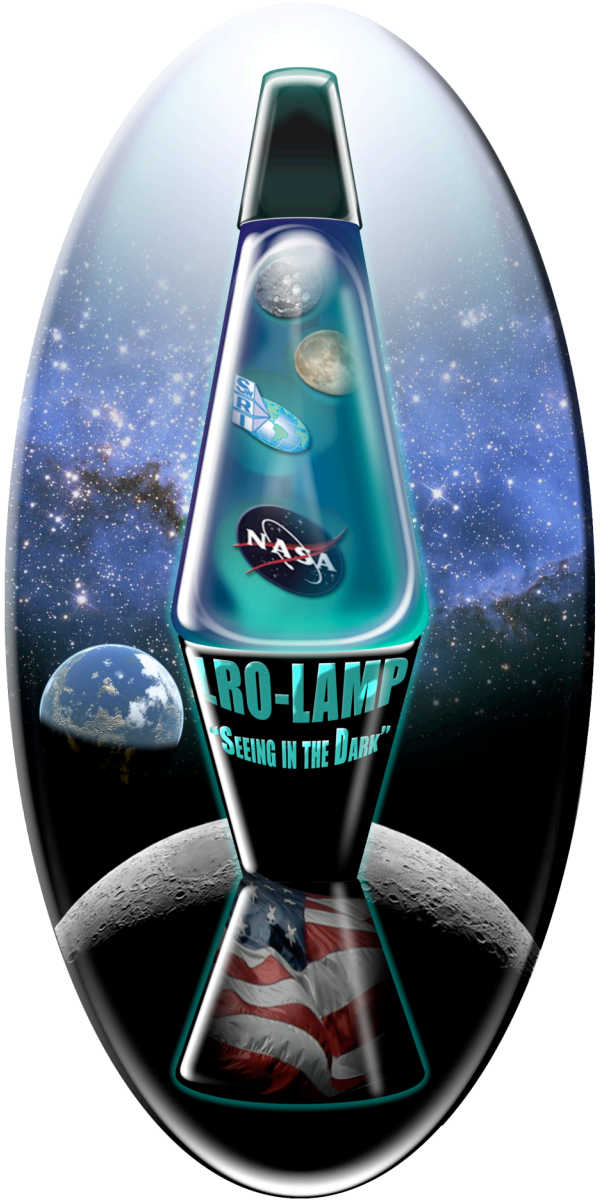
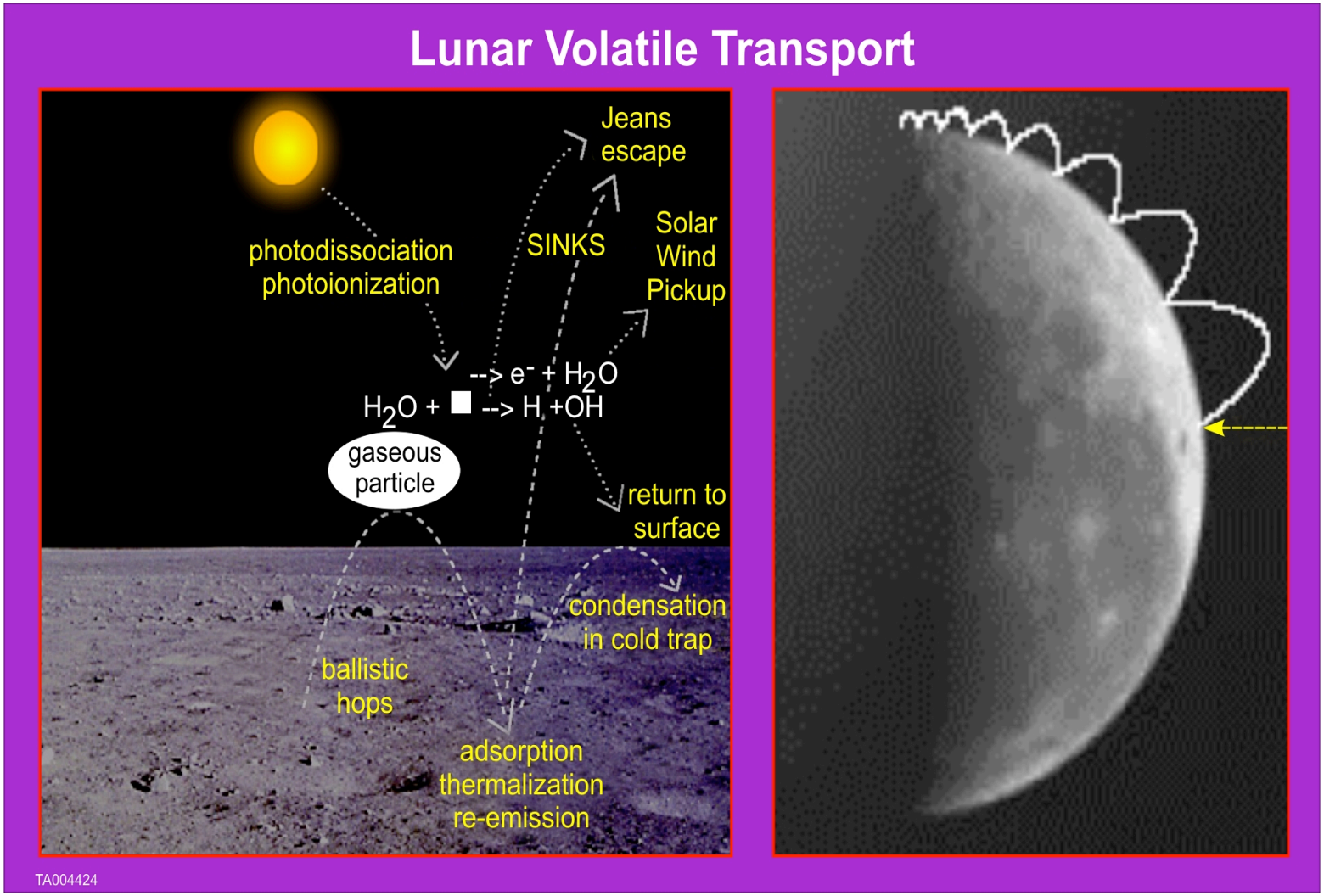
The Lyman-Alpha Mapping Project (LAMP)



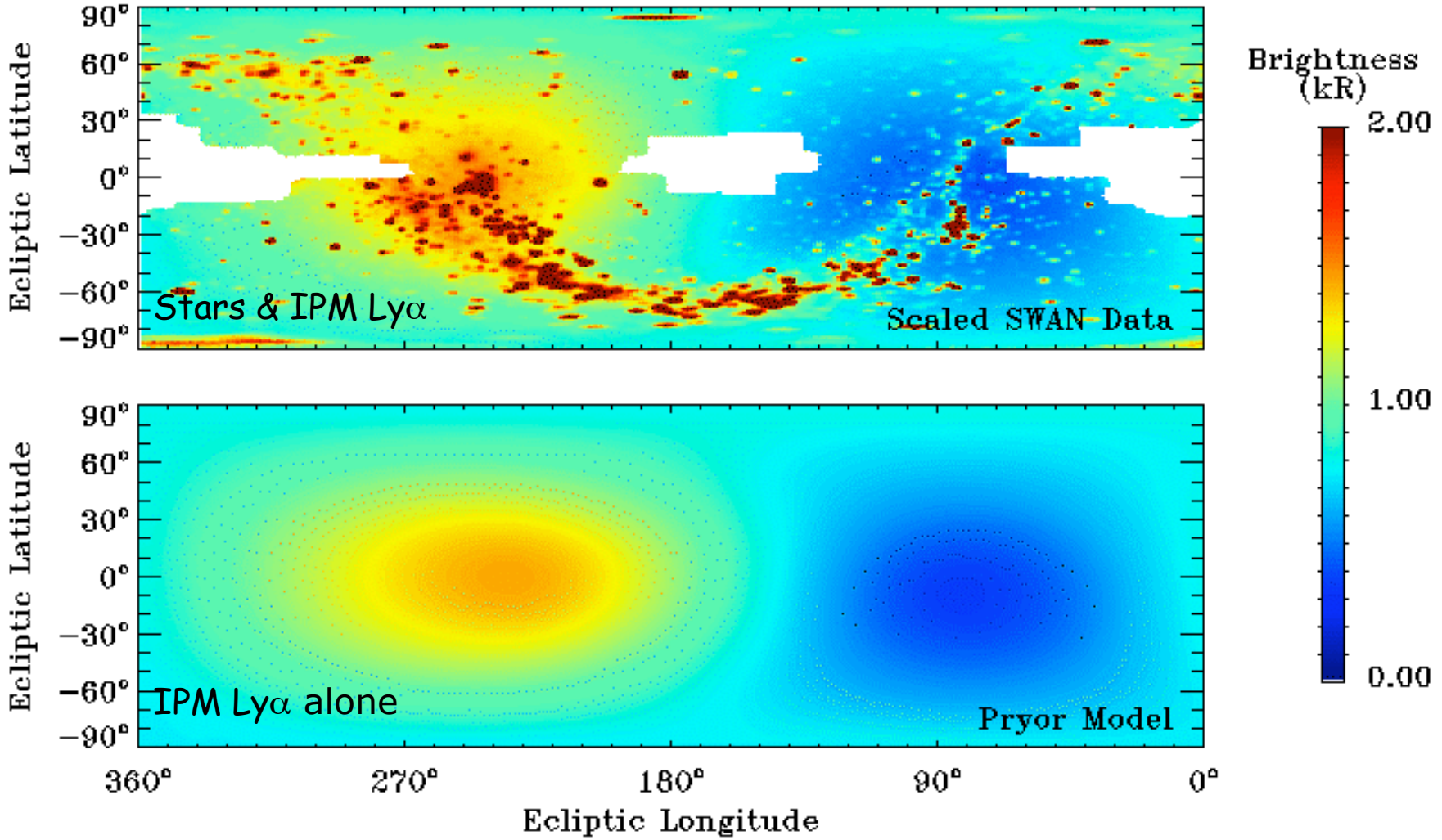
Randy Gladstone (SwRI)
& the LAMP Team

Lunar Science Forum
NASA/ARC
July 21-23, 2009

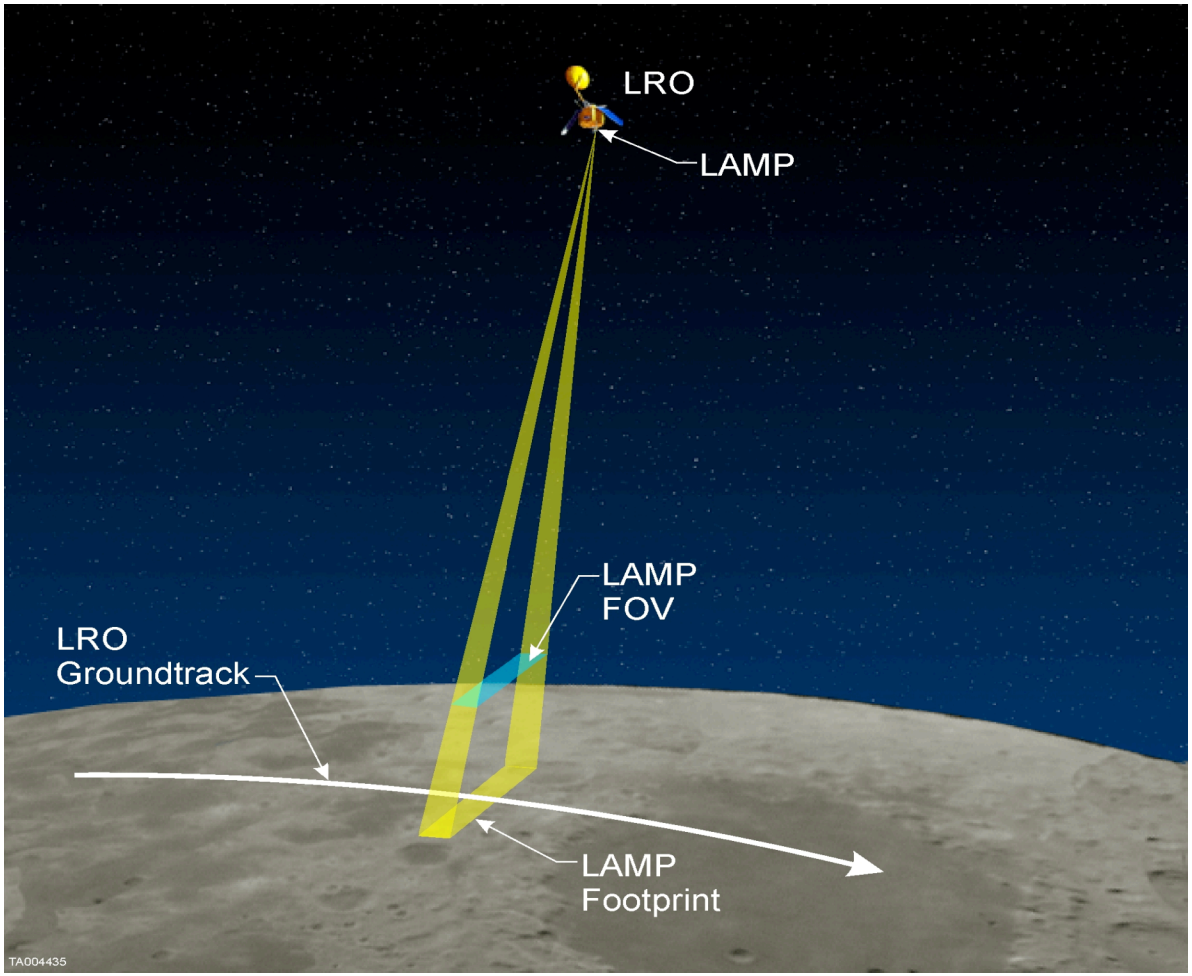


Why is LAMP on LRO? Water is expected to collect at polar cold traps from solar wind protons & comets Crider & Vondrak [2000] …

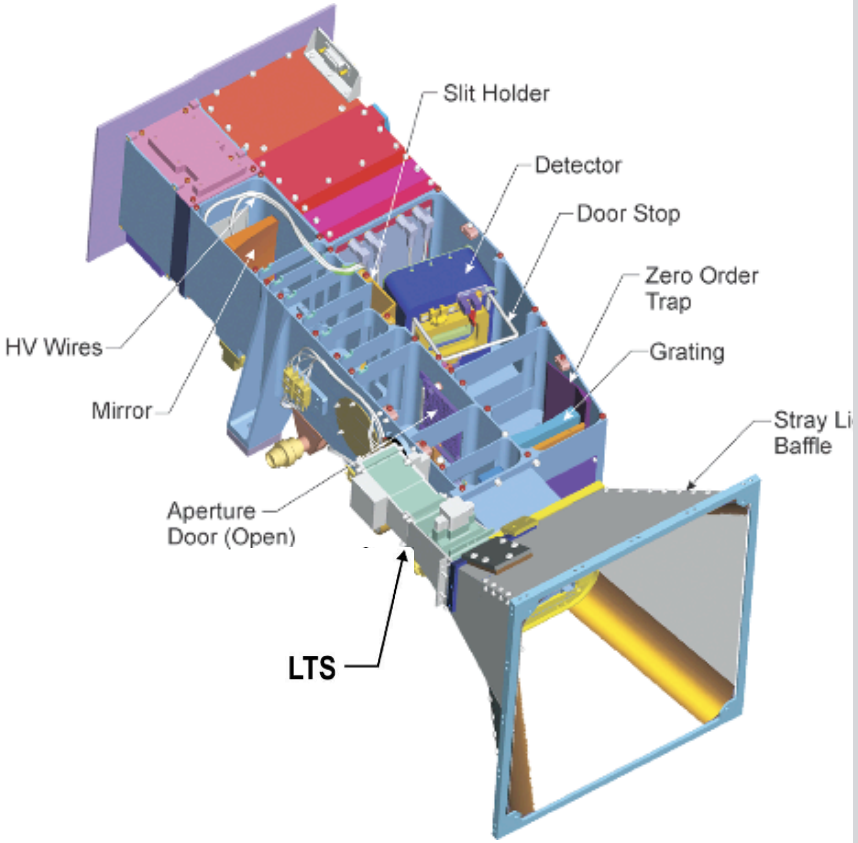
IPM Lyα Data & Model

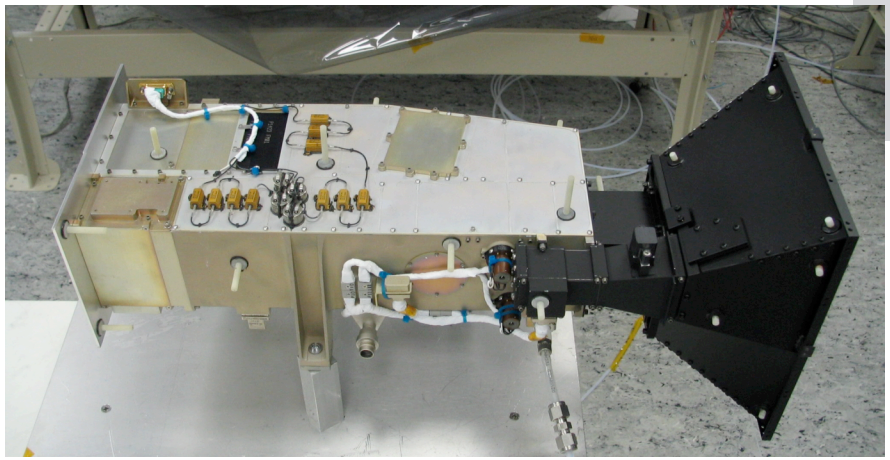


… but the bright interplanetary medium (IPM) emission at Lyα should photolyze any water at the surface in just a few years Morgan & Shemansky [1991]



The LAMP concept: Why not use this same IPM Lyα (along with some UV starlight) as a source of illumination to look at the lunar nightside & permanently shadowed regions (PSRs)? The IPM illumination is the same inside & outside of the PSRs

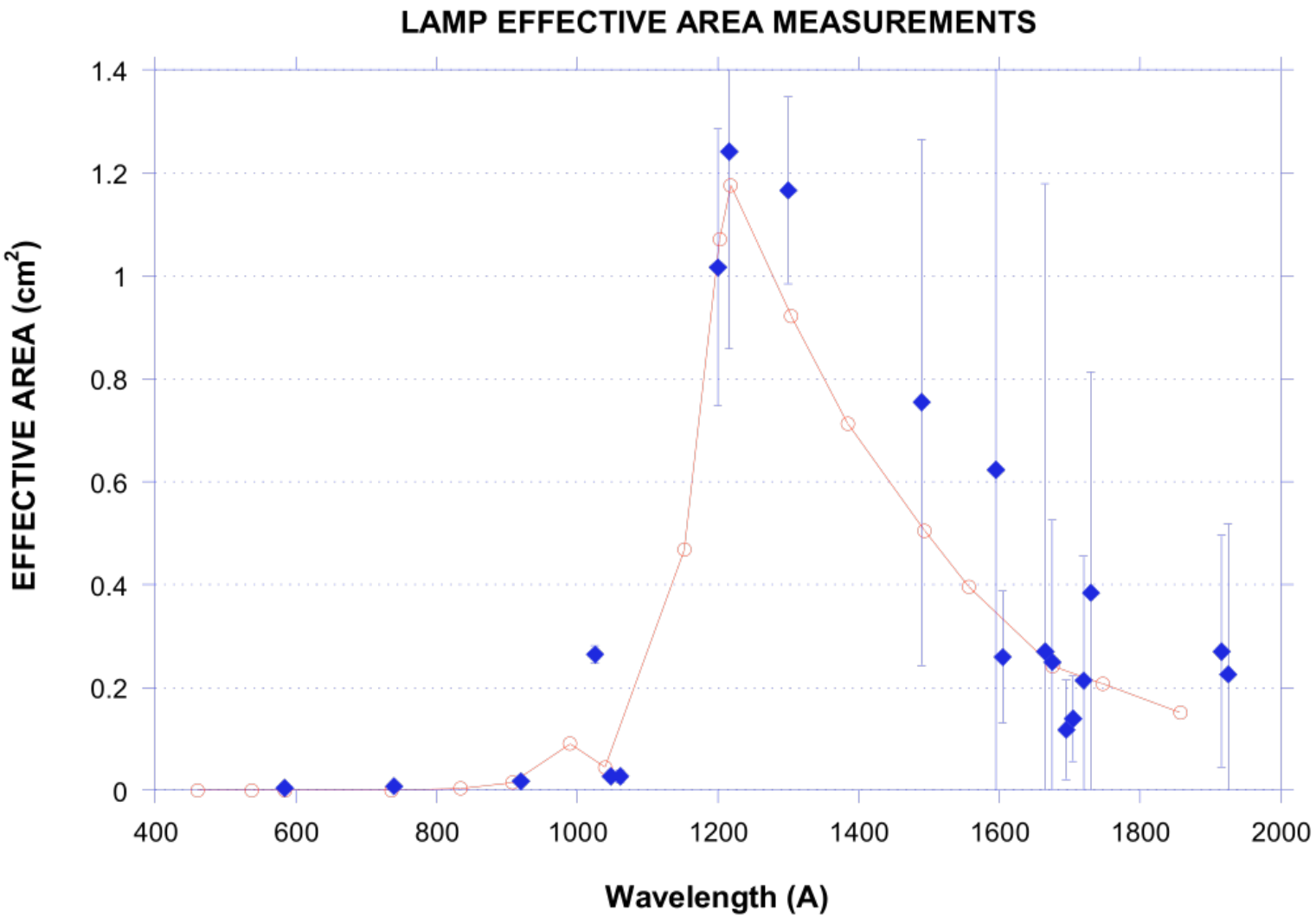




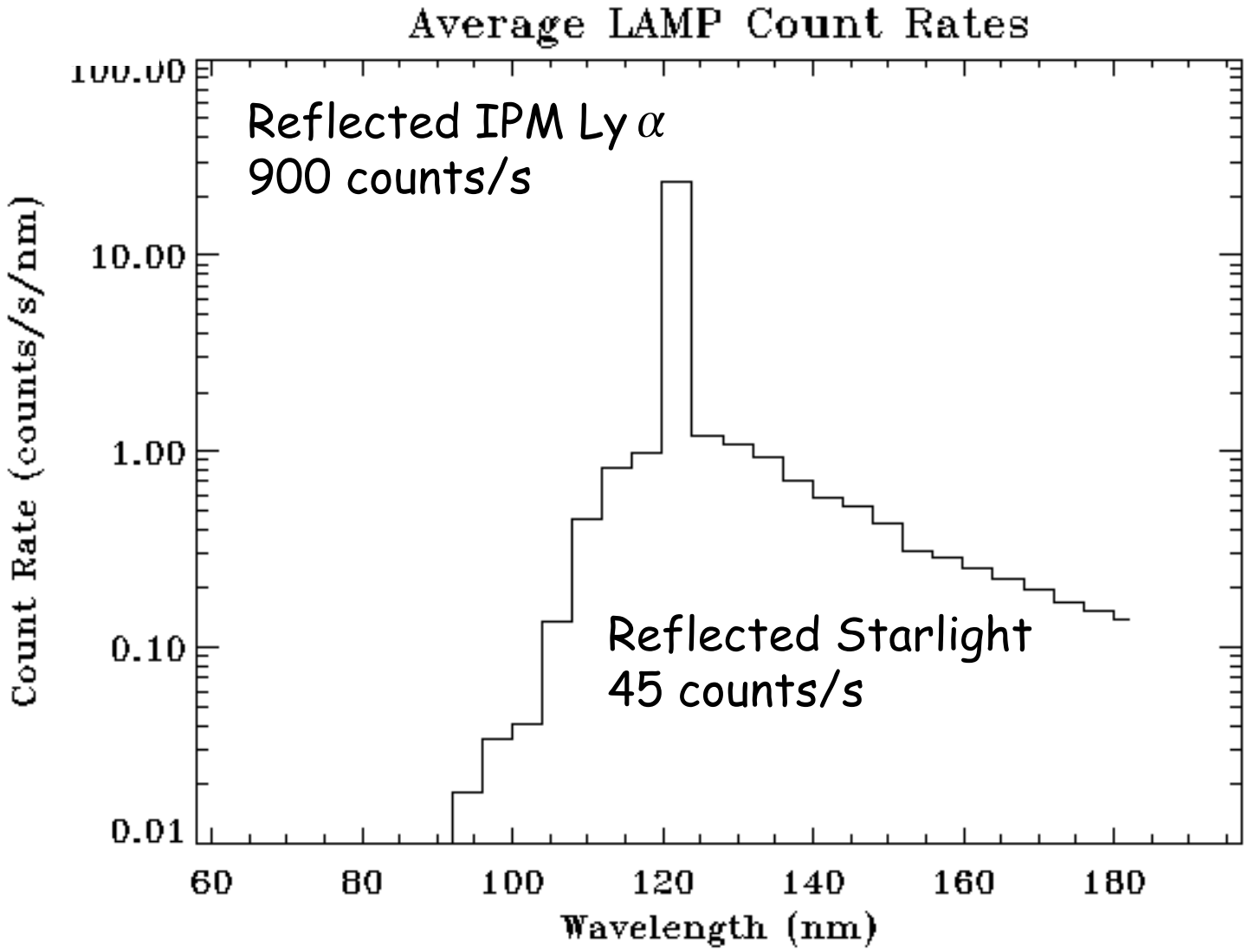
LAMP is an imaging ultraviolet spectrograph composed of:

- A 41 x 65 mm off-axis paraboloid primary telescope mirror
- A 50 x 50 mm toroidal holographic diffraction grating
- A 2-D imaging photon counting DDL microchannel plate (MCP) detector with a vacuum cover/window assembly
- A Lunar Terminator Sensor (LTS) with dual visible-light photodiodes
- A stray-light baffle at the entrance aperture
- An aperture door with a pinhole for dayside observations

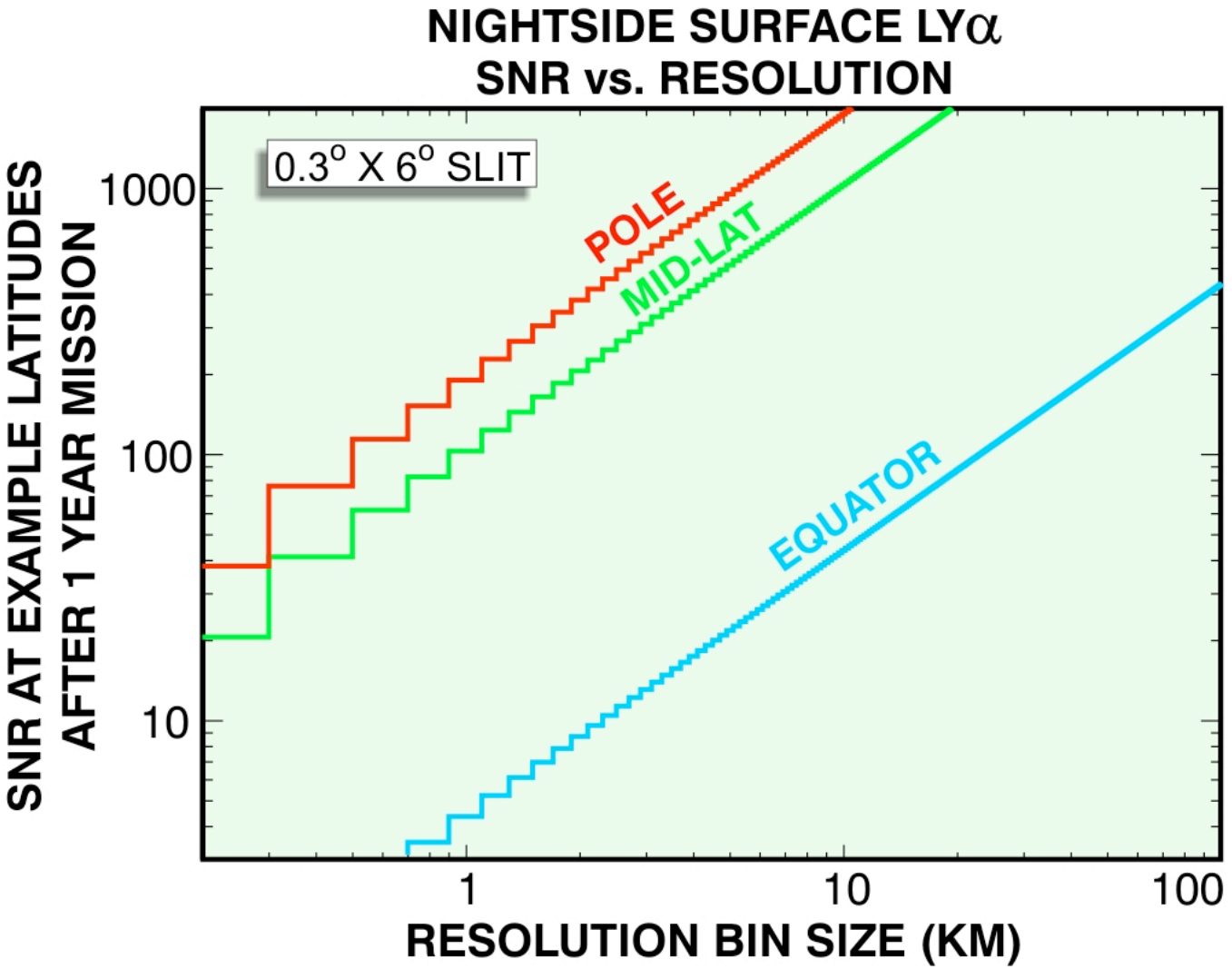
LAMP Specs:
Mass: 6.06 kg
Power: 4.52 W
FOV: 0.3° × 6.0°
λ Range: 57-196 nm
λ Resolution: <4 nm (filled slit)



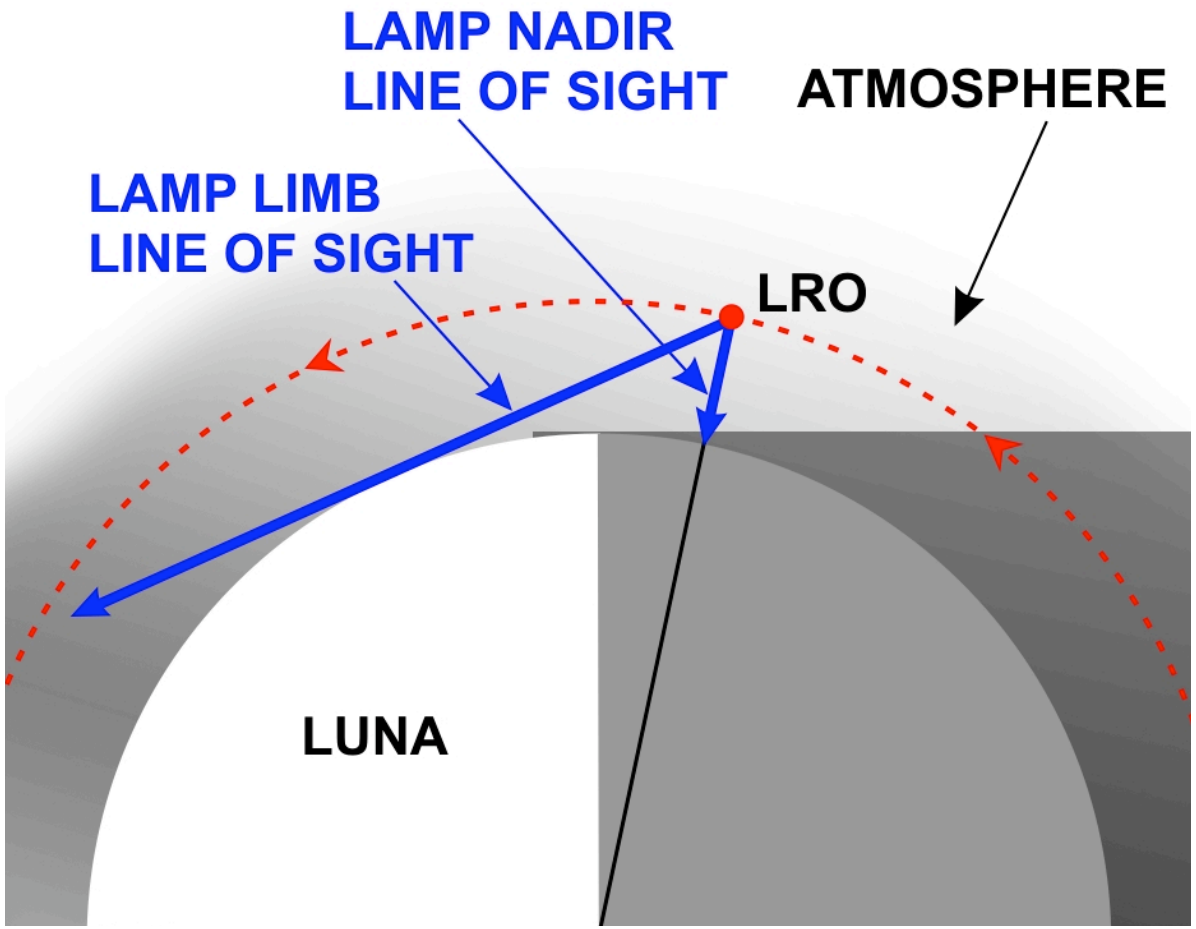
LAMP's effective area - the microchannel plate detector is coated with CsI and the optical elements are coated with Al/MgF_2 to provide peak sensitivity at Lyα



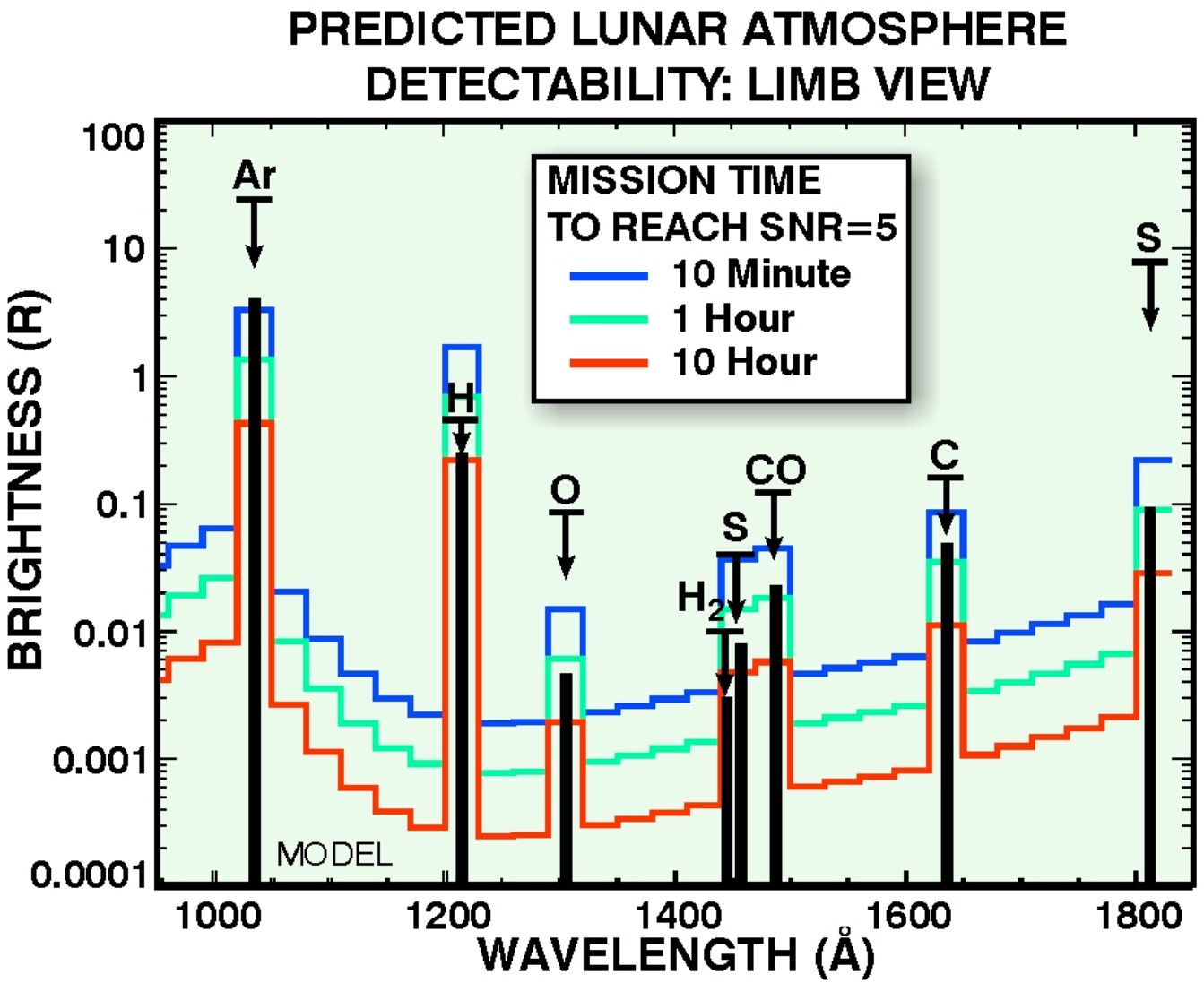
Predicted LAMP spectrum from the lunar nightside. Assumes 800 R of IPM Lyα [Pryor et al., 1998] and composite sky spectrum of starlight [Henry, 2002]



Expected LAMP SNR at Lyα after a 1-year LRO mission as a function of bin size for polar and mid-latitude regions (e.g., SNR>100 achieved in the polar regions for 0.5 km bins)



LAMP will also explore the tenuous lunar atmosphere by accumulating spectra where the surface is in shadow but most of the atmosphere is sunlit (and by monthly limb-pointed observations as well)



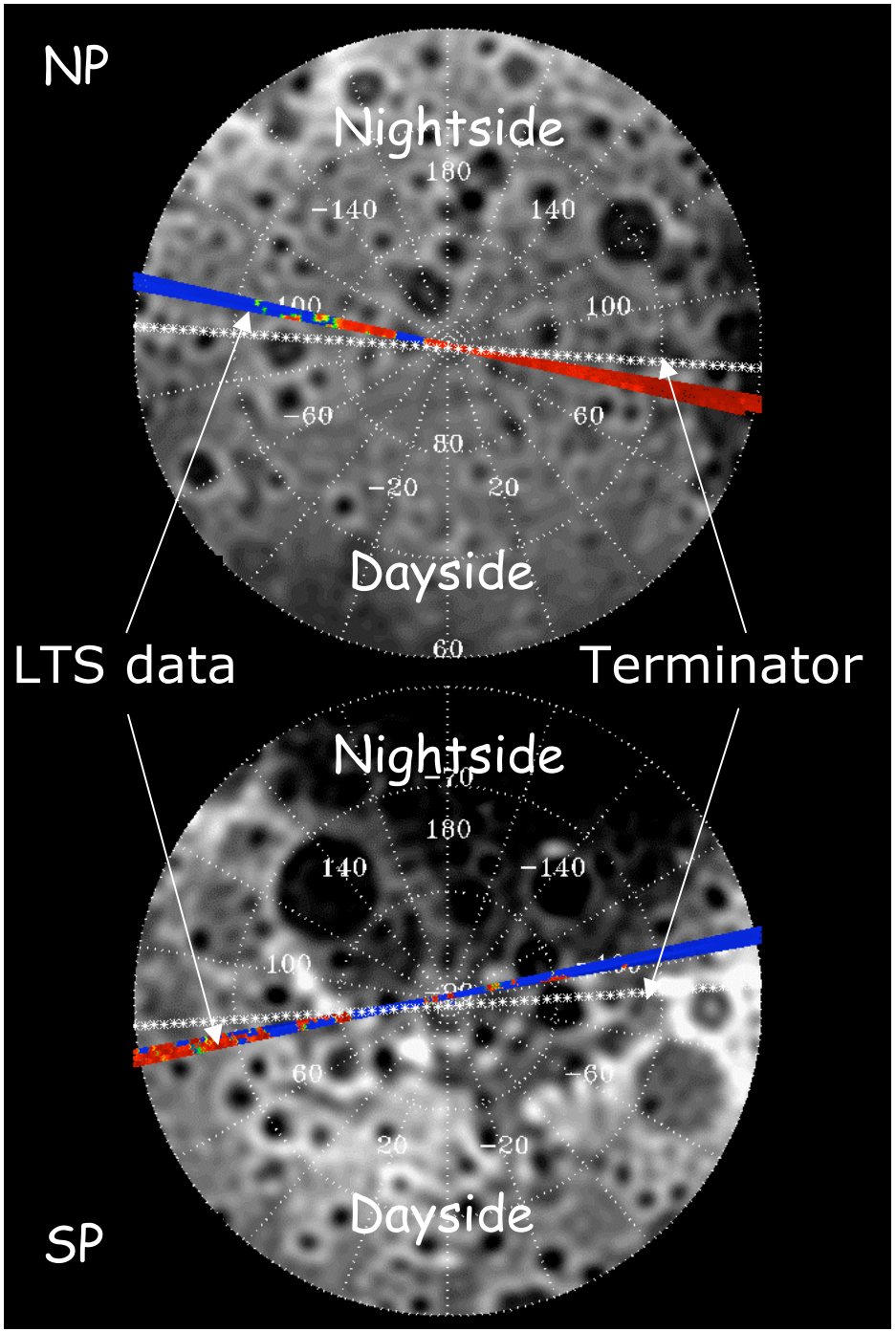
LAMP's sensitivity to several possible atmospheric species at a few times in the LRO mission. Current upper limits are from Feldman & Morrison [1991] and Parker et al. [1998]

Current Status:

• We are very paranoid about contamination, so we don't really get going until the LRO spacecraft has had plenty of time to outgas

• LAMP has been turned on and has tested its aperture door & Lunar Terminator Sensor (LTS)

•High-voltage ramp up will begin next week



Conclusions:

• LAMP will provide landform mapping (from Lyα albedos) at sub-km resolution in and around the permanently shadowed regions (PSRs) of the lunar surface

• LAMP will be used to identify and localize exposed water frost in PSRs

• LAMP will demonstrate the feasibility of using starlight and IPM Lyα skyglow for future surface mission applications

• LAMP will detect (or better constrain) the abundances of several atmospheric species