EPSC Abstracts
Vol. 13, EPSC-DPS2019-435-1, 2019
EPSC-DPS Joint Meeting 2019

EPSC
EPSC-DPS Joint Meeting 2019
15–20 September 2019 | Geneva, Switzerland

Three Stellar Occultations by the Plutino Object (84922) 2003 VS2

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Abstract

In the past decade, Stellar occultations by Trans-Neptunian Objects (TNOs) showed that it is a powerful and direct technique to obtain accurate diameters, shapes and albedos of these bodies [1 - 11]. Interesting and puzzling results were obtained, including topographic features, atmospheres, and satellites, besides the discovery of rings around the Centaur chariklo [5] and the dwarf planet Haumea [9]. It apears that some bodies are not in the usual assumption of Jacobi hydrostatic equilibrium [9]. Here we present new findings from three world wide observing campaigns that resulted in the detection of two single-chord (in December 2013 and March 2014) and one multi-chord stellar occultation (in November 2014) by the plutino object (84922) 2003 VS2.

1. Introduction

Stellar occultations by TNOs showed that it is a powerful and direct technique to obtain accurate diameters, shapes and albedos of these bodies, besides topographic features, atmospheres, satellites, and the discovery of rings around a Centaur and a Dwarf Planet. In 2013 and 2014 we organized three world wide observing campaigns to detect stellar occultations by the plutino object 2003 VS2, resulting in two single-chord and one multi-chord detection. We obtained positive detection of the occultation in four sites among seven in Argentina, Uruguay, Chile and Brazil.

2. Results

The single-chord detections provided a good position for improving the ephemeris of the object (uncertainties at mas level) and improved the accuracy to predict for the following occultations. The multi-chord occultation data provided the apparent instantaneous cross section with equatorial diameter 627.6 ± 14.2 km, apparent oblateness 0.190 (+0.052 -0.060) and area equivalent diameter of 564.8 (+33.8 -30.2) km, which is about 8% bigger than values derived from Hershel and Spitzer data [12]. From those values we derived a value for the visible geometric albedo (0.123 +0.015 -0.014).

Combining the occultation data with the rotational period and the light curve amplitude determined from a short-term photometry data obtained a few days ater the occultation, we derived the rotational phase during the occultation. We observed that the occultation took place near one of the maximum brightness and then it was possible to derive its 3D-shape, with axis "a x b x c" = 313.8 (± 7.1) km x 265.5 (+8.8 -9.8) km x 247.3 (+26.6 -43.6) km. This shape is not consistent with a Jacobi triaxial equilibrium figure, as is the case for the dwarf planet Haumea.

Assuming that 2003 VS2 has an oblate Maclaurin equilibrium figure and the light curve amplitude is mostly due to albedo features, we derive an upper limit of 1400 kg m^{-3} for its density.

The disappearances and reappearances of the star during the occultations do not show any compelling evidence for a global atmosphere, nor secondary features (e.g. rings or satellite) around the main body.

3. Summary and Conclusions

We observed three stellar occultations by the plutino object 2003 VS2, resulting in two single-chord and one multi-chord detections. The single-chord detections provided a good position for the object ephemeris and improved the prediction for the

following events. The multi-chord detection presented a best-fitting ellipse to the limb of the body at the time of occultation that is 8% bigger than previously determined using Hershel and Spitzer data but within the error bars, from which we derived the geometric albedo.

Using the occultation data combined with the rotational light curve amplitude, we determined a triaxial solution for 2003VS2 which differs from a Jacobi equilibrium figure. Assuming that 2003 VS2 has a Maclaurin shape, we determine an upper limit for its density.

We did not detected any sign of an atmosphere nor the presence of rings or satellites around the main body.

Acknowledgements

G.B.R. is thankful for the support of the CAPES and FAPERJ/PAPDRJ (E26/203.173/2016) grant. Part of the research leading to these results has received funding from the European Research Council under the European Community's H2020 (2014-2020/ERC Grant Agreement no. 669416 ``LUCKY STAR''). The research leading to these results has received funding from the European Union's Horizon 2020 Research and Innovation Programme, under Grant Agreement No. 687378 (SBNAF). P.S.-S. and J.L.O. would like to acknowledge financial support by the Spanish grant AYA-2017-84637-R and the Proyecto de Excelencia de la Junta de Andalucía J.A. 2012-FQM1776. MA thanks to the CNPq (Grants 473002/2013-2 and 308721/2011-0) and FAPERJ (Grant E-26/111.488/2013). J.I.B.C. acknowledges CNPq grant 308150/2016-3. RV-M thanks grants: CNPq-304544/2017-5, 401903/2016-8, Faperj: PAPDRJ-45/2013 and E-26/203.026/2015.

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