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ESO/VLT/SPHERE Survey of D>100km Asteroids (2017-2019): (7) Iris

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Abstract

The high angular resolution of the new-generation visible adaptive-optics camera SPHERE/ZIMPOL mounted on the ESO/VLT telescope on Cerro Paranal opened only recently an exciting opportunity to study asteroid topography and shapes in great details with the ground-based observations [V18]. Such task was so far possible only for the two largest asteroids – (1) Ceres and (4) Vesta. ZIMPOL observations with a pixel scale of 3.6 mas [S17] are about four times sharper than those from the HST (FGS instrument), therefore the instrument is capable of resolving the majority of $D > 100$ km main-belt asteroids, which usually have an angular diameter larger than 100 mas during their convenient apparitions. Currently, only in-situ observations by space probes can provide better images.

In 2016, ESO approved a Large program (PI: P. Vernazza; ID: 199.C-0074) that involves acquiring high angular images of ~40 asteroids larger than 100 km throughout their rotation during four semesters (starting April 2017). The aim of the observing campaign is to better understand asteroid shapes, their internal composition and local surface topography. Here, we draw our attention to the main-belt asteroid (7) Iris (hereafter simply Iris), which belongs to one of the three largest members of the S-type spectral class.

Five epochs of Iris well spaced in the rotation phase were observed with the SPHERE instrument [B08] during two consecutive nights in October 2017. We clearly resolved several surface features (impact basins) that are consistent throughout the deconvolved images obtained using an modified MISTRAL algorithm with a library set of PSF frames [F03]. The observations are exclusively limited to the south pole of Iris (aspect angle $\sim 160°$) due to the pole-on observing geometry. We compare our shape model to the independent shape model based on delay-Doppler radar data acquired at a similar observing geometry [O10].

The spectacular quality of the images is partly given by the large angular size of Iris – 0.33". Considering the large size of Iris ($\sim$215 km), one pixel represents $\sim$2.3 km at distance of Iris (0.89 au), which allows us to reliably detect surface details as large as $\sim$30 km.

We present a scaled-in-size 3D shape model with local topography of Iris (Fig. 1) derived by the All-Data Asteroid Modeling (ADAM) algorithm [V15,V16] that takes both optical lightcurves and disk-resolved images into consideration. Moreover, we also estimate Iris' bulk density. We further comment on the global and local features of Iris' shape with respect to its early and recent collisional history. Finally, we also re-examine the existence of a potential collisional family related to Iris in a search for a possible link with any of the large basins on its surface.

Acknowledgements

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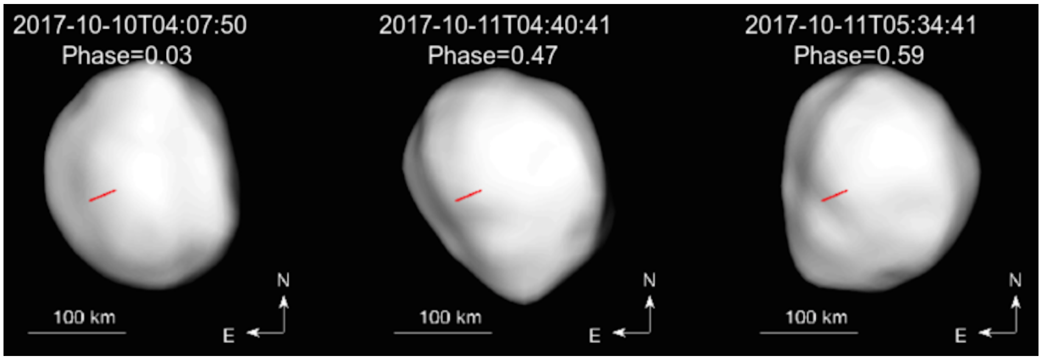

Figure 1: A low-resolution shape model of Iris reconstructed from the optical lightcurves and VLT/SPHERE images. The red line indicates the position of the spin axis with the ecliptic longitude $\lambda = 19°$ and latitude $\beta = 25°$.

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