EPSC Abstracts
Vol. 16, EPSC2022-242, 2022, updated on 07 Nov 2022
https://doi.org/10.5194/epsc2022-242
Europlanet Science Congress 2022

(65) Cybele is the smallest asteroid at hydrostatic equilibrium, why?

Michaël Marsset[1,2], Miroslav Brož[3], Julie Vermersch[4], Nicolas Rambaux[4], Marin Ferrais[5], Matti Viikinkoski[6], Josef Hanuš[3], Emmanuel Jehin[7], Edyta Podlewska-Gaca[8], Przemyslaw Bartczak[8], Grzegorz Dudziński[8], Benoit Carry[9], and Pierre Vernazza[5]

[1]European Southern Observatory (ESO), Alonso de Cordova 3107, 1900 Casilla Vitacura, Santiago, Chile mmarsset@eso.org
[2]Department of Earth, Atmospheric and Planetary Sciences, MIT, 77 Massachusetts Avenue, Cambridge, MA 02139, USA
[3]Charles University, Faculty of Mathematics and Physics, Institute of Astronomy, V Holešovičkách 2, CZ-18000, Prague 8, Czech Republic
[4]IMCCE, CNRS, Observatoire de Paris, PSL Université, Sorbonne Université, 77 Ave. Denfert-Rochereau, 75014 Paris, France
[5]Aix Marseille Univ, CNRS, CNES, Laboratoire d'Astrophysique de Marseille, Marseille, France
[6]Mathematics and Statistics, Tampere University, 33720 Tampere, Finland
[7]Space sciences, Technologies and Astrophysics Research Institute, Université de Liège, Allée du 6 Aoút 17, 4000 Liège, Belgium
[8]Astronomical Observatory Institute, Faculty of Physics, Adam Mickiewicz University, Słoneczna 36, 60-286 Pozna´n, Poland
[9]Université Côte d'Azur, Observatoire de la Côte d'Azur, CNRS, Laboratoire Lagrange, France

Context – Cybele asteroids constitute an appealing reservoir of primitive material genetically linked to the outer Solar system. The physical properties (size, shape) of the largest members can be directly measured with high-angular resolution imagers mounted on large (8-m class) telescopes.

Aim – We took advantage of the bright apparition of the most iconic member of the Cybele population, (65) Cybele, in July and August 2021 to acquire high angular resolution images and optical light curves of the asteroid that were used to analyze its shape, topography and bulk properties (volume, density).

Methods – Eight series of images were acquired with SPHERE+ZIMPOL on the Very Large Telescope (ESO Program ID 107.22QN.001; PI: Marsset) and combined with optical light curves to reconstruct the shape of the asteroid using the ADAM (Viikinkoski et al. 2015), MPCD (Capanna et al. 2013) and SAGE (Bartczak & Dudziński 2018) algorithms.

Results – We will present Cybele's bulk properties, including its volume-equivalent diameter and average density, in the context of other low-albedo P-type asteroids. We will show that Cybele's shape and rotation state are entirely compatible to those of a Maclaurin equilibrium figure, opening up the possibility that D≥260 km (M≥1.4x10^19 kg) small bodies from the outer Solar System formed at equilibrium. We will further present the results of N-body simulations used to explore whether the equilibrium shape of Cybele is the result of a large resetting impact (similarly to the case of Hygiea; Vernazza et al. 2020), or if it is primordial (i.e., the result of early internal heating due to the radioactive decay of short- and long-lived radionuclides).