STATUS OF A PROGRAM MONITORING OPTICAL LUNAR SURFACE TRANSIENTS. A. P. S. Crotts[1], A. Berger[1], G. Cecil[2], P. Cseresnjes[1], D. Ebel[3], P. Hickon[4], M. Joner[5], T. Pfrommer[4], S. Marka[1], R. Morehead[1], J. Radebaugh[5], P. Schultz[6] for AEOLUS[7] collaboration; [1]Columbia U., [2]U. NC, Chapel Hill, [3]Amer. Museum of Natural Hist., [4]U. Brit. Columbia, [5]Brigham Young U., [6]Brown U., [7]Atmosphere from Earth, Orbit and LUnar Surface

Introduction: Until 20 to 30 years ago, optical transients on the lunar surface (Transient Lunar Phenomena: TLP or LTP) were seen as an important, outstanding lunar mystery in need of study. [1,2,3] Since then, we have gained little understanding of TLPs, although recent work offers statistical evidence that they are at least highly correlated with lunar surface outgassing traced by ^{222}Rn. [4] The debate on even the reality of TLPs as a coherent physical effect (as opposed to observer error) has been limited to the popular literature, both pro and con. [5,6]

The primary difficulty with TLPs is the largely anecdotal nature of nearly all of the historical observational database. Although many TLP reporters were trained observers, and even though ^{222}Rn results above [4] were greatly expunged of many such effects, [7] this topic suffers from lack of an unbiased, objective data sample. We report on progress to produce such a dataset exploiting recent advances in robotic telescope technology, and follow-up studies to enhance the value of these observations, simultaneous to lunar satellite surveys bearing on outgassing. The *Kaguya*/ARD is in lunar polar orbit and designed to detect ^{222}Rn outbursts like those seen on Apollo and *Lunar Prospector.*

Transient Monitoring Dataset: Since early 2008 we have monitored the Near Side with 0.25-meter telescopes imaging onto 16 Mpix CCDs. The two robotic telescopes are stationed at Cerro Tololo Inter-american Observatory near La Serena, Chile (70°.82W Long, 30°.16S Lat) and Rutherford Observatory in New York, NY (73°.96W Long, 40°.81N Lat). These allow possibly simultaneous observation of the same event at widely separated (~8000 km) sites, to help certify the lunar origin of a doubly-detected event.

Images produced by each monitor are nearly identical, corresponding to ~1.0 arcsec per pixel (~1.8 km). Since the historical database of TLP reports concentrate almost entirely in 1-100 minute durations, each monitor is programmed to take an exposure every 20 s, with a typical duration of 10 ms. As of 2009 January 8 these monitors have produced approximately 120,000 science images, equivalent to 1 month of continuous operation. Our goal is to at least triple this duration (based on several estimates from historical report rates, indicating intrinsic rates of several per month).

Data Reduction and Analysis. Once images are bias level subtracted and flat fielded, they are convolved with an image kernal that adjusts each image to a common image quality and subtracts the resulting flux from a reference image common to all exposures. This image subtraction residual has nearly all of the constant flux removed from each original image. In this case a change due a transient source is much easier to detect (by approximately a factor of 10 over what the eye detects as changes in the original image) to a level of order 1-2% of the original flux contained in a 1-arcsec point source (FWHM).

Results. At this point (2009 January 8) we have processed a test sample of 3000 images and found that there are still effects limiting the sensitivity to flux changes by about a factor of three. We are in the process of identifying and treating those before anayzing the entire dataset. We continue to operate the two robotic stations. The summary of this effort is found at http://www.astro.columbia.edu/~arlin/TLP/ We will report at the meeting on the status of event detection.

Followup Observations: If TLP events are due to outgassing from the lunar surface, one plausible mechanism for these is the accumulation of gas below the regolith, leading to a localized blowout through the overlaying material as gas pressure increases. [8] One possible observable consequence beyond short-lived TLP events might be the quasipermanent change in the photometric properties of the regolith surface due to the age of dust indicated by the 0.95 micron Fe^{2+} band. Not only is this band covered at high spatial resolution by current and future lunar missions, but we are conducting (approaching) diffraction-limited “Lucky Imaging” observations from the ground during this time with roughly 0.5-km resolution. [8] These are being made at the Calypso 1.2-meter imaging-optimized telescope over the period 2008-2010.

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