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 ANNOUNCEMENT

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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Concept of Lander – Engineering constrains for landing – investigations with selected instruments of the Lander – coordination with another missions - presentations of landing sites candidates – definition of candidates list

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”
Lunar Exploration Analysis Group Meeting

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)
Lunar Exploration Analysis Group Meeting

Landers configuration

LUNA-RESOURCE

Mini-Rover (India)

Manipulator

Drilling system

LUNA-GLOB

Manipulator

(in India)
Main Scientific Tasks of Landers:

**TASK 1**: Investigation of composition of subsurface and processes of its formation at Lunar Poles (volatiles, H$_2$O, 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 > 6
### Selected Scientific Payload of Landers of L-R and L-G

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Radio-Beacon Transmitter

Two transmitters X and K band 0.2 Wt

Frequency stability $5 \times 10^{-13}$ for $<100$ s or $1 \times 10^{-13}$ 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 to 1052 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 hydration and for decay of hydration 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

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
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
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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
Lunar Exploration Analysis Group Meeting

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 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
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Strategy and time of missions implementation (Landers)

- FU01, FU02, FU03
- QU
- EU
- Mass U
- Thermal U

- Baikonor for LUNA-GLOB
- India for LUNA-RESOURCE
- Flight Spare

Science Study Teams

2011 2012 2013 2014
Long-term Strategy:
Successive Steps for Robotic Lunar Missions (2011 – 2020)
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