



Stellar Occultations by TNOs: the January 08, 2011 by (208996) 2003 AZ84 and the May 04, 2011 by (50000) Quaoar

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Abstract

Between February 2010 and May 2011, our group has observed five stellar occultations by Trans-Neptunian Objects (TNOs), giving the size and shape for some of the biggest TNO's: Varuna, Eris, 2003 AZ84, Make-make and Quaoar. Here we present two of them: the January 08 stellar occultation by 2003 AZ84, and the May 04 by Quaoar. For the event of 2003 AZ84 we obtained one positive and another negative occultation chords in Chile. We give a lower limit to the diameter of the TNO. The event of Quaoar was observed from 16 sites distributed in Uruguay, Argentina, Chile and Brazil. Five of them yielded positive detection of the occultation. A preliminary analysis shows that the body is probably elongated and significantly bigger than the size determined by Fraser & Brown 2010, with a diameter of 890km. Using the size determined by the occultation, we will discuss the implications for the body density and albedo determination. The upper limit of the atmosphere is also studied.

1. Introduction

The Trans-Neptunian Objects are some of the most primitive objects of the solar system, as the currently heliocentric distance of the known bodies, range from 30 to 100 astronomical units (AU). Stellar occultation

is a powerful tool to measure their size, up to the kilometer level, shape and (putative) atmospheres. As the size is one of the most fundamental physical properties, and the occultations are the only way to study possible atmospheres, large international campaigns are elaborated to observe this kind of events by the TNOs.

The prediction of stellar occultations are very difficult. Assafin et al. 2011 [1] have performed a large survey to find occultation star candidates by the biggest TNO's from 2009 to 2015, to minimize errors on the candidate star position. With this catalogue and systematic astrometric updates of the candidate star and the TNO, we already had success in five opportunities. On February 19, 2010 we recorded the occultation by Varuna, on November 06 of the same year by Eris, on January 08, 2011 by 2003 AZ84, on April 23 by Makemake, and on May 04 by Quaoar. Here we present the results of the occultation by 2003 AZ84 and Quaoar.

2. 2003 AZ84 stellar occultation

Discovered in January 2003, (208996) 2003 AZ84 is a plutino object that orbits the Sun at an average distance of 39.4AU. It has a satellite discovered in 2007 with an estimated size of 68 km.

On January 08, 2011, the TNO occulted a faint star (R 18). Observations were performed from San

Pedro de Atacama (SPACE observatory) with the C. Harlinton 0.5m Planewave and the 0.4m ASH2 telescopes and from La Silla with the 0.6m TRAPPIST telescope, both sites in Chile. The San Pedro de Atacama telescopes had positive detection of the event, while TRAPPIST observation, 610km from San Pedro, does not show any drop of flux ([4]).

The derived chord from the light curves, show a duration of 21.7 +/- 0.8 seconds, centered at 06h29m59s of January 08, 2011. This duration corresponds to a length of 573 +/- 21km, which can be compared to the diameter of 686 +/- 95.5 km derived by [2], from Spitzer data, and to the estimation of 910 +/- 60 km by [3], from Hershel data. Our result gives a lower limit to 2003 AZ84 diameter. Even though it was not expected, we can affirm that no evident signature of atmosphere can be seen in the light curves.

3. Quaoar stellar occultation

Also known as 2002 LM60, (50000) Quaoar is a dwarf planet, discovered in 2002, that orbits the Sun at an average distance of 43.4AU. At the time of the discovery, its size was estimated to be 1260 +/- 190km [5]. Fraser & Brown 2010 [6] used new methods and measurements to re-estimate the diameter to 890 +/- 70km. They also determined the orbit of Quaoar's satellite Weywot, which has an estimated size of 74km. With the satellite orbit and new size, they derived a density of 4.2 +/- 1.3g/cm³ to the main body.

An occultation by a R 16 magnitude star was predicted for May 04, 2011. It was observed from 16 sites, distributed in Uruguay, Chile, Argentina and Brazil. The occultation was detected from five of them, well distributed in Quaoar's latitude.

The longest chord has a duration of 64 seconds, or an equivalent length of 1170km, in good agreement to the diameter estimated on its discovery [5]. So, probably, the volume of Quaoar is much bigger than the one assumed by [6], which implies an object significantly less dense. The observed chords suggest that Quaoar has an elongate shape. No evidence of atmosphere is seen in the occultations light curves, but an upper limit will be determined.

4. Summary and Conclusions

Here we presented the preliminary results of the observed stellar occultations of 2003 AZ84 and Quaoar.

For 2003 AZ84 we give a lower limit of 573 +/- 21km to its diameter, compared to 686 +/- 95.5 km[2]

and 910 +/- 60 km [3]. No evidence of atmosphere is seen on the light curves.

From the Quaoar stellar occultation our preliminary results show that it is elongated and bigger than the body assumed by [6] of 890km in diameter, its density is then probably much smaller than the one derived by them. No signature of atmosphere is seen on the light curves.

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