The flux of large meteoroids observed with lunar impact monitoring

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The flux of large meteoroids is not well determined due to relatively low number statistics, due mainly to the lack of collecting area available to meteor camera systems (10^2–10^5 km^2). Larger collecting areas are needed to provide reasonable statistics for flux calculations. The Moon, with millions of square kilometers of lunar surface, can be used as a detector for observing the population of large meteoroids in the tens of grams to kilogram mass range. This is accomplished by observing the flash of light produced when a meteoroid impacts the lunar surface, converting a portion of its kinetic energy to visible light detectable from the Earth.

A routine monitoring program at NASA's Marshall Space Flight Center has recorded over 300 impact flashes since early 2006. The program utilizes multiple 0.35-m (14-inch) Schmidt-Cassegrain telescopes, outfitted with video cameras using the 1/2 inch Sony EXview HAD CCDTM chip, to perform simultaneous observations of the earthshine hemisphere of the Moon when the lunar phase is between 0.1 and 0.5. This optical arrangement permits monitoring of approximately 3.8×10^6 km^2 of lunar surface. A selection of 126 flashes recorded in 266.88 hours of photometric skies was analyzed, creating the largest and most homogeneous dataset of lunar impact flashes to date. Standard CCD photometric techniques outlined in [1] were applied to the video to determine the luminous energy, kinetic energy, and mass for each impactor, considering a range of luminous efficiencies.

The flux to a limiting energy of 2.5×10^{-6} kT TNT or 1.05×10^7 J is 1.03×10^{-7} km^{-2} hr^{-1} and the flux to a limiting mass of 30 g is 6.14×10^{-10} m^{-2} yr^{-1}. Comparisons made with measurements and models of the meteoroid population indicate that the flux of objects in this size range is slightly lower (but within the error bars) than the power law distribution determined for the near-Earth-object population by [2].

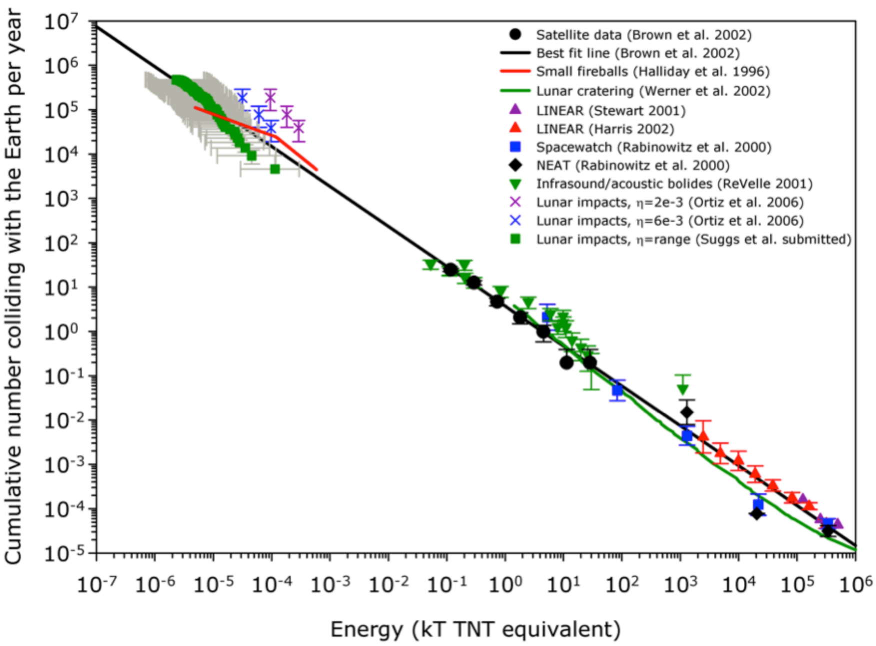

Figure: Number of meteoroids vs. energy striking the Earth each year after [2]. Lunar impacts used in this study are shown in the upper left. Error bars indicate extremes of luminous efficiency (along the x axis) and Poisson statistics (along the y axis).

References: [1] Suggs, R. M., Moser, D. E., Cooke, W. J., and Suggs, R. J. Icarus, submitted. [2] Brown, P. G., Spalding, R., ReVelle, D., Tagliaferri, E., and Worden, S. (2002) Nature 420, 294–296.