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The 2017 January 21st multi-chord stellar occultation by the dwarf planet Haumea. Preliminary results.

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Abstract

We will report exciting results from a multi-chord stellar occultation by dwarf planet Haumea on 2017 January 21st recorded with 12 telescopes at 10 observatories in Europe. This is the best occultation by a Trans-Neptunian Object ever published, in terms of the number of chords. Among the most interesting results, the 12 chords of the occultation allowed us to fit an ellipse for the limb of Haumea at the moment of occultation with kilometric accuracy. A new 3D shape for Haumea is derived from the occultation data combined with rotational light curve data. And also accurate density and albedo are determined for Haumea for the first time. Upper limits on the surface pressure of a N_2 or CH_4-dominated atmosphere are derived too.

1. Introduction

Haumea is a very exotic Trans-Neptunian Object (TNO) with unique characteristics [1,2,3,5] and is the only of the four objects currently classified as dwarf planets in the trans-neptunian region for which there aren't accurate determinations of their main physical properties (i.e. size, shape, albedo and density). For the other three dwarf planets, we have very precise determinations of these physical properties by means of stellar occultations and/or spacecraft visits [4,6,7].

Within our program to obtain physical properties of TNOs we predicted an occultation of the star URAT1 533-182543 (GaiaDR1 1233009038221203584) by the dwarf planet Haumea and arranged observations within the expected shadow path in Europe. The star is of similar brightness (R~15.7 mag) as Haumea, so medium to large telescopes were needed to record the occultation with sufficient signal to noise ratio.

2. Observations

Series of CCD images were obtained with different telescopes, and 12 of them recorded the disappearance and reappearance of the star. This is already a breakthrough because no stellar occultation by a TNO had ever been observed with so many chords. The telescopes that recorded positive observations were the following ones: the Wendelstein Observatory 2m telescope and the 0.4m telescope (Germany), the Skalnate Pleso Observatory 1.3m telescope (Slovakia), the Konkoly Observatory 1m telescope and the 0.6m telescope (Hungary), the Bavarian Public Observatory 0.81m telescope in Munich (Germany), the Ondrejov Observatory 0.65m telescope (Czech Republic), the Crni Vrh observatory 0.6m telescope (Slovenia), the S. Marcello Pistoiese observatory 0.6m telescope (Italy), the Lajatico Astronomical Centre 0.5m telescope (Italy) the Mount Agliale observatory 0.5m telescope (Italy) and the Asiago observatory, 1.8m telescope at Cima Ekar (Italy).

3. Main results

From the positive occultation observations we derived light curves which showed deep drops of different duration around the predicted occultation time. As these curves are abrupt at disappearance and reappearance of the star, Haumea must lack a global atmosphere of the type seen in Pluto. From the chords of the occultation produced by the main body we fitted an ellipse, which represents the instantaneous limb of Haumea at the moment of the occultation. This information, together with a very precise rotational light curve, allowed us to reconstruct the full 3D shape of this dwarf planet. We have found remarkable features that will be discussed in this conference.

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