# Some of the moon's craters are from interstellar impacts. Can we tell which?

November 10 2023, by Nancy Atkinson

Far side of the moon imaged by MoonKAM. This image of the lunar surface was taken by the MoonKAM system onboard NASA's Ebb spacecraft on March 15, 2012. Credit: NASA/Caltech-JPL/MIT/SRS

By discovering two interstellar objects (ISOs), we know that asteroids and comets from other star systems pass through the solar system from time to time. By inference, some of these must have crashed into the moon, creating impact craters. If we could study the impact sites, we might be able to learn about the star systems that they came from.

A new paper suggests there could be a way to determine which lunar craters came from interstellar object impacts. The authors say that young, small craters with high-melt volume near the moon's equator are likely the best candidates for ISO-generated craters on the lunar surface.

The two landmark discoveries of ISOs have changed our thinking on what's possible for the origins of objects in our solar system. Detecting the cigar-shaped body named 'Oumuamua (2017) and the speedy rogue Comet 2I/Borisov (2019) suggest that these objects—which have somehow been ejected from other solar systems—can wander through the Milky Way, unattached to any star system, for hundreds of millions of years.

Astronomers say their detections—made possible by improved telescopes and observing techniques—implies a large population of such objects exist and that ISOs enter our solar system on a fairly regular basis. Estimates have ranged from one, to seven, to 21 and even 70 objects every year.

Even if just a few pass through every year, over time there has likely been ISO-generated craters on the moon. This new paper by Daniel Chang, Cheng-Han Hsieh, and Gregory Laughlin, published in *Research Notes of the AAS*, explores how different crater properties such as age, size, melt, and position can be used to search for ISO-generated craters on the lunar surface.

"We find that selecting young, small craters with a high volume of melt

located away from the lunar poles increases the likelihood of association with a high-speed ISO by 100-fold as compared to selecting randomly, assuming high-speed ISO impacts generate melt," the authors wrote.

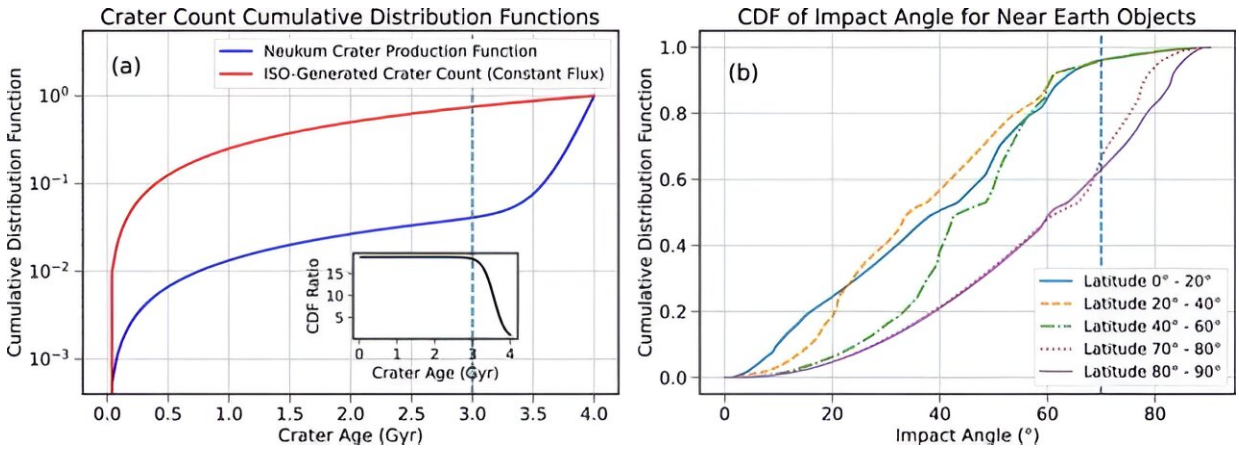


Figure 1. (a) shows the difference between the cumulative distribution functions of craters generated from solar system objects and ISOs. Most craters generated from solar system objects were formed in the first billion years, so that the ratio of the CDFs for craters with ages less than 3 Gyr is ~20. (b) shows the cumulative probabilities of impact angles at various latitudes on the moon for Near Earth Objects, calculated from the probability found in (Robertson et al, 2021). For latitudes 0° through 70°, there is a

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