THE SEARCH FOR A HIGH ALTITUDE DUST EXOSPHERE: OBSERVATIONAL STATUS AND DUST UPPER LIMITS. D. A. Glenar[1,2], T. J. Stubbs[3,4,2], W. M. Farrell[4,2], J. W. Keller[4,2], R. R. Vondrak[4,2], [1]New Mexico State University (dglenar@nmsu.edu), [2]NASA Lunar Science Institute, [3]University of Maryland, Baltimore County, [4]NASA Goddard Space Flight Center.

Introduction: Strong evidence for a lunar dust exosphere appeared during Apollo-era optical observations (see below). Additional confirmation has been much anticipated as a baseline for the upcoming LADEE mission[1], but so far, no confident detection of a dust exosphere has been made since that time. Dust is detected optically via single-scattering of sunlight, and would appear from orbit as faint horizon glow (HG) near the limb, a consequence of its small expected scale height (5-10 km). At near-UV/VIS wavelengths, HG would also be superimposed on the coronal-zodiacal light (CZL) background, which brightens rapidly at small solar elongation angle[2] and complicates the measurements. Line-of-sight (LOS) dust optical depth is expected to be very small ($< 10^{-5}$) with dust concentration < 0.01 cm^{-3} at a few km altitude, although these numbers are sensitive to grain size and illumination altitude. We summarize the search results that have so far been reported, and use these to estimate dust concentration and upper limits.

Searches for High Altitude Horizon Glow:

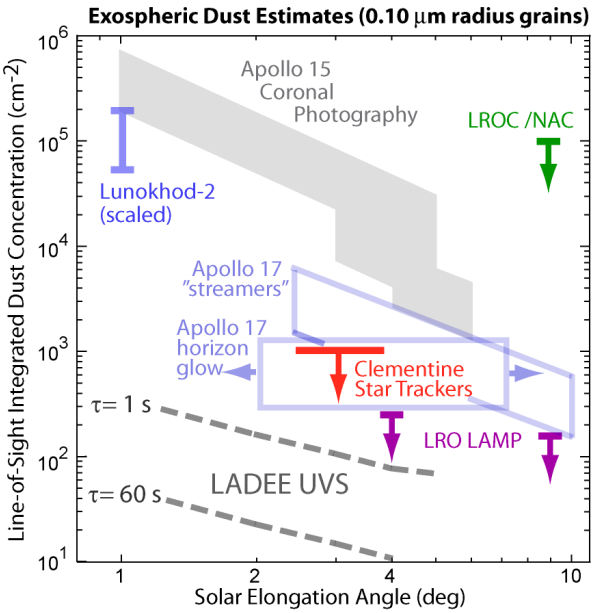
Apollo Era. Excess limb brightness was observed in Apollo 15 coronal photographs, and analyzed in terms of dust at altitudes of a few km or higher[3],[4]. The notion of a measurable dust exosphere was further supported by Apollo 17 astronaut observations[5] of horizon glow with apparent radial crepuscular rays, dubbed "streamers", as well as measurements of sky brightness by uplooking photometers on the Lunokhod-2 lander, acquired shortly after surface sunset[6].

Clementine Star Trackers. Portions of 25 orbits were allocated to limb searches for horizon glow using the Clementine navigational star trackers[7]. Four of the image sequences were made at small solar elongation angles and free of earthshine at the limb, which lessens the chance of stray light contamination. No obvious HG appears in these data sets above the detection limit of 2-3 x 10^{-12} B_{Sun} (with B_{Sun} the mean solar disk brightness), although this analysis is still in progress.

Limb Searches by LRO Instruments. Dust searches are being carried out at far-UV wavelengths by the LRO Lyman Alpha Mapping Project, LAMP[8] and also at VIS wavelengths by the LROC Narrow Angle Camera (NAC)[9]. Dust scattering has not yet been detected, although LAMP established firm upper limits at the times and locations of the measurements. Because the NAC was designed for imaging of the sunlit surface, it is rather insensitive to low brightness scenes[10].

Dust Estimates: The figure compares the resulting LOS dust estimates and observational upper limits for a tangential viewing geometry. Brightness was converted to LOS concentration using Mie scattering theory and a broadband model for lunar dust optical constants[11], assuming a narrow size distribution of dust grains, with r_{peak}= 0.10 μm. Tangent height is 5-10 km, but that is not tightly constrained in this comparison. The uplooking Lunokhod measurements are converted to limb viewing geometry using a dust distribution model with scale height of 5 km. Predicted LADEE UVS detection limits (at λ≅ 400 nm) are shown for comparison.

Were the Apollo-era observations in error? Upcoming measurements should provide needed aswers.



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