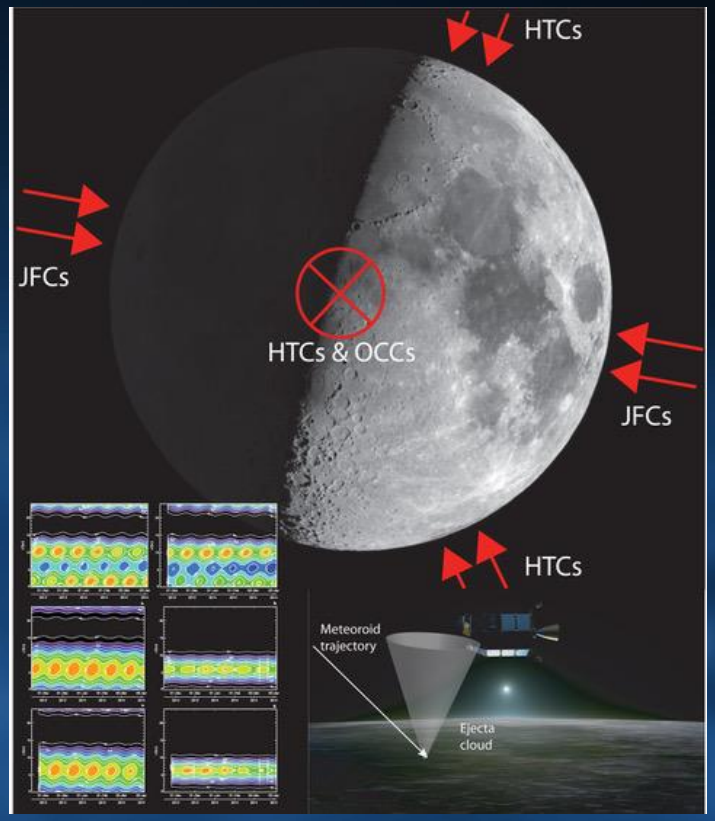
Tracing the Origin of Meteoroids Bombarding the Moon and Their Effect on the Lunar Exosphere



Many families of comet-based meteoroids — including Halley-type comets, Jupiter-family comets and Oort Cloud comets — impact the moon from many directions. Investigating the relationship between micrometeoroids and the Moon's exosphere provides insight into how future lunar missions could be affected by the meteoroid bombardment.

When meteoroids bombard planetary bodies such as Earth's Moon -- which lack multiple layers of atmosphere -- the meteoroids directly hit the surface without interference from atmospheric mechanisms. These surface impacts eject materials up from the Moon, resulting in a dust cloud exosphere. Understanding this exosphere and how it is created, provides insight into protecting future lunar missions.

NASA's Lunar Atmosphere and Dust Environment Explorer (LADEE), with the Lunar Dust Experiment (LDEX) aboard, previously showed that the dust cloud was a permanent, asymmetrical feature of the Moon. Using the velocity and mass of meteoroids impacting the lunar surface from dynamical models to explain the measured density and shape of the secondary dust cloud ejecta can be used to determine what population of parent comets this dust cloud originated from. New research published in AGU Publications used several sophisticated models to follow the lifespans of meteoroids, and modelled which kinds of comets contribute the most to the ejecta cloud observed by LADEE.

Comets with periods less than or equal to 20 years provide 1.3 times more meteoroids than that of comets with longer periods. However, since the meteoroids produced by long-period comets impact the Moon at much higher velocities than short-period comets, they are responsible for producing most of the ejecta. Future experiments and theoretical work will be needed to determine the velocity and mass dependence for dust ejecta production on the Moon.

Janches, D., Pokorn´y, P., Sarantos, M., Szalay, J. R., Horányi, M., & Nesvorny, D. (2018). Constraining the ratio of micrometeoroids from short- and long-period comets at 1 AU from LADEE observations of the lunar dust cloud. Geophysical Research Letters, 45. https://doi.org/10.1002/2017GL076065