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The multi-chord stellar occultation by the Transneptunian object (38628) Huya on March 18th 2019

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Abstract

Within our international program to obtain physical properties of Transneptunian objects (TNOs) we predicted a stellar occultation by the TNO (38628) Huya of a very bright star (mv= 10.6 mag) for 2019, March 18th. After a very extensive astrometric campaign we updated the prediction and it turned out to be favorable to central Europe. Therefore, we mobilized around a hundred of professional and amateur astronomers in this region and the occultation was finally detected from more than 20 sites in Europe. This makes the Huya event the best ever observed stellar occultation by a TNO in terms of the number of chords. In this work we will report the preliminary results obtained from this multi-chord stellar occultation produced by Huya. The positive chords of the occultation allowed us to fit an ellipse for the limb of the body at the moment of occultation with kilometric accuracy. From this limb we derive the geometric albedo for Huya. Tentative possible 3D shapes and densities will be also presented.

1. Introduction

From October 2009 -when the 1st stellar occultation by a TNO, apart from Pluto, was recorded [1]- to date, 71 stellar occultations by TNOs / Centaurs have been detected (44 by 24 TNOs, and 27 by 5 Centaurs). This means that we have characterized around 30 solar system distant objects using stellar occultations. This technique is a very elegant way to obtain highly accurate sizes, albedos and even densities and in some cases even 3D shapes for TNOs and Centaurs (e.g. [2], [3], [4], [5]). Atmospheres and satellites can also be detected and characterized by means of stellar occultations [6]. Very fine details, undetectable by any other groundbased technique, can also be detected using stellar occultations, such as rings around the centaurs Chariklo [4] and Chiron [7, 8] and around the TNO and dwarf planet Haumea [5] which have opened a new way of research within the planetary sciences community [9]. All the above points out that the stellar occultation technique is a very powerful means to obtain information about the physical properties of TNOs and Centaurs. Huya is a very interesting TNO, which is among the group of the ~100 largest TNOs. Its radiometric area-equivalent diameter is 439 km according to Herschel results [10] and it has a known satellite [11]. In the present work, the stellar occultation technique is applied to the analysis of the more than 20 chords obtained from the occultation of a 10.6 mag star by this TNO.

2. Observations

Sequences of images were obtained with ~50 different professional and amateur telescopes from around 15 minutes before and 15 minutes after the predicted occultation time. More than 20 of them recorded the disappearance and the reappearance of the star behind the limb of Huya. On the other hand, 5 sites were close to the shadow path, but outside of it and reported near misses. This is already a breakthrough because no stellar occultation by a TNO had ever been observed with so many chords across the main body (>20) and with constraining close misses. The telescopes that recorded positive observations were located in Romania (14 chords), Turkey (5 chords) and Israel (3 chords). Most of the positive observations were recorded by amateur astronomers, which highlights the importance of collaboration between professionals and amateurs in this field of research when the stars involved are sufficiently bright.

3. Results

The light curves obtained from the positive occultation observations show deep drops of different duration close to the predicted occultation time. These light curves are abrupt at disappearance and reappearance of the star which means that Huya must lack a Pluto-like atmosphere. We do not find hints for short brightness drops before or after the occultation by the main body, which means that a possible ring (or the satellite) around Huya is not detected in our data. From these light curves we derive the chords of the occultation that are fitted with an ellipse, which represents the limb of Huya at the moment of the occultation. From this ellipse we derive the albedo of Huya, and combining this determination with a precise rotational light curve, we can constrain the 3D shape of Huya. Constraints on the density can also be obtained under the assumption of hydrostatic equilibrium, but a more realistic density could be obtained if the orbit of the Huya's satellite is determined, which would allow us to obtain the mass of Huya, which combined with the volume determined from the occultation, would result in an accurate assumption-free density.

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