Scientific instruments

of Russian Lunar Landers

“Luna-Recourse” and “Luna-Glob”

Igor Mitrofanov,
Landers Mission Scientist
on behalf of “Luna-Resource” and “Luna-Glob” Teams

September 14, 2010

FIRST ANNOUNCMENT

1st International Workshop
"Landing site selection for Luna-Glob Lander"

Institute for Space Research
Moscow
January 25 – 27, 2011

Goal of the 1st Workshop:
Identification of the most interesting and safe landing sites candidates for Lander of "Luna-Glob" Mission

Participation in the 1st Workshop:
Co-investigators of "Luna-Glob" mission, participants of another lunar missions with intention for cooperation, endorsed representatives of space agencies and space science centers, authors of invited and contributed presentations

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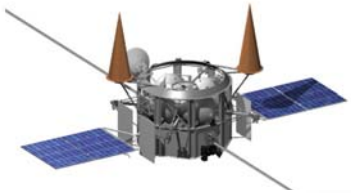
Applications
for participation with Abstracts of presentations should be submitted to Igor Mitrofanov (*imitrofa@space.ru*) or Maxim Litvak (*mlitvak.iki@gmail.com*) with deadline of October 17, 2010

Workshop Organizers:
Academician Lev Zelenyi, Scientific Lead of "Luna-Glob" mission
Dr. Igor Mitrofanov, Mission Scientist of Lander of "Luna-Glob"



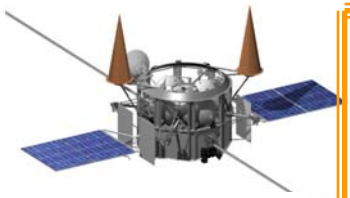
Luna-Glob
with
Polar Lander and Orbiter

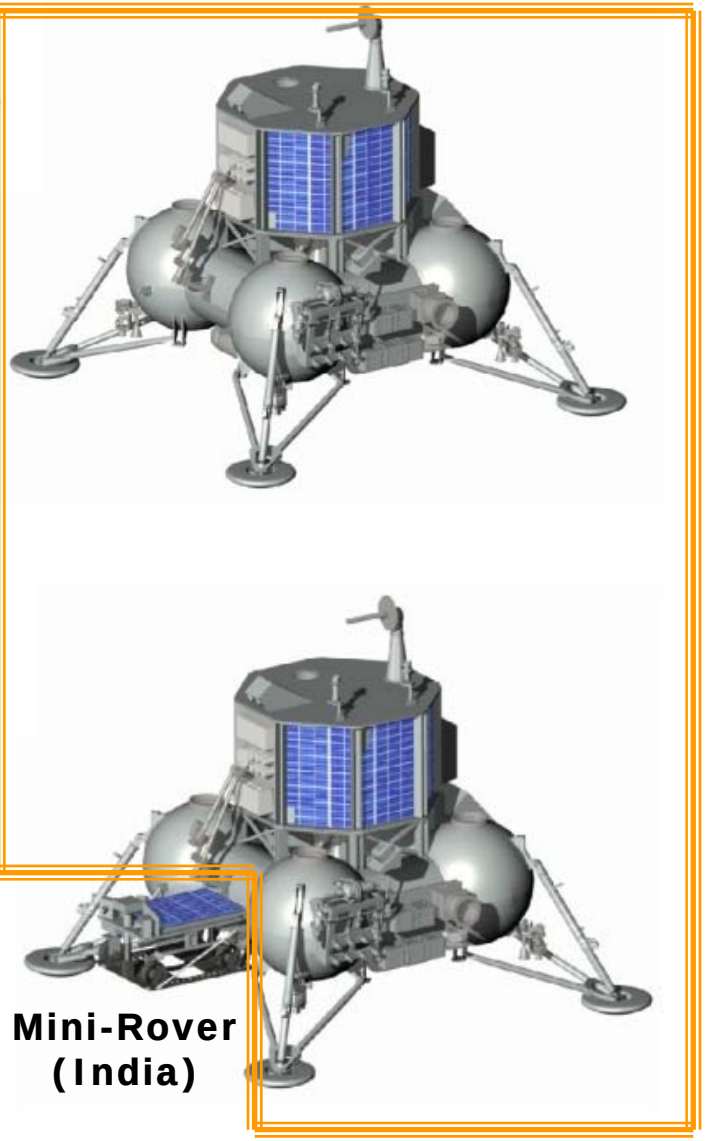
2012

Luna-Resource
(Polar Lander)
with
Chandrayaan-2 (India, Orbiter)

2013

Mini-Rover
(India)





Luna-Glob
with
Lander and Orbiter

2012

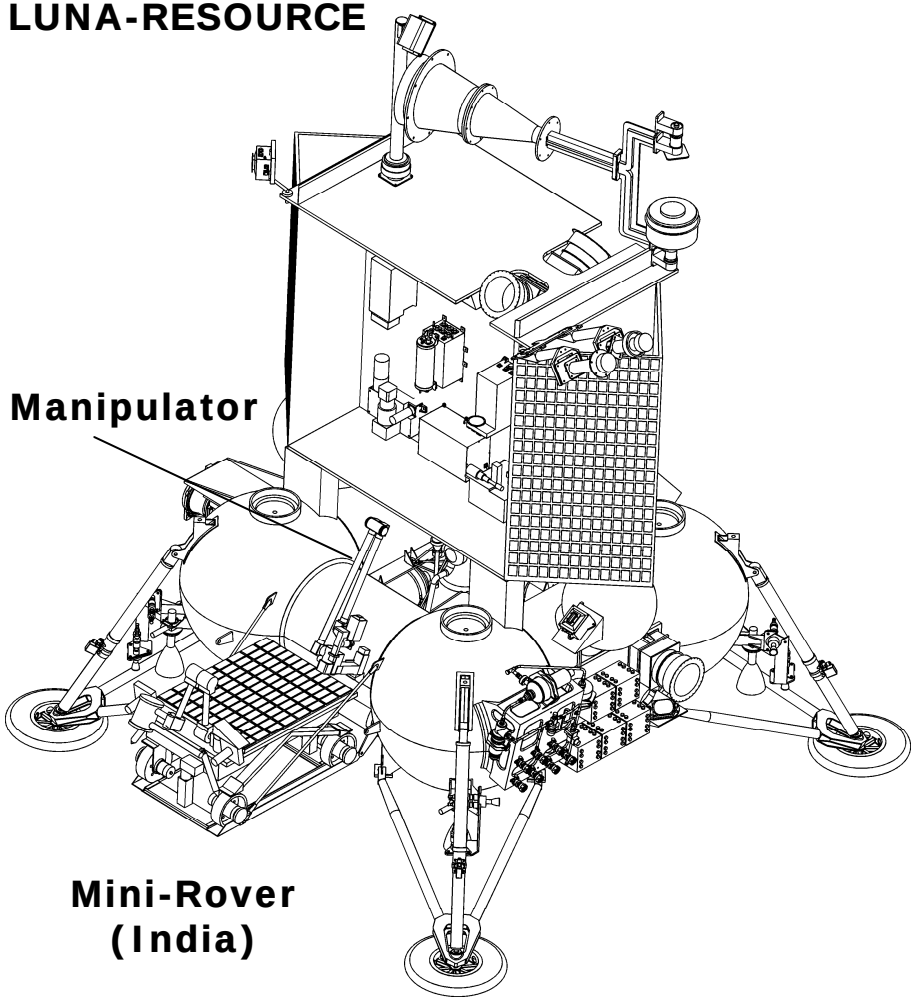
Luna-Resource (Lander)
with
Chandrayaan-2 (India, Orbiter)

2013

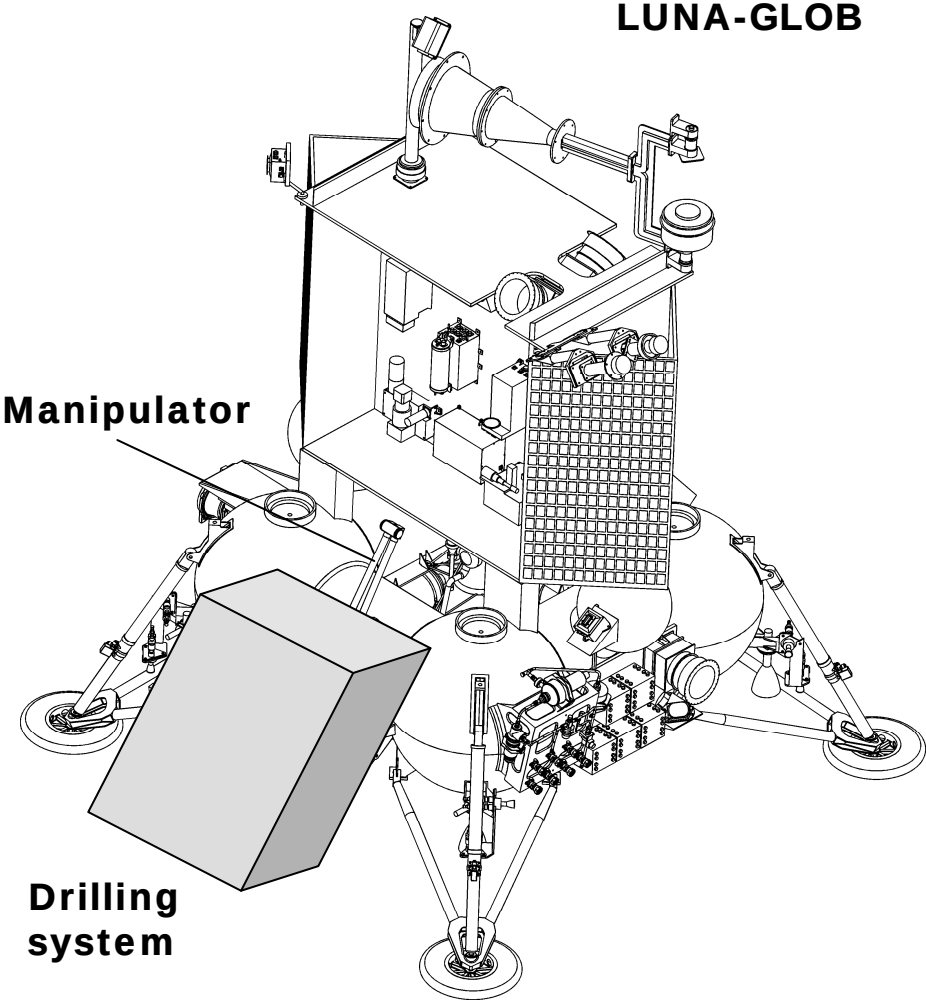
Mini-Rover (India)

Landers configuration

LUNA-RESOURCE



LUNA-GLOB



Main Scientific Tasks of Landers:

TASK 1: Investigation of composition of subsurface and processes of its formation at Lunar Poles (volatiles, H_2O, layering, etc.)

TASK 2: Investigation of interaction between cosmic plasma and surface and processes of exosphere at Lunar Poles (solar wind, neutrals, dust)

Main Criteria for payload Selection

1) Correspondence to TASKS 1 or 2

2) High TDR Level $\geq$ 6

Selected Scientific Payload of Landers of L-R and L-G

Instrument	Measurements/Operations	Mass (kg)	PI
Navigation			
Radio-Beacon	Radio signal with good stability	1.1	A.S.Kosov, IKI
Instruments for remote studies of regolith on Manipulator			
TV for Field of Operations	Imaging of Field of Operation with Pointing Capability	0.5	A.V.Bondarenko, IKI
UF Imaging Spectrometer	UF spectra of minerals	0.5	A.N.Lipatov, IKI
LIS_IR	IR spectra of minerals	1.0	O.I.Korablev, IKI
Instruments for analysis of regolith served by Manipulator			
Gas analytic complex	Analysis of volatiles content and isotopic ratios	10.4	M.V.Gerasimov, IKI and Vernadsky Institute
LASMA	Laser mass-spectrometer	2.6	G.G.Managadze, IKI
Instruments for remote sensing			
ADRON	Active neutron and gamma-ray analysis of nuclei composition	6.7	I.G.Mitrofanov, IKI
Radiometer-Thermometer	Measurements of temperature of subsurface regolith	0.5	D.P.Skulachev, IKI
Contact Thermometer	Measurements of temperature of regolith on surface and in drilling hole (for L-G only)	0.4	L.P.Moskaleva, Vernadsky Institute
PmL	Measurements of dust	1.5	G.G.Dolnikov, IKI
LINA and ARIES	Measurements of plasma and neutrols	3.8	A.A.Skalsky and O.L.Vaisberg, IKI
Seismometry			
SEISMO	Measurements of seismic activity	1.0	A.B.Manukin, Institute of Physics of Earth

Radio-Beacon Transmitter

Two transmitters X and K band 0.2 Wt

Frequency stability 5 x 10^{-13} for <100 s or 1 x 10^{-13} for <10^3 s

Flight prototype for Phobos-Soil-Return mission

Science Task 1:

Study of internal motions of the Moon by the phase-referencing method with support of ground radio telescopes for investigations of internal structure of the Moon

Science Task 2:

Study of relative motion between Lander and Orbiter of Lunar-Glob for investigation of lunar gravity field

Service Task:

To provide radio-beacon service for future landers and orbiters

UV-Optical Spectrometer-Imager

Imaging of surface at three optical spectral bands

Photometry of surface at 9 narrow spectral bands from 278 to1052 nm

UV-luminescent analysis

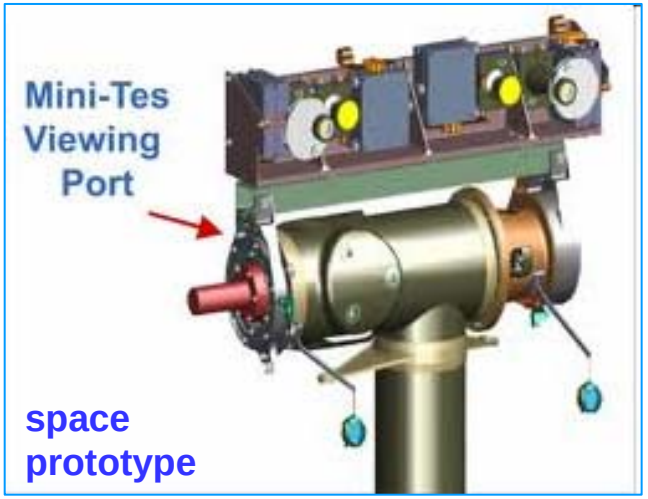
Science TASK 1:

Mineralogical composition of polar regolith and separate stones on the surface and within a shallow subsurface

Science/Service TASK 2:

Imaging of Field of Manipulator Operations in 3 optical spectral bands

LIS – Lunar IR Spectrometer



Spectral range 1.4 – 3.5 microns

Spectral resolution 15 – 25 nm

Field of View about 1°, or 17 cm at 10 m

Science TASK 1:

Measurements of OH and H2O content in polar regolith on the surface and within a shallow subsurface

Science TASK 2:

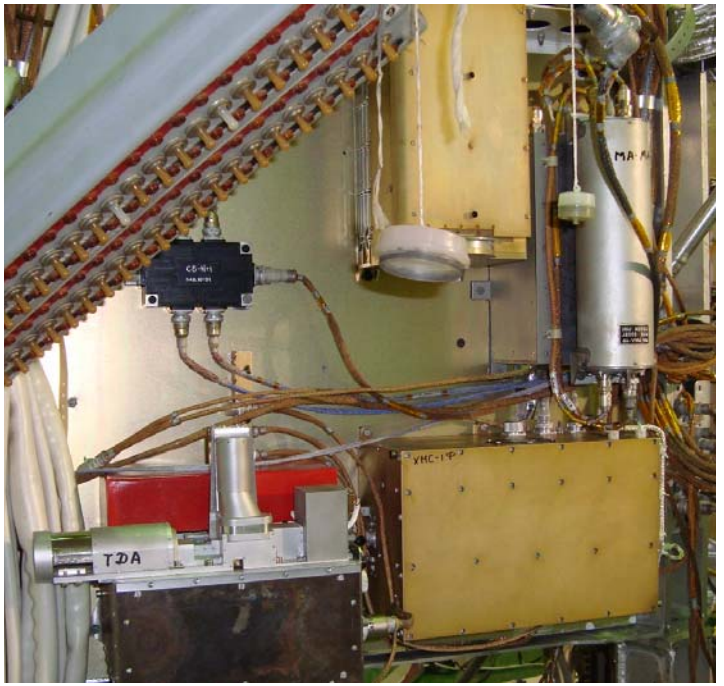
Testing for daily variations of hydratation and for decay of hydratation after removing of the upper-most layer

Gas Analytic Complex

- Thermal Differential Analyzer

- Gas Chromatograph

- Mass Spectrometer



Instrument for Phobos-Soil-Return, as prototype

Science TASK 1:

Measurements of volatiles in lunar regolith from the surface and within a shallow subsurface

Science TASK 2:

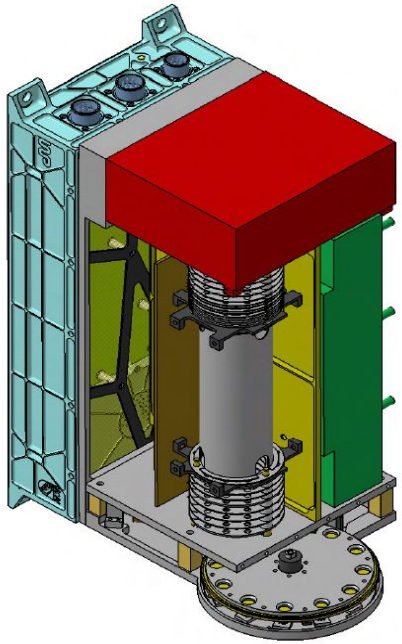
Testing for isotopic ratios of particular elements of volatiles in lunar regolith

LASMA – Laser Mass Analyzer

- Laser-evaporation system of testing samples

- Mass Spectrometer

Instrument for Phobos-Soil-Return, as prototype



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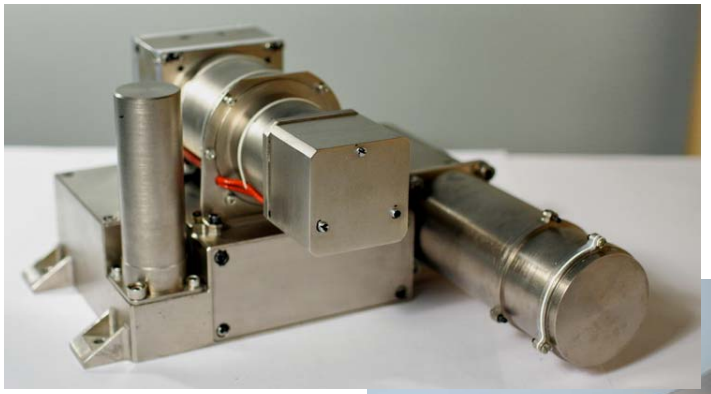
ADRON



- Pulsing neutron generator to study composition of subsurface regolith

- Detector of post-pulse neutrons

- Detection of post-pulse gamma-rays

Instruments for Phobos-Soil-Return and NASA MSL, as prototype

Science TASK 1:

Measurements of neutron post-pulse emission to study content of hydrogen and layering structure of shallow subsurface

Science TASK 2:

Measurements of gamma-rays post-pulse emission to study composition of regolith and layering structure of shallow subsurface

Radiometer-Thermometer

- Measurements of radiation from subsurface at 2.5, 3.3 and 5.0 cm

- 1 meter depth temperature variation with 15 cm discreetness and accuracy about 1 degree

Instrument for Relict project is used, as prototype

Science TASK 1:

Measurements of diurnal and annual variations of subsurface temperature

Science TASK 2:

Measurements of complex dielectrical parameter of regolith

PmL – Dust Detector

- Measurements of impacts from dust grains with accuracy of 10^{-12} – 10^{-14} N sec

- Measurements of charge about -10^{-12} Qoulomb

Instrument for Phobos-Soil-Return mission is used, as prototype

Science TASK 1:

Measurements of flux, distribution of mass and distribution charge of lunar dust

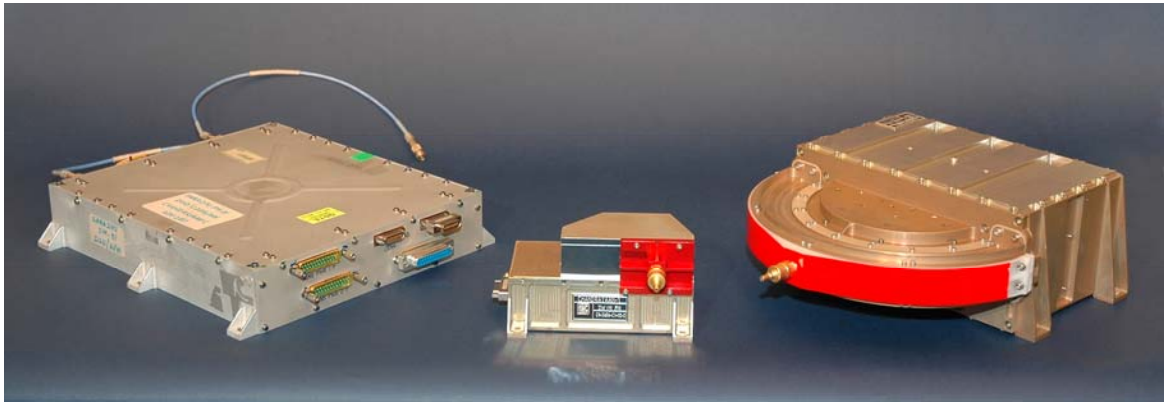
Science TASK 2:

Detection of micro-meteorites and secondary particles of regolith

LINA – Detector of charge particles and neutrals

- Measurements of ions <40 amu of solar wind 10 eV – 15 keV

- Measurements of neutral particles 1 – 56 amu with energy 10 eV – 3.2 keV



Instrument for Phobos-Soil-Return mission is used, as prototype

Science TASK 1:

Interaction of solar wind with lunar surface at poles

Science TASK 2:

Creation and transport of charged and neutral particles in lunar exosphere

ARIES – Panoramic energy-mass spectrometer of ions

- Measurements of ions 1 - 100 amu
  of solar wind 3 and exosphere 3 eV – 5 keV

- Directional measurements of of impact
  particles 7.5° x 15°

Instrument for Phobos-Soil-Return mission is used, as prototype

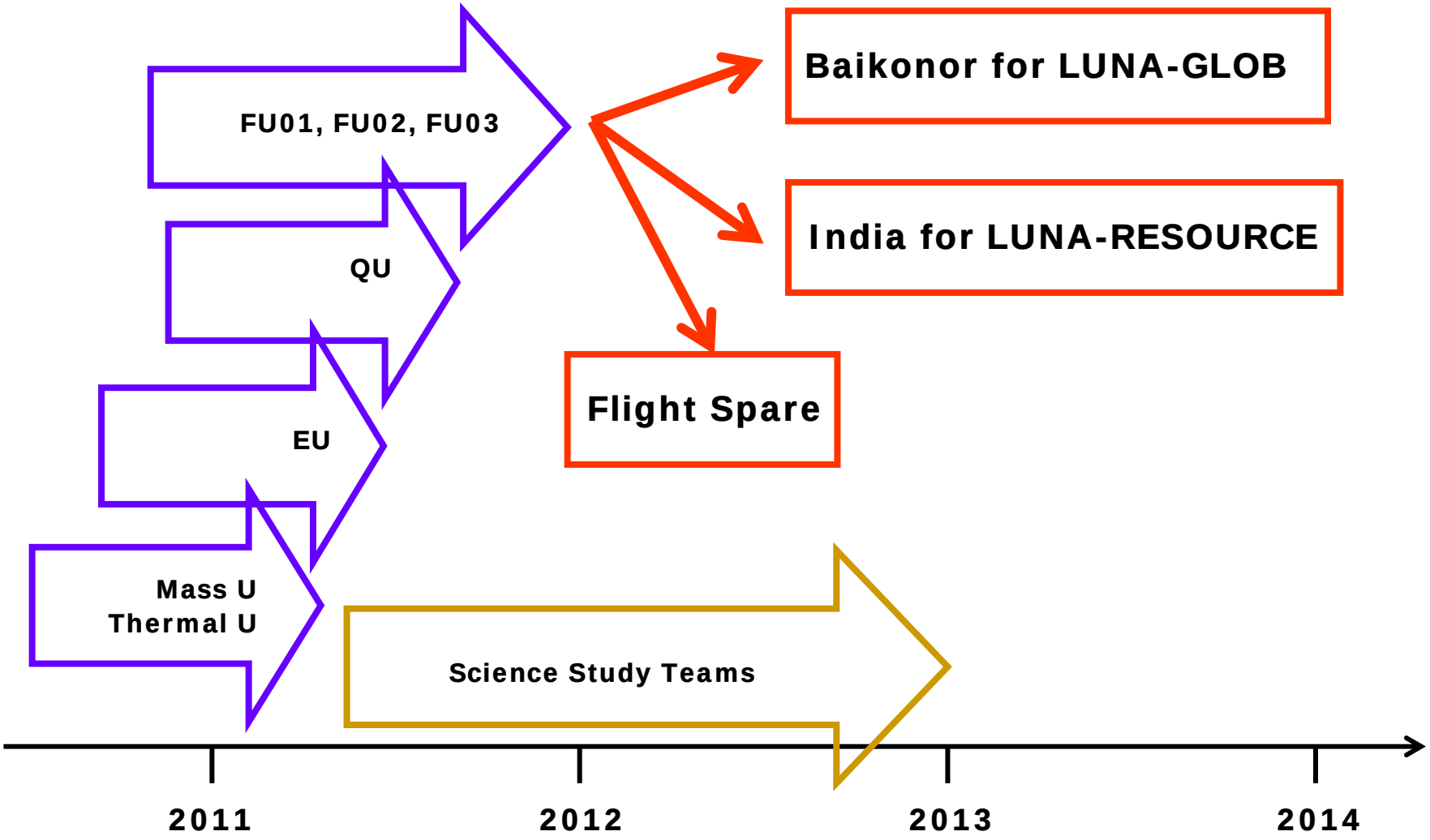
Science TASK 1:

Interaction of solar wind with lunar surface at poles

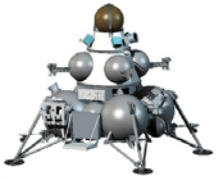
Science TASK 2:

Creation and transport of charged particles in lunar exosphere

Strategy and time of missions implementation (Landers)



Long-term Strategy:
Successive Steps for Robotic Lunar Missions (2011 – 2020)



Посадочный аппарат
с взлетной ракетой

LUNA-SR

Посадочный аппарат
с луноходом

LUNA-LD-ROVER

Посадочная станция (Россия)
с минировером (Индия)

LUNA-RESOURCE

Орбитер

Посадочная станция

LUNA-GLOB

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