International Occultation Timing Association / European Section e.V.
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Press Kit

Citizen Science - Satellite of Asteroid (5457) Queen's discovered

For the first time, an moon of an asteroid has been discovered from an European site using "Citizen Science".

During an observation of a stellar occultation in the Czech Republic on 2023 September 4th by the asteroid (5457) Queen's, Jan Mánek from the International Occultation Timing Association / European Section (IOTA/ES) discovered a satellite with a diameter of approx. 2 kilometres orbiting the asteroid. This discovery was confirmed on September 20th by an observation made by Serge Dramonis in Greece. The Central Bureau for Astronomical Telegrams of the International Astronomical Union (IAU) published the discovery on 2023 November 16.

The Discovery on 2023 September 4

Jan Mánek observed a 1.6-second stellar occultation by the asteroid (5457) Queen's, which was at the time of the observation about 2 au away from Earth. After less than a second, the star G2750746718513211520 (brightness: 12.5 mag) in the constellation of Pisces, disappeared a second time for 0.2 seconds. Other members of IOTA/ES observed the event as well. Stefan Meister and Andreas Schweizer in Switzerland were also able to measure occultations by the asteroid, but there was no occultation by the satellite at their observation stations.

Dr Christian Weber from the SODIS team at IOTA/ES evaluated the observations and determined a shadow profile of 24.6 km (+/- 0.9 km) x 16.2 km (+/-0.7 km) for the asteroid and a diameter of 2 kilometres (+/- 0.2 km) for the moon.

Confirmation of the Discovery on 2023 September 20

On September 20th, the asteroid once again occulted a star in the constellation of Pisces. Serge Dramonis in Greece was able to measure a 0.2-second occultation of the star G2749281138232702080 (13.1 mag) by the suspected satellite before the asteroid (5457) Queen's itself occulted the star for 1.4 seconds.
Dr Christian Weber's analysis of this measurement revealed minimum diameters of 17.5 kilometres (+/- 0.5 km) for the asteroid and 2.8 kilometres (+/-0.5 km) for the satellite.

Further measurements are necessary to determine the orbit of the satellite around the asteroid.

Link:

Announcement from the Central Bureau for Astronomical Telegrams:
http://www.cbat.eps.harvard.edu/iau/cbet/005300/CBET005318.txt

Figure 1:

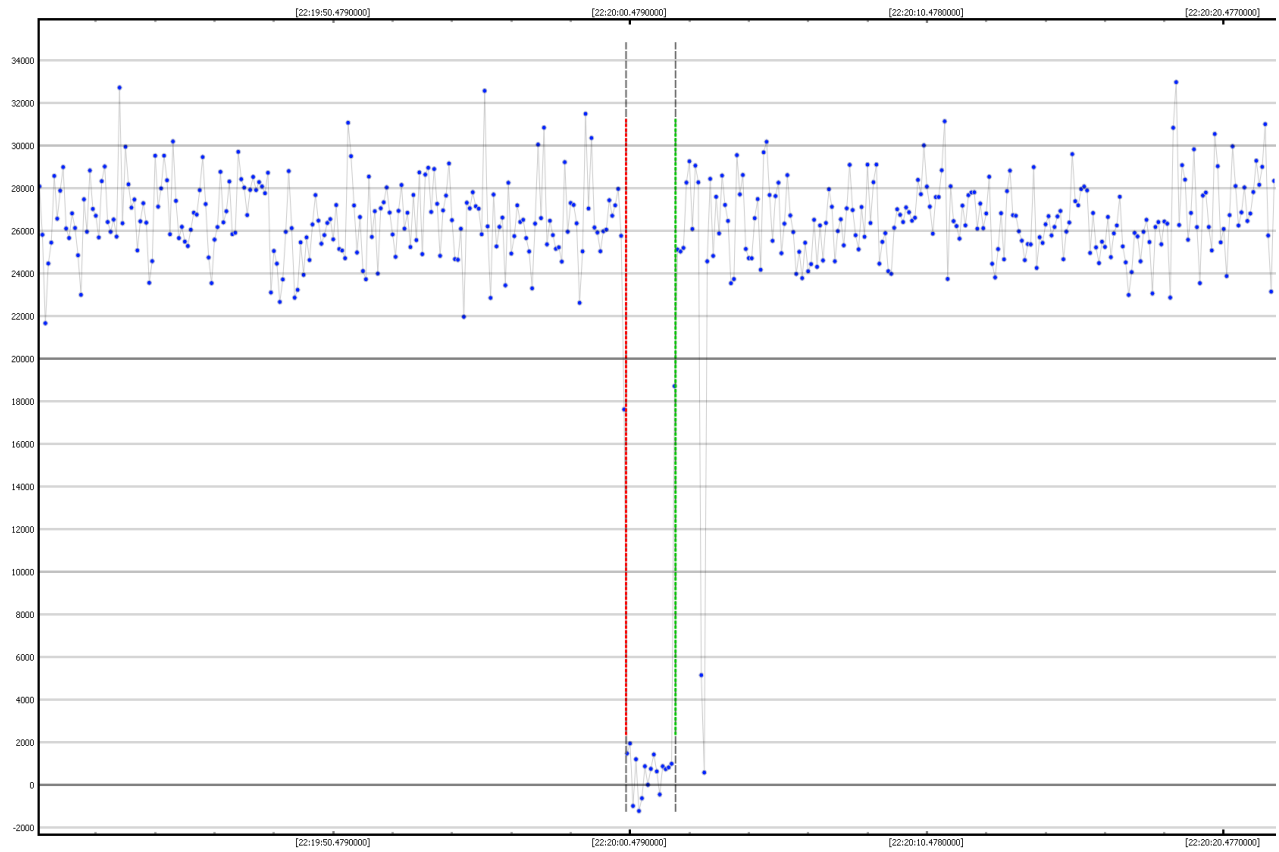

Figure 1. The recorded light curve during the occultation by the asteroid (5457) Queen's on 2023 September 4th. The occultation by the minor planet begins at the red line and ends at the green marker. Less than a second later, the star is occulted again by the newly discovered satellite. The fluctuations in the light curve are caused by air turbulence in the Earth's atmosphere. The X-axis shows the time in Universal Time (UT), the Y-axis the intensity of the light. (Graphic: J. Mánek, IOTA/ES)

Figure 2:

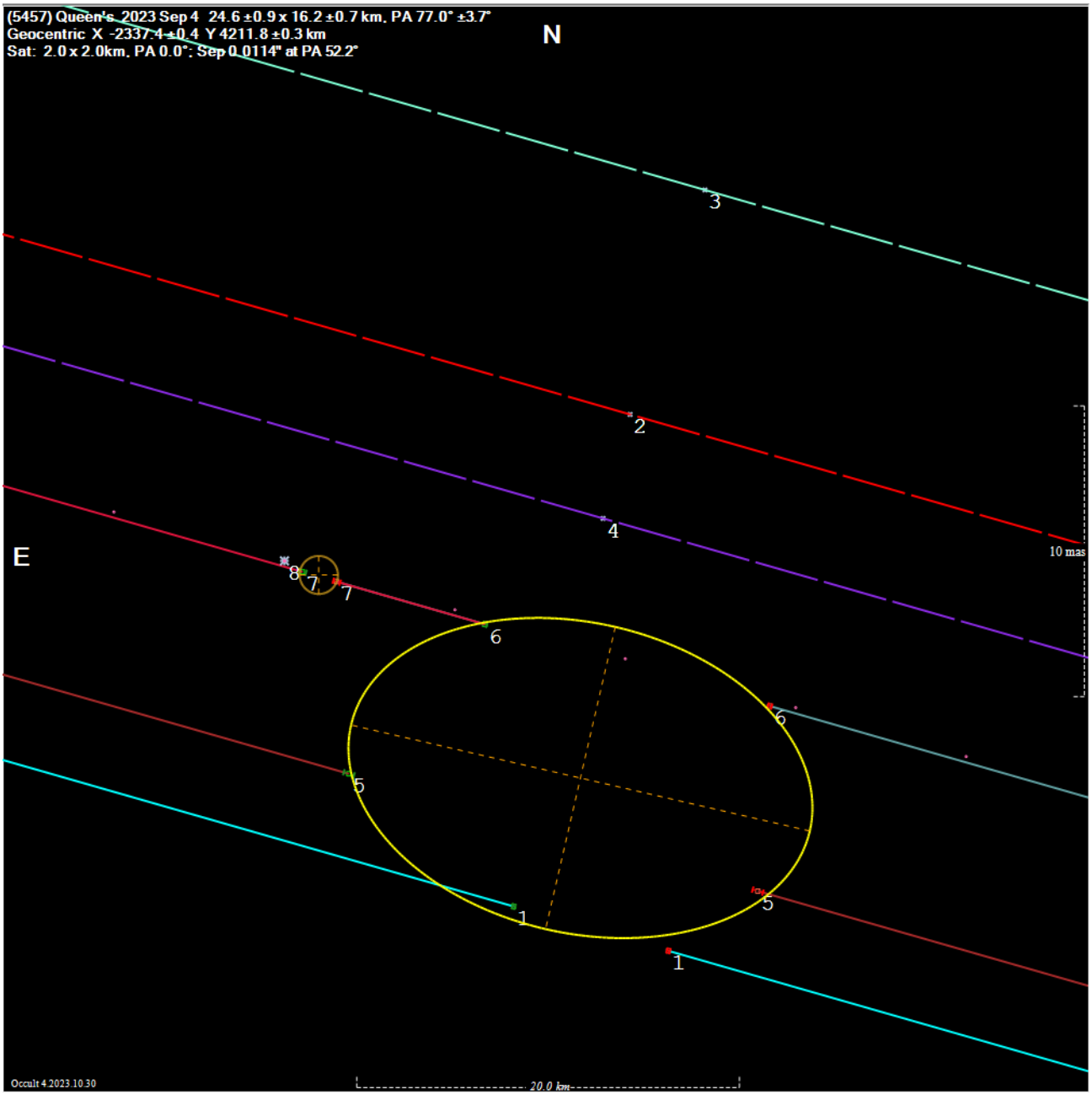

Figure 2. The measured chords are displayed graphically with the Occult V4 software by Dave Herald. The negative observations from the Czech Republic and Poland are shown as dashed lines 2, 3 and 4. The two positive observations from Switzerland are labelled 1 and 5. Jan Mánek's measurement shows the chords no. 6 and 7. The yellow ellipse shows the determined, slightly elongated shadow profile of (5457) Queen's. The congruent chord No. 8 represents the calculated centre line of the asteroid in the prediction of the stellar occultation. It can be seen that the real position of the asteroid had shifted about 10 kilometres to the south compared to the prediction. (Graphic: C. Weber, D. Herald, Occult V4, IOTA/ES)

Figure 3:

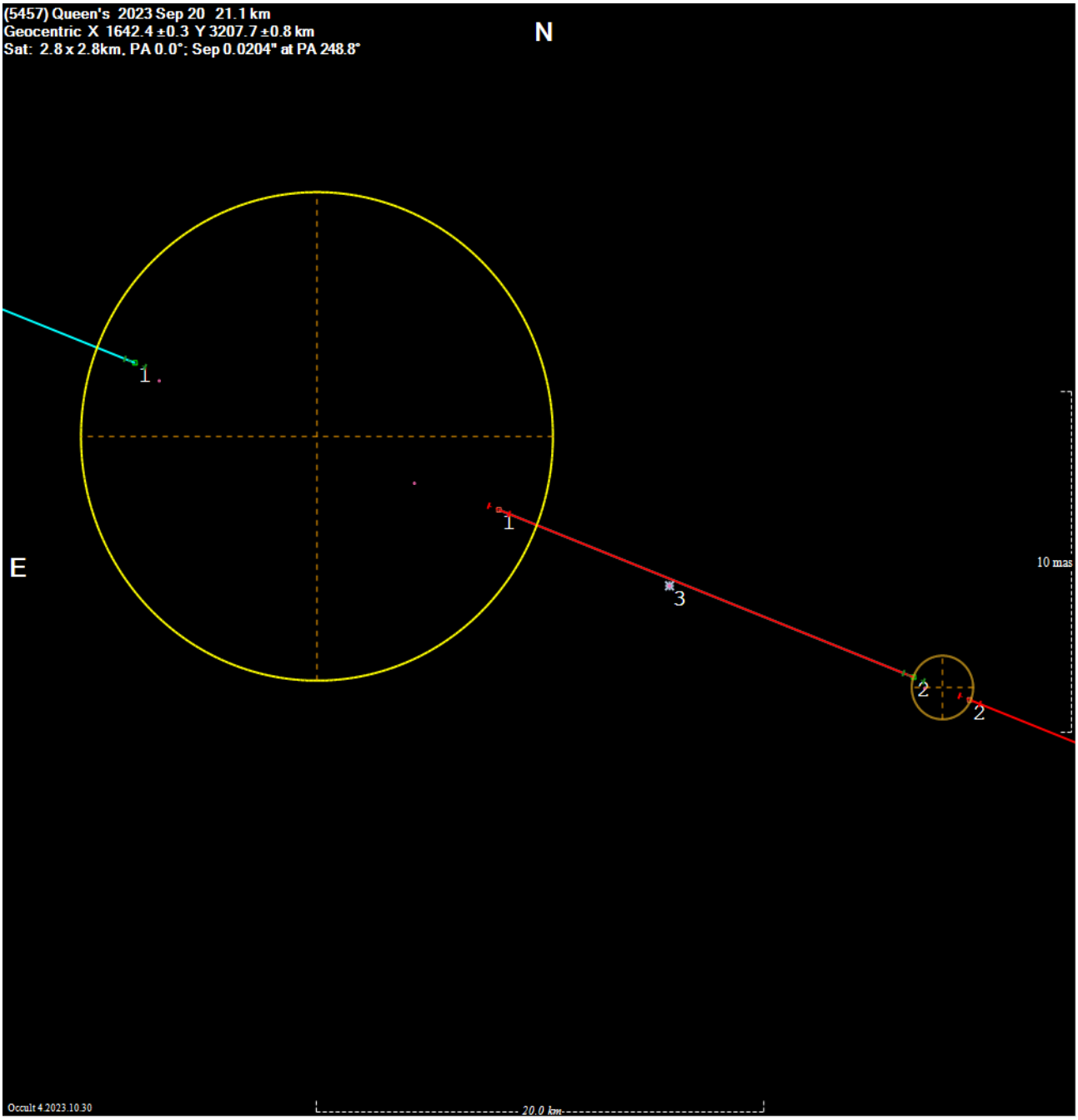

Figure 3. The individual chords (labelled No. 1 and 2) of Serge Dramonis, measured on 2023 September 20th. The prediction of the shadow path (chord no. 3) was very accurate for this stellar occultation. The yellow circle represents the assumed diameter of the asteroid. (Graphic: C. Weber, D. Herald, Occult V4, IOTA/ES)

Technical terms - briefly explained:

Stellar occultation

Asteroids move in orbits around the sun, they move across the sky like planets or the Moon. For an observer on Earth, it can happen that an asteroid passes directly in front of a star. The asteroid then casts a shadow on the Earth's surface. Observation stations located in this shadow path experience a "stellar eclipse" when the star's light is blocked out by the asteroid. If several stations in the path observe such a phenomenon, the measured duration of the occultation and the positions of the observation stations in the shadow path can be used to measure the diameter of the shadow and thus determine the shape and size of the minor planet. In addition, the observation of a stellar occultation provides a very precise measurement of the asteroid's position in the sky at the time of the occultation. This data improves the calculations of the orbits of the asteroids. These calculations are particularly important for the orbits of near-Earth asteroids in order to identify any dangerous objects. Space probes to asteroids also need precise position data in order to navigate to these celestial bodies.

au - astronomical unit

Measure of length. An astronomical unit is the average distance between the Sun and the Earth of 149,597,870.7 km.

Chord

Each successful measurement represents a line in the shadow profile due to its duration and the position of the observer. This is called a chord. Several differently positioned chords provide information about the shape and size of the shadow profile.

Background information:

Asteroid:

(5457) Queen's
The asteroid was discovered on 9 October 1980 by Carolyn Shoemaker and belongs to the main belt of asteroids between Mars and Jupiter. It was named after Queen's University in Kingston, Ontario, Canada, which is colloquially known as "Queen's".

Star catalogue Gaia DR3:

The star numbers given refer to the star catalogue of the European Space Agency's (ESA) astrometric satellite *Gaia*. Today, the precise star positions of this catalogue make calculations of very accurate predictions of stellar occultations by asteroids possible.
https://www.cosmos.esa.int/web/gaia/dr3

Observation Equipment:

Jan Mánek:
Newtonian reflector telescope with a diameter of 350 mm and a focal length of 1650 mm, digital video recording with direct feed of a GPS time signal into the camera.

Serge Dramonis:
Newtonian reflector telescope with 400 mm diameter, focal length 1826 mm, digital video recording, timing with GPS time signal.

List of observers of the occultation on 4 September 2023:
(in order of the chord numbers)

Andreas Schweizer, CH
Jiří Kubánek, CZ
Daniel Antuszewicz, PL
Michal Rottenborn, CZ
Stefan Meister, CH
Jan Mánek, CZ

SODIS

The Stellar Occultation Data Input System (SODIS) of IOTA/ES collects and analyses observations of stellar occultations by asteroids throughout Europe. Regional coordinators analyse the data for their countries before it is transferred to an international database. The regional coordinators all work on a voluntary basis.

IOTA/ES

IOTA/ES e.V. (International Occultation Timing Association / European Section) is an association registered in Germany with more than 100 members in over 20 countries. For over 30 years, the observation of occultation phenomena, the dissemination of predictions and the worldwide coordination of observers have been among the tasks of its members. Furthermore, IOTA/ES supports observers in the publication of observation results and provides information on the technical requirements for a scientifically analysable measurement, thus supporting "Citizen Science". IOTA/ES publishes the "Journal for Occultation Astronomy" every three months and organises the annual "ESOP" conference (European Symposium on Occultation Projects). The association also acts as the "Specialist Group on Occultations" of the German Association "Vereinigung der Sternfreunde" (VdS).

Links:
IOTA/ES Homepage
https://www.iota-es.de

Next ESOP confernce:
ESOP 43 in Stuttgart on 23.-27. August 2024
https://sternwarte.de/esop43/

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