LUMINOUS EFFICIENCY OF HYPERVELOCITY METEOROID IMPACTS ON THE MOON DERIVED FROM THE 2015 GEMINID METEOR SHOWER

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Meteoroids cannot be observed directly because of their small size. In-situ measurements of the meteoroid environment are rare and have very small collecting areas. The Moon, in contrast, has a large collecting area and therefore can be used as a large meteoroid detector for gram-kilogram sized particles.

Meteoroids striking the Moon create an impact flash observable by Earth-based telescopes. Their kinetic energy is converted to luminous energy with some unknown luminous efficiency $\eta(v)$, which is likely a function of meteoroid velocity (among other factors). This luminous efficiency is imperative to calculating the kinetic energy and mass of the meteoroid, as well as meteoroid fluxes, and it cannot be determined in the laboratory at meteoroid speeds and sizes due to mechanical constraints.

Since laboratory simulations fail to resolve the luminous efficiency problem, observations of the impact flash itself must be utilized. Meteoroids associated with specific meteor showers have known speed and direction, which simplifies the determination of the luminous efficiency. NASA has routinely monitored the Moon for impact flashes since early 2006 [1]. During this time, several meteor showers have produced multiple impact flashes on the Moon, yielding a sufficient sample of impact flashes with which to perform a luminous efficiency analysis similar to that outlined in Bellot Rubio et al. [2, 3] and further described by Moser et al. [4], utilizing Earth-based measurements of the shower flux and mass index.

The Geminid meteor shower has produced the most impact flashes in the NASA dataset to date with over 80 detections. More than half of these Geminids were recorded in 2015 (locations pictured in Fig. 1), and may represent the largest single-shower impact flash sample known. This work analyzes the 2015 Geminid lunar impacts and calculates their luminous efficiency. The luminous efficiency is then applied to calculate the kinetic energies and masses of these shower meteoroids.

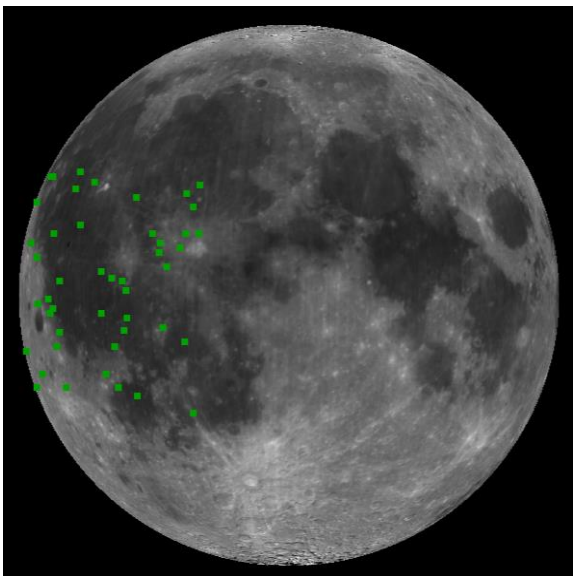

Figure 1. Location of lunar impact flashes observed during the 2015 Geminid meteor shower.

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