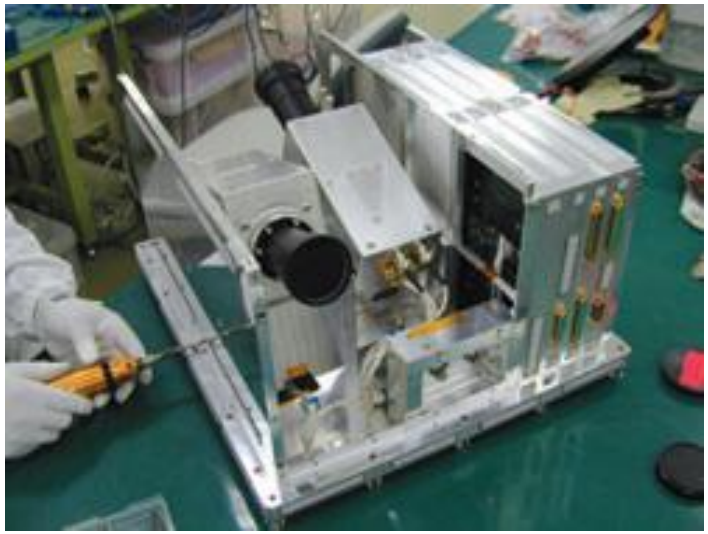
Concluding Remarks

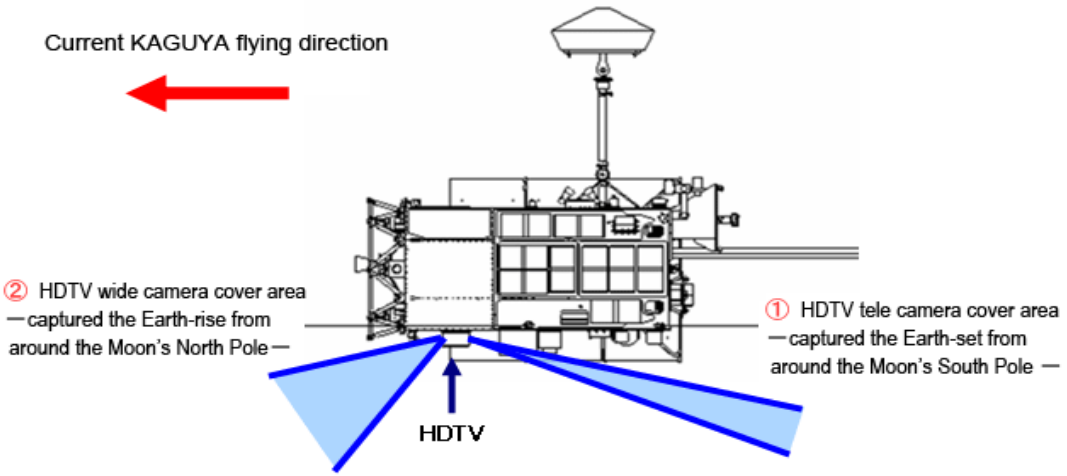


1. Scientific observation is under way as planned.
2. Major scientific goals are expected to be fully achieved by the end of this year.
3. Extended mission will be conducted for further fruits.
4. We are now confident to contribute greatly to the lunar science.
5. International collaboration for new lunar exploration and utilization for human society is now on the horizon.

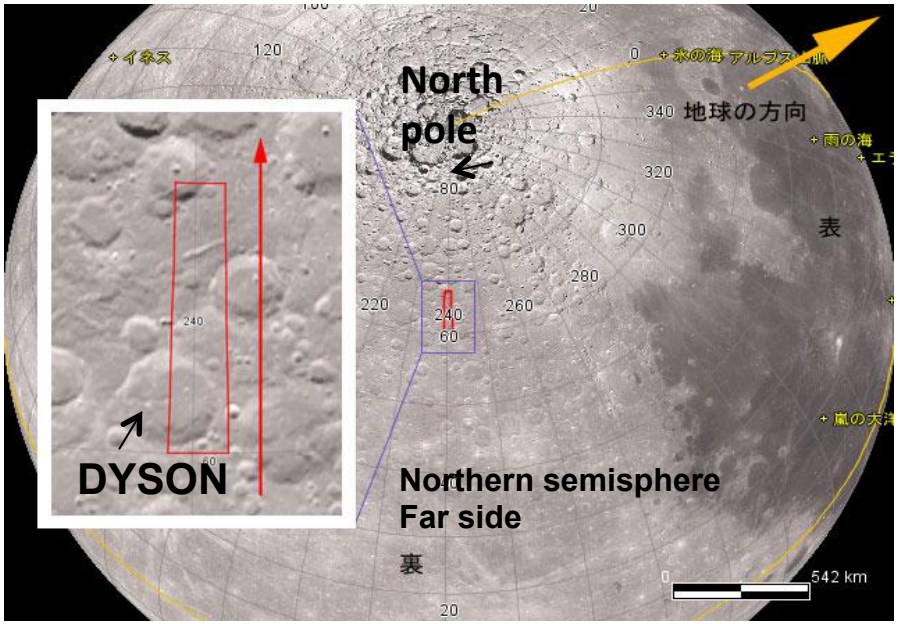
Thank you for your attention!

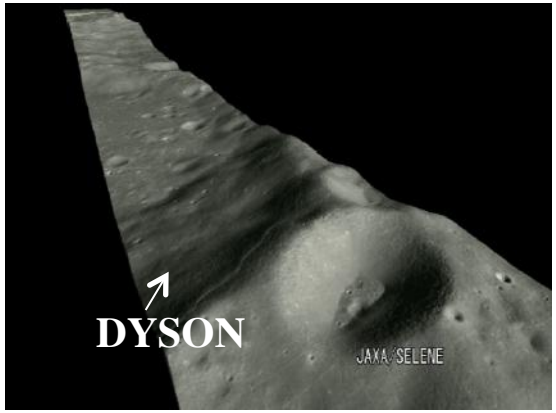
High Definition TV System

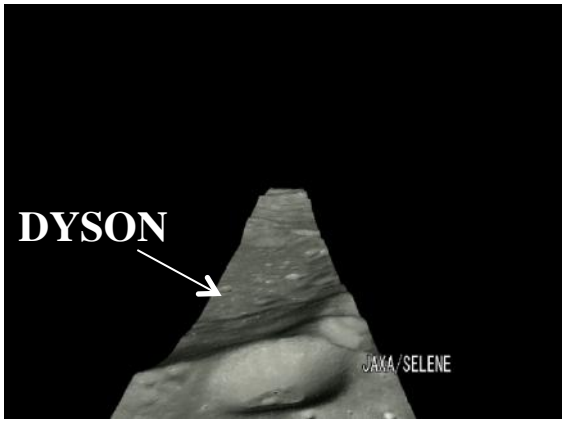




Three-dimensional image processed by TC







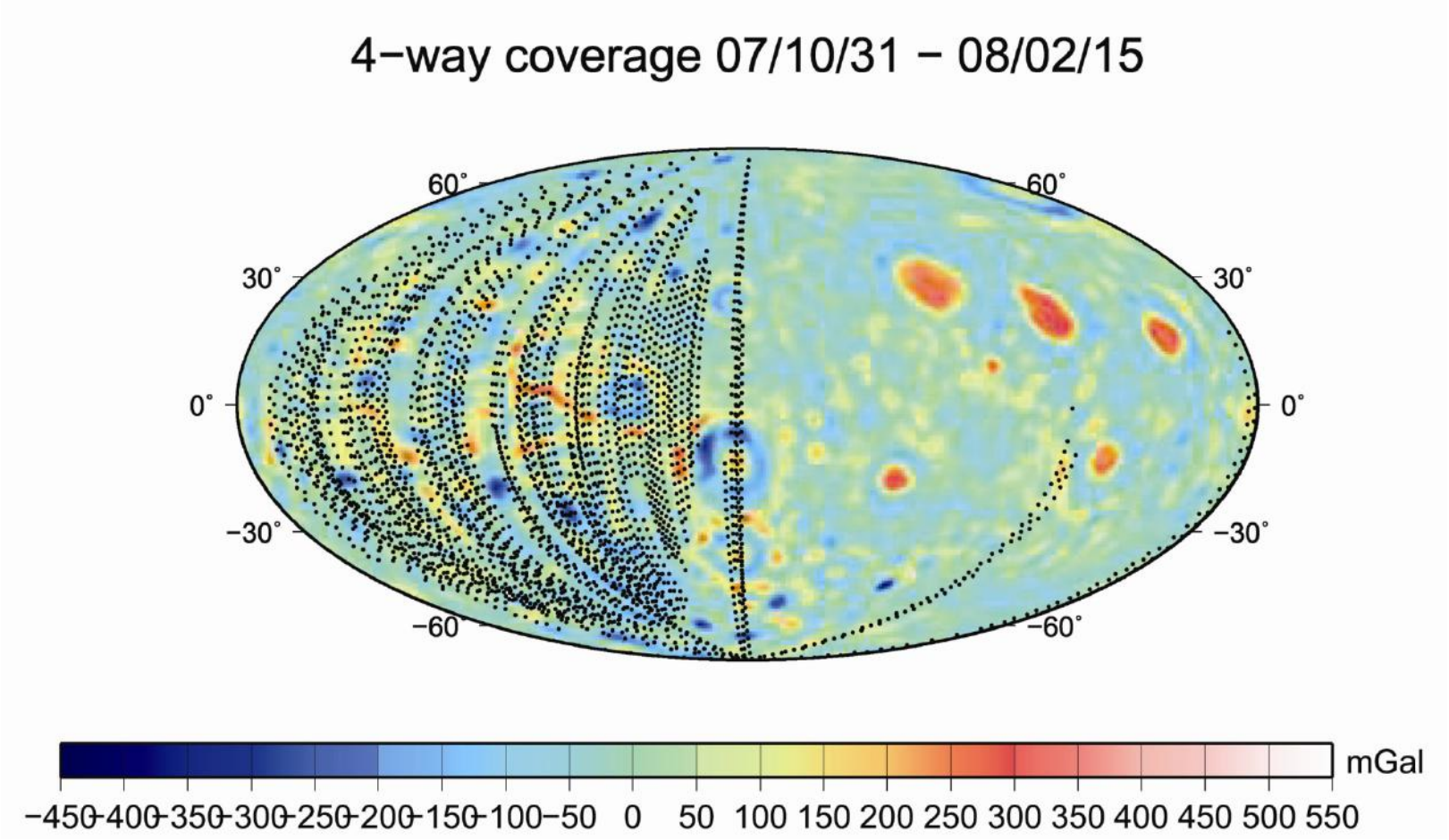
・Date：2007,Sep 3
・Location： East longitude 240deg.
North latitude 60～66deg.
（Far side, Near DYSON crater）

（Lunar global image by Clementine/UVVIS）

Stereo image composed by TC
10m resolution stereo data

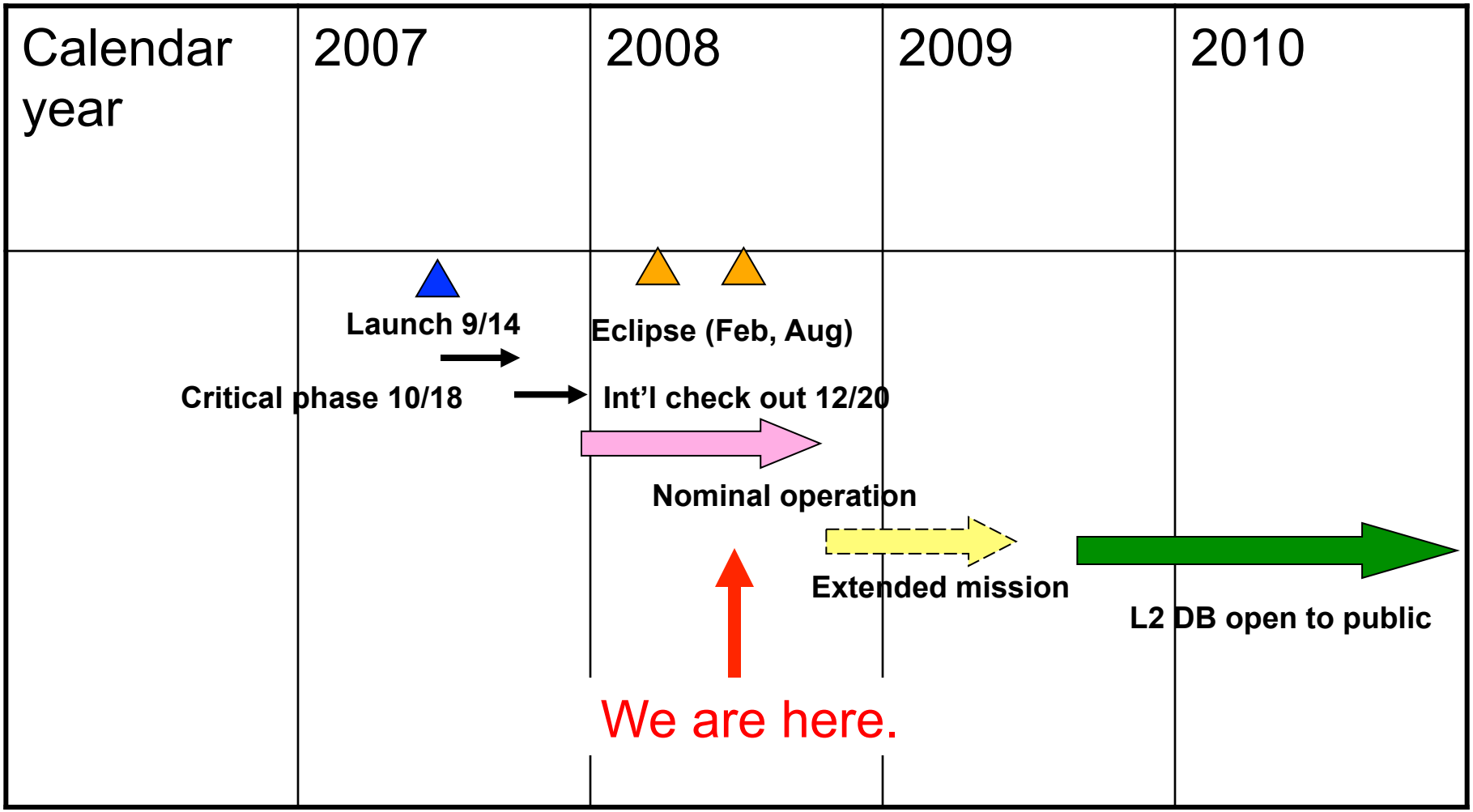
17

Coverage for Gravity Observation in the Far Side



Coverage more than 1/4, suggesting new findings for the far side gravity field.

Mission Operation Schedule



KAGUYA Mission Objectives

Global survey of the Moon

To study the origin and evolution of the Moon by observing the distribution of the elements and minerals on the surface, the structure of the surface and subsurface, the gravity field, the remnant of the magnetic field

Data Acquisition for Future Moon Utilization

To be used for human activities on the Moon and the possibility of future utilization of the Moon

Technology Development for the Lunar Exploration

Technologies such as orbit control, attitude control, thermal control on lunar orbit to be developed

Public Outreach

To make a public outreach by taking the movies of the beautiful Earth Rising using its onboard High Definition Television System

SELENE Mission Instruments

Category	Observation	Instrument	Measurement
Science of the Moon	Element Abundance	X-ray Spectrometer(XRS)	Al, Si, Mg, Fe, etc.
		Gamma-ray Spectrometer(GRS)	U, Th, K, H etc.
	Mineral Composition	Multi-band Imager(MI)	mineral distribution
		Spectral Profiler(SP)	mineral composition
	Topography, Geological Structure	Terrain Camera(TC)	geographical features
		Lunar Radar Sounder(LRS)	subsurface structure
		Laser Altimeter(LALT)	topography
	Gravity Field	Differential VLBI Radio Source(VRAD)	lunar gravity field
		Relay Satellite(RSAT)	far side local gravity field
Science on the Moon	Magnetic Field	Lunar Magnetometer(LMAG)	magnetic field
		Electron Energy Analyzer(part of PACE)	surface magnetic field
	Radiation Environment	Charged Particle Spectrometer(CPS)	energetic particles
	Plasma Environment	Plasma Energy Angle and Composition Experiment(PACE)	electrons and ions
	Ionosphere	Radio Science(RS)	ionospheric electrons
Science from the Moon	Solar-Terrestial Plasma Environment	Uppe-Atmosphere and Plasma Imager(UPI)	earth magnetosphere, aurora
		Wave Receiver(part of LRS)	planetary radiations
Publicity	Earth and Moon	High Definition TV(HDTV)	high-definition movie

Data Accumulation for Integration Science