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Constraining the shape and density of binary asteroid (121) Hermione

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Context

(121) Hermione is a large binary asteroid [1] located at the outer edge of the asteroid belt in the Cybele region, where asteroids are thought to be linked to the outer Solar System. Hermione has a Ch/Cgh-type that has been linked to CM chondrites. Adaptive optics observations between 2003 and 2008 suggest a rare bilobate shape for the primary [2,3]. However, Hermione's shape and bulk density (ranging between 1.4 and 2 $g.cm^{-3}$) remain poorly constrained to this day.

Aim

We acquired spatially resolved images and optical lightcurves of Hermione during its close apparition of September 2021. It was the best chance in 13 years to acquire such high angular resolution images (angular diameter = 0.14"). We aimed to constrain Hermione's 3D shape, hence its volume, and the orbit of its satellite, hence the mass of the system. Combining the volume and the mass allows to constrain the bulk density with high accuracy.

Methods

We obtained 8 series of 5 images with the SPHERE/ZIMPOL instrument on the Very Large Telescope (ESO Program ID 107.22UT.001; PI: P. Vernazza). These images were combined with optical lightcurves and stellar occultations by the ADAM and MPCD methods [4,5] to reconstruct the asteroid's 3D shape. For the determination of the satellite's orbit, we complemented the SPHERE images with a compilation of archival data from other large ground-based AO instruments (KeckII/NIRC2, ESO/VLT/NACO and Gemini-North/NIRI). Then, we used the meta-heuristic

algorithm Genoid [6] to accurately determine the orbital elements.

Results

The determined volume and mass of Hermione yield a new higher bulk density of ~1.7 g.cm^{-3}, more compatible with its Ch/Cgh classification. We will also present our analyse of the shape and compare it with other elongated Ch/Cgh asteroids.

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