LIMB TOPOGRAPHY OF 2014 MU69: FIRST RESULTS FROM THE NEW HORIZONS FLYBY.

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Introduction: MU_{69} is the first cold classical Kuiper belt object ever visited by a spacecraft [1]. By understanding the shape and topography of MU_{69}, we can begin to characterize the first order processes that formed this object. Prior to the New Horizons encounter there was a suggestion from occultations that MU_{69} is a bilobate body [2]. In this work we present the first direct measurements of the shape and limb topography of MU_{69}.

Methods: Four independent methods are being deployed to determine the limb in the MU_{69} flyby images. All methods start with an initial estimate for the body center and use sub pixel interpolation to increase precision. These methods find the exact limb as follows

1) Scanning along each row and column of pixels, pick the point at which the brightness is 50% of the face brightness.

2) Scanning radially away from the body center, pick the point at which the brightness is 50% of the face brightness.

3) Because the limb is a sharp change in brightness it is often a peak in the image gradient. Our third approach finds the circle that minimizes the distance between the rim and peak gradient.

4) Scanning radially away from the body center, pick the maximum gradient.

Methods 1-3 were also used to determine the shape of Pluto and Charon. These methods are described in detail in Nimmo et al. [3]. These methods are able to consistently pick the limb with <0.5 pixel accuracy when compared with synthetic images and with each other.

Initial Results: At the time of writing, the highest resolution image of MU_{69} that has been received is 0.14 km/pixel (Figure 1). MU_{69} consists of two, nearly circular, lobes. By fitting best fit circles to each lobe, we estimate radii of 9.73+/-0.02 km and 7.12+/-0.06 km. These are the best fit circles projected onto the image frame. The volume equivalent radii may be outside the errors due to long wavelength shape; some visible in Figure 1 and some that may be outside the plane of the image. As images from more viewing geometries are downlinked the full body shape will become more clear [4].

These limb picks also provide the first estimation of the topography of MU_{69}. While the precise values depend on the body shape, it is clear that there is topography with an amplitude of at least ~1 km and ~0.5 km on the large and small lobes respectively. This topographic amplitude is small relative to similarly sized bodies [5]. The source of this topography is still unclear but may be some combination of craters, hills, and accretional landforms.

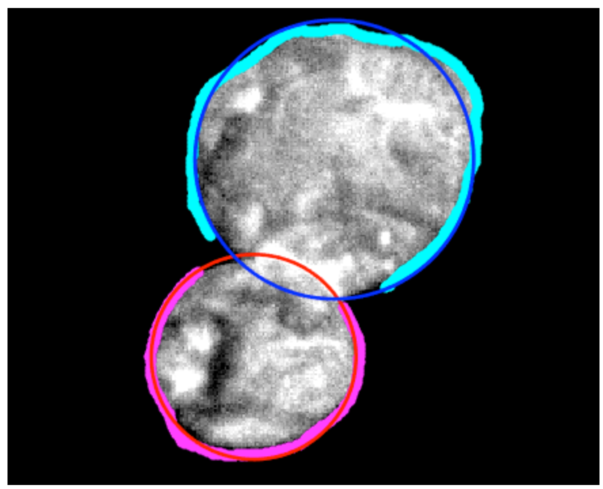

Figure 1: *CAO4 LORRI image of MU69. This image has a pixel scale of 0.14 km/pix. Limb picks shown are from method 1. Also shown are the best fit circles for each lobe.*

Future work: Limb picks on higher resolution images will be presented at the meeting that are not downlinked as of this writing. The anticipated highest resolution images have ~33 m/pix. With these new images, we also anticipate different viewing angles that will help constrain the long-wavelength shape. We will present comparisons of the topography between the lobes and with similarly sized objects.

References: [1] Stern S. A. et al. (2019) *LPSC 50, This meeting* [2] Buie M. W. et al. (2019) T *LPSC 50, This meeting* [3] Nimmo F. et al. (2017) *Icarus* 287, 12-29 [4] Porter S. et al. (2019) *LPSC 50, This meeting* [5] Ermakov A. I. (2018) *JGR:Planets* 123, 8, 2038-2064