Japan's lunar explorer "KAGUYA“ one year operation and early results

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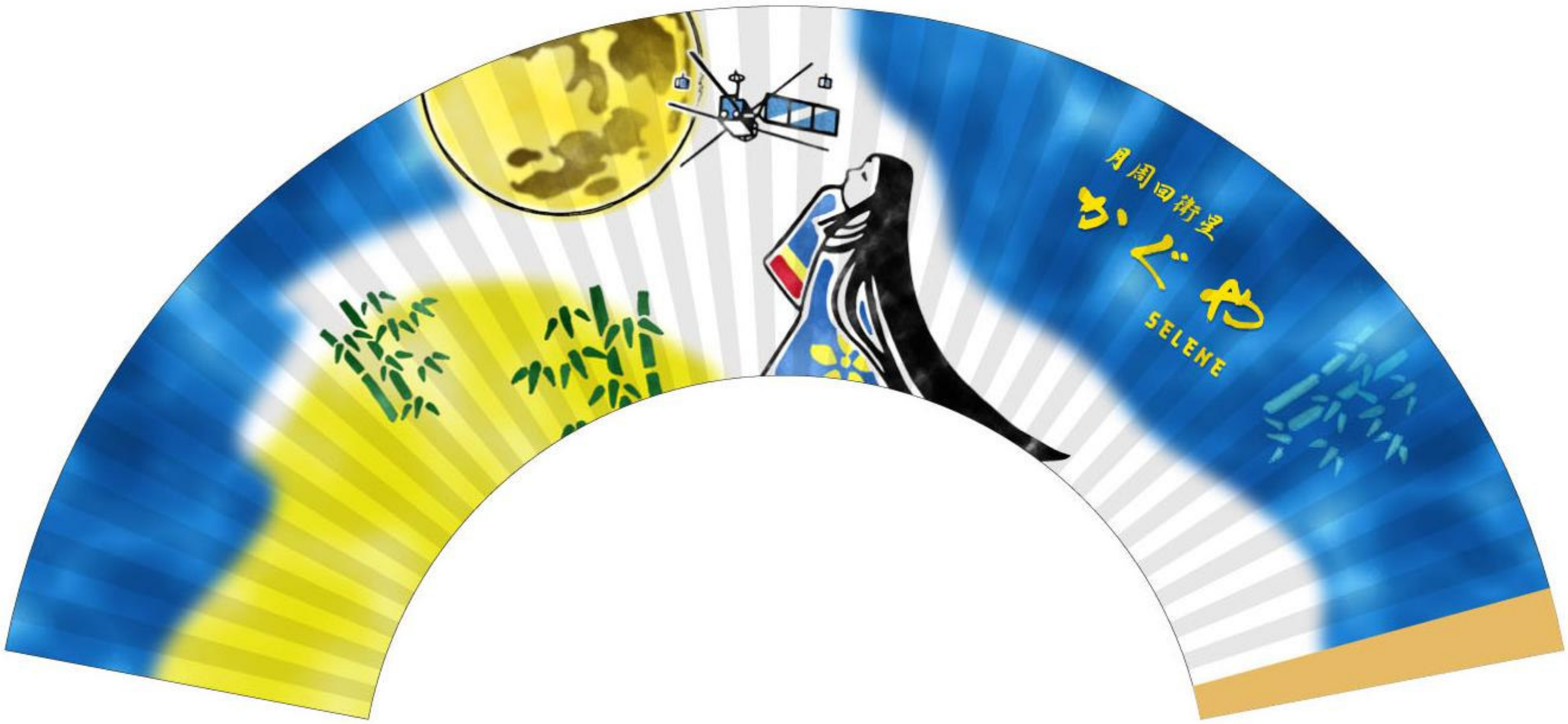
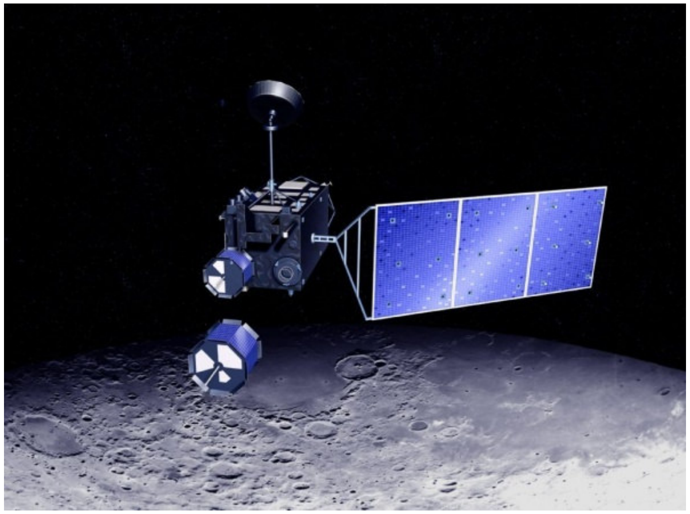
Why we name “KAGUYA” to our Japan’s lunar explorer?



Among all the varied suggested nicknames, about 24 percent suggested names related to “Princess Kaguya” from the old classic Japanese story “Taketori Monogatari (or the story of a bamboo cutter and the princess from the Moon.)” From among these names, “KAGUYA” accounted for almost 70 percent. It appears that SELENE, which travels to the Moon, reminds many people of “Princess Kaguya,” who returned to the Moon.

KAGUYA Characteristics



Rstar (OKINA) separation from main orbiter

- **Global survey for the lunar origin and evolution study**
- **Data Application to Future Moon Utilization**
- **Technology development for the lunar exploration**
- **Public Outreach**

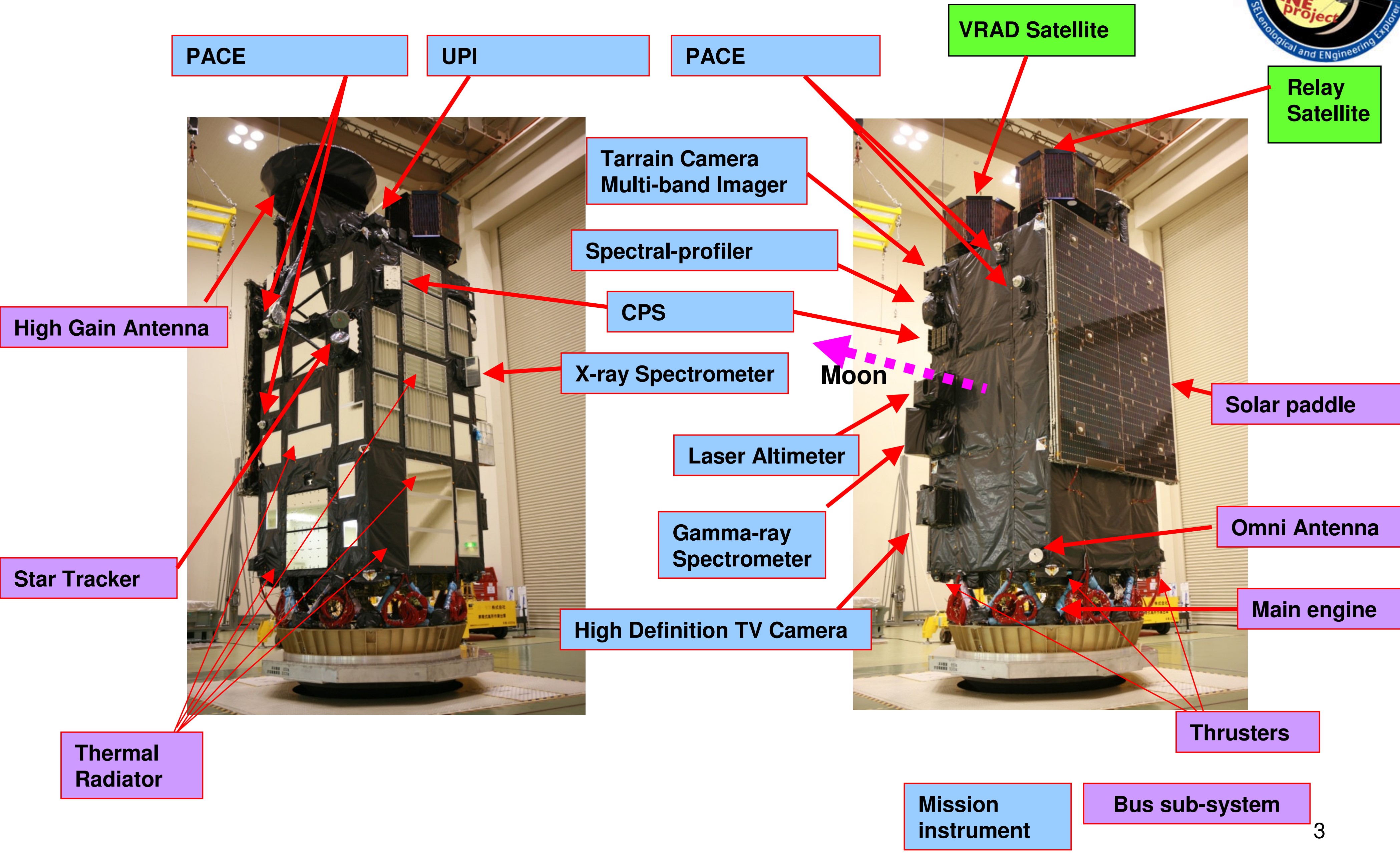
Main Orbiter : KAGUYA
- Weight : 3 ton (at launch) (including sub-satellites50kg×2)
- Dimension : 2.1m×2.1m×4.8m
- Mission Period : 1 Year
- Orbit : 100km Altitude ／Inclination 90deg.

Sub-satellites
- Rstar(Relay satellite):OKINA
- Vstar(VLBI Radio satellite):OUNA
- Weight : 50kg
- Dimension : 0.99m×0.99m×0.65m (Octagonal column shape)
- Mission Period : 1 Year
- Orbit (at Separation) :
  - (Rstar : OKINA) 100km×2400km
  - (Vstar: OUNA) : 100km× 800km

Mission
- (1) Chemical elements distribution: XRS, GRS
- (2) Mineralogical distribution: SP, MI
- (3)Surface structure: TC, LALT, LRS
- (4) Surface & Space environment: LMAG, PACE, CPS, RS, UPI
- (5) Gravitational field distribution: VRAD, RSAT
- (6) Public outreach: HDTV

X-ray Spectrometer (XRS) Gamma-ray Spectrometer (GRS) Spectral Profiler (SP) Multi-band Imager (MI) Terrain Camera (TC) Lunar Radar Sounder (LRS) Laser Altimeter (LALT) Lunar Magnetometer (LMAG) Upper-atmosphere and Plasma Imager (UPI) Charged Particle Spectrometer (CPS) Plasma energy Angle and Composition Experiment (PACE), Radio Science (RS), VLBI Radio-source (VRAD), Relay Sat. transponder (RSAT), High Definition Television ca (HDTV)

KAGUYA Flight model outlook



KAGUYA Mission Instruments

	Observation	Instrument and Characteristics
Main Orbiter	Chemical elements distribution	**X-ray Spectrometer** (Al, Si, Mg, Fe distribution, spatial resolution 20 [km]) **Gamma-ray Spectrometer** (U, Th, K distribution, resolution 160 [km])
	Mineralogical distribution	**Spectral Profiler** (Continuous spectral profile λ = 0.5 to 2.6 [μm], spatial resolution 500 [m]) **Multi-band Imager** (UV-VIS-IR imager, λ = 0.4 to 1.6 [μm], 9 bands, spatial resolution 20 [m])
	Surface structure	**Terrain Camera** (High resolution stereo camera, spatial resolution 10 [m]) **Lunar Radar Sounder** (apparent depth 5 [km], resolution 100 [m]) **Laser Altimeter** (height resolution 5 [m], spatial resolution 1600 [m])
	Environment	**Lunar Magnetometer** (Magnetic field measurement, accuracy 0.5 [nT]) **Plasma Imager** (Observation of plasmasphere of the earth, XUV to VIS) **Charged Particle Spectrometer** (Measurement of high-energy particles) **Plasma Analyzer** (Charged particle energy and composition measurement)
	Imaging	**High Definition Television camera** (Images of the earth and the lunar surface, for public outreach)
VRAD satellite (OUNA)	Gravitational field distribution	**VLBI Radio-source** on the VRAD satellite (lunar gravitational field) (VRAD = VLBI RADio source)
	Environment	**Radio Science** (Detection of the tenuous lunar ionosphere)
Relay satellite (OKINA)	Gravitational field distribution	**VLBI Radio-source** on the Relay satellite (lunar gravitational field) **Relay Sat. transponder** (Far-side gravity field using 4-way range rate from ground station to Orbiter via Relay Satellite)

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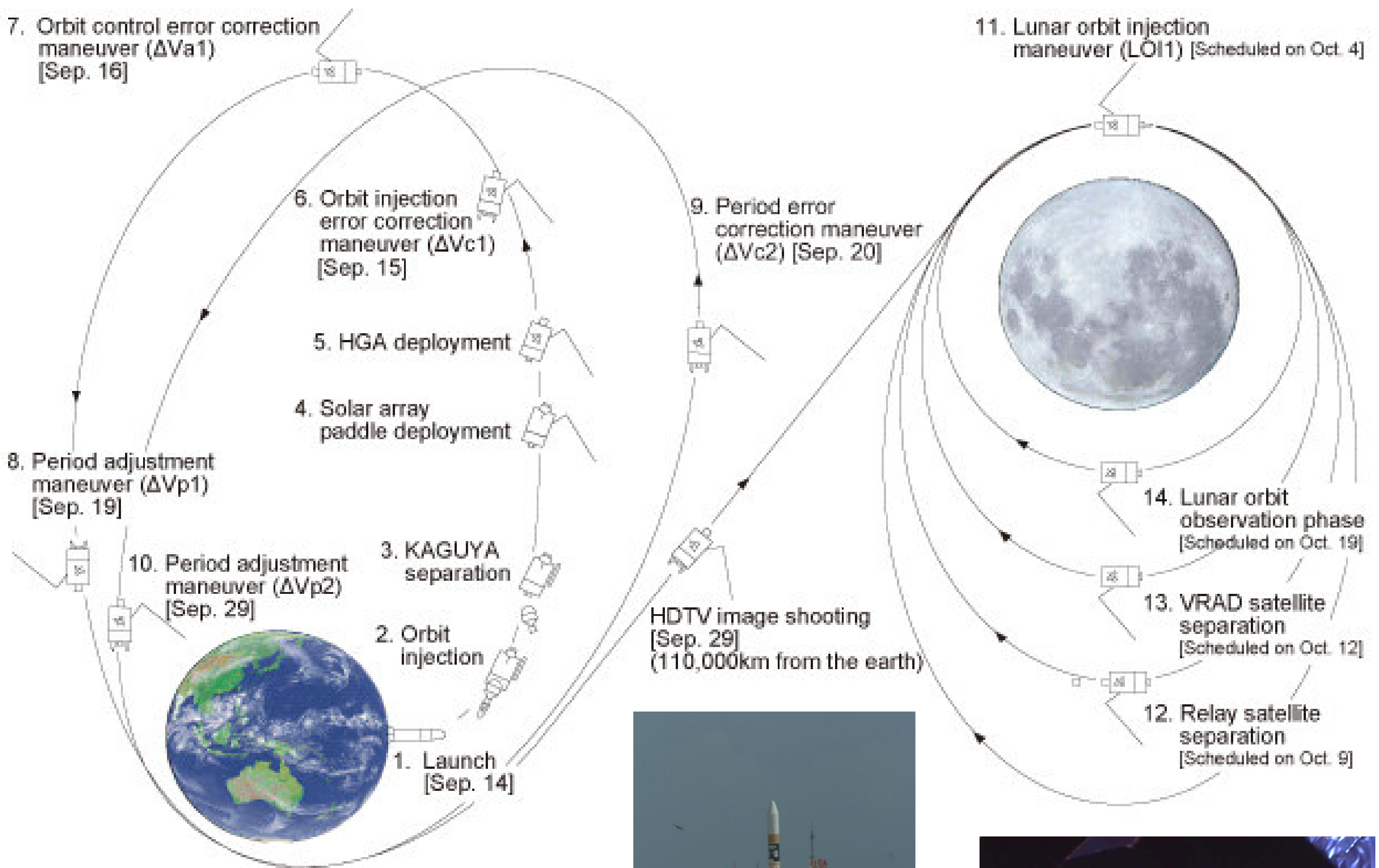
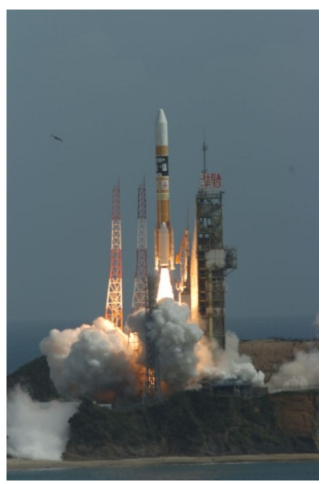
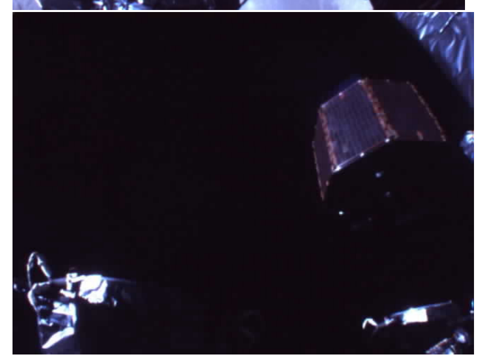
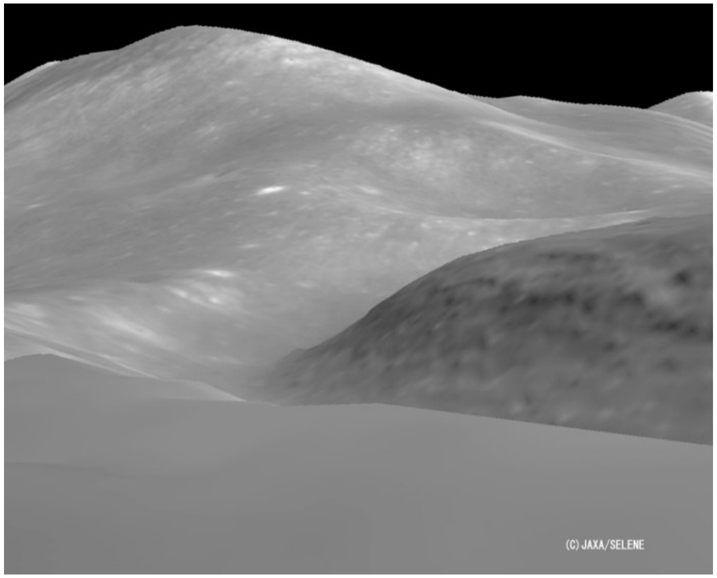
Road to the Moon by KAGUYA







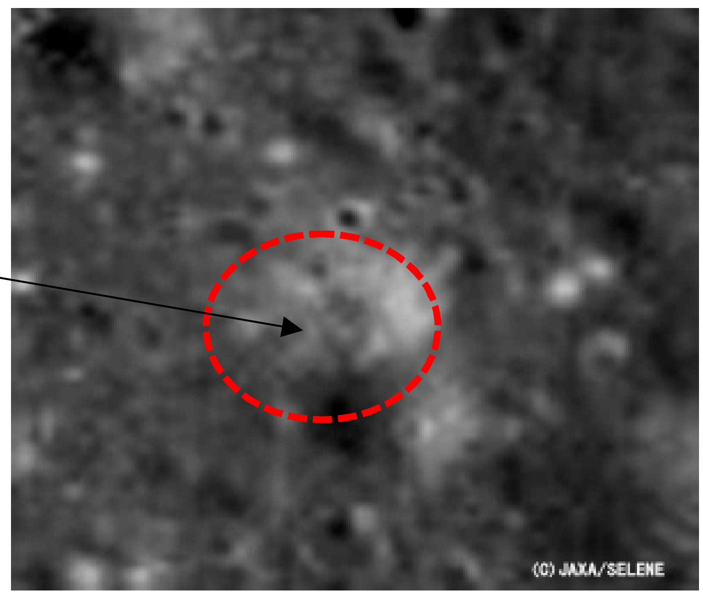
KAGUYA Terrain Camera TC Three Dimenional Images with Astronaut Apollo 15 photographic image



3D Terrain Camera(TC)

Taken by Astronaut Apollo

Pan image by Terrain Camera(TC) that it assume “Hello (Jet mark)”of the Apollo 15

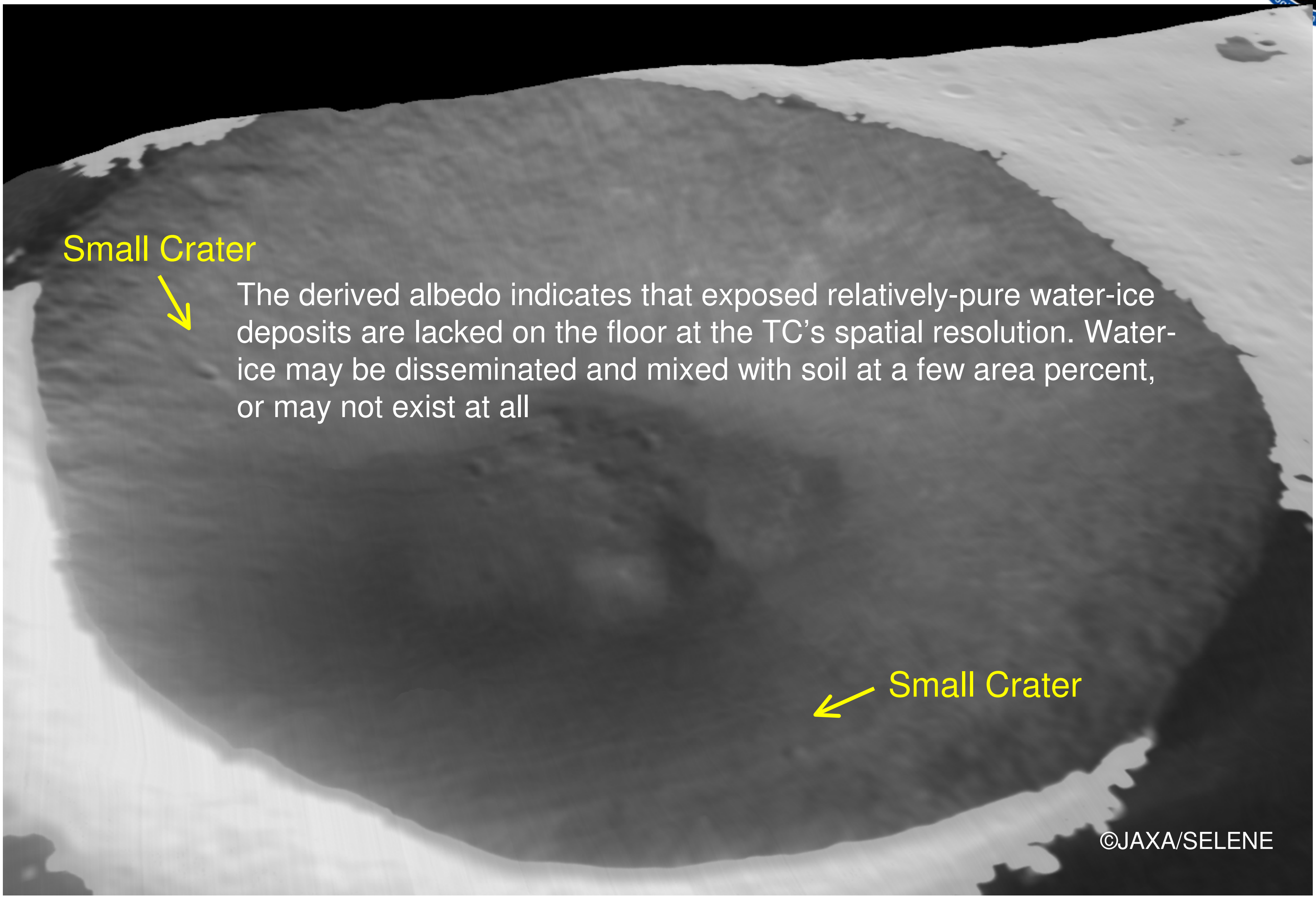


Lack of Exposed Ice Inside Lunar South Pole Shackleton Crater published in Science Express of Science Magazine

This still image was cut out from a moving image (tele shot) taken by the HDTV onboard the KAGUYA at 12:07 p.m. on November 7, 2007 (Japan Standard Time, JST,)

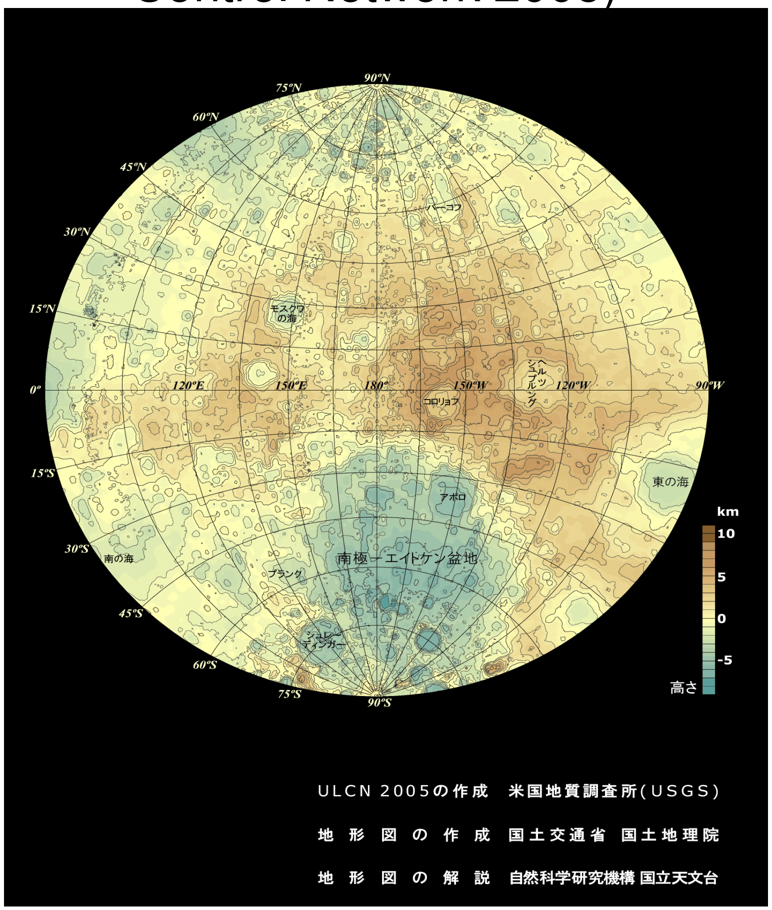
the Moon's surface is near the South Pole, and we can see the Australian Continent (center left) and the Asian Continent (lower right) on the Earth. (In this image, the upper side of the Earth is the Southern Hemisphere, thus the Australian Continent looks upside-down.)

Three dimensional image inside the Shackleton Crater by using TC observation data

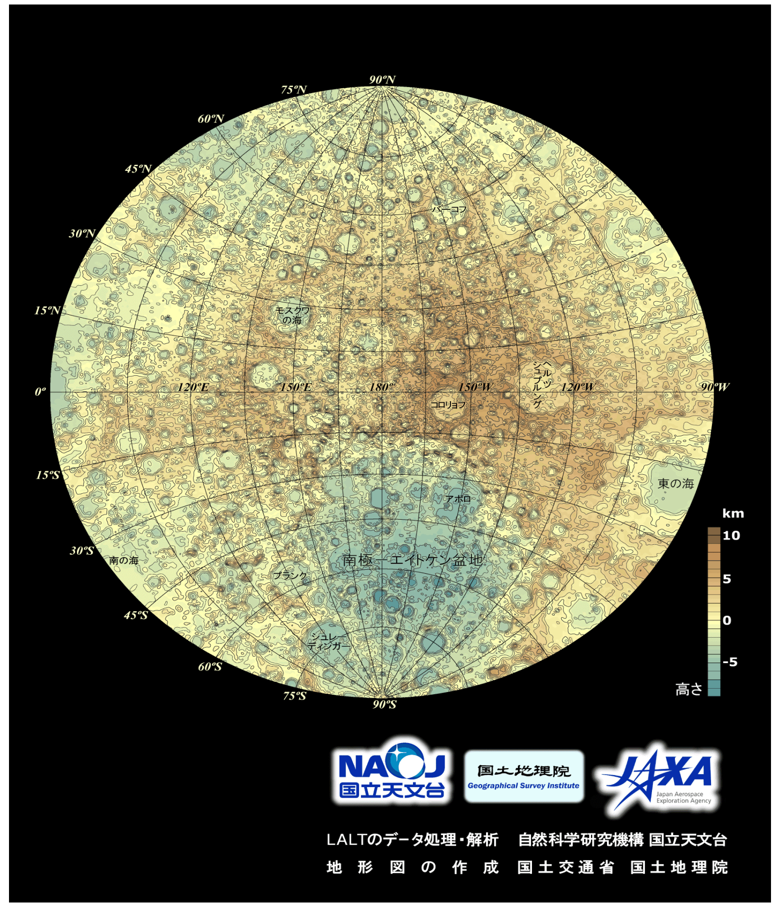


New Lunar Topography Map by KAGUYA
FarSide Moon Comparison

ULCN 2005 (Unified Lunar Control Network 2005)

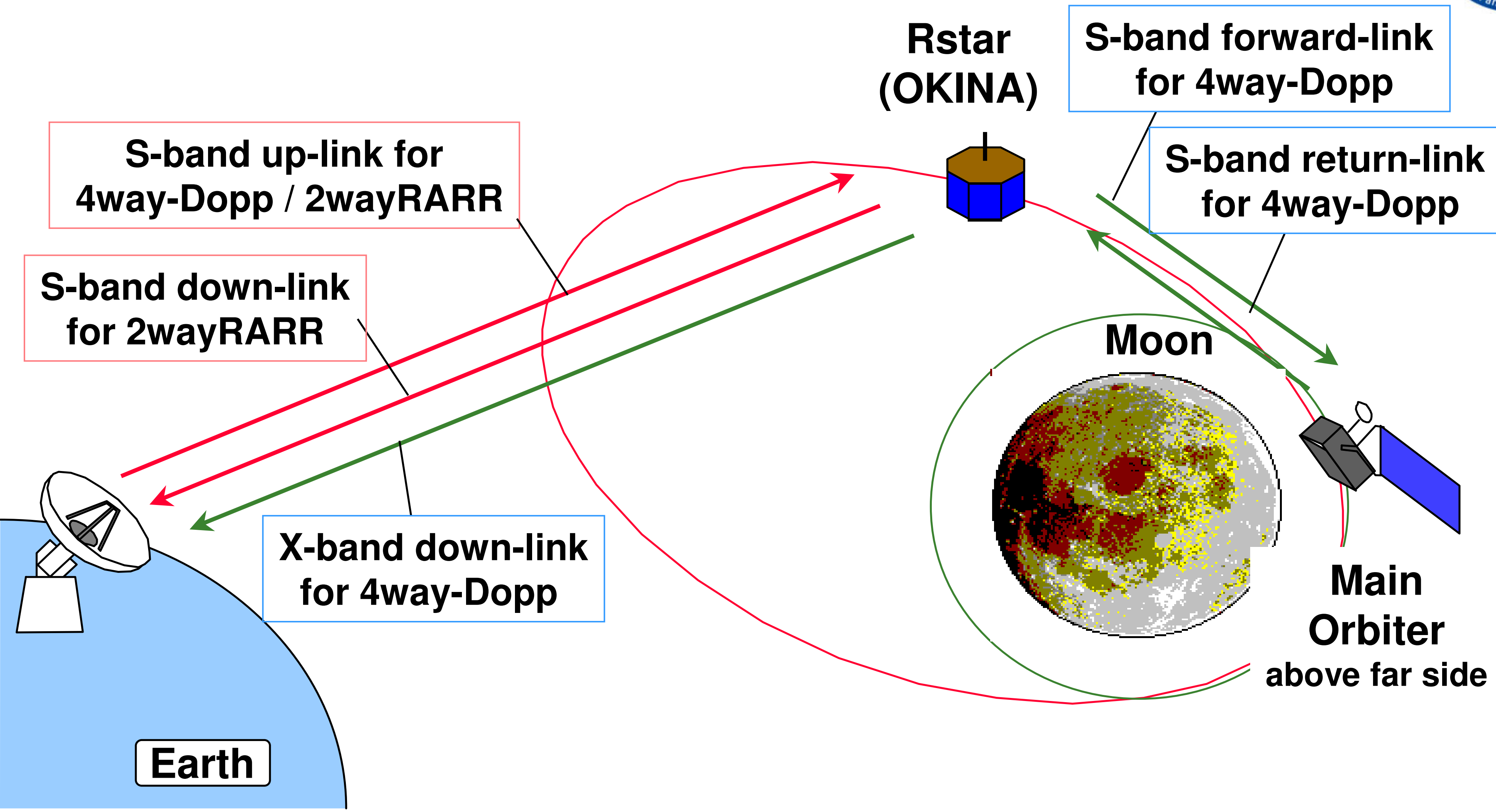


KAGUYA-LALT

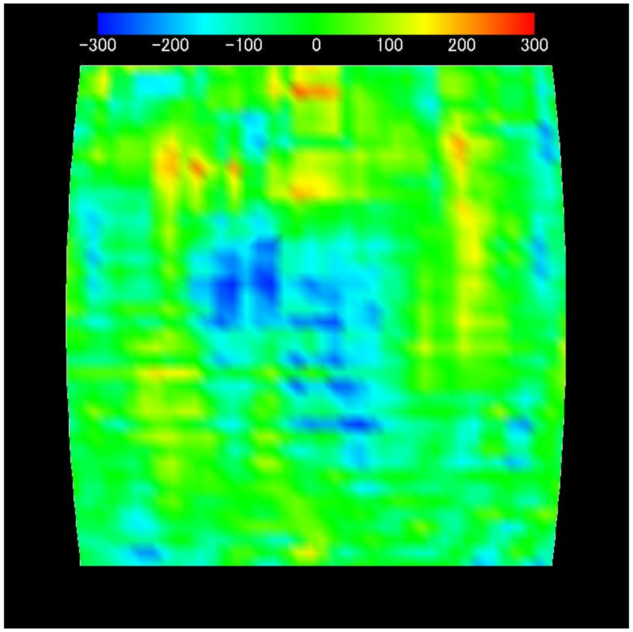


The KAGUYA Laser Altimeter (LALT) is able to obtain a range of data on a global scale along the satellite's trajectory including the high latitude region above 75 degrees that has never been measured by an altimeter. The number of measurement points as of this March is about 6 million and it is more than 10 times larger than the number for the ULCN 2005 model. The continuous range data of the LALT will enable us for the first time in the world to construct an accurate and precise global topographic map of the Moon.

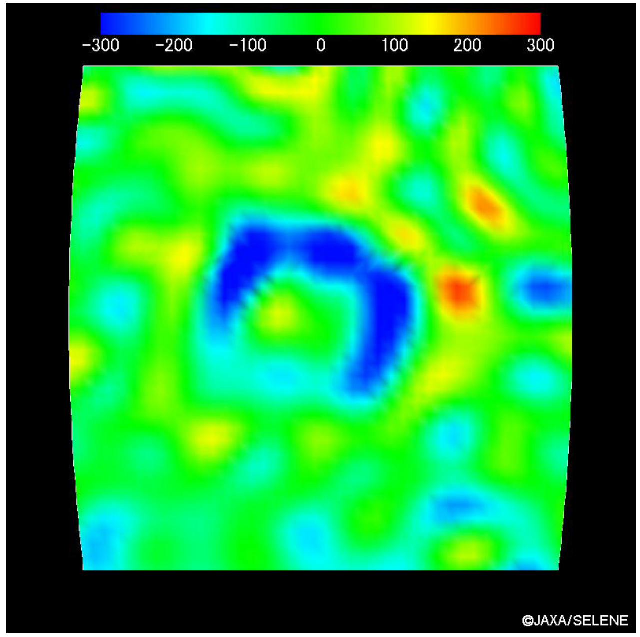
Gravity Anomaly of the Moon
First Direct Observation of the Farside by KAGUYA in the world



Gravity anomaly of the Moon

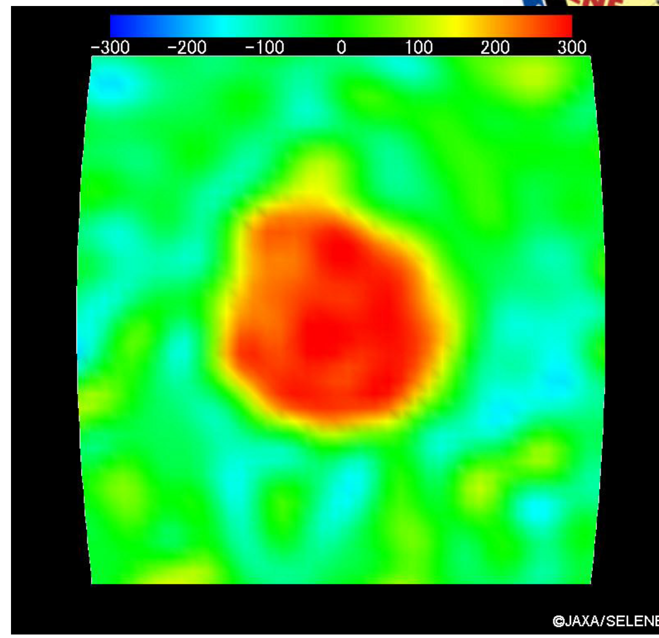


Legacy



Kaguya

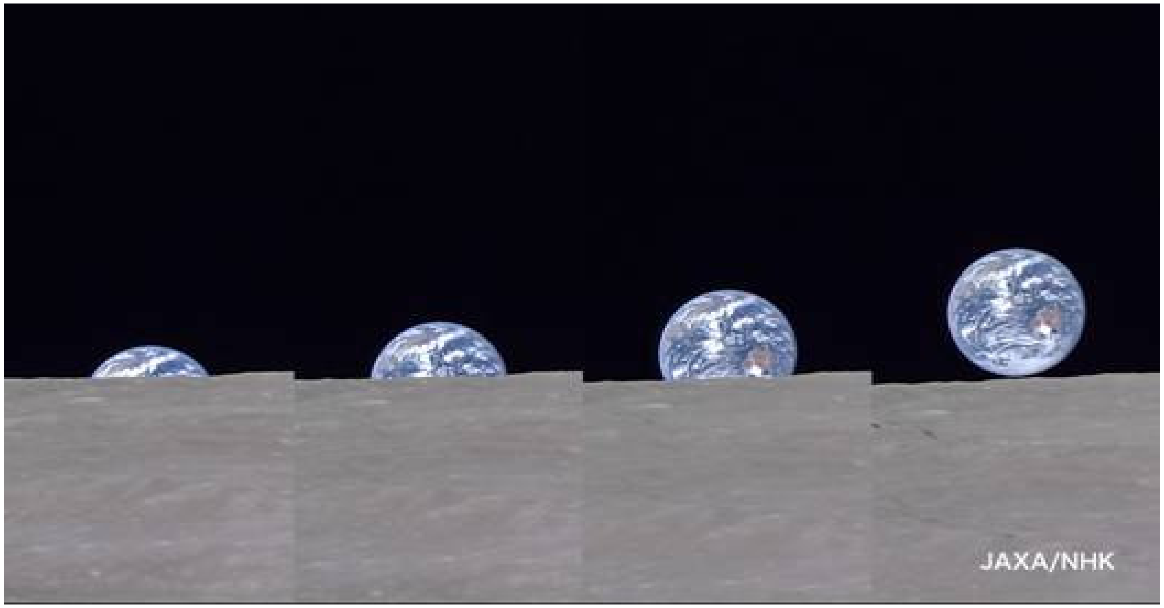
The Apollo basin located at the far side of the moon



The Mare Serenitatis at the near side of the moon

Current lunar gravity field models include large uncertainties on the far side of the Moon. The figure in the left shows the current gravity distribution model for the Apollo basin by LP165P. The color of the figure shows strength of the gravity field in blue, green, yellow, and red, in that order. Red indicates a positive gravity anomaly related to either a topographic high or a dense material in the subsurface. In contrast, blue shows that a negative gravity anomaly related to a topographic low or less dense material. The gravity anomaly shown in the figure in the center is processed by new data taken by the KAGUYA. The gravity anomaly in the Apollo basin is now identified as concentric rings of yellow, blue, and thin red from the center to outside. In addition, such a signature of far side gravity is distinguished from that on the near side. The Mare Serenitatis, the representative basin on the near side, shows a strong positive (red color) gravity anomaly at the center of the basin (figure in the right). The newly found difference of gravity anomaly on the near side and the far side gives us clues to important questions regarding the structure of the lunar interior and the formation of the far side and near side of the Moon.

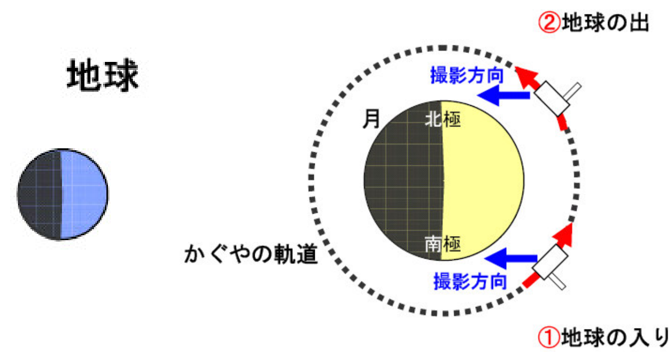
Full Earth Rise by HDTV



『Earth Rise』

9/30/2008

Near north pole



『Earth Set』

9/30/2008

Near south pole

SELENE(KAGUYA) on Web

http://www.kaguya.jaxa.jp

YouTube JAXASELENE channel
www.youtube.com/jaxaselene

Way Forward

- -Nominal operation December 2007 - October 2008
- -Extended mission November 2008 - Early summer 2009
- -Will open SELENE data to public from November, 2009