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Detection of the lunar impact-generated dust ejecta cloud by LRO/LAMP

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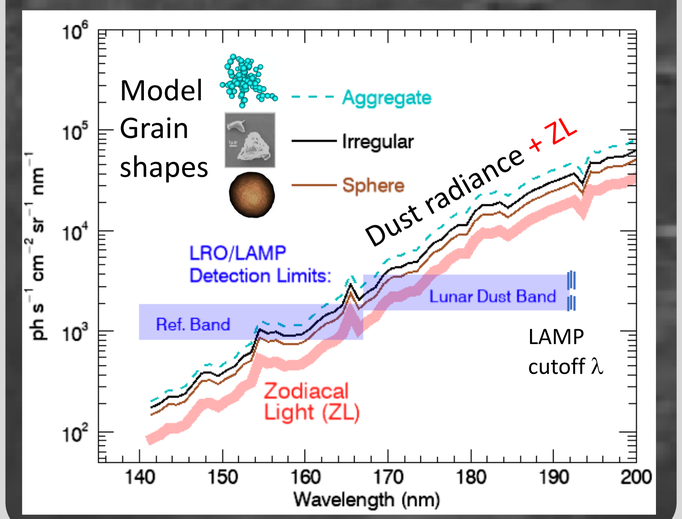
Motivations

- The LADEE dust detector (LDEX) made low latitude measurements of the permanent, impact-generated ejecta cloud surrounding the Moon [1]. Features[2,3]: Peak concentration near dawn (apex) limb, scale height ~ 200 km, grain size power law α~0.91.
- GSFC-developed suite for simulating dust-scattered sunlight from UV to near-IR using library of discrete dipole (DDA) scattering properties for multiple grain shapes[4,5].
- **Is the ejecta cloud bright enough to observe optically?**
- ***YES.*** Predicted radiance is above the LAMP detection limit (below), with intensity comparable to zodiacal light.
- LAMP should be able to detect the cloud above the dawn limb, at all latitudes.

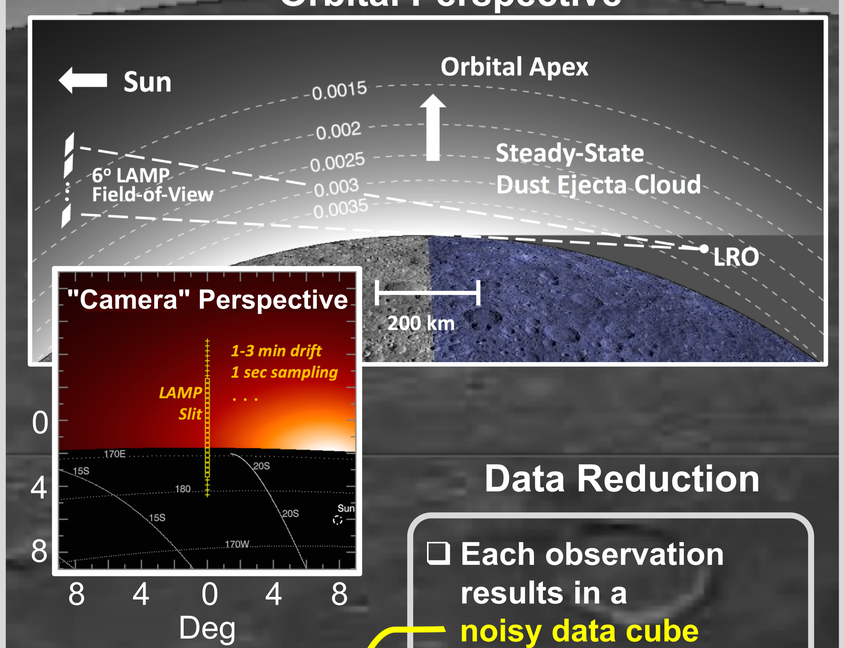
Predicted Ejecta Cloud Radiance above Dawn Limb

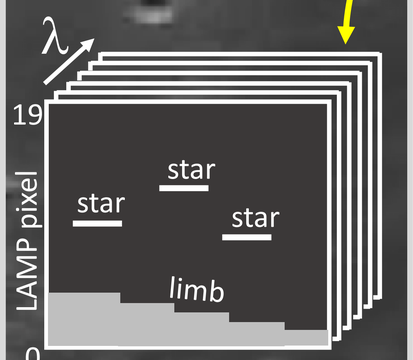


LAMP Observations

- Reanalyze existing 2012, 2013, limb searches by LRO/LAMP Ly-α mapping FUV spectrograph[6]
- Four dawn limb observations & four dusk limb observations.

Orbital Perspective



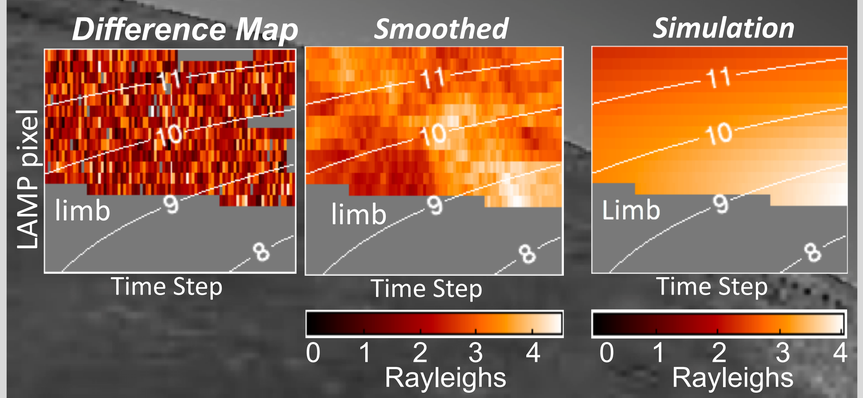


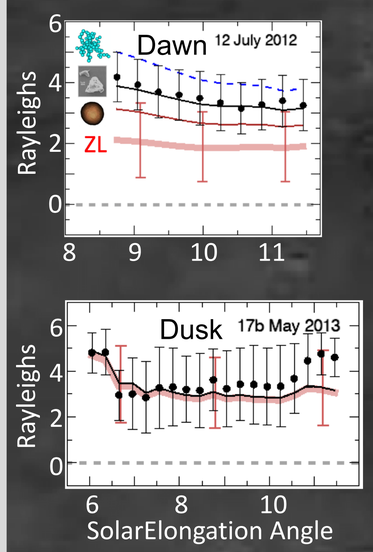
Data Reduction

- Each observation results in a **noisy data cube**
- Remove instrument scattered Lyman-α by subtracting "reference band" (140-167 nm) from "dust band" (167-192 nm). Result is a band difference map.
- Remove bright stars using outlier rejection routine. Create masks.
- Smooth using nearest-neighbor averaging

Results

- LAMP detected exospheric dust scattering super-imposed on zodiacal light (ZL) in all four dawn observations. Dusk observations show ZL only.
- This example shows the July 2012 dawn result & model simulation. Radiances are band-integrated values. Contours show solar elongation angle. Exospheric dust + ZL seen in the "smoothed" map





- Exospheric dust & ZL contributions separated by comparing dawn & dusk.
- LAMP measurements & uncertainties (in black).
- Model radiances are super-imposed on ZL.
- Consistent with scattering from irregular grains.
- Above the dusk (anti-apex) limb, only ZL is detectable, as predicted.
- Negligible exospheric dust contribution at dusk.

References:
[1] Horányi et al., *Nature*, **522**, 2015. [2] Szalay & Horányi, *GRL*, **43**, 2016. [3] Szalay et al., *JGR Planets*, **124**, 2019. [4] Richard et al., *PSS*, **59**, 2011, [5] Lolachi et al., Poster *NESF20-013* {this meeting}. [6] Feldman et al., *Icarus*, **233**, 2014.

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