SMALL BODIES

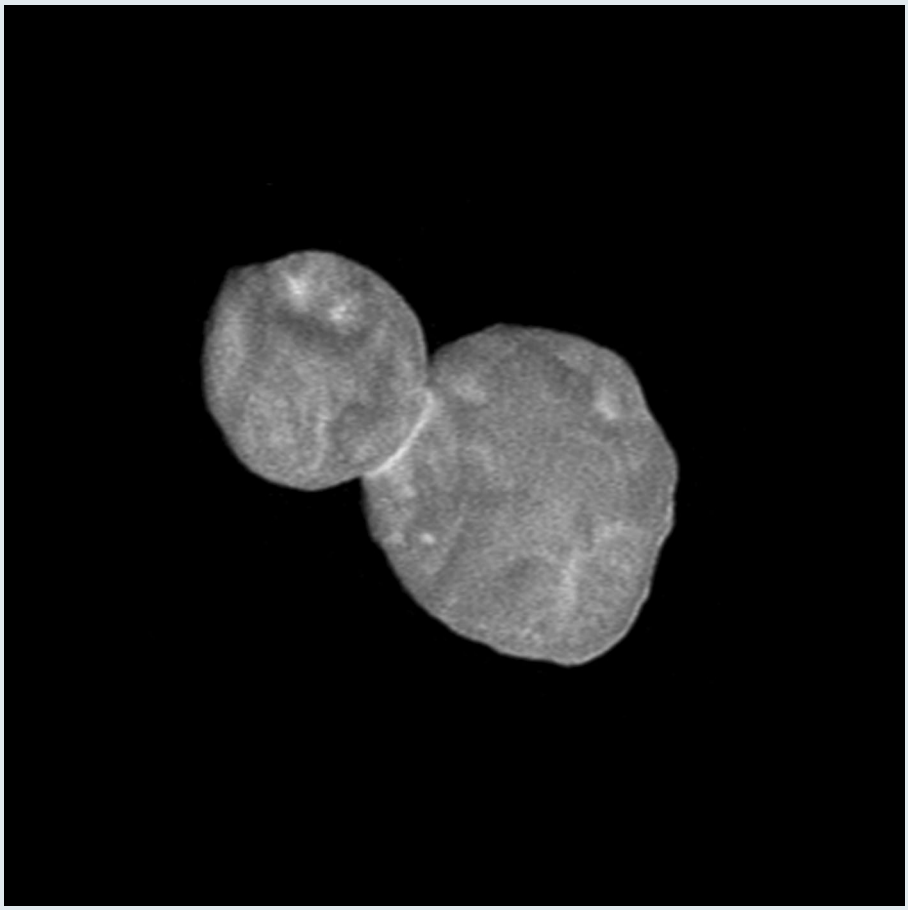
A snowman far, far away

Space exploration in 2019 started with a bang, with the flyby of trans-Neptunian object (TNO) (486958) 2014 MU_{69}, also known as Ultima Thule, by the New Horizons spacecraft. The NASA mission performed an even more technically challenging feat than its flyby of Pluto three and a half years ago: MU_{69} was significantly less characterized than the dwarf planet (it had been discovered, in fact, only in June 2014, eight years after the launch of New Horizons itself) and much smaller — around 40 times in linear dimensions. The data acquired during the closest part of the flyby haven't been released yet, but the team released a series of images acquired during approach. This is by far the most pristine and farthest planetary body observed from close-by.

The first obvious feature of MU_{69} is its shape, distinctly made up by two roundish objects in contact. MU_{69} is in fact the most perfect representative of a contact binary that we have discovered. Such a shape is not a complete surprise. In July 2017, a series of occultations of MU_{69}, performed by observing a star being eclipsed by the body from various locations on Earth, discovered that MU_{69} is elongated. Indeed, the occultations predicted the actual shape almost perfectly. In addition, based on the results of ground-based surveys of TNOs and from models of planet formation, we expect a significant number of binaries or contact binaries in the TNO population. However, the details of the shape of MU_{69} — essential to determine its history and evolution — couldn't be resolved from ground-based observations, due to the reduced spatial resolution attainable from Earth and the small dimensions of the object. Interestingly, the most recent images, taken from different angles, seem to suggest that the two lobes are not as spherical as they looked from the first released images, but rather flatter on one side, so the snowman analogy could possibly not hold at further scrutiny.

As the two parts of MU_{69} mostly retained their original shapes, their collision must have been a gentle one, happening at low speed. This scenario gives strong indications on how MU_{69} was formed, supporting the 'pebble accretion' theory: the two objects were formed close to each other by aggregation of smaller planetesimals and spiralled towards each other until contact. The contact region is distinctly brighter than the rest of the object, for reasons yet to be clarified, but in general the object is pretty dark, with an albedo between 6% and 13%, and dominated by a red hue. 'Red' usually means 'organics' in the outer Solar System, like the patches observed by New Horizons on Pluto and Charon, produced by irradiation of surface ices. But we will need to wait for the data from the spectrometers on New Horizons to identify the material of MU_{69}'s surface and its surficial distribution.

As usual for space missions, these first impressions give some answers and generate even more questions: what is the actual shape of MU_{69}? Why is the neck bright? What are its composition and topography? Are there any craters or boulders? Can we confirm and better constrain the pebble accretion scenario or are there alternative explanations for MU_{69}'s formation? Luckily we have another 20 months of upcoming data taken from the whole suite of instruments on New Horizons, (hopefully) including the highly resolved images from closest approach, to look forward to. ❐



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