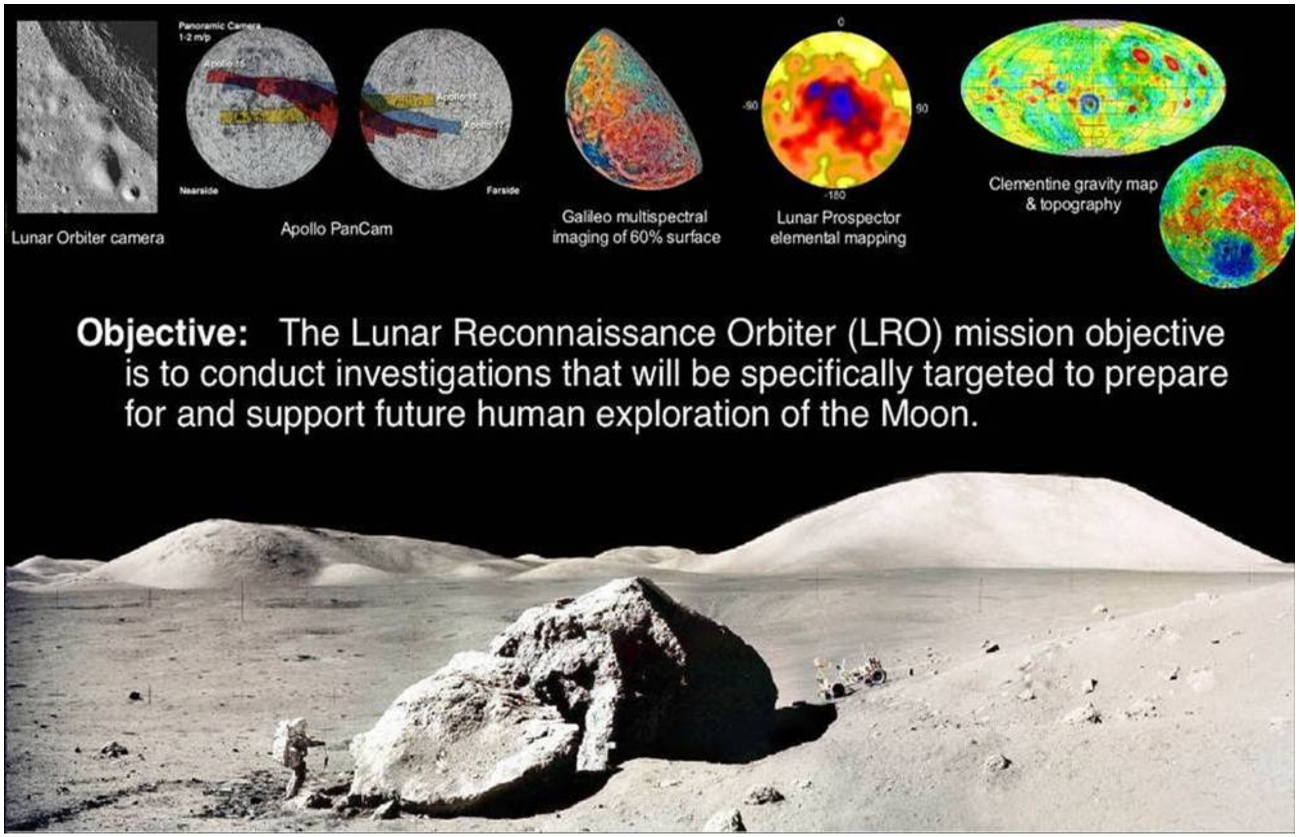
Fall AGU 2009 Press Conference

NASA UNVEILS LATEST RESULTS FROM LUNAR MISSION, HELPS PREPARE FOR NEXT STAGE OF SCIENTIFIC DISCOVERY

Mike Wargo,
Chief Lunar Scientist,
NASA HQ

LRO Mission Objectives



LOCATE RESOURCES
Hydrogen/water at the lunar poles
Continuous solar energy
Mineralogy

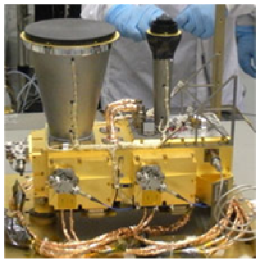
SAFE LANDING SITES
High resolution imagery
Global geodetic grid
Topography
Rock abundances

SPACE ENVIRONMENT
Energetic particles
Neutrons

LRO Instruments and Investigations

LOLA: Lunar Orbiter Laser Altimeter

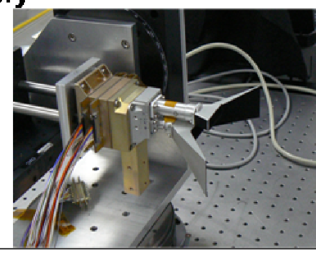
- Topography
- Slopes
- Roughness



Full Orbit
Autonomous

LROC/WAC: Wide-Angle Camera

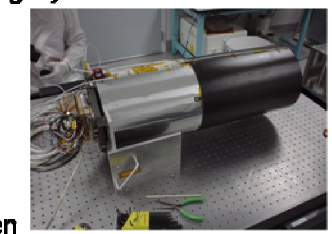
- Global Imagery
- Lighting
- Resources



Day Side
Autonomous

LROC/NACs: Narrow-Angle Cameras

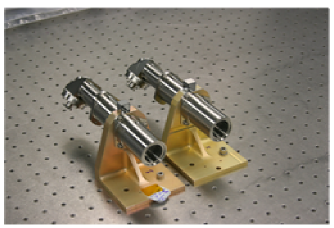
- Targeted Imagery
- Hazards
- Topography



Day Side
Timeline Driven

LR: Laser Ranging

- Topography
- Gravity



GSFC LOS
Autonomous

DLRE: Diviner Lunar Radiometer Exp.

- Temperature
- Lighting
- Hazards
- Resources

Full Orbit
Autonomous

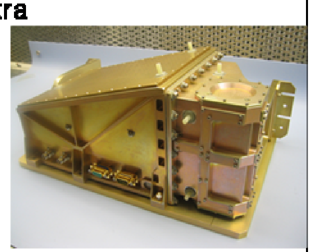
Mini-RF: Synthetic Aperture Radar

- Tech Demonstration
- Resources
- Topography

Polar Regions
Timeline Driven

CRaTER: Cosmic Ray Telescope...

- Radiation Spectra
- Tissue Effects



Full Orbit
Autonomous

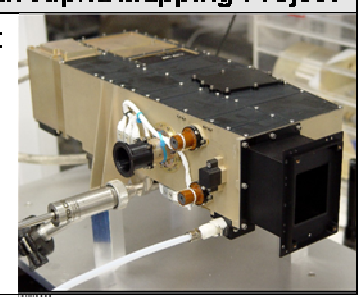
LEND: Lunar Explr. Neutron Detector

- Neutron Albedo
- Hydrogen Maps

Full Orbit
Autonomous

LAMP: Lyman-Alpha Mapping Project

- Water-Frost
- PSR Maps



Night Side
Autonomous

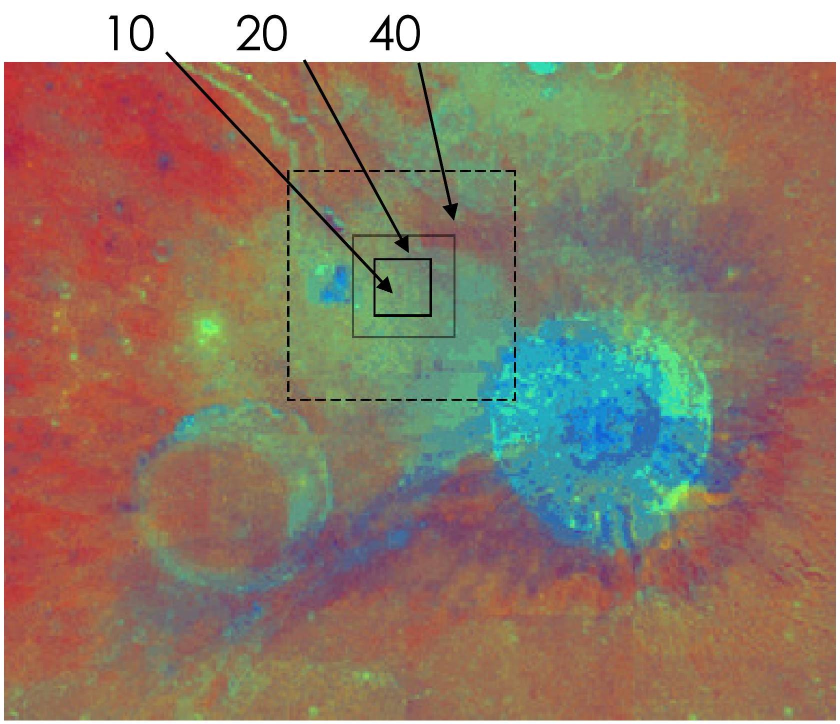
LRO Instrument Montage Video

http://svs.gsfc.nasa.gov/goto?10249

Mark Robinson,
LROC Principal Investigator,
Arizona State University

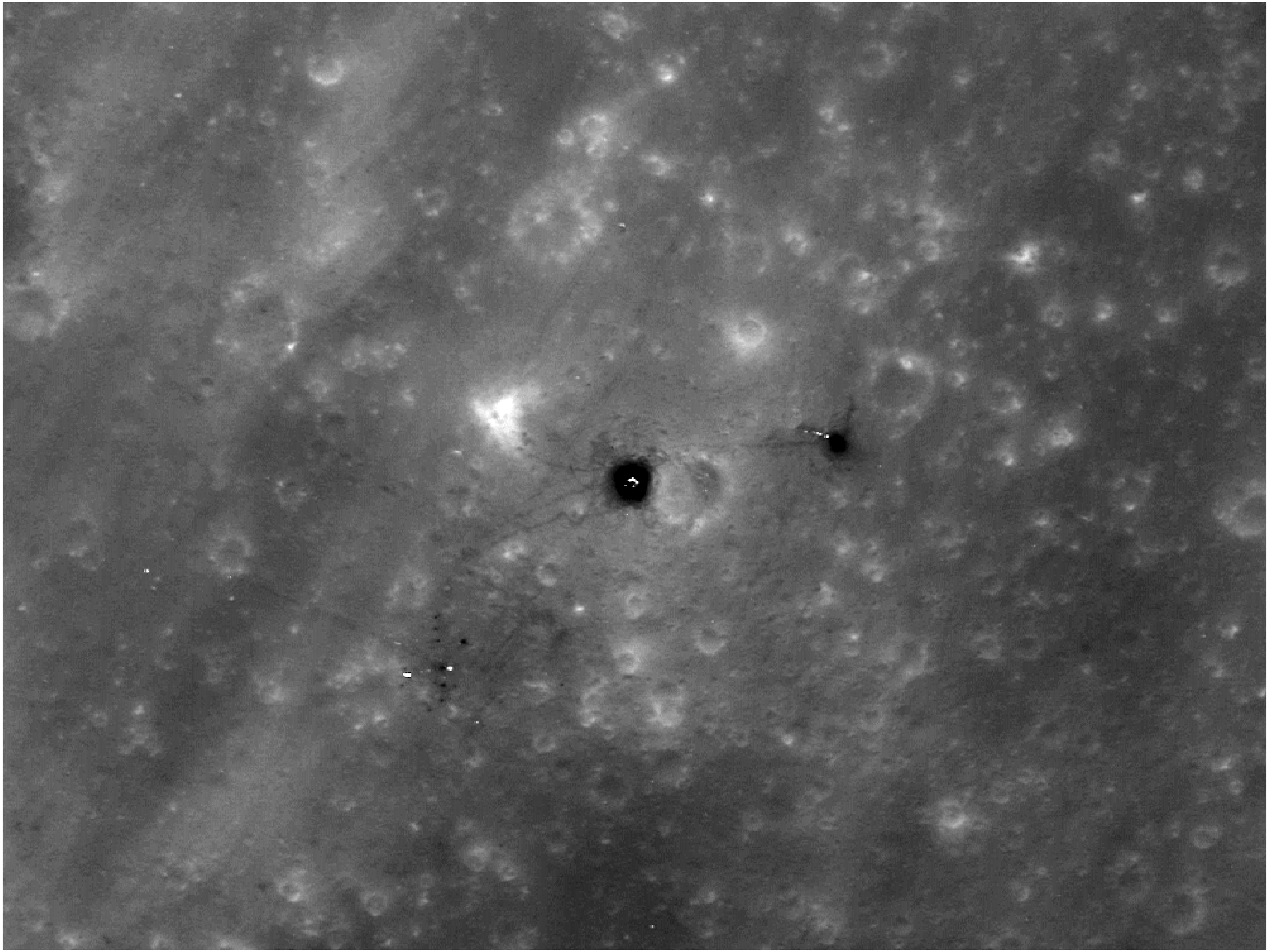
Constellation Design Reference Sites (50)

- A diverse and representative set of sites selected on scientific, engineering, resource potential, and terrain
- 10 x 10 km – full coverage, stereo
- 20 x 20 km – best effort, stereo
- 40 x 40 km – best effort



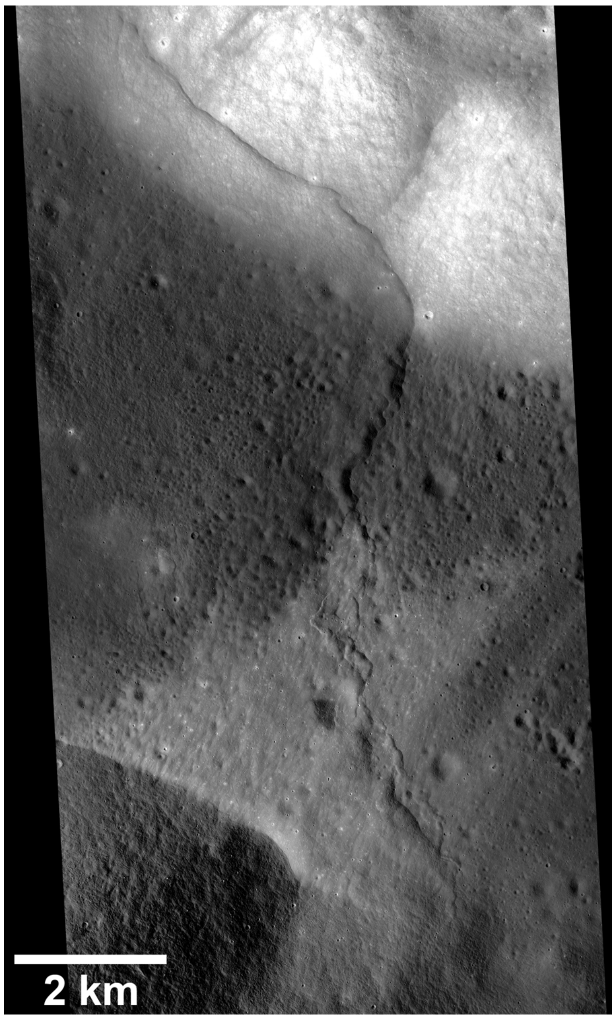
Not landing sites! At least not for now…

http://ser.sese.asu.edu/LSM/targeting.php

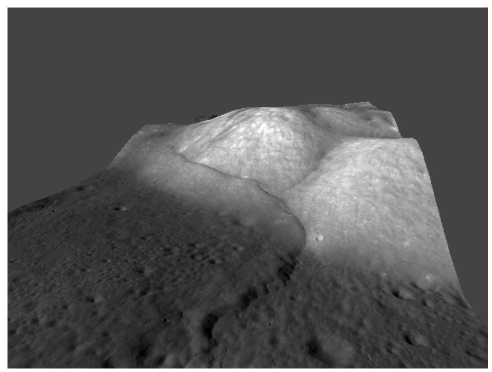


Lunar Scarps

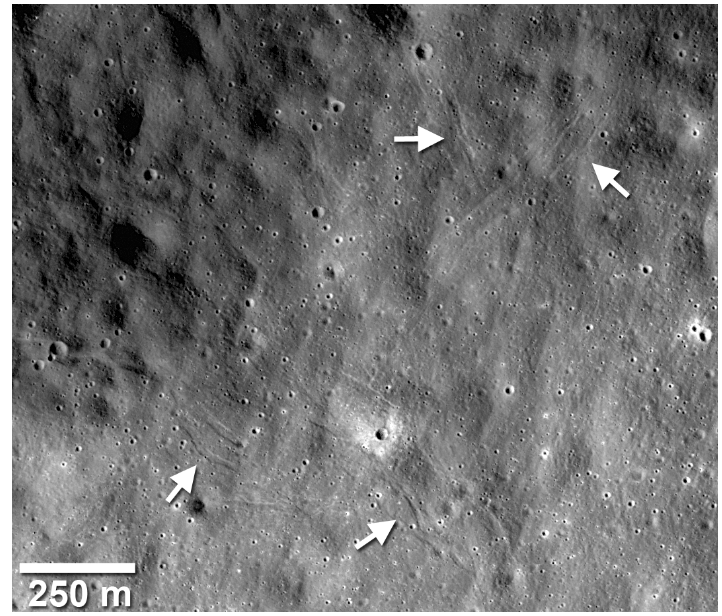
• LROC NAC images show meter-scale tectonic landforms associated with previously known and newly discovered lobate scarps.

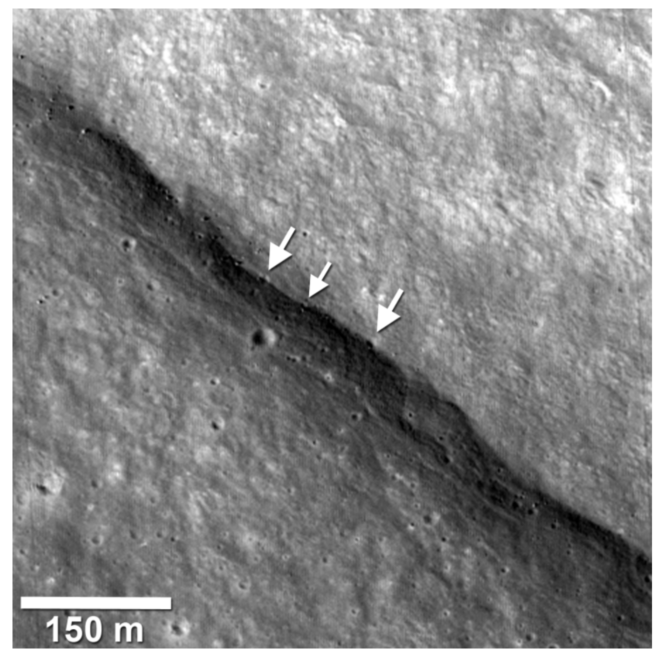


•Newly discovered set of fractures behind Lee-Lincoln scarp



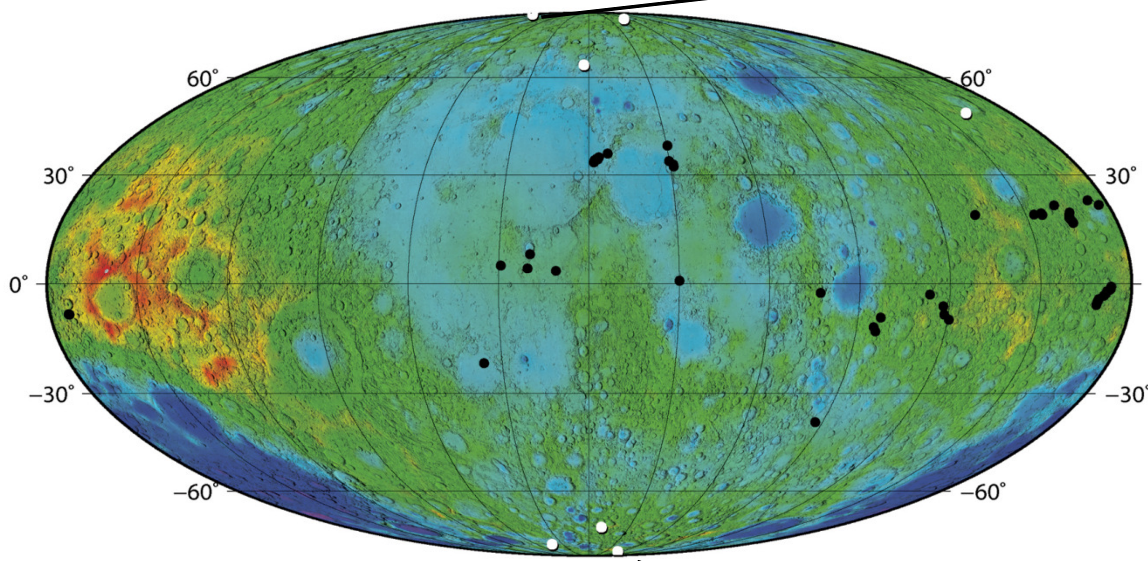
• We can see that Lee-Lincoln was pushed up and over small, young impact craters indicating a very young age for the scarp.

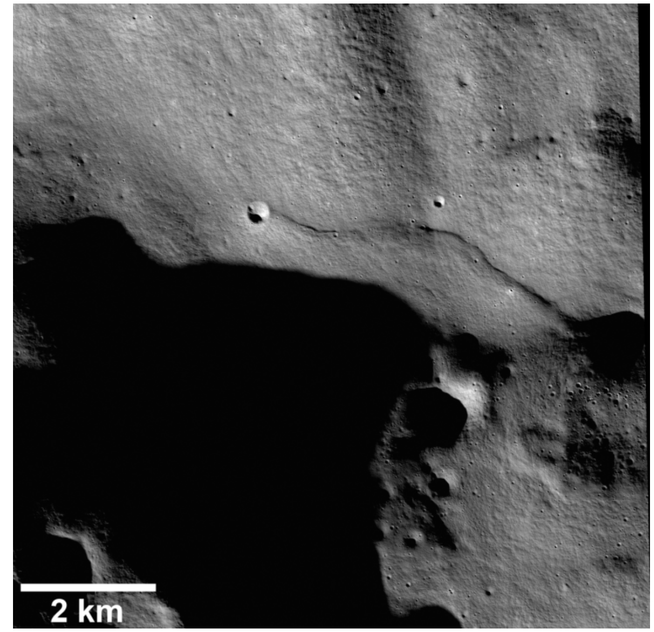


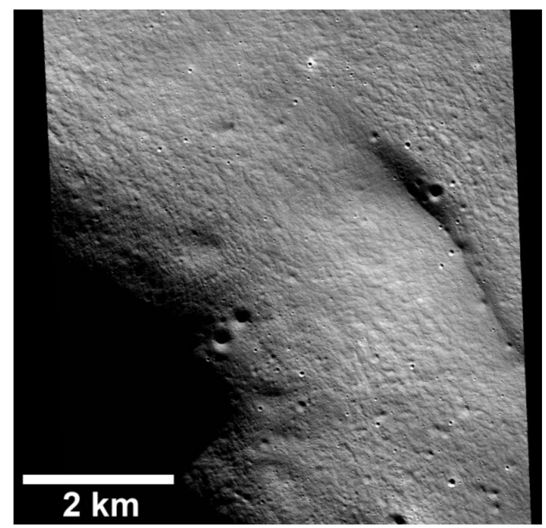


Newly Discovered Lobate Scarps

• Six of the newly detected lunar scarps (white dots) are at high latitudes (> ±60°).







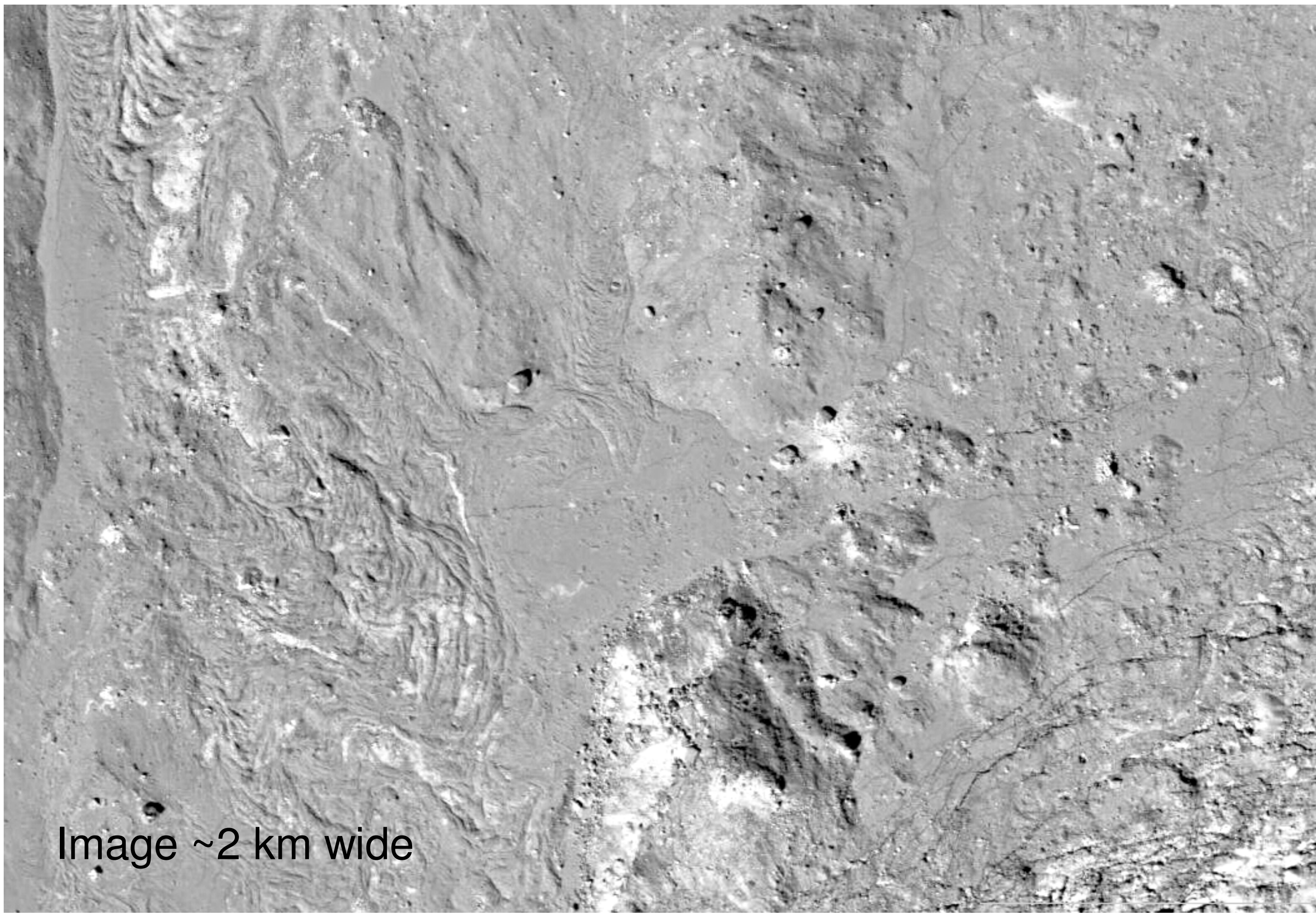
• Newly detected scarps suggest thrust faults are globally distributed.

• A global distribution of thrust faults has important implications for the thermal history of the Moon.

Impact Melts

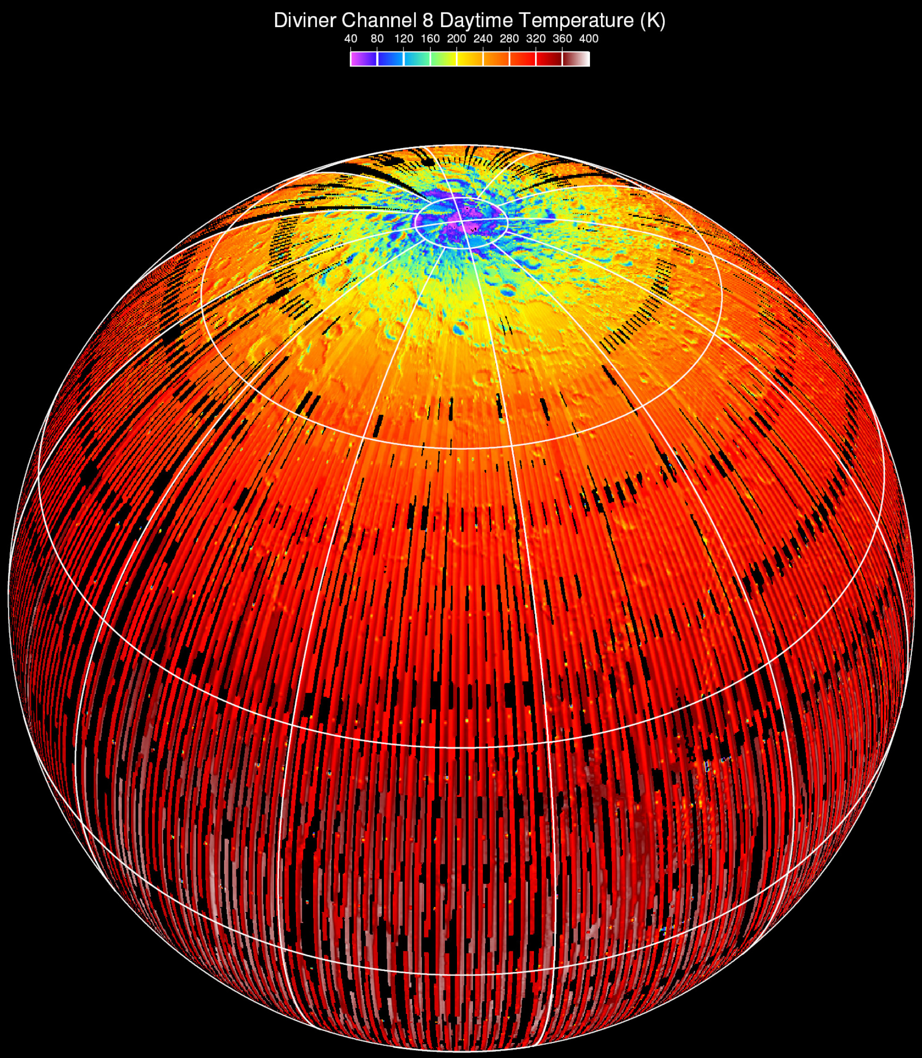
Impact melt deposits are well preserved in Copernican craters. Important markers of cratering dynamics and conditions. Giordano Bruno crater (22 km diam., below). Mandel'shtam F farside crater (17 km diam., right).

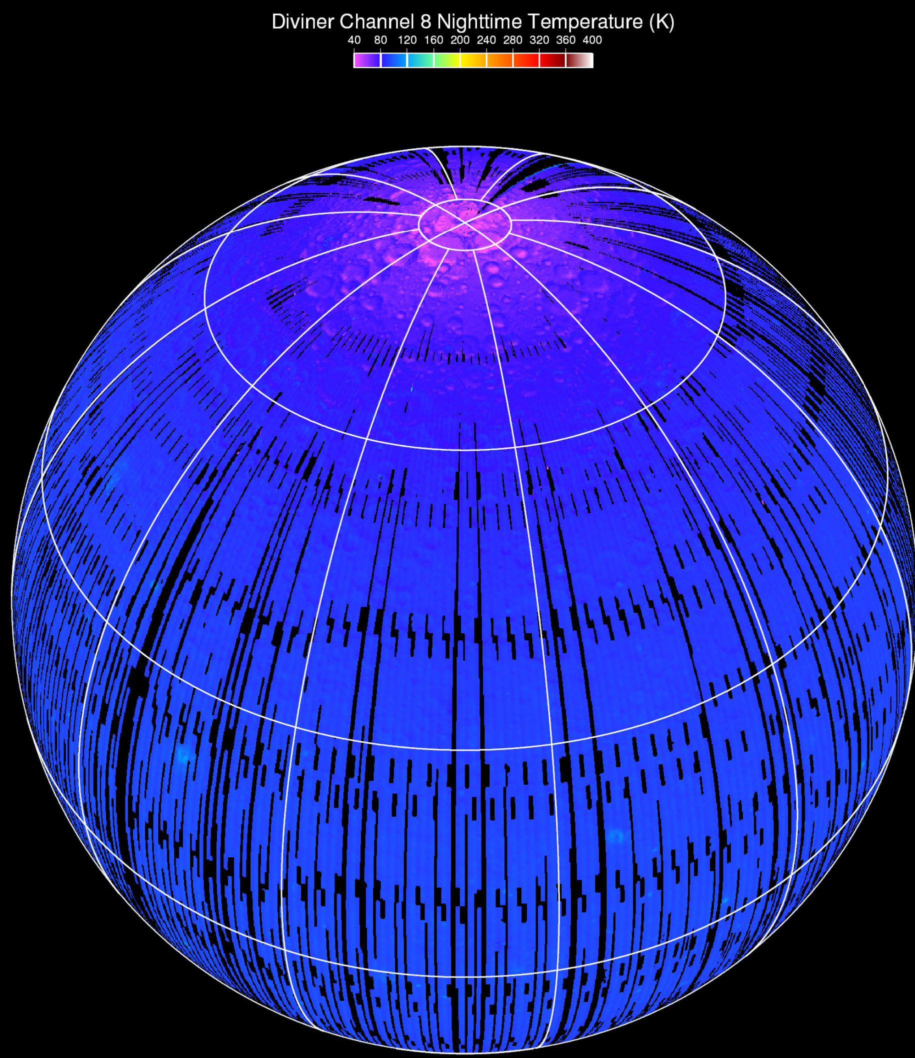
http://lroc.sese.asu.edu

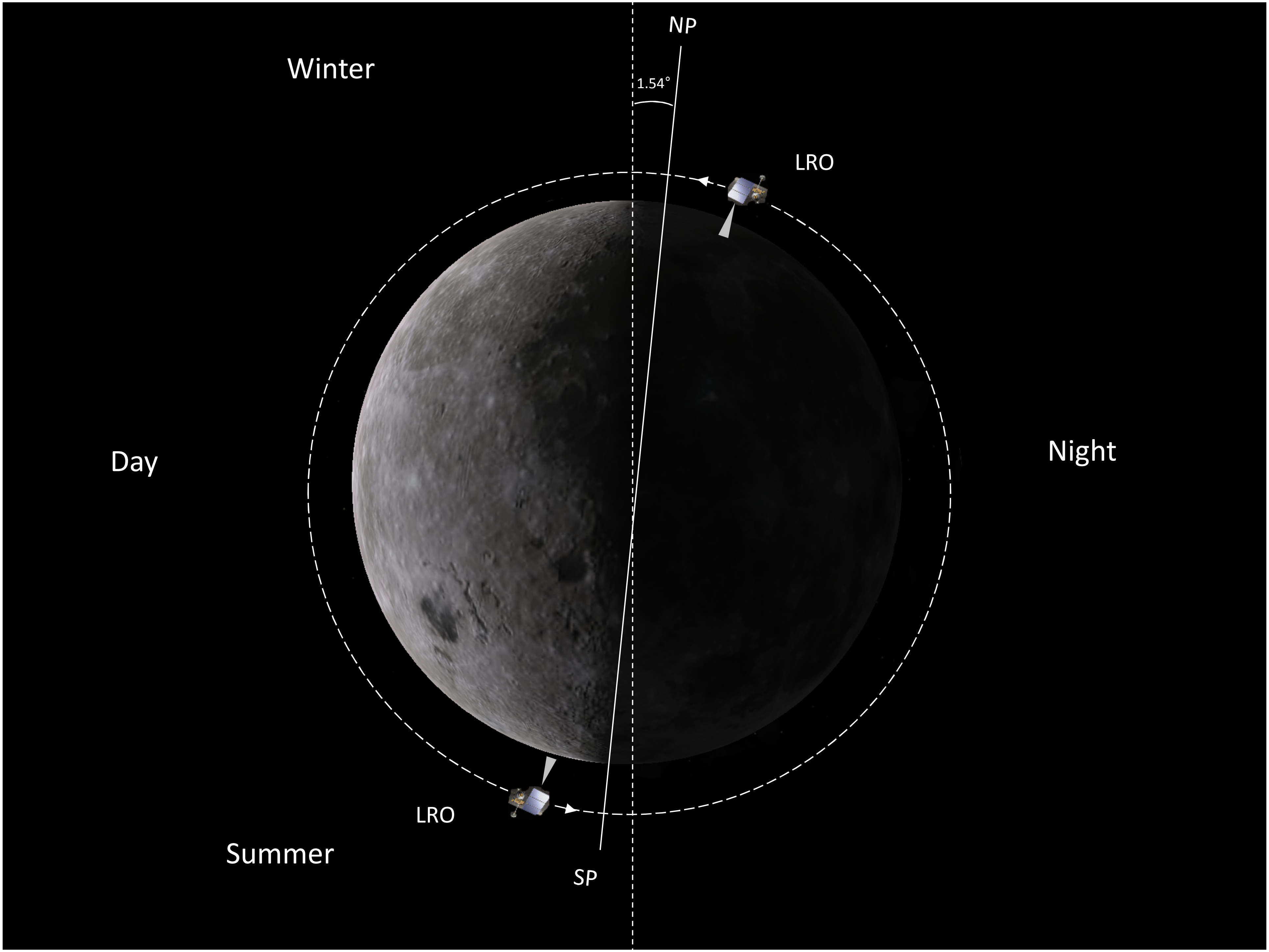


David Paige,
Diviner Principal Investigator,
UCLA

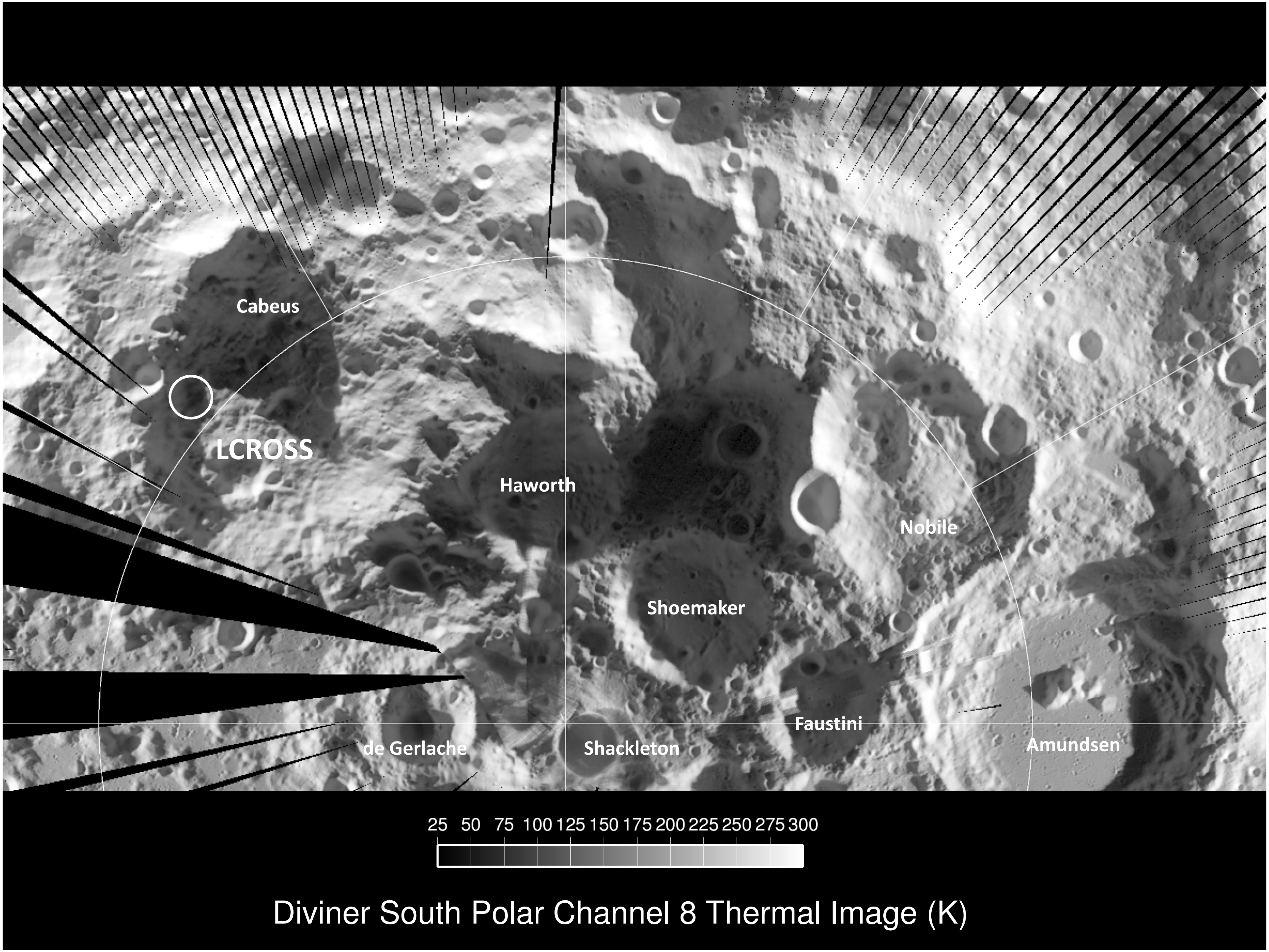
Diviner Day and Night Global Temperature Maps





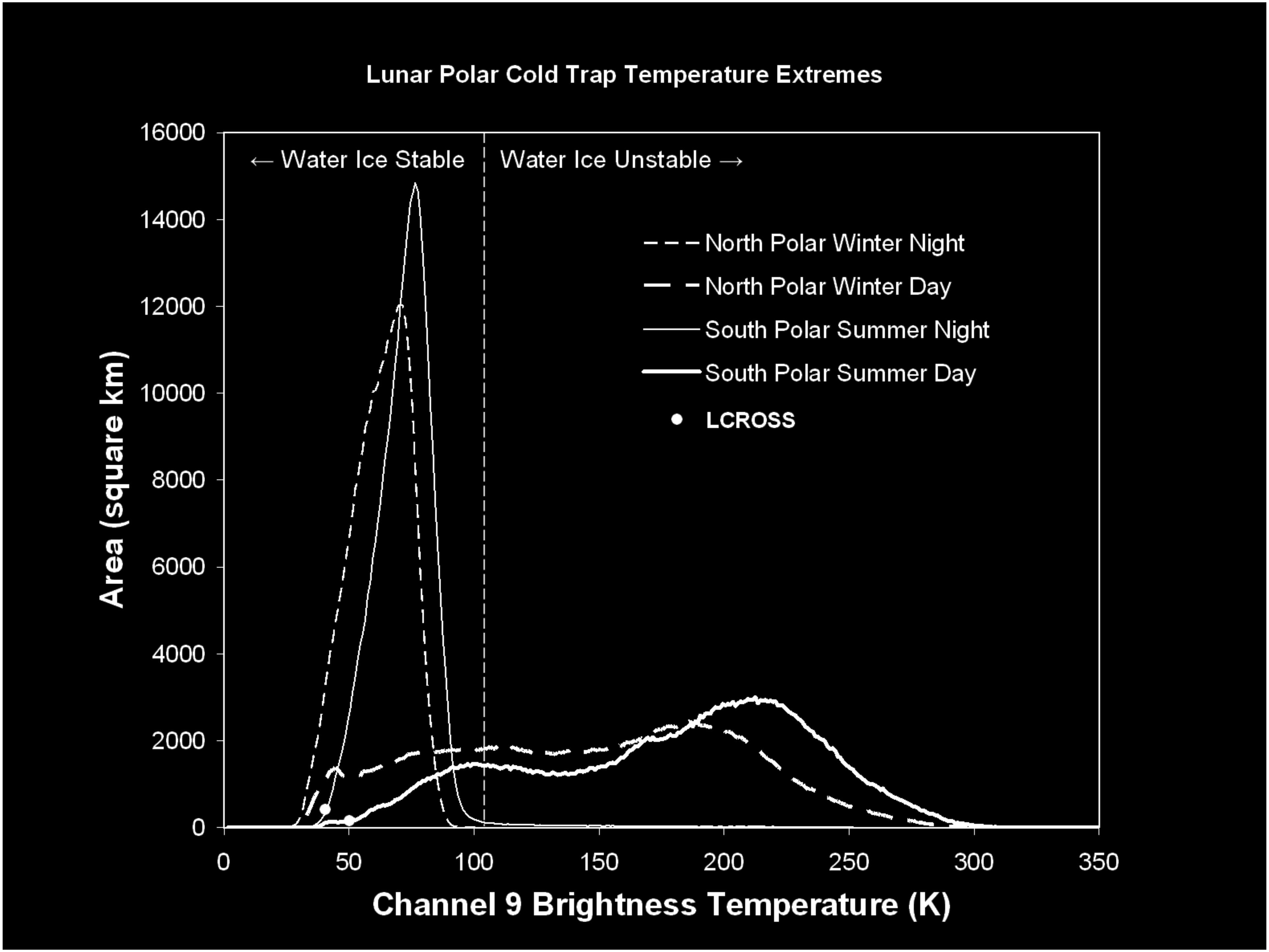

NP
Winter
1.54°
LRO
Day
Night
LRO
Summer
SP

Diviner South Polar Channel 8 Thermal Image (K)



Cabeus
LCROSS
Haworth
Nobile
Shoemaker
Faustini
de Gerlache
Shackleton
Amundsen
25 50 75 100 125 150 175 200 225 250 275 300
Diviner South Polar Channel 8 Thermal Image (K)

Movie:
north_pole_winter_flyover_640x360.mov

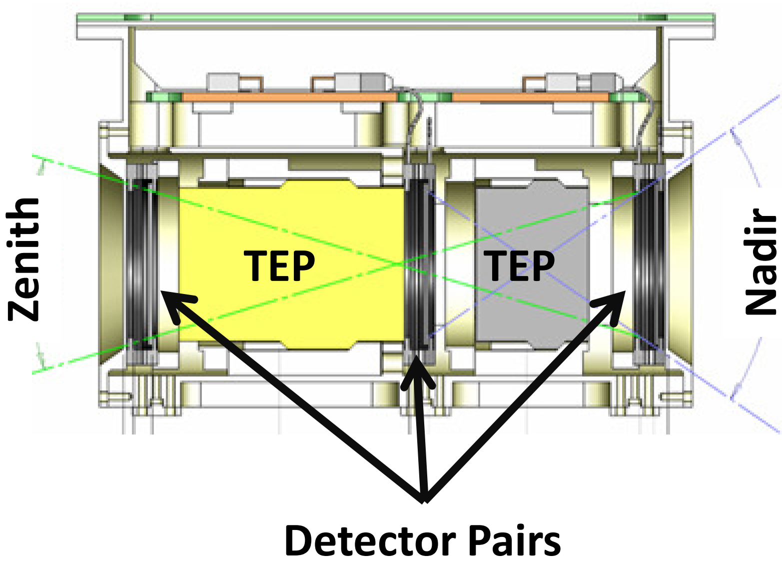


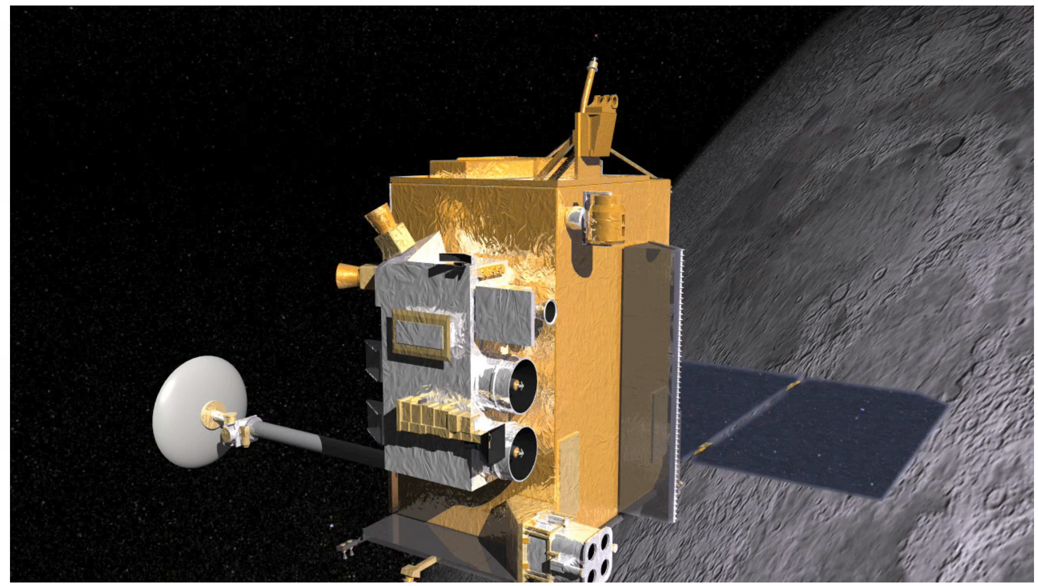
Lunar Polar Cold Trap Temperature Extremes
← Water Ice Stable
Water Ice Unstable →
North Polar Winter Night
North Polar Winter Day
South Polar Summer Night
South Polar Summer Day
LCROSS
Area (square km)
0
2000
4000
6000
8000
10000
12000
14000
16000
Channel 9 Brightness Temperature (K)
0
50
100
150
200
250
300
350

Harlan E. Spence, CRaTER Principal Investigator, Boston University and University of New Hampshire

Galactic Cosmic Rays Near the Moon

- Cosmic Ray Telescope for the Effects of Radiation (CRaTER): 6-element, solid-state detector and tissue-equivalent plastic (TEP) telescope measures radiation caused by galactic cosmic rays (GCR)





- **CRaTER's Exploration Goal:** Characterize global lunar radiation environment

- **CRaTER's Science Goal:** Explore physical interaction of GCR with lunar surface

Movie:

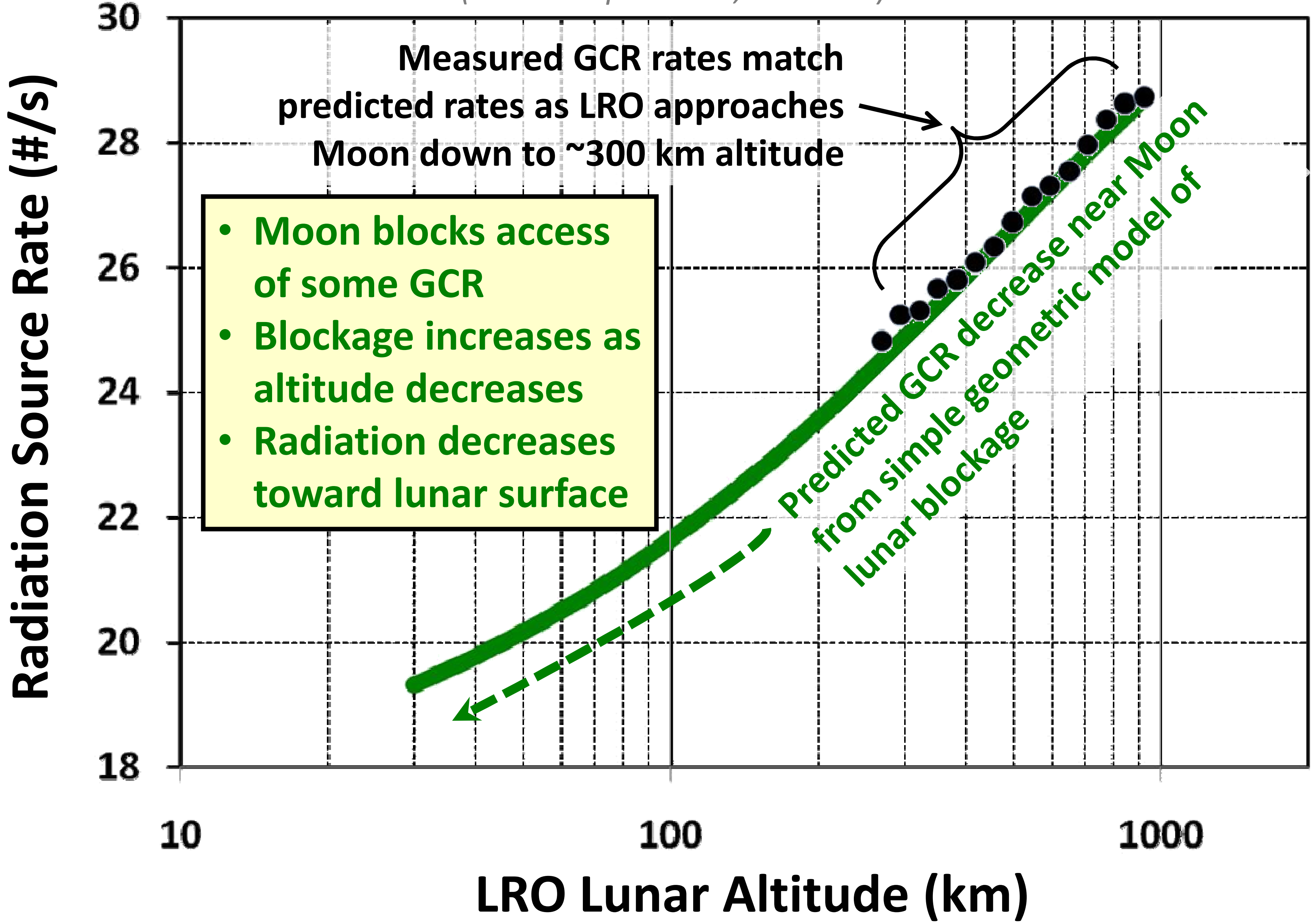
CRaTER_640x360.mov

Radiation Dose Near Lunar Surface Tolerable During Deep Solar Minimum With Peak GCR

- We estimate solar-minimum radiation dose from GCR that an astronaut would encounter on lunar surface, protected by only a thin level of shielding (spacesuit or hull of structure)
- **Example: Human eye dose rate (relevant for cataracts):**
  - **~ 50 milli-Gray/year** *(see H. Spence et al., U21C-07)*
  - One year on lunar surface → total eye lens dose: ~50 milli-Gray
  - **Comparable to US yearly exposure limit (established by the Nuclear Regulatory Commission) for people with occupational exposure to ionizing radiation (x-ray technicians, uranium miners, nuclear power plant workers)**
- CRaTER results consistent with expectations from earlier data and models
- Current deep and prolonged solar minimum yields (worst-case) GCR rates **~ 20% higher** than earlier space-age solar minima (and ~x3.5 higher than during typical solar maximum) *(see R. Mewaldt et al., SH13C-08)*

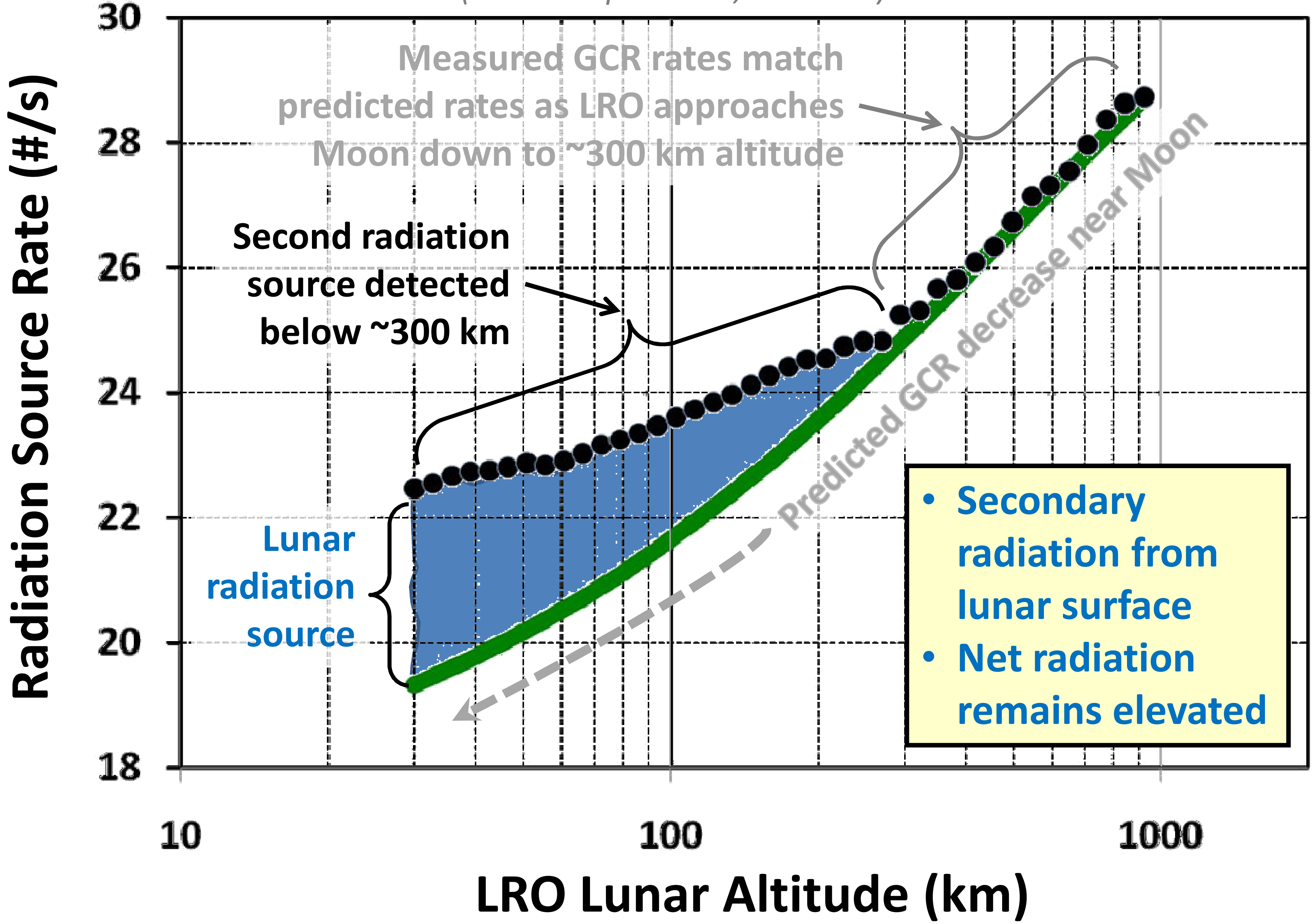
CRaTER Reveals Lunar Blockage of GCR

(see J. Kasper et al., U21C-08)



CRaTER Discovers Excess Radiation Near Moon

(see J. Kasper et al., U21C-08)

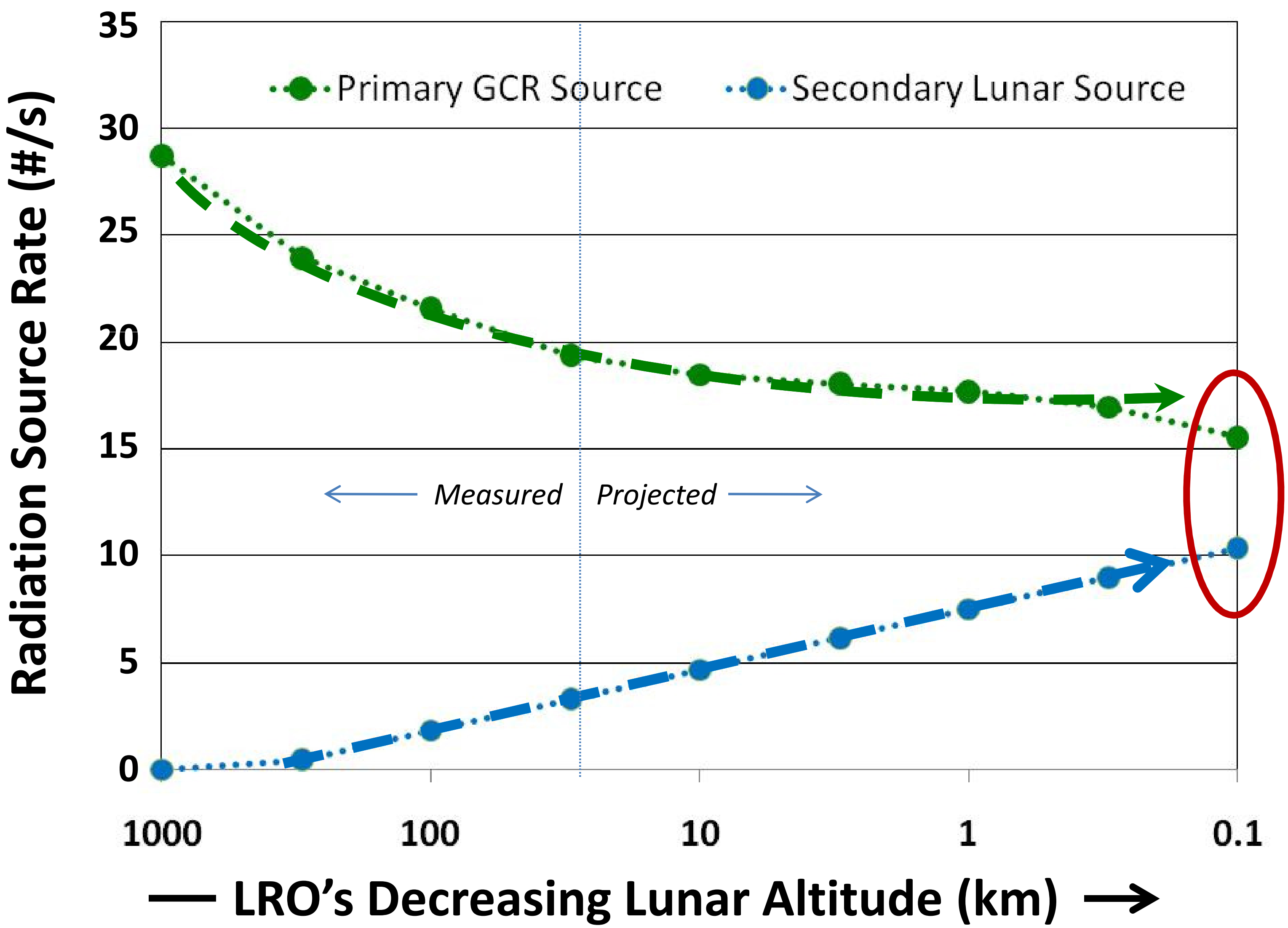


CRaTER Discovers Excess Radiation Near Moon

(see J. Kasper et al., U21C-08 and Looper et al., U31B-25)

- - -> **Moon blocks GCR; primary radiation source falls predictably with altitude**

- - -> **Secondary radiation source increases systematically closer to the Moon**



Lunar Radiation Source May Be As Large As GCR Radiation Source Near Moon's Surface

Summary of CRaTER Results

- CRaTER's Exploration Goal: Characterize global lunar radiation environment
  - **Lunar surface radiation elevated during this extreme solar minimum, but still at tolerably low-level radiation risk.**

- CRaTER's Science Goal: Explore physical interaction of GCR with lunar surface
  - **Moon blocks GCR, reducing radiation near surface, but secondary radiation source discovered, caused by GCR interactions with Moon.**