The May 26, 2020 multi-chord stellar occultation by the trans-Neptunian object (119951) 2002 KX_{14}

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Introduction

Centaurs and trans-Neptunian objects (TNOs) are considered to be the most pristine members of our solar system, beside Oort cloud objects.

2002 KX_{14} is a low-inclination ($i \sim 0.4°$), low-eccentricity ($e \sim 0.04$) cold classical TNO, orbiting the Sun at an average distance of $a \sim 39$ au. The absolute magnitude, geometric albedo and radiometric diameter are given as $H_V = 4.86$, $p_V = 0.097$, and $D = 455 \pm 27$ km (Vilenius+, 2012).

The rotational period is yet unknown, but a lightcurve amplitude of $\Delta m < 0.05$ mag is reported (Benecchi+, 2013).

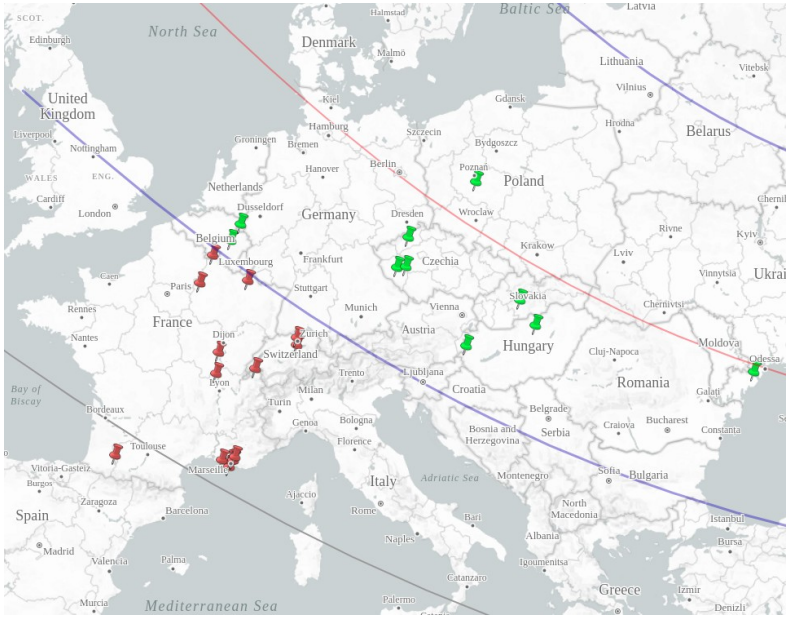
From a single-chord stellar occultation observation in 2012 (with a chord length of 415 ± 1 km), combined with accurate astrometry at the time of occultation, an area-equivalent diameter of at least 365^{+30}_{-21} km was estimated for this object (Alvarez-Candal+, 2014).

Method and Results

The observation of stellar occultations by solar system objects is a powerful technique to directly measure size and profile shapes of these objects with kilometre accuracy.

Within the Lucky-Star ERC project we predicted the occultation of a G = 14.6 mag star (Gaia DR2 4111560308371475840) by 2002 KX_{14} for the date May 26, 2020.

The shadow was predicted to cross eastern Europe and the event was observed successfully by about 10 stations supplemented by another dozen of stations which had a miss (no event detected).



Red: shadow center line, blue: northern / southern limits, gray: 1σ−limit, green pins: positive detection, red pins: negative (miss)

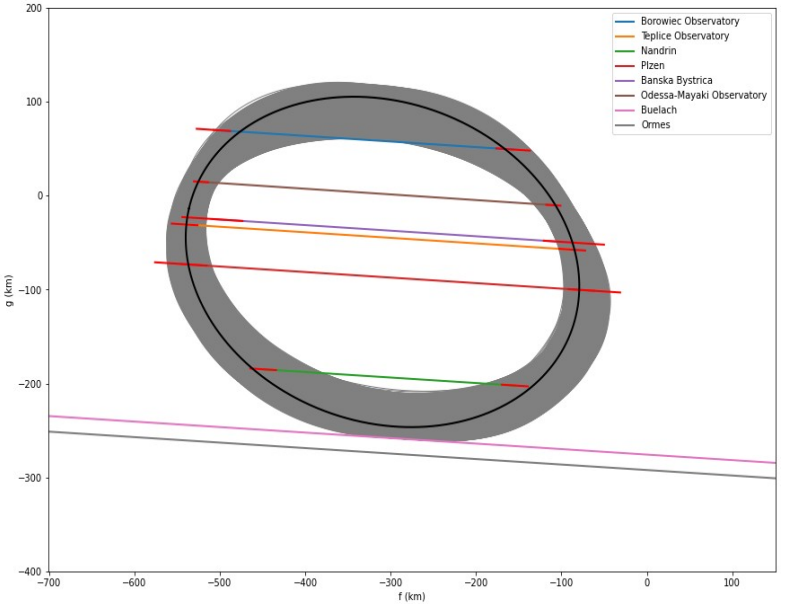
Method and Results

The occultation immersion and emersion times were derived from fitting a square-well model to the observed lightcurves.

In order to derive the instantaneous limb of 2002 KX_{14} for the time of occultation the extremities of the positive chords were fitted to an ellipse.

From the five fit parameters (center of the ellipse, semi-major axis a, flattening f and the position angle θ of the ellipse orientation) we derived the size and shape of the 2D limb for the time of occultation.

From our preliminary analysis for a subset of chords we derived the values $a = 233 \pm 6$ km, $f = 0.29 \pm 0.06$, $b = a - f \cdot a = 166 \pm 15$ km, yielding to a profile mean diameter of $d = 393 \pm 19$ km.



Ellipse fit to the positive chords. The immersion / emersion timing uncertainties are colored in red. The 3-σ uncertainty region is shaded in gray and is constrained by the close negative observation.

Summary and Conclusions

We predicted, observed and analyzed a stellar occultation by cold classical TNO 2002 KX_{14}.

We found an apparent equatorial diameter of 466 ±12 km for the time of occultation. The mean (2D profile) diameter we derived for 2002 KX_{14} is 393 ± 19 km. This preliminary value will be refined with the remaining positive chords yet not included in this analysis.
The effective diameter we found is comparable to the radiometric value of 455 ± 27 km (Herschel / Spitzer: PACS / MIPS instrument) or 485^{+83}_{-93} km (Herschel: PACS instrument) by Vilenius+ (2012) .

As yet no spin parameter for 2002 KX_{14} are available, further constraints on the 3D size and shape cannot be made at this point.

Therefore we schedule photometric observations for the next season (2022) and also encourage other observers to target this object for lightcurve measurements.

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AstroImageJ, Tangra, PyMovie and the SORA Python package have been used for this work.

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