



The Moon and Space Astronomy



"If you in the astronomy community can't make use of the capabilities we're going to develop to go to the Moon and Mars, then shame on you!"

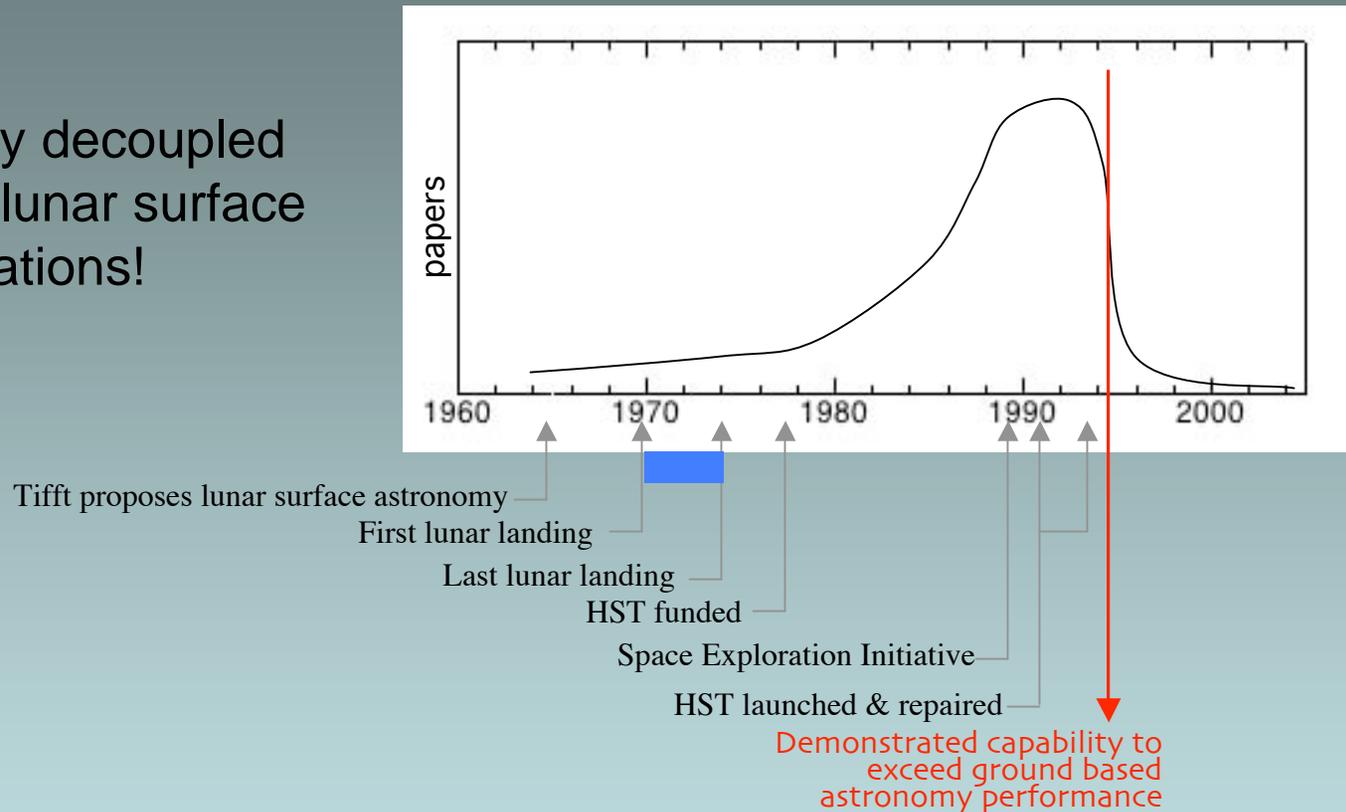
NASA Administrator Mike Griffin 10/12/05

- What does the Moon offer space astronomy?
- Can we agree on metrics of value?
- Does lunar exploration need astronomy?
- How have things changed?



A schematic history of “excitement” about lunar astronomy

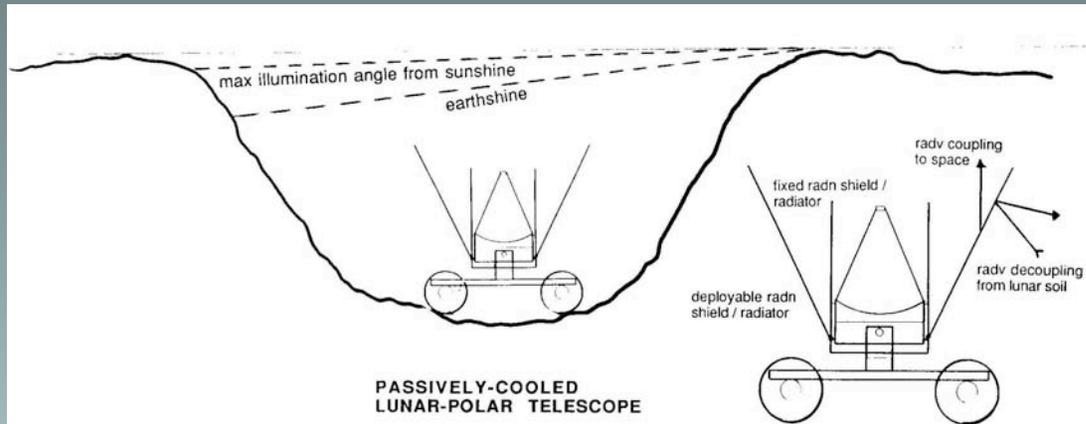
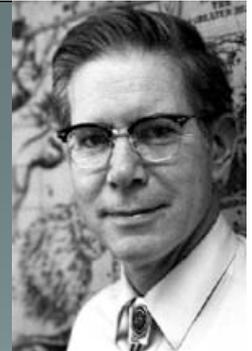
Remarkably decoupled
from actual lunar surface
operations!



The lack of current enthusiasm in the science community for lunar surface astronomy is precisely because we know how to do things in free-space that we thought we needed to do on a solid surface!

Were we “wrong” then? No! Our technology has dramatically improved.

Let us not to deny value of the Moon for astronomy, but make sure we approach it in a manner that is fully cognizant of science priorities and modern capabilities in free-space.



The only way we knew to get a 35K IR space telescope then.

D. Lester 1988 "Future Astronomical Observatories on the Moon" p85.

One of many designs for how we plan to do that now.



Is astronomy from the Moon an intrinsically bad idea? No.
The Moon IS a vastly better place for astronomy than the Earth's surface!
But let's consider free-space (which we use now!) ...

| | Moon | Free-Space | Earth |
|---------------|---------|---------------|-------|
| Convenience | ? | ? | X |
| People | will be | now and later | X |
| Vacuum | X | X | |
| Cold Sky | X | X | |
| No clouds | X | X | |
| No wind | X | X | |
| Stability | X | X | |
| Cryo-friendly | X | X | |

We have developed huge expertise in free space astronomy.
We know how to point, track, chill, service

For certain kinds of astronomy, the lunar surface may be of value but we will do astronomy there only if it is truly enabling in some respect. Why? Lunar telescopes are harder than free-space telescopes.

Gravity and Structure:

Precision alignment over changing sky angles is compromised by gravity. Mitigation by active control or massive structure.

Gravity and Risk:

Safe deployment requires a highly capable propulsion subsystem.

Contaminants:

Grit, dust, and possibly evaporated condensables seriously handicap precision optical and mechanical systems. (Suits as well!)

Thermal Control:

While polar craters offer some thermal “opportunities”, most of the Moon is nonequilibrium -- problematic for precision structures and backgrounds.

Field of View:

No access to the whole sky on the Moon, especially at the poles.

The Moon offers dirt and gravity. Neither are particularly valuable to astronomy.

“Well, OK, but we’re going to have *people* on the Moon!
You know, for setup, service, maintenance, repair ...”

Fundamental (and astonishing) misconception about space astronomy is that you’d only find people in space on the Moon!



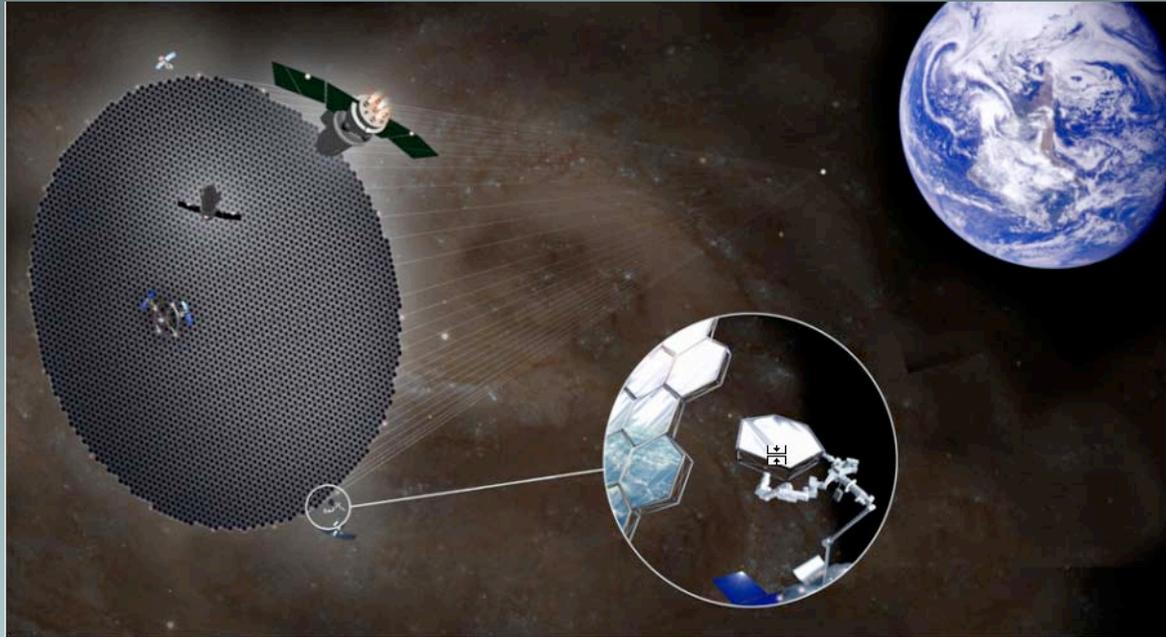
In-space operations, with astronauts working in free-space with robots, will offer huge opportunities to Exploration as well as science.

So how can lunar exploration offer value to space astronomy?

By letting astronomy leverage the capabilities that will be developed, Propulsion, nav, communication, human physiology, perhaps hab sites at scientifically enabling cis-lunar sites in free-space (e.g. L1). ISRU opportunities are also of great interest to free-space space astronomy.

Space astronomy isn’t looking for lunar condo living, and our free-space observatories won’t be found at Burger King.

Stretch astronomy goals for ISRU - a 150m telescope in space?



LARGE APERTURE SPACE SURVEILLANCE (OPTICAL) (LASSO) PHASE I, DARPA BAA04-36

The Tactical Technology Office (TTO) of the Defense Advanced Research Projects Agency (DARPA) is soliciting proposals for the initial study phase (phase 1) of the four phase DARPA LASSO program.

The system envisioned is a 150 meter optical system in geosynchronous orbit with the capability of 24/7 persistence and 6-inch resolution. Manufacturing in the space environment will enable novel structures that could not survive the loads experienced during terrestrial launch as well as the production of extremely large structures that enables optical systems resolution and accuracy that are not otherwise conceivable.



Does the Lunar Surface Still Offer Value As a Site for Astronomical Observatories?

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Abstract: Current thinking about the Moon as a destination has revitalized interest in lunar astronomical observatories. Once seen by a large scientific community as a highly enabling site, the dramatic improvement in capabilities for free-space observatories prompts reevaluation of this interest. Whereas the lunar surface offers huge performance advantages for astronomy over terrestrial sites, free-space locales such as Earth orbit or Lagrange points offer performance that is superior to what could be achieved on the Moon. While astronomy from the Moon may be cost effective once infrastructure is there, it is in many respects no longer clearly enabling compared to free space.
