Center of Research in Astronomy, Astrophysics and Geophysics
(Algiers Observatory)

The positive Observation of the Stellar Occultation by the Transneptunian Object 19521 Chaos at Algiers Observatory (CRAAG)

Presented by :
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Outline

- Presentation of Algiers Observatory CRAAG
- Presentation of the Transneptunian Objects
- Presentation of the Transneptunian (19521) Chaos
- The positive Result of the stellar occultation by (19521) Chaos
- The negative stellar occultation by the TNO (833) Monica on March, 21th 2023
- Participative Astronomy occultation in Algeria in 2023
- The two stellar Occultation by (319) Leona on September, 13th and december 6th 2023
- The occultation of Betelgeuse by Leona on December, 12th 2023
- Near Futur prospects 2024
- Summary

Center for Research in Astronomy, Astrophysics and Geophysics (ALGIERS Observatory) IAU Observatory code : 008

Our Research Center has two astrophysics research divisions :

- The first focuses on solar physics, solar system and spaceweather.

- The second focuses on stellar physics and high-energy astronomy.

Each division has 5 research teams.

I’m part of the first division and for a year and a half I've been a team leader called DyMOs.

My research study is about stellar occultation by small bodies specially Near Earth Asteroids.

DyMOs Team :

DYnamics of small solar system bodies, **M**eteoritic **O**bservation and Stellar Occultation**S**

Head of the team :

BABA AISSA Djounai (Researcher in Astronomy – Phd in progress)

Members :

BOUYAHIAOUI Zineddine (Researcher in Astronomy – Phd)

BOUDIBA Ghoulam Imad eddine (Engineer in Astronomy – Phd in progress)

GRIGAHCENE Zaki Engineer in Astronomy

Field of Research :

Observation and Characterization of Small bodies by Stellar Occultation

Observation and Characterization of Near Earth Asteroids by Stellar Occultation

Dynamics of small solar system bodies and specially Jupiter Troyan asteroids and calculation of orbital elements by observations

Observation of fireballs and tracking meteorites using a Network of All-Sky cameras

Atmospheric Entrance of Meteorites and Space objects Tracking using Infrasound devices

Photometric study of asteroids (In project)

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By the way, here the observational instruments that we use in our researches :

1 – Instruments that we can be moved throughout Algiers Observatory

- Two Celestron 8 with CGEM mount
- Two Celestron 11 with CGEM mount
- One Celestron 11 with CGE Pro mount
- One Meade 12 LX200

2 – Fixed Instruments at Algiers Observatory

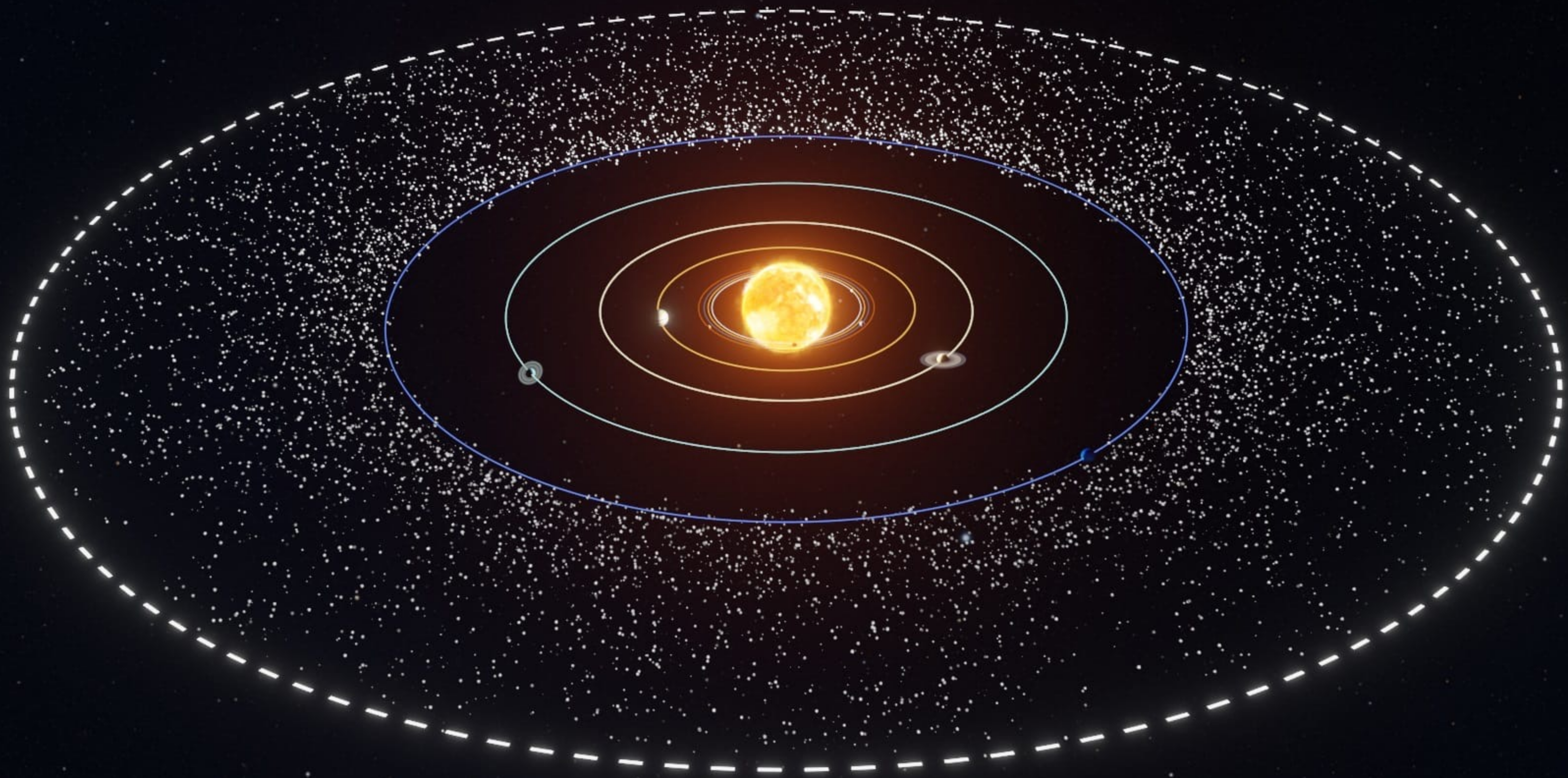
- A 152 mm Apochromatique Refractor F/D 10 to observe the Sun
- A 200 mm Apochromatique Refractor F/D 9 as a guide
- A Richtey-Chretien Telescope 810 mm F=6400 mm

3 – 3 WATEC 910 HR/XC Cameras with IOTA VTI Inserters

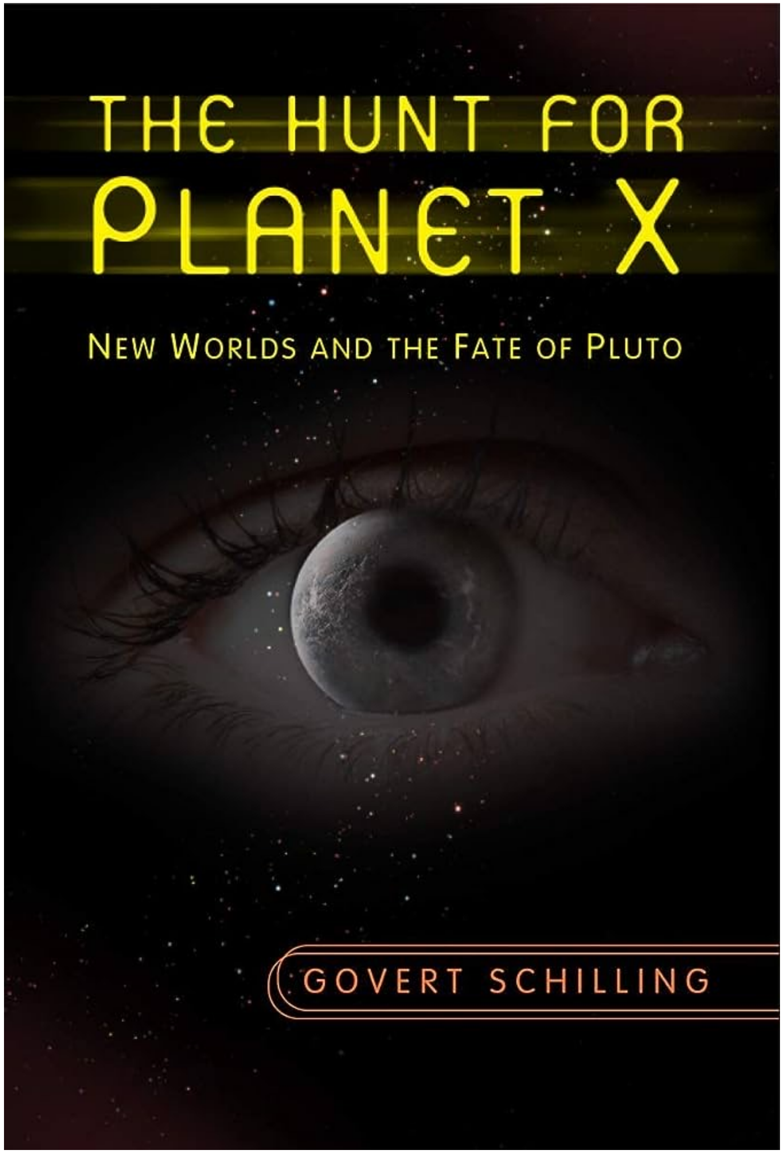
Presentation of the Transneptunian Objects

Beyond the planet Neptune, there are billions of a large **icy bodies** that turn arround the Sun. While astronomers estimate that there could be billions of TNOs in this belt, more than 3000 have been discovered, and fewer have been studied or observed.

Trans-Neptunian objects are very remote and faint objects. They orbit at some 30–48 AU from the Sun and have magnitudes typically fainter than 18, thus requiring large telescopes. They subtend small angular diameters, for example, at most 100 milli-arcsec (mas) or so for the largest one, Pluto, and less than 35 mas for other large ones like Eris and Makemake.



Largest known trans-Neptunian objects (TNOs)



Govert Schilling
Dutch popular science writer and amateur astronomer
(1956 -)

We thought that Kuiper is the first who propose theoricly a belt of icy asteroids beyond planet Netpune.

Doubts about Pluto's uniqueness were expressed as early as 1930. At the University of California in Berkeley, Armin Leuschner posited that the newly discovered object may have been a rogue asteroid or a giant comet. And if there is one such body, there may of course be more. Later that year Leuschner's younger colleague Frederick Leonard, of the University of California in Los Angeles, wrote these prophetic words in the *Leaflet of the Astronomical Society of the Pacific*: 'Is it not likely that in Pluto there has come to light the first of a series of ultra-Neptunian bodies the remaining members of which still await discovery, but which are destined eventually to be detected?'

It was, however, an Irish ex-soldier and retired amateur astronomer who first launched the theory in 1943 that there was a disk of small, comet-like objects beyond the orbit of Neptune. At the age of 63, Kenneth Edgeworth wrote an article about his theory in the *Journal of the British Astronomical Society*, a publication for amateur astronomers. Six years later, he outlined his ideas in much greater detail in the scholarly *Monthly Notices of the Royal Astronomical Society* and in 1961, at the age of 81, he published a book entitled *The Earth, the Planets and the Stars*, in which he also presented the comet-disk theory.

Edgeworth's reasoning was actually very simple. He assumed that, long ago when the Sun was very young, the planets coagulated together in a flat, rotating disk of gas and dust. This process of accretion had naturally started with the formation of small fragments and condensations. Only later did they combine to form larger bodies. But according to Edgeworth it was improbable that the disk had a sharp outer edge. It was more logical that it tapered off gradually. If that were true, there must be a large number of smaller objects beyond Neptune's orbit which had never come together to form full-fledged planets.

In the mid-1940s, little was known with certainty about the formation of the solar system, but many scientists toyed with the idea of a turbulent disk of matter in which small particles eventually grew into larger bodies. In 1946, for example, Hendrik Petrus Berlage, the son of the famous Dutch architect, submitted a long article about this theory to *The Astrophysical Journal*, the editors of which had their offices at Yerkes Observatory. It was never published but it must have aroused the interest of Gerard Kuiper there in Williams Bay; and Kuiper is sure to have seen Edgeworth's publication in the *Monthly Notices* a couple of years later.

The Kuiper Belt

It is therefore remarkable to say the least that neither Berlage nor Edgeworth appear in the bibliography of an extensive article entitled *On the Origin of the Solar System* which Kuiper wrote in the early 1950s. The article was published in 1951 as Chapter 8 of a thick report on the symposium marking Yerkes Observatory's 50th anniversary. The book was edited by Allen Hynek of Ohio State University, who was to later become famous for his research into

Kenneth Edgeworth
Irish army officer, engineer, economist and independent theoretical astronomer
(1880 - 1972)

He presents a theory in 1943 to discribe this outer belt beyond planet Neptune inner than Kuiper.

It was an Irish amateur astronomer who first launched the theory in 1943 that there was a disk of small icy objects beyond the orbit of Neptune.

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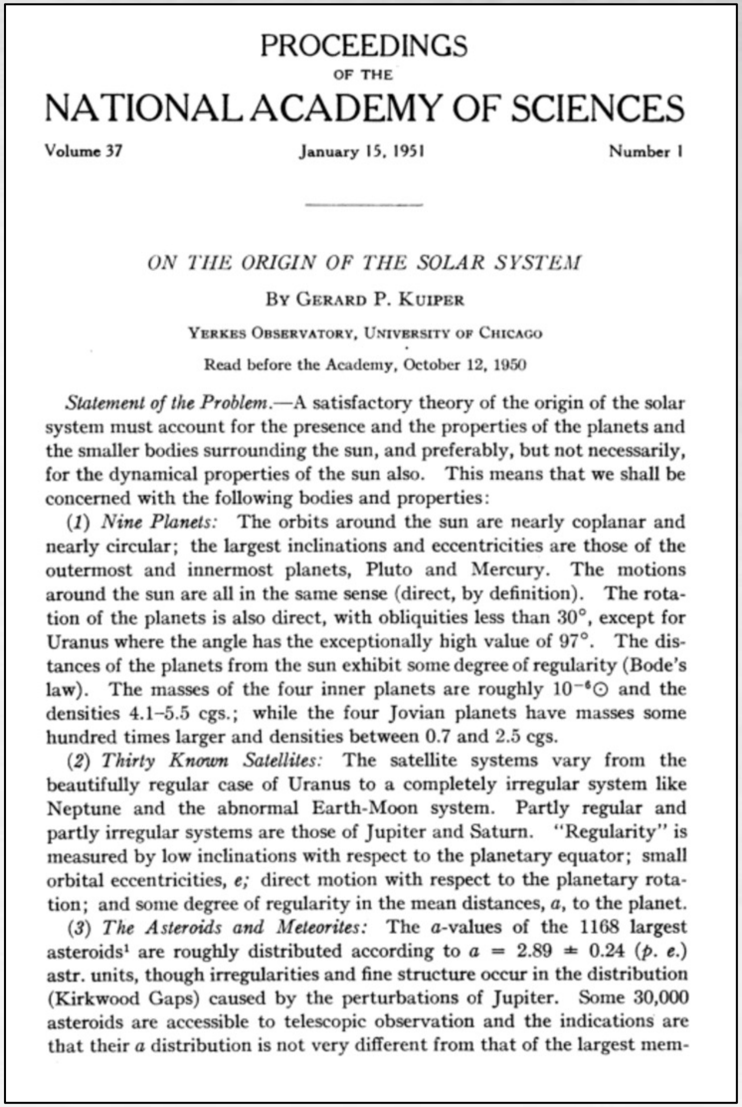
After Edgeworth, the Dutch-American astronomer **Gerard Kuiper** who suggested its existence in 1951.



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ON THE ORIGIN OF THE SOLAR SYSTEM

BY GERARD P. KUIPER

YERKES OBSERVATORY, UNIVERSITY OF CHICAGO

Read before the Academy, October 12, 1950

Statement of the Problem.—A satisfactory theory of the origin of the solar system must account for the presence and the properties of the planets and the smaller bodies surrounding the sun, and preferably, but not necessarily, for the dynamical properties of the sun also. This means that we shall be concerned with the following bodies and properties:

(1) *Nine Planets:* The orbits around the sun are nearly coplanar and nearly circular; the largest inclinations and eccentricities are those of the outermost and innermost planets, Pluto and Mercury. The motions around the sun are all in the same sense (direct, by definition). The rotation of the planets is also direct, with obliquities less than 30°, except for Uranus where the angle has the exceptionally high value of 97°. The distances of the planets from the sun exhibit some degree of regularity (Bode's law). The masses of the four inner planets are roughly $10^{-6}\odot$ and the densities 4.1–5.5 cgs.; while the four Jovian planets have masses some hundred times larger and densities between 0.7 and 2.5 cgs.

(2) *Thirty Known Satellites:* The satellite systems vary from the beautifully regular case of Uranus to a completely irregular system like Neptune and the abnormal Earth-Moon system. Partly regular and partly irregular systems are those of Jupiter and Saturn. "Regularity" is measured by low inclinations with respect to the planetary equator; small orbital eccentricities, *e;* direct motion with respect to the planetary rotation; and some degree of regularity in the mean distances, *a*, to the planet.

(3) *The Asteroids and Meteorites:* The *a*-values of the 1168 largest asteroids[1] are roughly distributed according to $a = 2.89 \pm 0.24$ (*p. e.*) astr. units, though irregularities and fine structure occur in the distribution (Kirkwood Gaps) caused by the perturbations of Jupiter. Some 30,000 asteroids are accessible to telescopic observation and the indications are that their *a* distribution is not very different from that of the largest mem-

Gerard Peter Kuiper
Dutch astronomer
(1905 - 1973)

The last ten years have revealed that the outer solar system is densely populated with icy objects called transneptunians.

This population is also known as the **Edgeworth-Kuiper belt**, in honour of **Kenneth Edgeworth** and **Gerard Kuiper**, who were the first to hypothesise the existence of these small bodies.

David Clifford Jewitt
British-American astronomer
(1958 -)

Jane Luu
Vietnamese-American astronomer
(1963 -)

The first trans-Neptunian object to be discovered was Pluto in 1930.
It took until 1992 to discover a second trans-Neptunian object orbiting the Sun directly, **1992 QB1** known after (15760) **Albion**. The most massive TNO known is Eris, followed by Pluto, Haumea, Makemake, and Gonggong.

David Clifford Jewitt and **Jane Luu** published in Nature - Volume 362, April 1993 an article concerning the first discovery of the trans-Neptunian object **1992 QB1**.

nature
THE INTERNATIONAL WEEKLY JOURNAL OF SCIENCE

FIG. 3 Sky-map of the region near $\alpha = 288°$, $\delta = +11°$. The large circle (B) represents the average location of the three BATSE events. The size of this circle (~5°) reflects mainly the statistical errors of the three measured positions. Burst locations are obtained from the relative strength of their signals in the relevant subset of the eight identical Large Area Detectors (LADs). The position determination includes the detailed spectral dependence of the angular sensitivity of the detectors, and corrections for photon back-scattering by the Earth's atmosphere[23]. The diamond (K) represents the 2σ error box of SGR1900+14 (E. Mazets, personal communication). The small cross shows the location of the recently discovered[18,19] transient X-ray source GRS1915+105 (accuracy ~3′).

before the first SGR trigger and remained at maximum during the subsequent two triggers. Are the BATSE events related to the X-ray transient? For both the transient and SGR1900+14 the probability of being located inside the BATSE error box by chance is fairly small (~0.2% for assumed uniform sky distribution). As the positions for both SGR1900+14 and the transient are known with high accuracy (of the order of arcminutes) and they differ by more than ~1.5°, the KONUS events cannot be related to the Aquila transient. Moreover, a recent analysis[20] indicates that there was no persistent X-ray emission (upper limit of ~100 μJy) from this region in the sky, during the 1979 SGR bursts. We conclude that it is improbable that the BATSE events originate from GRS1915+105.

Our results suggest that burst activity from the 'old' SGR1900+14 has been detected again ~13 years after its discovery. If our detection is indeed the recurrence of activity from this source, it shows that SGRs keep their ability to be active for many years. The extended duration of SGR activity strengthens the argument that these sources are related to galactic (possibly population I) objects, plausibly neutron stars[4,5]. Recurrent SGR emissions do not signify a unique (catastrophic) event in the life cycle of the source, as is the case in the cosmological models currently favoured for the classical γ-ray bursts[21,22]. If on the other hand, the new SGR is not related to the SGR1900+14, the case for the SGRs to be associated with population I objects becomes even stronger than it was before, with four (rather than three) sources following their distribution. This is very different from recent results on classical γ-ray bursts, for which a galactic disc origin is excluded[6,21,22]. The long-term monitoring capability of BATSE gives hope of obtaining valuable information on the recurrence timescale of SGRs and (combined with other spacecraft) accurate source positions, which may lead to a better understanding of the nature of these objects. □

Discovery of the candidate Kuiper belt object 1992 QB$_1$

David Jewitt* & Jane Luu†

* Institute for Astronomy, University of Hawaii, 2680 Woodlawn Drive, Honolulu, Hawaii 96822, USA
† Department of Astronomy, 601 Campbell Hall, University of California at Berkeley, Berkeley, California 94720, USA

THE apparent emptiness of the outer Solar System has been a long-standing puzzle for astronomers, as it contrasts markedly with the abundance of asteroids and short-period comets found closer to the Sun. One explanation for this might be that the orbits of distant objects are intrinsically short-lived, perhaps owing to the gravitational influence of the giant planets. Another possibility is that such objects are very faint, and thus they might easily go undetected. An early survey[1] designed to detect distant objects culminated with the discovery of Pluto. More recently, similar surveys yielded the comet-like objects 2060 Chiron[2] and 5145 Pholus[3] beyond the orbit of Saturn. Here we report the discovery of a new object, 1992 QB$_1$, moving beyond the orbit of Neptune. We suggest that this may represent the first detection of a member of the Kuiper belt[4,5], the hypothesized population of objects beyond Neptune and a possible source of the short-period comets[6–8].

Our observations are part of a deep-imaging survey[9] of the ecliptic, made with the University of Hawaii 2.2-m telescope on Mauna Kea. The survey uses Tektronix 1,024 × 1,024 pixel and 2,048 × 2,048 pixel charge-coupled devices (CCDs) at the $f/10$ Cassegrain focus. Both CCDs have anti-reflection coatings which yield quantum efficiencies of ~90% at wavelength $\lambda \approx$ 7,000 Å (K. Jim, personal communication). Survey observations are obtained in sets of four images per field with a total timebase of 2 or more hours. Each image is exposed for 900 s while autoguiding at sidereal rate. Because objects in the outer Solar System have small proper motions, our survey was optimized to detect slowly moving objects (SMOs). The angular motions of SMOs are sufficiently small that little trailing-loss results from sidereal tracking. This strategy is found to provide optimum sensitivity to the linear, correlated motion expected of slowly moving objects. By restricting observations to stellar images of full width at half maximum (FWHM) ≤ 1.0 arcsec, and to moonless skies, we obtain limiting magnitudes $m_R \sim 25$. To date, a

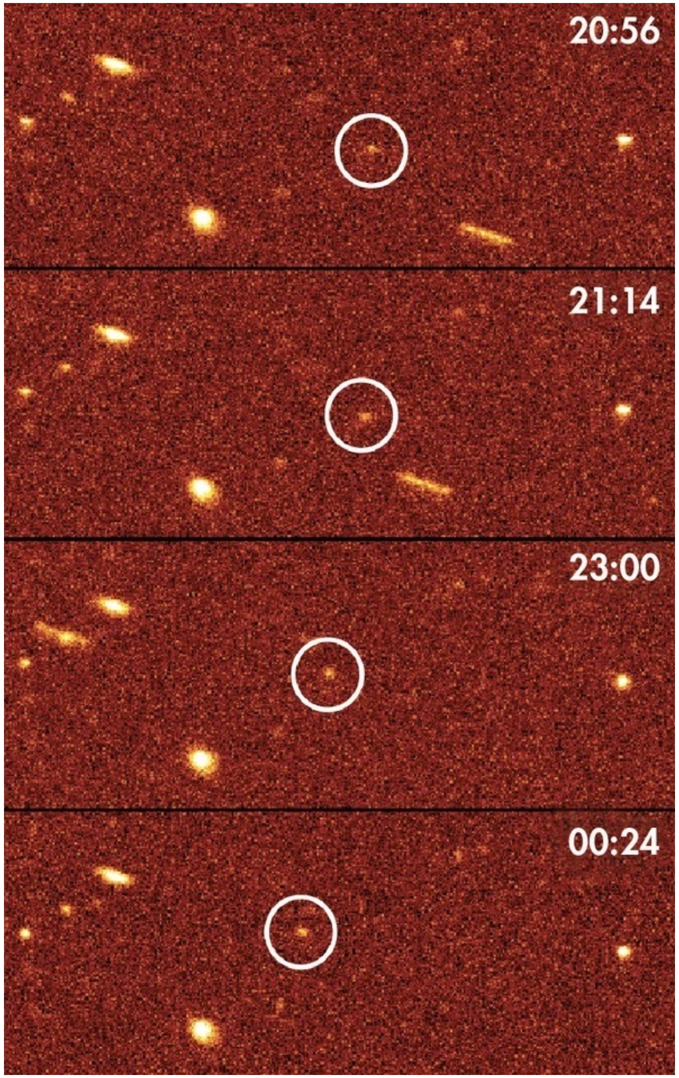
Afterwards, it was renamed **(15760) Albion** as a well-known mythological character by William Blake.

William Blake
English painter, printmaker
and pre-Romantic poet
(1757 - 1827)

William Blake - **Albion Rose** -
from *A Large Book of Designs*

In the mythology of William Blake, **Albion** is the primeval man whose fall and division results in the Four Zoas: Urizen, Tharmas, Luvah/Orc and Urthona/Los. The name derives from the ancient and mythological name of Britain, **Albion**.

UH88 2.2 MAUNE KEA TELESCOPE



These two pictures discribe how the astronomers found Albion using the UH88 (2.2 meters) in Maune Kea Telescope.

Presentation of the Transneptunian (19521) Chaos

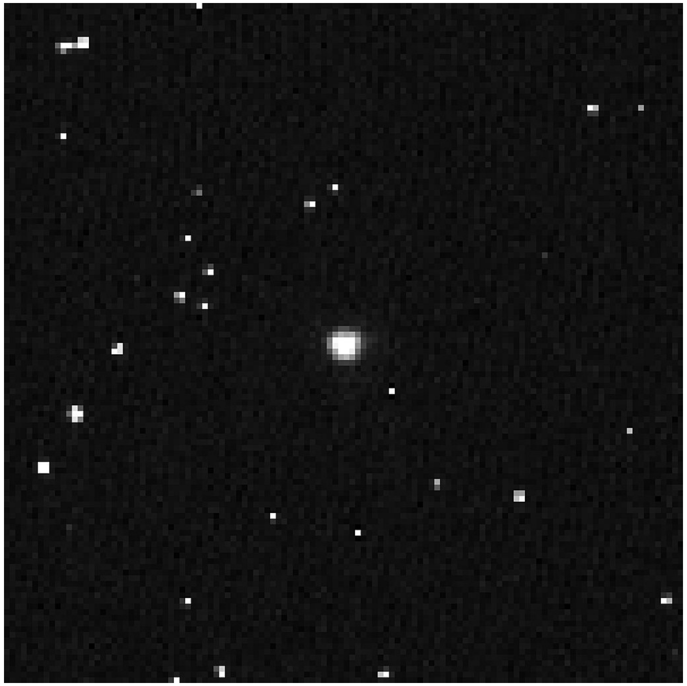
The transneptunian (19521) Chaos is a **cubewano**, a Kuiper-belt object not in resonance with any planet. Chaos was discovered in 1998 by the **Deep Ecliptic Survey** with **Kitt Peak's** 4 m telescope with an average diameter of 600 km.

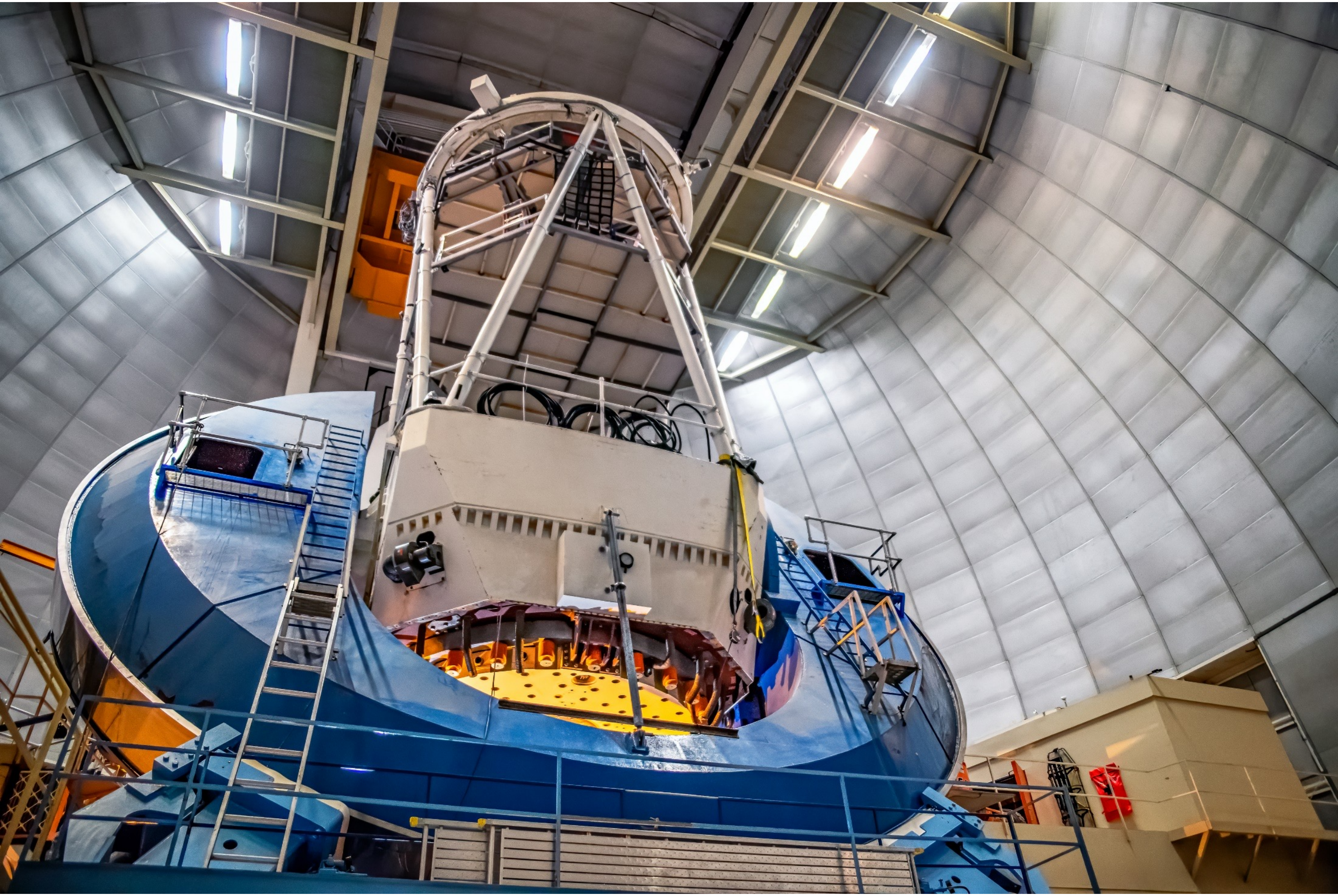
Chaos is a dark object, with an albedo estimated at 5%.

The **Deep Ecliptic Survey** is a project to find Kuiper belt objects, using the facilities of the **National Optical Astronomy Observatory** (NOAO).

The principal investigator is the American astronomer **Robert L. Millis**.

(19521) Chaos as imaged by the Hubble Space Telescope in September 2001





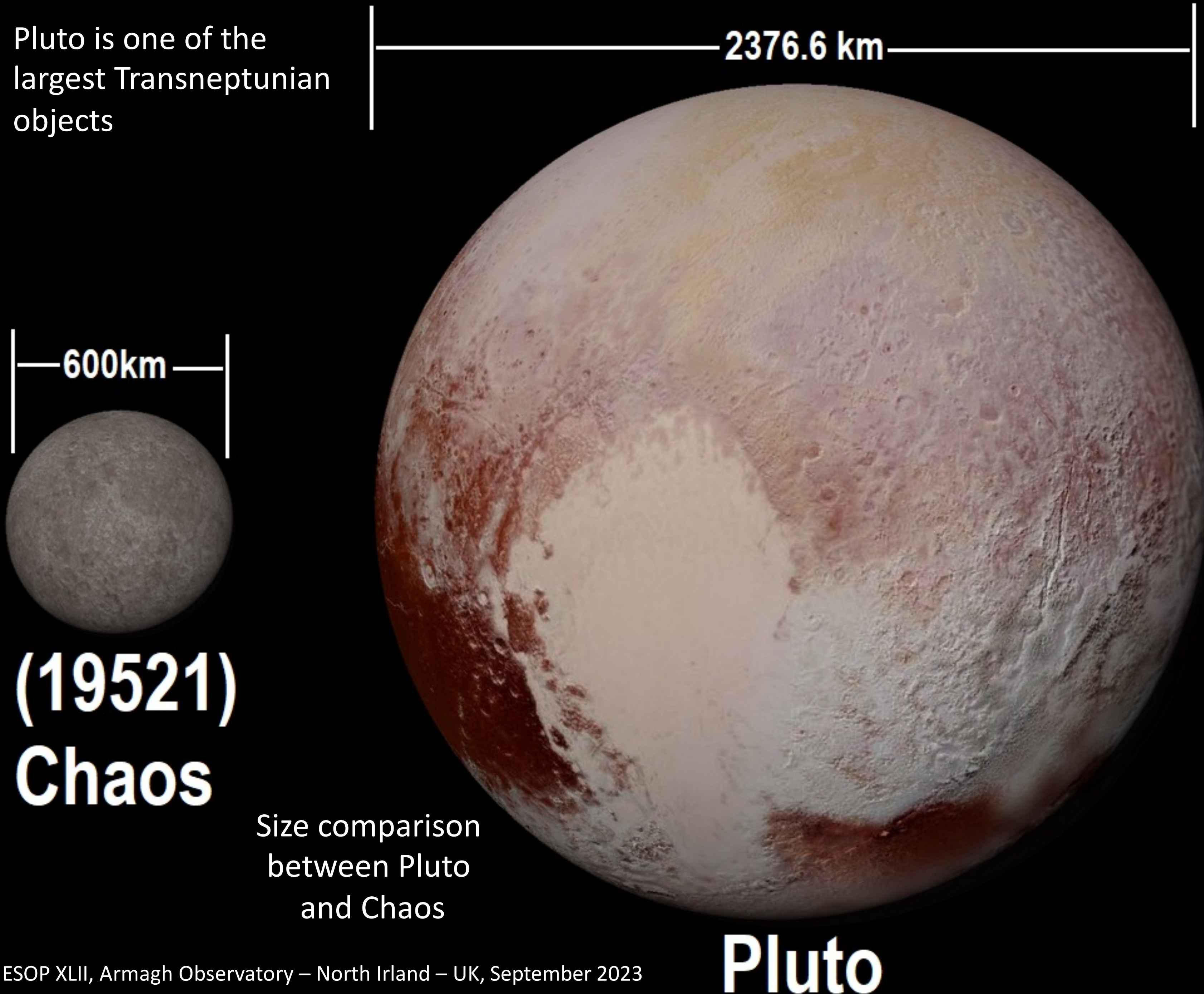
- The transneptunian (19521) Chaos moves West to East (right to left) across the sky, discovered in Taurus in 1998, and precovered back to 1991.

- This icy object will reach its perihelion in 2033.

- 3 different positive observations of Chaos over time have been observed.

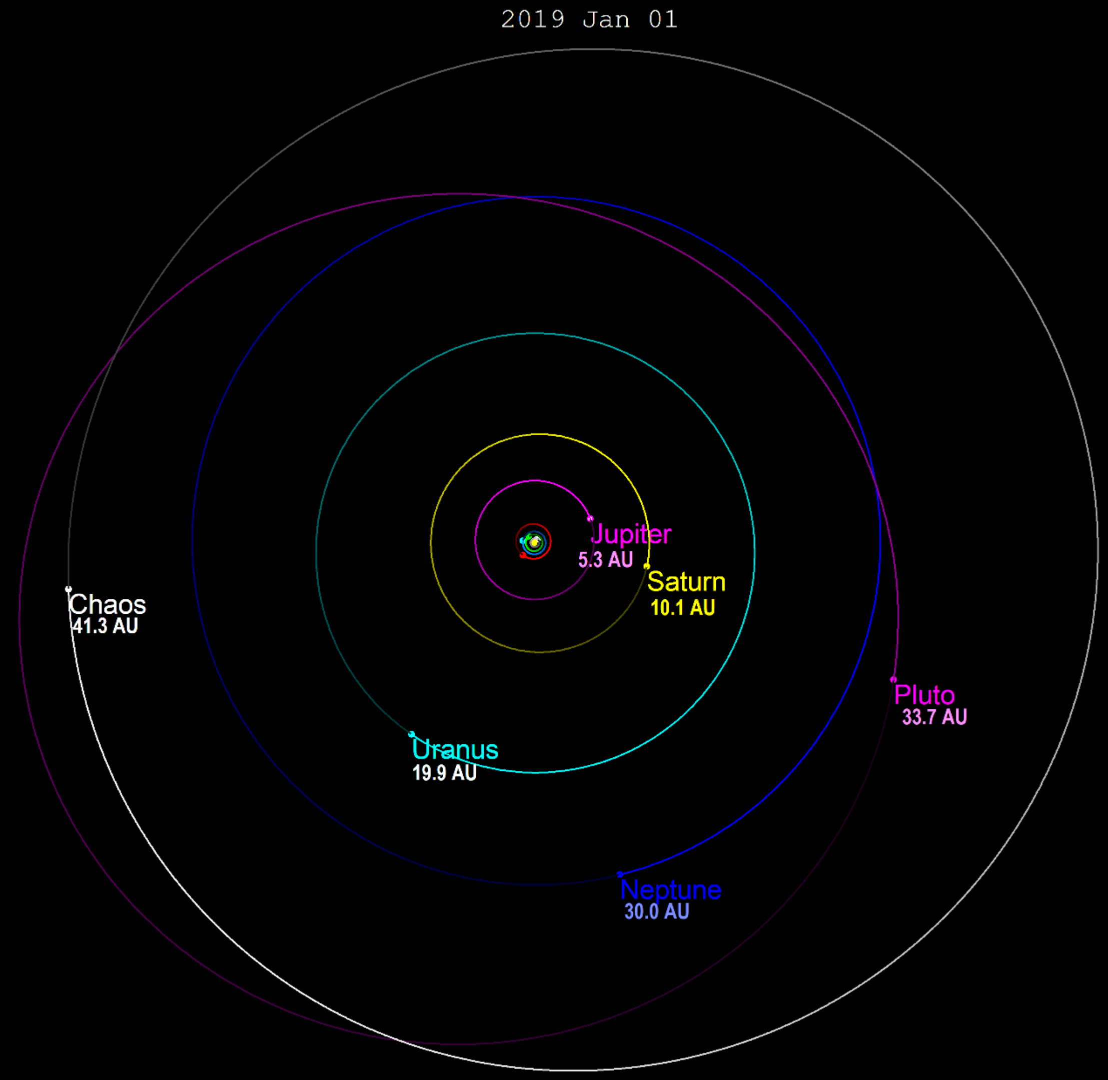
- José Luis Ortiz's team has published several proceedings about Chaos, including one in the Bulletin of the American Astronomical Society, Vol. 53 in October 2021.

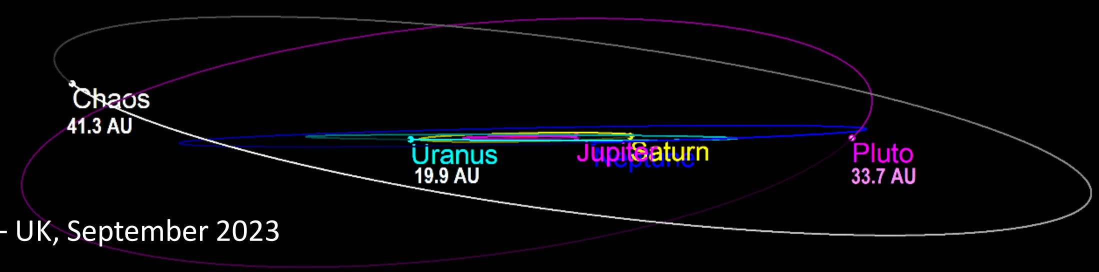
Pluto is one of the largest Transneptunian objects

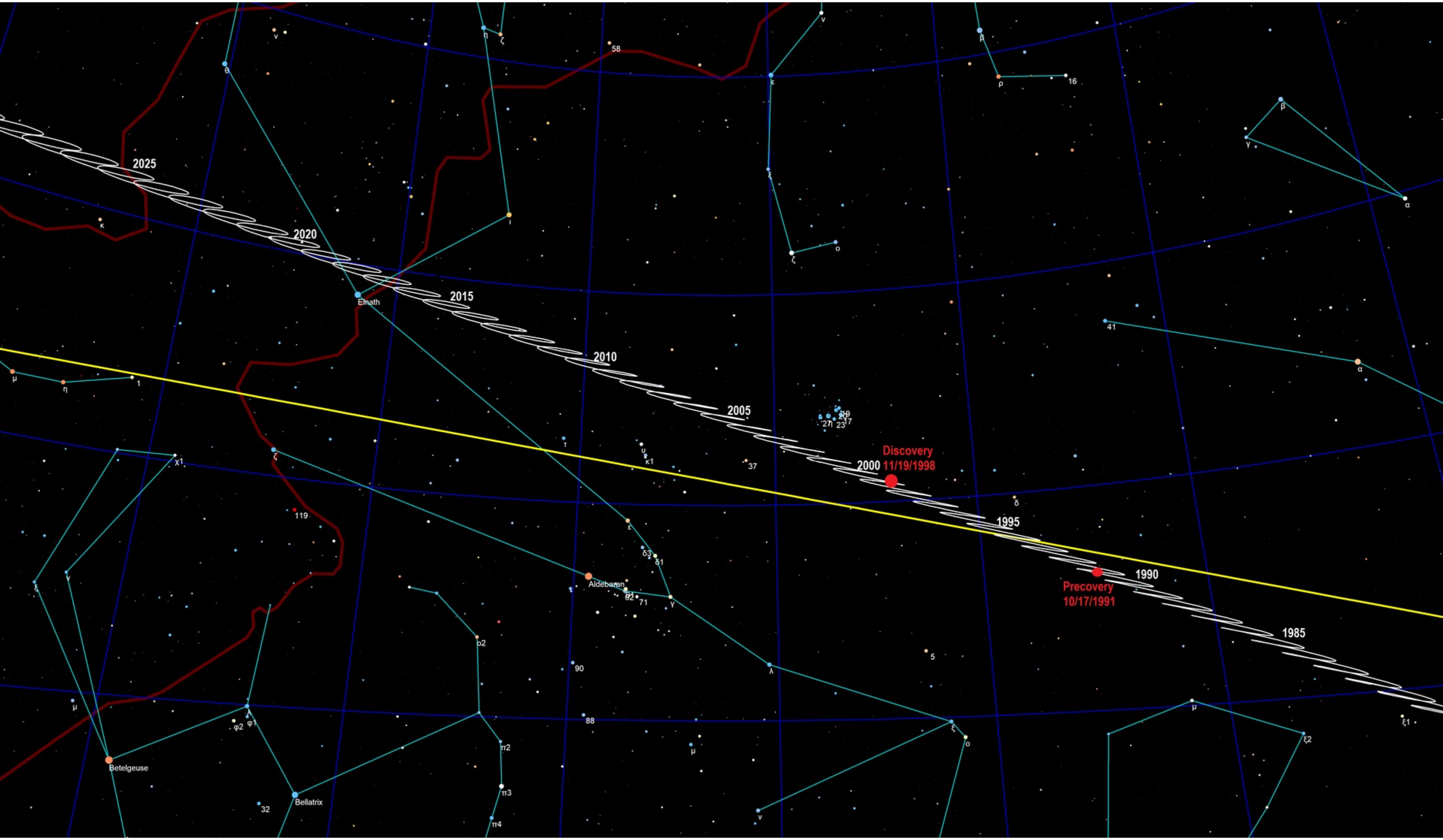


Size comparison between Pluto and Chaos

The orbit of Chaos (white) compared Pluto and the four giant planets: Jupiter, Saturn, Uranus, and Neptune with positions for 2019







Chaos moves west to east (right to left) across the Sky, discovered in Taurus in 1998, and precovered back to 1991.

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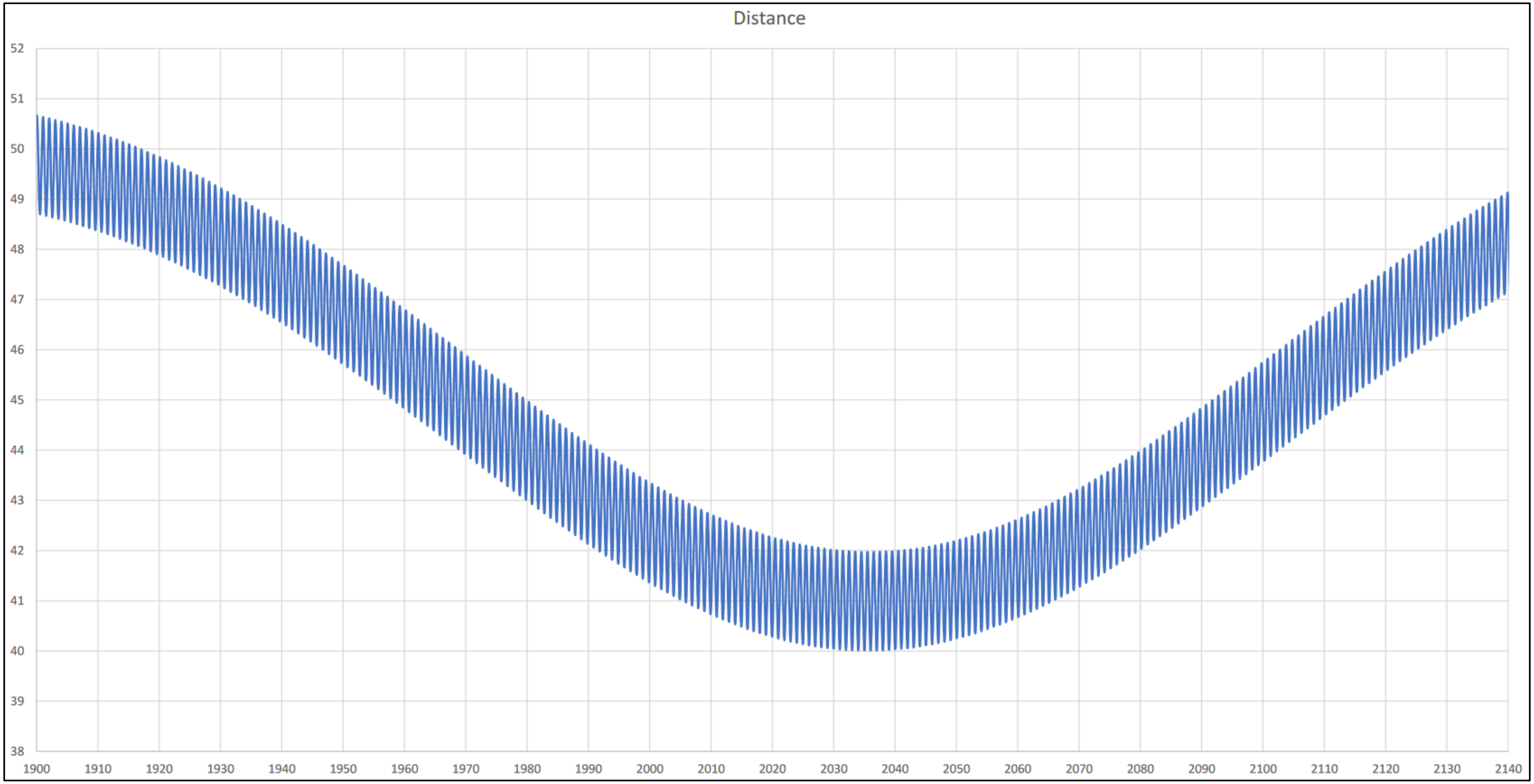
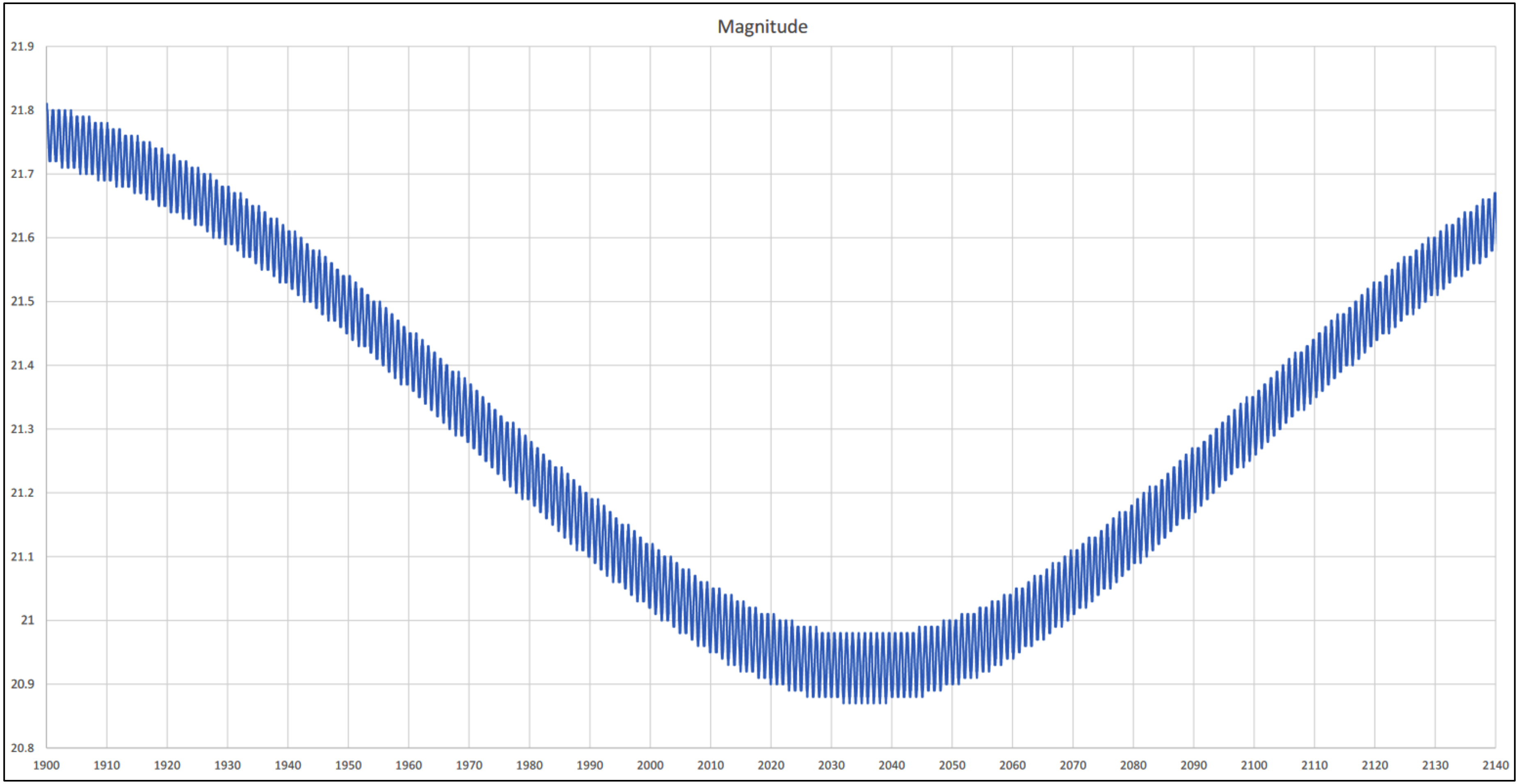


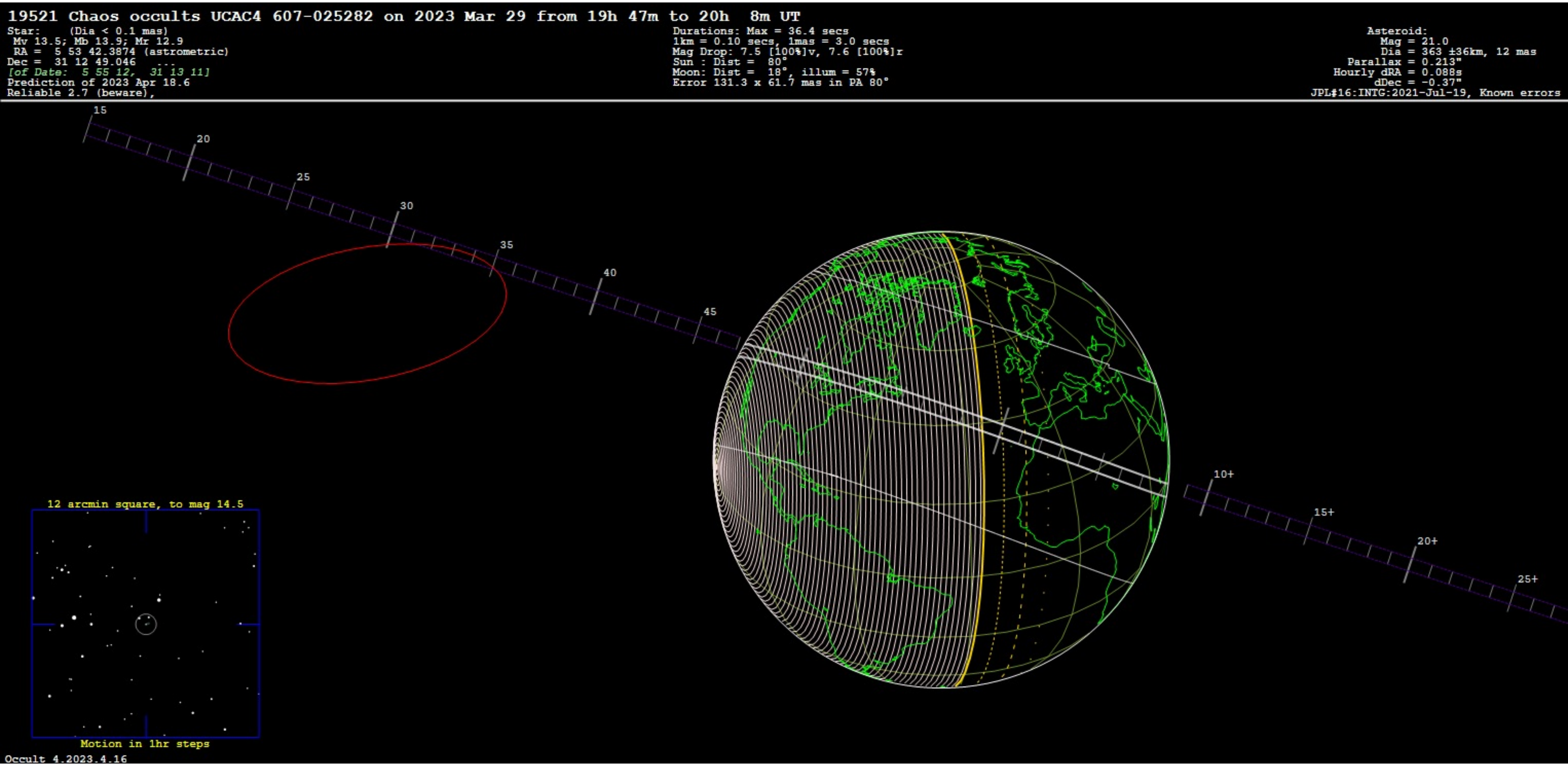
Distance from Earth (AU)



Apparent magnitude from Earth

The positive stellar occultation by the TNO (19521) Chaos on March, 29th 2023

First prediction of the stellar occultation by (19521) Chaos with **a large uncertainty in the trajectory and time of occultation using Occult software**.

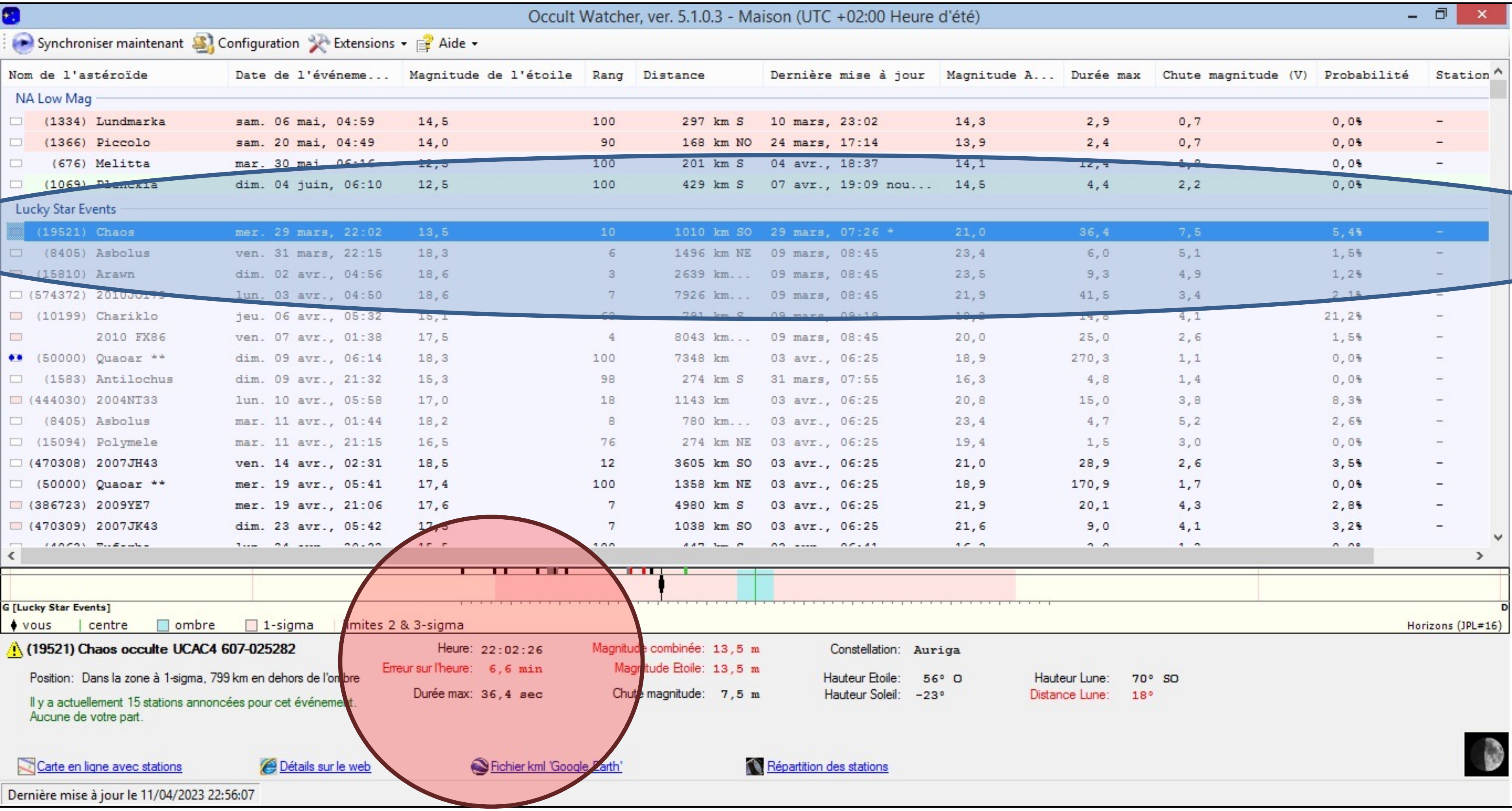


The **first probability of the occultation estimated at 5.8% in the central ligne** with a large uncertainty of the path.

Répartition des stations pour (19521) Chaos le 29 mars 2023

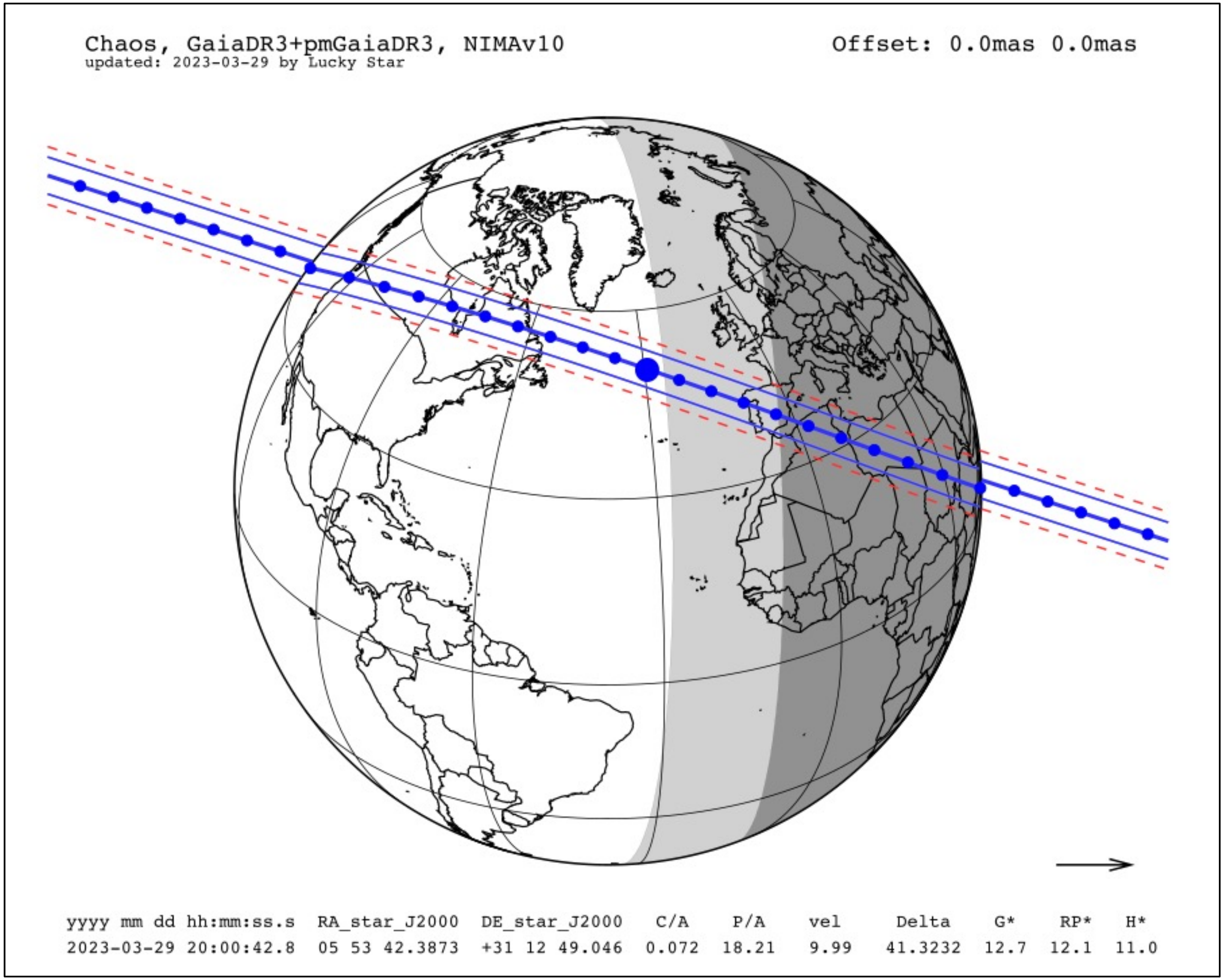
Distance (Occ...	Prob.	Nuages	Info station	Soumis par	Ville
7772,8 km	0,1%	-	== Limite droite plus 3-Sigma ==		
5243,7 km	0,7%	-	== Limite droite plus 2-Sigma ==		
2714,6 km	3,3%	-	== Limite droite plus 1-Sigma ==		
185,5 km	5,8%	-	=== Limite droite ===		
0,0 km	5,8%	-	==== Ligne centrale ====		
-185,5 km	5,8%	-	=== Limite gauche ===		
-730,9 km NE	5,6%	0%	(13) Casarramona F Home : video + gps	F. Casarramona	Las Negras
-1088,0 km NE	5,3%	0%	(10) Garcia F Home : video + gps	Faustino Garcia	Muñas de Arriba
-1170,3 km NE	5,3%	90%	(6) O. Canales Botorrita : video + gps	Oscar Canales Moreno	Botorrita
-1309,7 km NE	5,1%	10%	(14) Schnabel C Home : video + gps	Carles Schnabel	Sant Esteve Sesrovires
-1324,6 km NE	5,1%	0%	(16) Perelló & Selva : video + gps	Carles Perelló	Sabadell
-1325,3 km NE	5,1%	0%	(15) Ricard Casas : video + gps	R. Casas	Sabadell
-1977,1 km NE	4,3%	100%	(5) Haymes T Home : video + gps	Tim Haymes	Oxford
-2083,3 km NE	4,2%	100%	(3) Roland B Home : video + gps	BONINSEGNA Roland	DOURBES
-2105,9 km NE	4,1%	100%	(7) Z92 : video + gps	Alex Pratt	Leeds
-2121,7 km NE	4,1%	100%	(11) Thill F Home : video + gps	Frederic Thill	Senningerberg
-2162,7 km NE	4,1%	100%	(8) Schreurs O Home : video + gps	Olivier Schreurs	Liege
-2277,7 km NE	3,9%	100%	(2) Jan Maarten Winkel : video + gps	Jan Maarten Winkel	Zeddam
-2605,7 km NE	3,4%	80%	(1) Korec M Maximilian Hell Observatory : video + radio	Matej Korec	Ziar nad Hronom
-2714,6 km	3,3%	-	== Limite gauche plus 1-Sigma ==		
-2720,5 km NE	3,3%	100%	(17) Chalin : photoelectric + gps	Anna Marciniak	Poznań
-3055,7 km NE	2,8%	20%	(9) Burzyński W Home : video + gps	Wojciech Burzyński	Białystok
-	0,7%	-	== Limite gauche plus 2-Sigma ==		
-	0,1%	-	== Limite gauche plus 3-Sigma ==		

The **error time** was around 6.6 minutes as mentioned by the first prediction using Occult Watcher software.

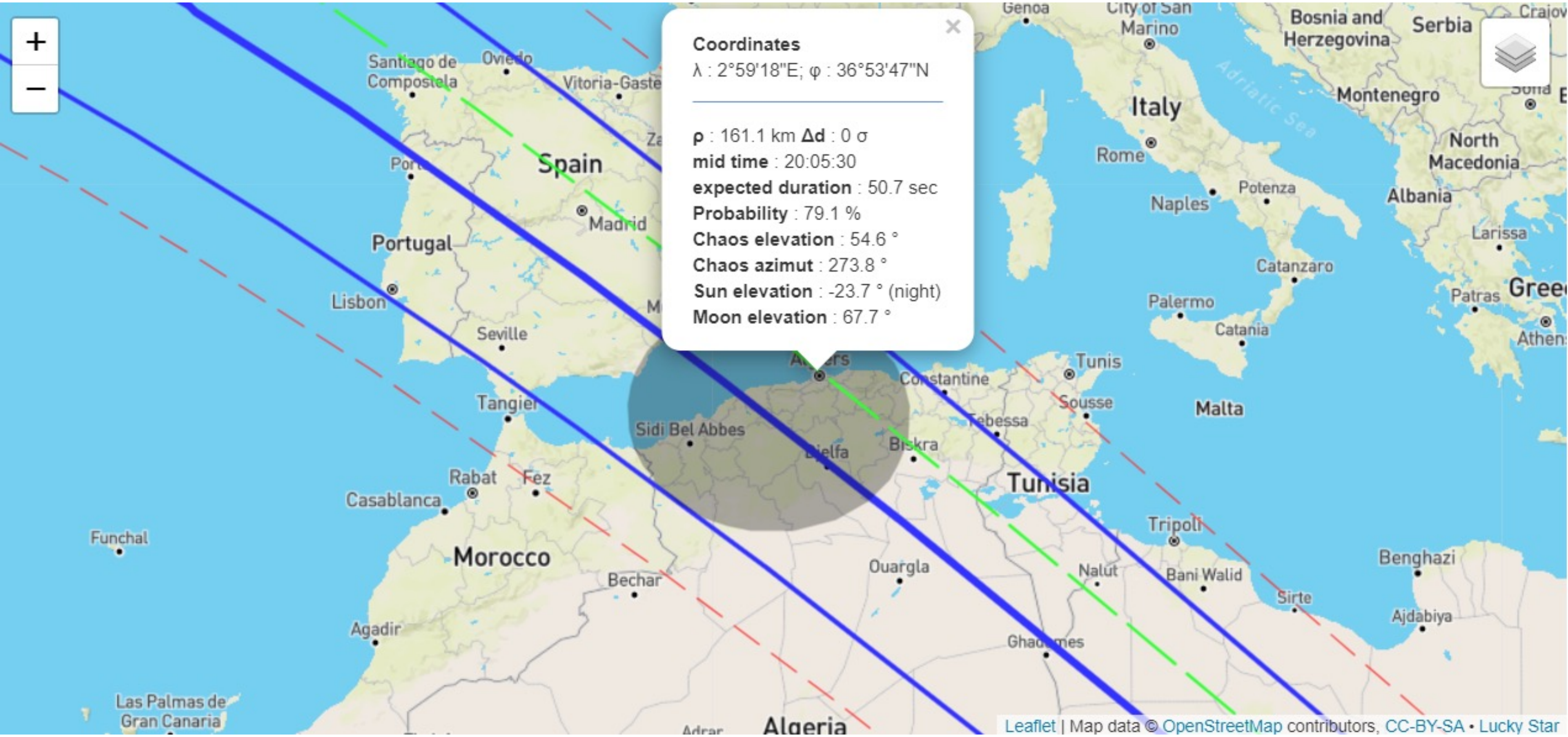


Nom de l'astéroïde	Date de l'événeme...	Magnitude de l'étoile	Rang	Distance	Dernière mise à jour	Magnitude A...	Durée max	Chute magnitude (V)	Probabilité	Station
NA Low Mag										
(1334) Lundmarka	sam. 06 mai, 04:59	14,5	100	297 km S	10 mars, 23:02	14,3	2,9	0,7	0,0%	-
(1366) Piccolo	sam. 20 mai, 04:49	14,0	90	168 km NO	24 mars, 17:14	13,9	2,4	0,7	0,0%	-
(676) Melitta	mar. 30 mai, 06:16	[illegible]	100	201 km S	04 avr., 18:37	14,1	[illegible]	[illegible]	0,0%	-
(1069) [illegible]	dim. 04 juin, 06:10	12,5	100	429 km S	07 avr., 19:09 nou...	14,5	4,4	2,2	0,0%	
Lucky Star Events										
(19521) Chaos	mer. 29 mars, 22:02	13,5	10	1010 km SO	29 mars, 07:26 *	21,0	36,4	7,5	5,4%	-
(8405) Asbolus	ven. 31 mars, 22:15	18,3	6	1496 km NE	09 mars, 08:45	23,4	6,0	5,1	1,5%	-
(15810) Arawn	dim. 02 avr., 04:56	18,6	3	2639 km...	09 mars, 08:45	23,5	9,3	4,9	1,2%	-
(574372) 2010JO179	lun. 03 avr., 04:50	18,6	7	7926 km...	09 mars, 08:45	21,9	41,5	3,4	[illegible]	-
(10199) Chariklo	jeu. 06 avr., 05:32	15,1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4,1	21,2%	-
2010 FX86	ven. 07 avr., 01:38	17,5	4	8043 km...	09 mars, 08:45	20,0	25,0	2,6	1,5%	-
(50000) Quaoar **	dim. 09 avr., 06:14	18,3	100	7348 km	03 avr., 06:25	18,9	270,3	1,1	0,0%	-
(1583) Antilochus	dim. 09 avr., 21:32	15,3	98	274 km S	31 mars, 07:55	16,3	4,8	1,4	0,0%	-
(444030) 2004NT33	lun. 10 avr., 05:58	17,0	18	1143 km	03 avr., 06:25	20,8	15,0	3,8	8,3%	-
(8405) Asbolus	mar. 11 avr., 01:44	18,2	8	780 km...	03 avr., 06:25	23,4	4,7	5,2	2,6%	-
(15094) Polymele	mar. 11 avr., 21:15	16,5	76	274 km NE	03 avr., 06:25	19,4	1,5	3,0	0,0%	-
(470308) 2007JH43	ven. 14 avr., 02:31	18,5	12	3605 km SO	03 avr., 06:25	21,0	28,9	2,6	3,5%	-
(50000) Quaoar **	mer. 19 avr., 05:41	17,4	100	1358 km NE	03 avr., 06:25	18,9	170,9	1,7	0,0%	-
(386723) 2009YE7	mer. 19 avr., 21:06	17,6	7	4980 km S	03 avr., 06:25	21,9	20,1	4,3	2,8%	-
(470309) 2007JK43	dim. 23 avr., 05:42	17,3	7	1038 km SO	03 avr., 06:25	21,6	9,0	4,1	3,2%	-

The stellar occultation by the TNO (19521) Chaos March, 29th 2023 using the data of Lucky Star site

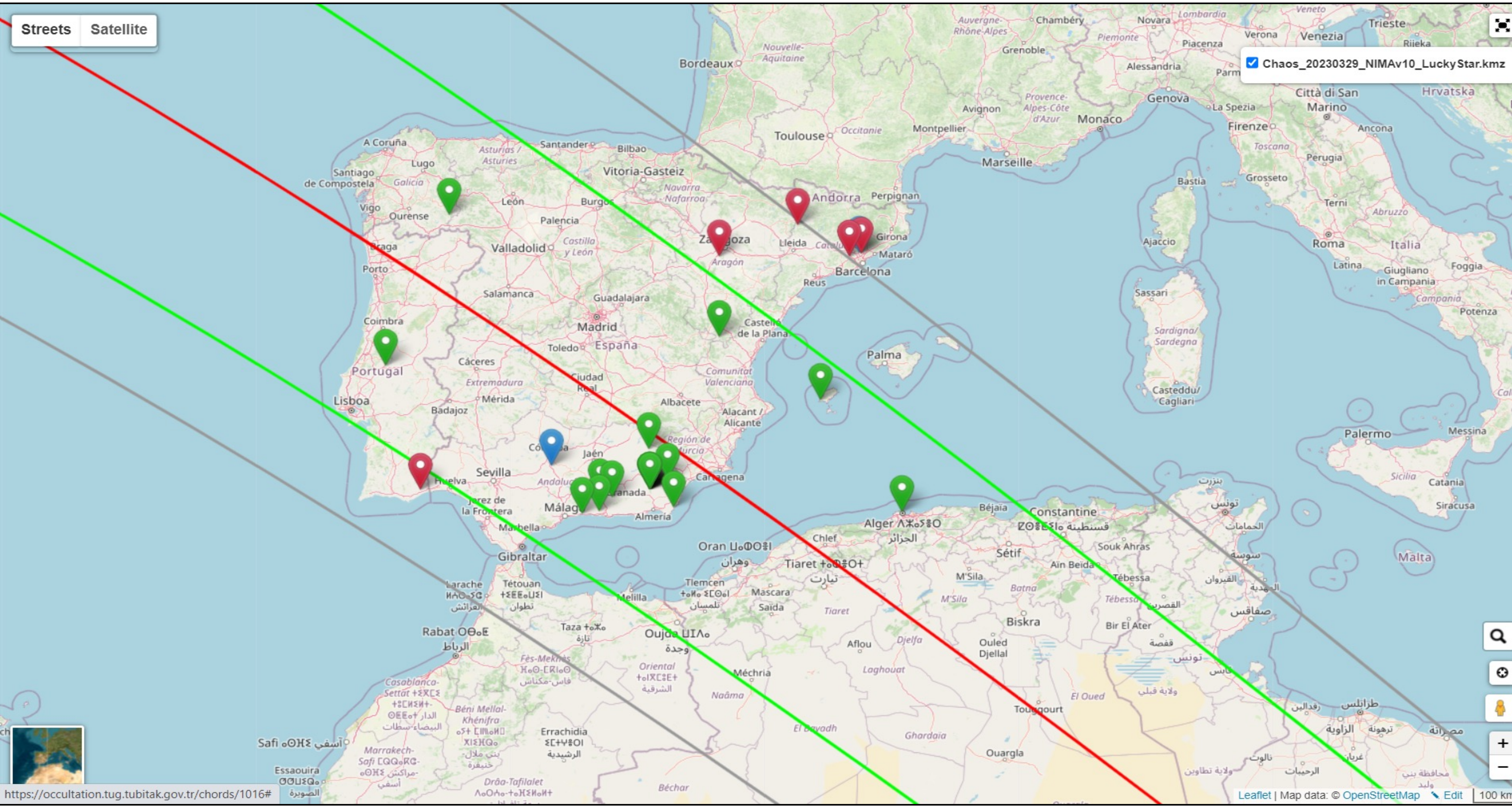


New prediction of the stellar occultation by (19521) Chaos with **a probability of 95% by Ortiz Team from the Andalusian Institute of Astrophysics in Granada (Spain) and the Lucky Star team**.

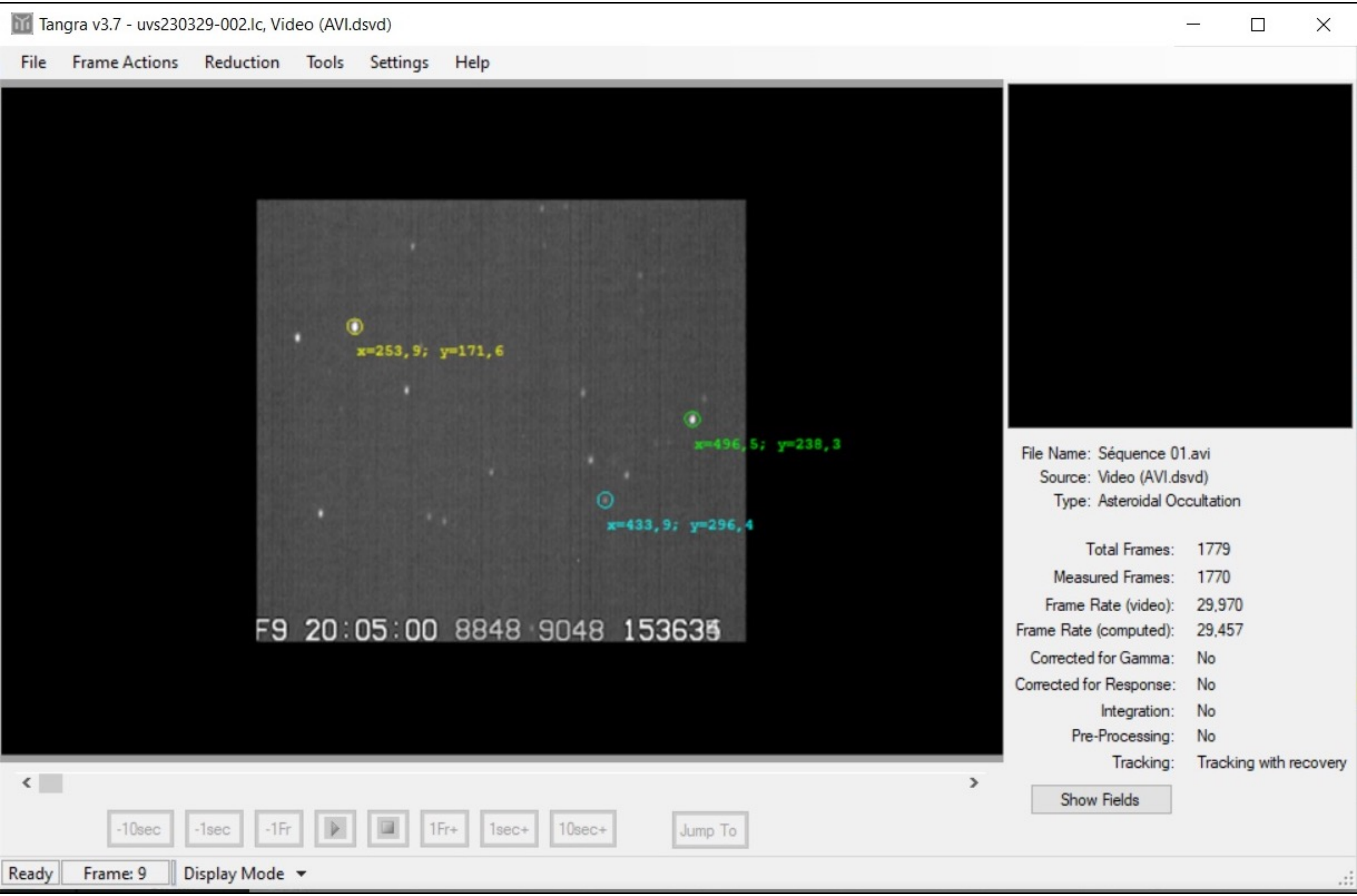


Result and distribution of the observers along the occultation path

According to data from the **Tubitak site**, there were **13 positive occultations** and **5 negative occultations**.



Positive observation **Negative observation** **The Headquarters**


Tangra v3.7 - uvs230329-002.lc, Video (AVI.dsvd)
File
Frame Actions
Reduction
Tools
Settings
Help
x=253,9; y=171,6
x=496,5; y=238,3
x=433,9; y=296,4
F9 20:05:00 8848 9048 153635
File Name: Séquence 01.avi
Source: Video (AVI.dsvd)
Type: Asteroidal Occultation
Total Frames: 1779
Measured Frames: 1770
Frame Rate (video): 29,970
Frame Rate (computed): 29,457
Corrected for Gamma: No
Corrected for Response: No
Integration: No
Pre-Processing: No
Tracking: Tracking with recovery
Show Fields
-10sec
-1sec
-1Fr
1Fr+
1sec+
10sec+
Jump To
Ready
Frame: 9
Display Mode

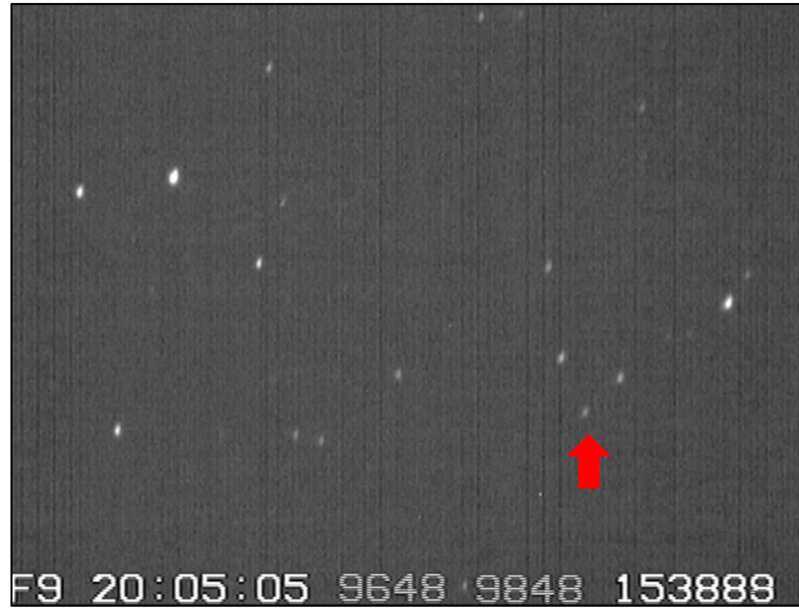
We began observing 15 minutes before the time indicated by the **Occult Watcher software** using the **81 cm telescope of the Algiers Observatory** by placing the Watec 910 HX/RC video camera with an IOTA VTI inserter.

According to **Occult Watcher software**, the disappearance should have taken place at **22h02mn** UT.

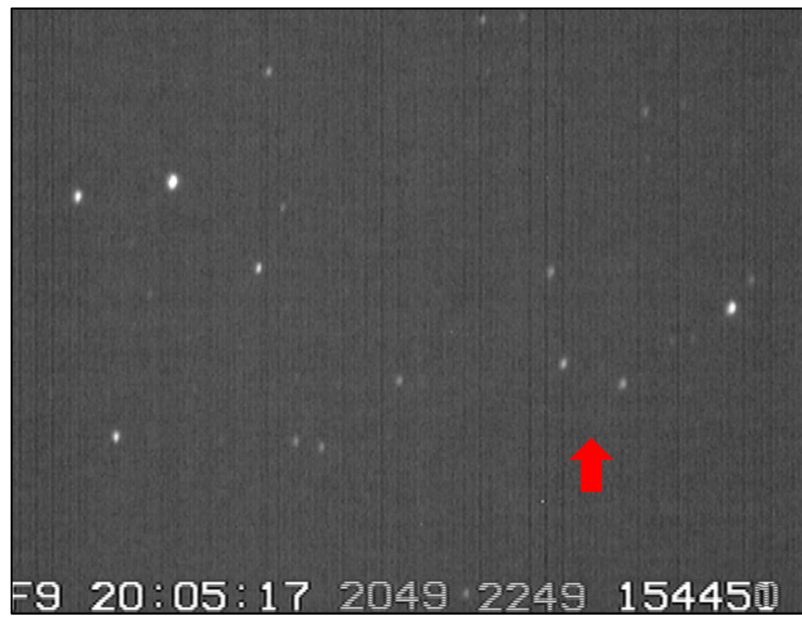
But the occultation began at **20h05mn16s UT**.

And ended at **20h05mn33s UT**.

It lasted approximately **17 seconds** !



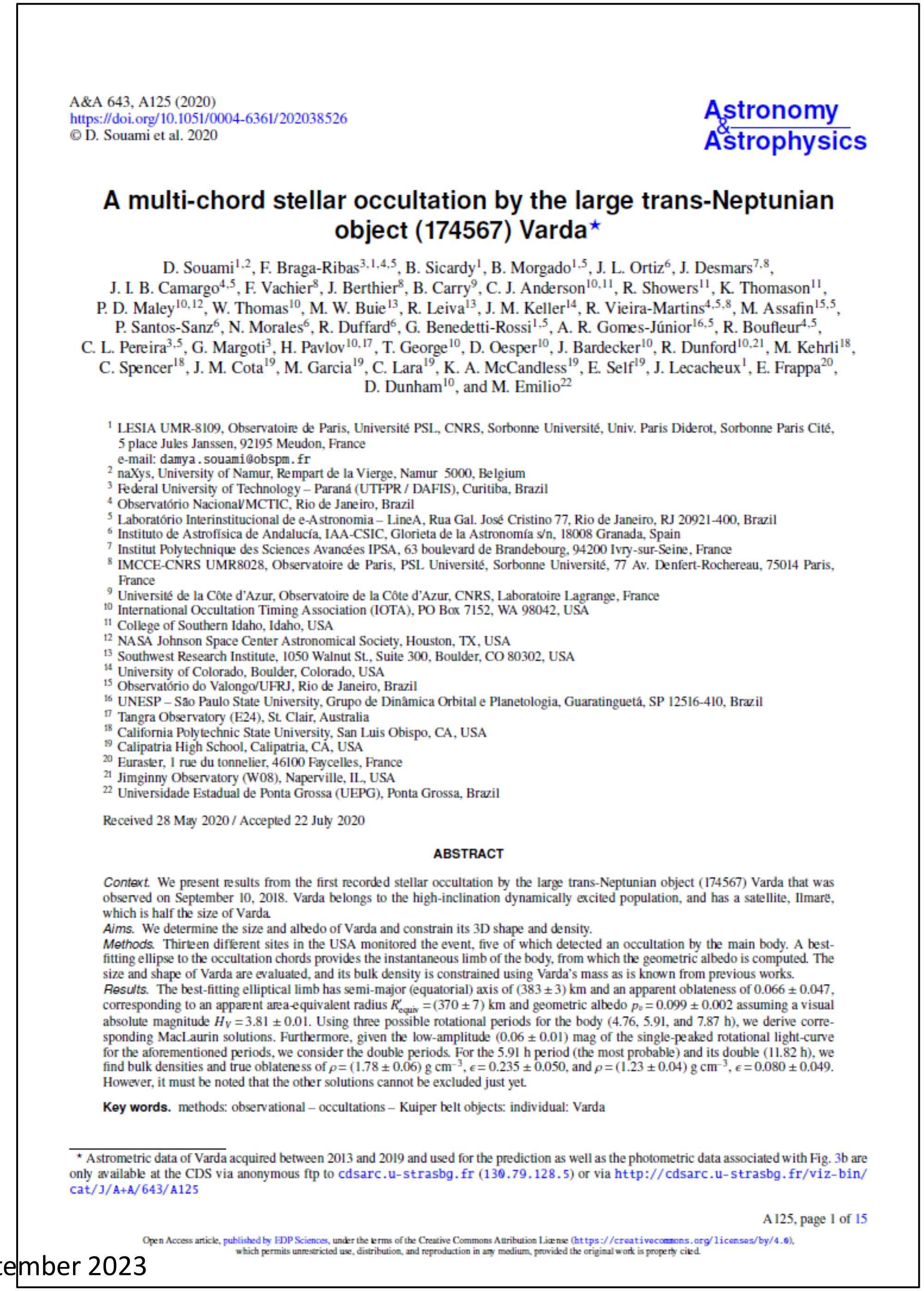
Before the occultation



During the occultation

Here the **light curve** obtained using **Tangra** software.
Note **the gradual disappearance** and **reappearance** of the star, as if (19521) Chaos had a **tenuous atmosphere** like the dwarf planet Pluto or Neptune's satellite Triton.
We thought it might have an atmosphere because this icy object will be at its perihelion in 2033.

But according to **José Luis Ortiz** and the scientific article published in the journal **Astronomy and Astrophysics** and written by **Samya Souami and al** in 2020 which concerns the object **(174567) Varda**. The gradual disappearance and reappearance was also observed by this TNO and in fact, it is an **optical artefact**.



A&A 643, A125 (2020)
https://doi.org/10.1051/0004-6361/202038526

Astronomy & Astrophysics

A multi-chord stellar occultation by the large trans-Neptunian object (174567) Varda*

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ABSTRACT

Context. We present results from the first recorded stellar occultation by the large trans-Neptunian object (174567) Varda that was observed on September 10, 2018. Varda belongs to the high-inclination dynamically excited population, and has a satellite, Ilmarë, which is half the size of Varda.
Aims. We determine the size and albedo of Varda and constrain its 3D shape and density.
Methods. Thirteen different sites in the USA monitored the event, five of which detected an occultation by the main body. A best-fitting ellipse to the occultation chords provides the instantaneous limb of the body, from which the geometric albedo is computed. The size and shape of Varda are evaluated, and its bulk density is constrained using Varda's mass as is known from previous works.
Results. The best-fitting elliptical limb has semi-major (equatorial) axis of (383 ± 3) km and an apparent oblateness of 0.066 ± 0.047, corresponding to an apparent area-equivalent radius $R'_{equiv} = (370 \pm 7)$ km and geometric albedo $p_v = 0.099 \pm 0.002$ assuming a visual absolute magnitude $H_V = 3.81 \pm 0.01$. Using three possible rotational periods for the body (4.76, 5.91, and 7.87 h), we derive corresponding MacLaurin solutions. Furthermore, given the low-amplitude (0.06 ± 0.01) mag of the single-peaked rotational light-curve for the aforementioned periods, we consider the double periods. For the 5.91 h period (the most probable) and its double (11.82 h), we find bulk densities and true oblateness of $\rho = (1.78 \pm 0.06)$ g cm^{-3}, $\epsilon = 0.235 \pm 0.050$, and $\rho = (1.23 \pm 0.04)$ g cm^{-3}, $\epsilon = 0.080 \pm 0.049$. However, it must be noted that the other solutions cannot be excluded just yet.

Key words. methods: observational – occultations – Kuiper belt objects: individual: Varda

* Astrometric data of Varda acquired between 2013 and 2019 and used for the prediction as well as the photometric data associated with Fig. 3b are only available at the CDS via anonymous ftp to cdsarc.u-strasbg.fr (130.79.128.5) or via http://cdsarc.u-strasbg.fr/viz-bin/cat/J/A+A/643/A125

The future stellar occultations by the TNO (19521) Chaos

- **In September 28th, 2023 - North America, Mexico - JPL calculations - Mv 14.4 - Moon illumination : 98%.**

- In October 26th, 2023 - South Pacific, Cook Islands - JPL calculations - Mv 14.5 Moon illumination : 93%.

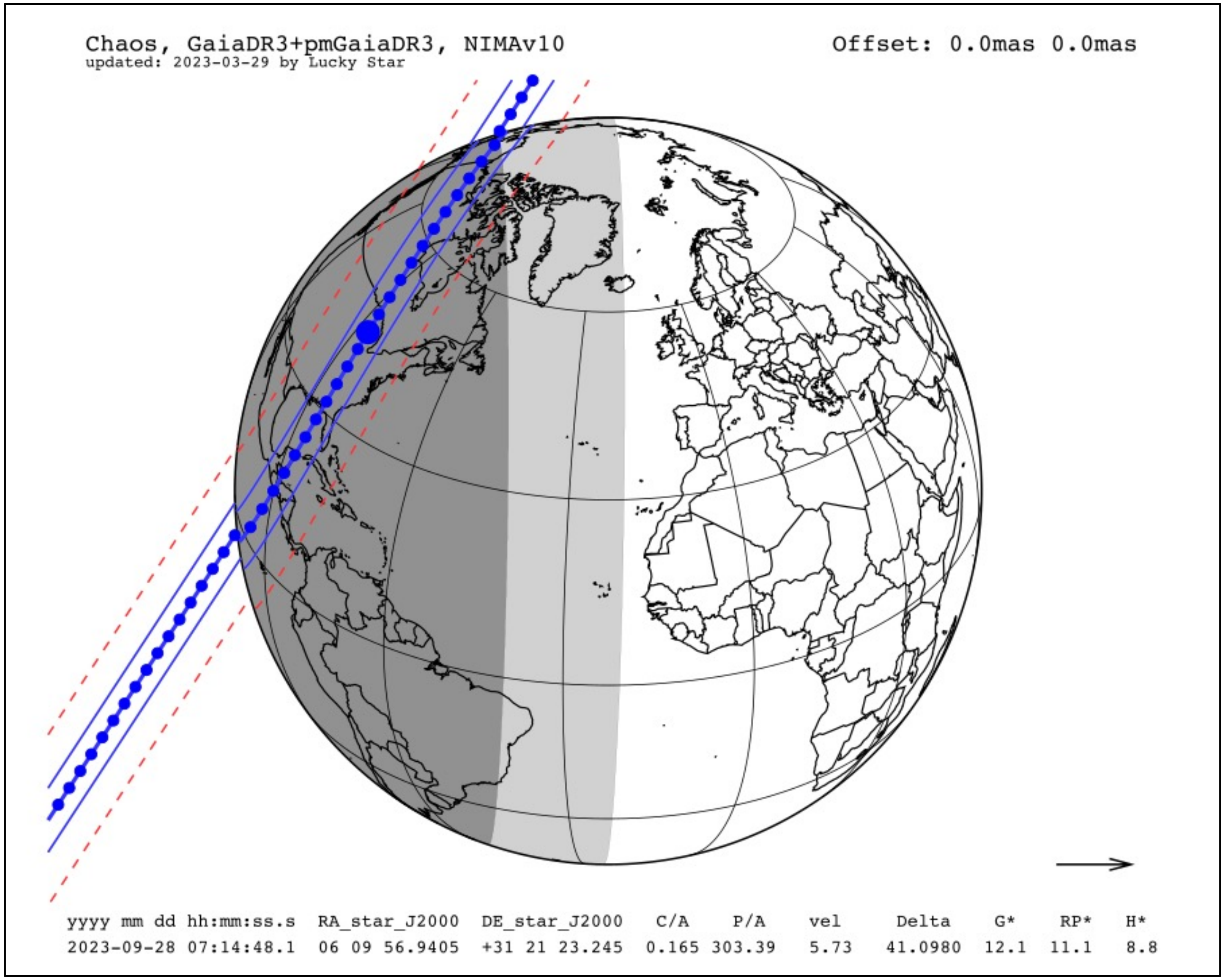
- In August, 12th 2026 - Uzbekistan, Turkmenistan, Iran - JPL calculations - Mv 14.2 - Moon illumination : 00%.

- In November, 21st 2028 - **????** - JPL calculations beyond Earth's northern hemisphere - Mv 11.6 - Moon illumination : 23%.

- **In January, 23th 2029 - Spain, Italy - JPL calculations - Mv 13.7 - Moon illumination : 59%.**

- In January, 19 th 2030 - **????** - JPL calculations - Just beyond Earth's northern hemisphere - Mv 13.2 – Moon illumination : 100%.

The next stellar occultation by the TNO (19521) Chaos
September, 28th 2023



The star that will be occulted has a magnitude of 12 and is very close to a star of magnitude 10.5 called **V* BU Aur**, a Mira Variable TYC 2420-258-1.

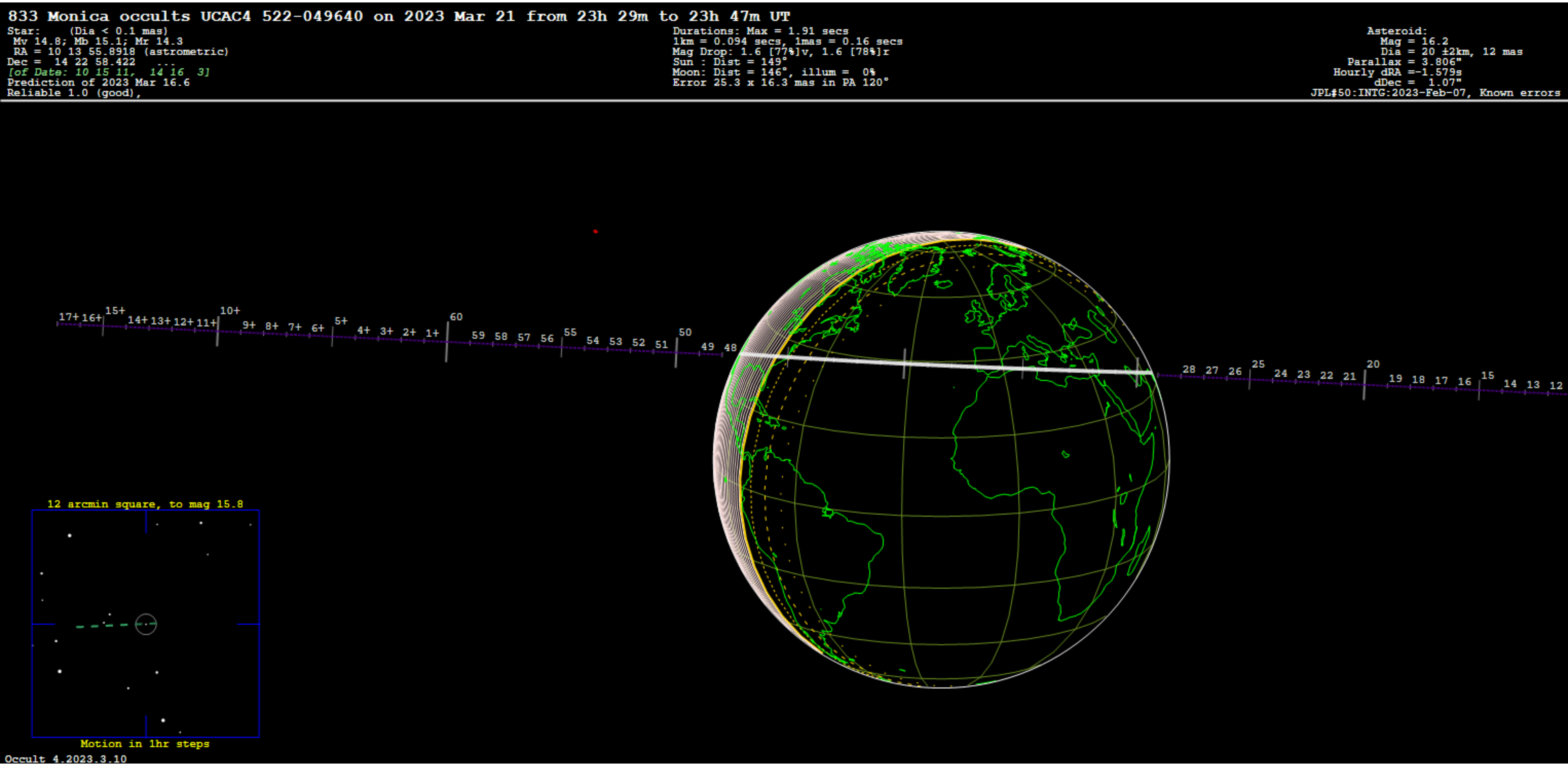
We know that new astrometric observations of (19521) Chaos are needed to predict with a high probability new occultations that will make it possible to refine the geographical positions and characterize the exact shape of this trans-Neptunian object.

In fact, **David Dunham** mentioned that Chaos is probably a **bilobed body** like Arrokoth but larger that it according to a conference presented at the Seventh edition of **the Spanish Meeting of Planetary Sciences and Exploration of the Solar System** (7th CPESS), held 11-13 July, 2023 in Valladolid, Spain.

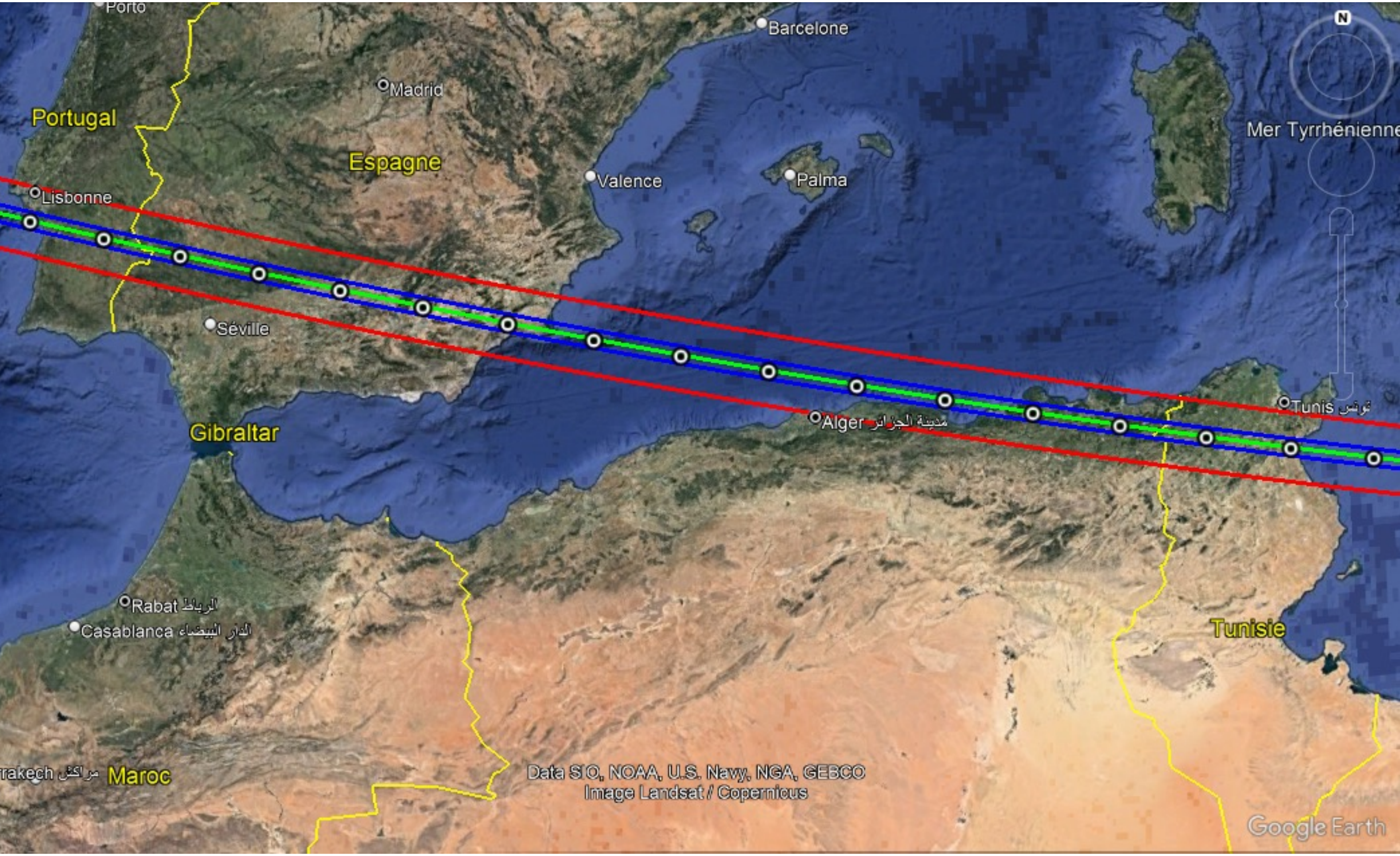
According to the calculation of the Occult software, the next famous stellar occultation by (19521) Chaos will be crossing Spain.

The negative stellar occultation by the (833) Monica on March, 21th 2023

The negative stellar occultation by the asteroid (833) Monica on March, 21th 2023



The negative stellar occultation by the asteroid (833) Monica on March, 21th 2023



We observed this negative occultation through the 81 centimeters telescope at the Algiers Observatory, using the Watec 910 HX/RC video camera and an IOTA VTI inserter, at the request of **Anna Marciniak** and **José Luis Ortiz**, because it is a very slow rotator.

OccultationPortal — Quick Guide · Predictions · My Events · My Locations · My Equipments · Djounai BABA AISSA

(833) Monica's chord(s)

March 21, 2023, 11:38 p.m.

PDF | Copy | Excel | CSV | Print | Column visibility — Search:

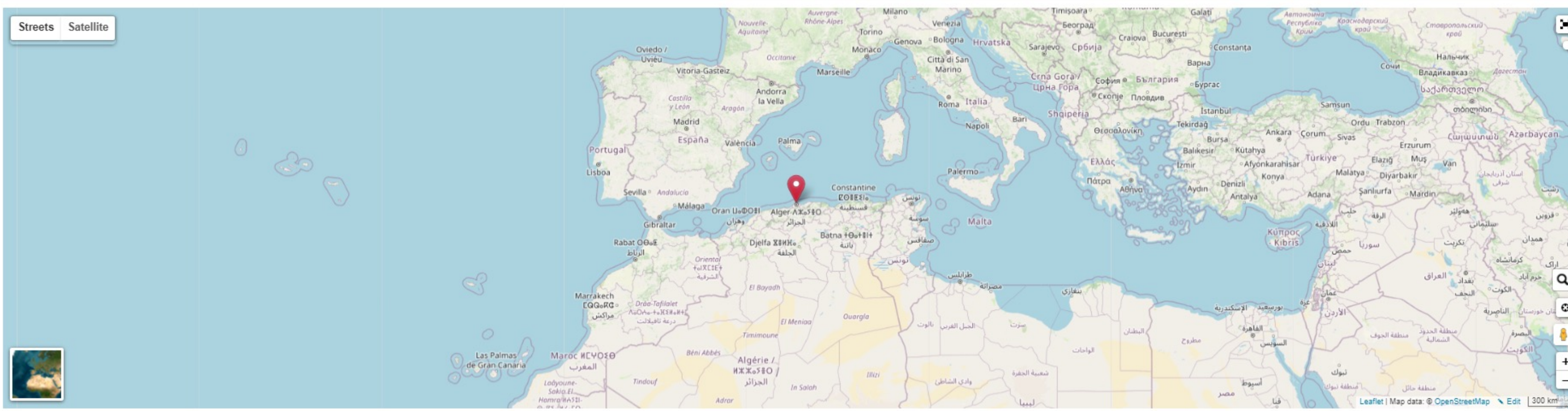
Event	Observer(s)	Site	Status	Telescope aperture (mm)	Camera	Exptime (s)	Filter	Sky condition	Data status
(833) Monica	BABA AISSA Djounai & GRIGAHCENE Zaki & BOUYAHIAOUI Zineddine	Algiers Observatory	Negative	810.0	Watec 910HX/RC Mono Camera (FOV: 3.35' x 2.68')		Focal Reducer 0.5 x	Clear	Data not provided

Showing 1 to 1 of 1 entries — Previous 1 Next

Total 1 (Planned: 0, Positive: 0, Negative: 1, Overcast: 0, Technical failure: 0, Unknown: 0, Cancelled: 0) chord is listed.

Chords map

Planned | Positive | Negative | Overcast | Technical failure | Unknown | Cancelled



Participative astronomy in Algeria according to observe stellar occutation by asteroids in 2023

The 12th National Meeting to observe stellar occultation by 132 Aethra, Thursday, November 16th 2023

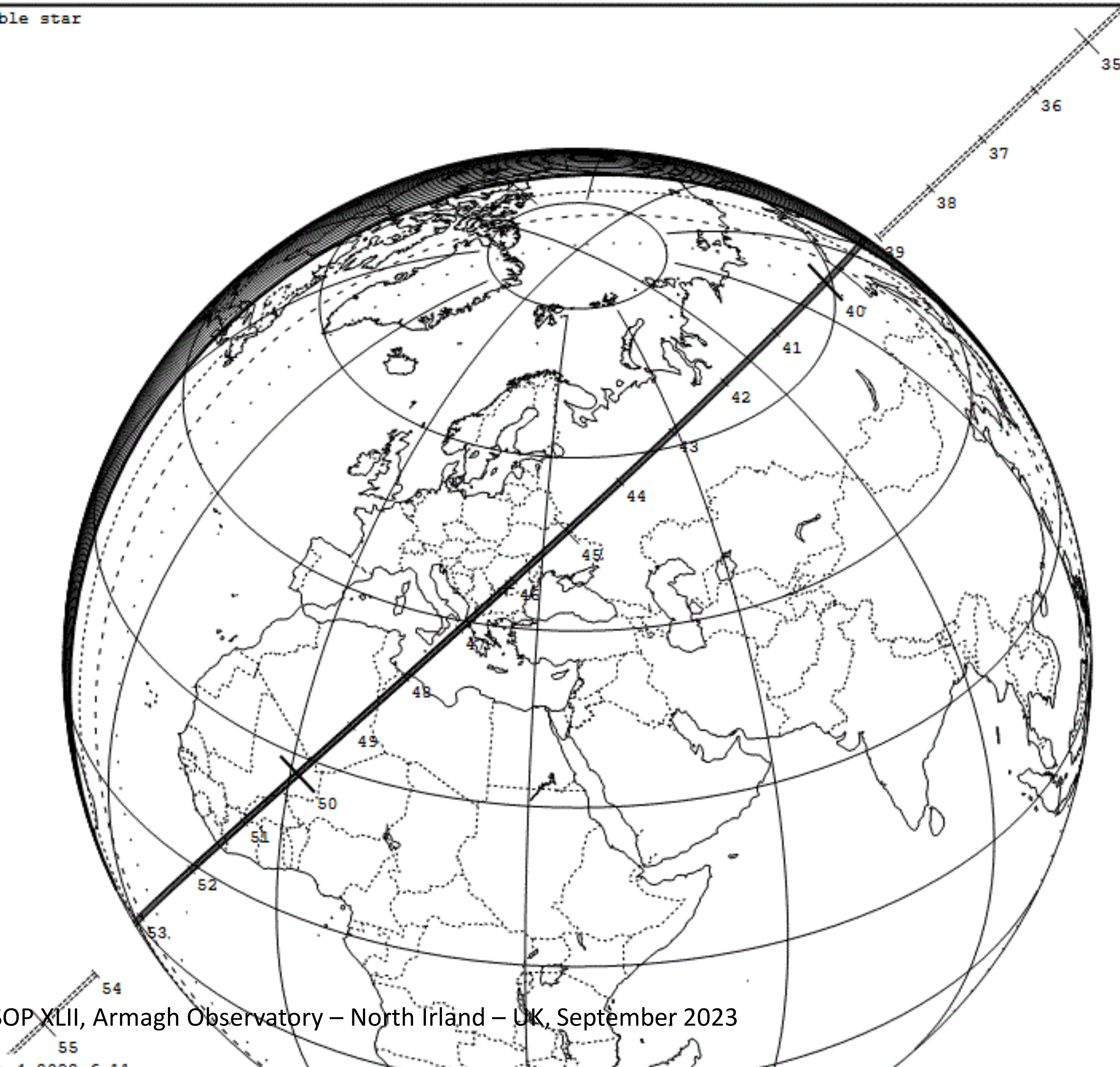
132 Aethra occults HIP 13252 on 2023 Nov 16 from 20h 39m to 20h 53m UT

Star: (Dia < 0.1 mas)
Mv 7.5
RA = 2 50 33.5454 (astrometric)
Dec = 36 17 48.577 ...
[of Date: 2 52 4, 36 23 49]
Prediction of 2022 Jun 15.2
Reliable not available

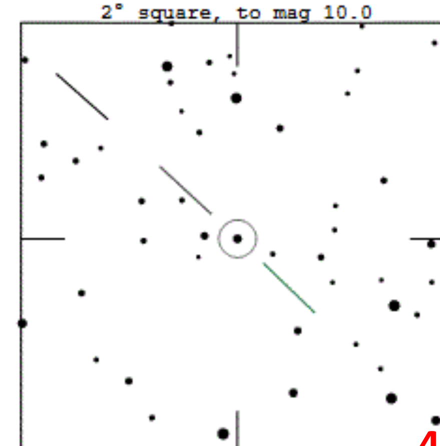
Durations: Max = 3.1 secs
1km = 0.067 secs, 1mas = 0.073 secs
Mag Drop = 4.9 [99%]v
Sun : Dist = 161°
Moon: Dist = 133°, illum = 14%
Error 13.0 x 3.3 mas in PA 89°

Asteroid: (in DAMIT, ISAM)
Mag = 12.4
Dia = 46 ±3km, 42 mas
Parallax = 5.911"
Hourly dRA =-2.980s
dDec =-33.89"
JPL#69 2022Jun06, Known errors

Variable star



2° square, to mag 10.0



Motion in 24hr steps

Occult 4.2022.6.11

This time, we are expecting **150 amateur astronomers** to take part, using **75 telescopes** divided into **25 points** along the occultation band.

The two stellar Occultation by (319) Leona on September, 13th and december 6th 2023

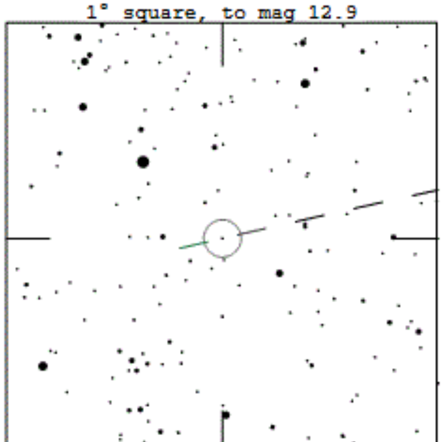
319 Leona occults UCAC4 521-014751 on 2023 Sep 13 from 3h 42m to 3h 51m UT

Star: (Dia < 0.1 mas)
Mv 11.9
RA = 5 42 12.5290 (astrometric)
Dec = 14 0 4.107 ...
[of Date: 5 43 33, 14 0 51]
Prediction of 2023 Aug 6.7
Reliable not available

Durations: Max = 2.8 secs
1km = 0.046 secs, 1mas = 0.087 secs
Mag Drop = 3.7 [97%]v
Sun : Dist = 85°
Moon: Dist = 65°, illum = 3%
Error 24.3 x 10.7 mas in PA 91°

Asteroid:
Mag = 15.5
Dia = 61 ±3km, 32 mas
Parallax = 3.388"
Hourly dRA = 2.756s
dDec = -9.34"
JPL#662023Jul30, Known errors

1° square, to mag 12.9



Motion in 6hr steps

Occult 4.2023.8.5

The stellar occultation by (319) Leona on 13 September was to pass through the Algiers Observatory.

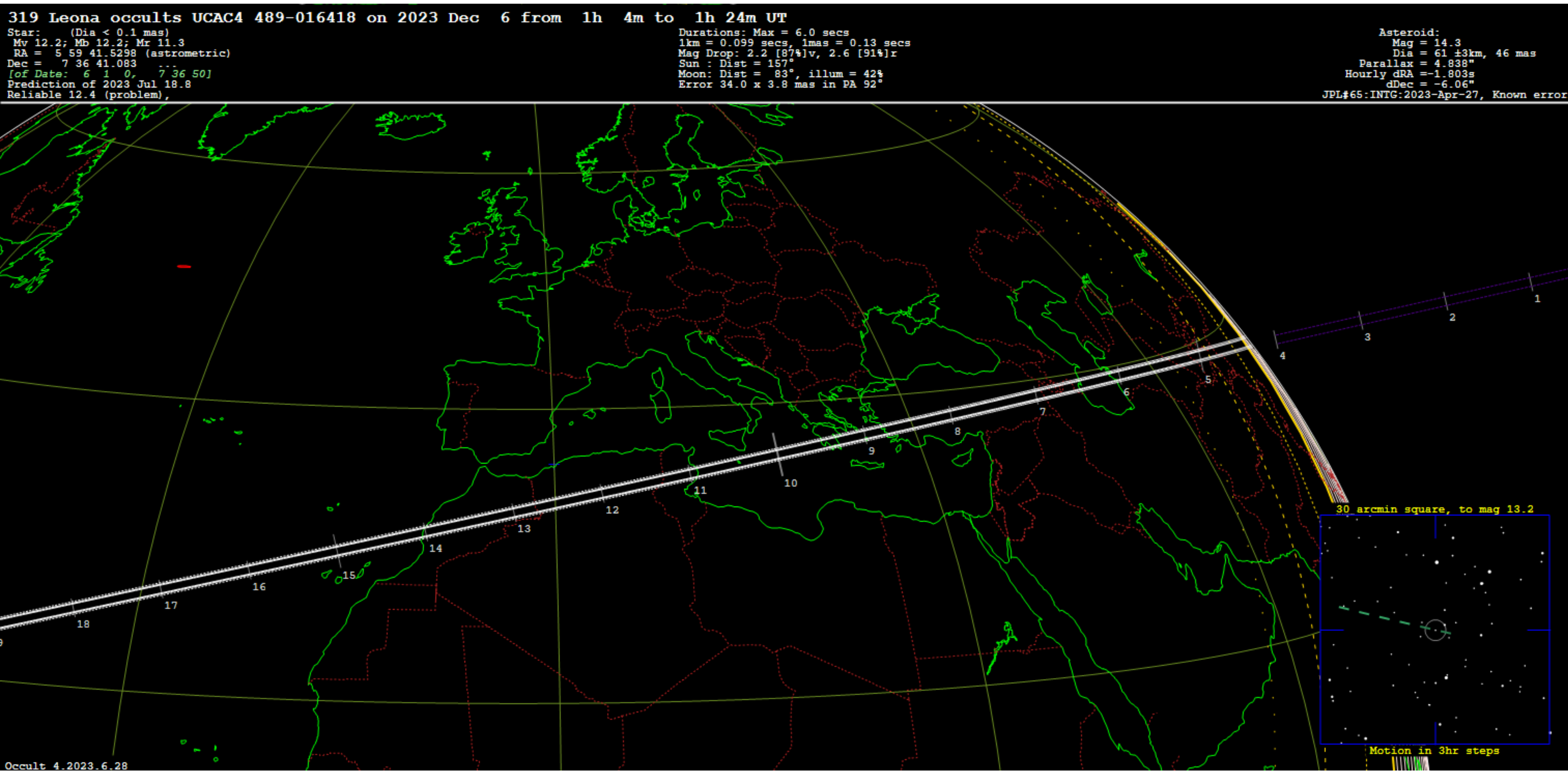
Even though I was preparing to come to Armagh Observatory. I had planned to observe it with the 81-centimetre telescope. Unfortunately, the latest calculations had changed the path of the occultation several tens of kilometers to the North.
I had to move towards the Algerian-Tunisian border to have any hope and this was impossible.

Fortunately, the Spanish team with **Carles Schabel** were able to obtain several positive observations.

The stellar occultation by the asteroid (319) Leona on December, 06th 2023

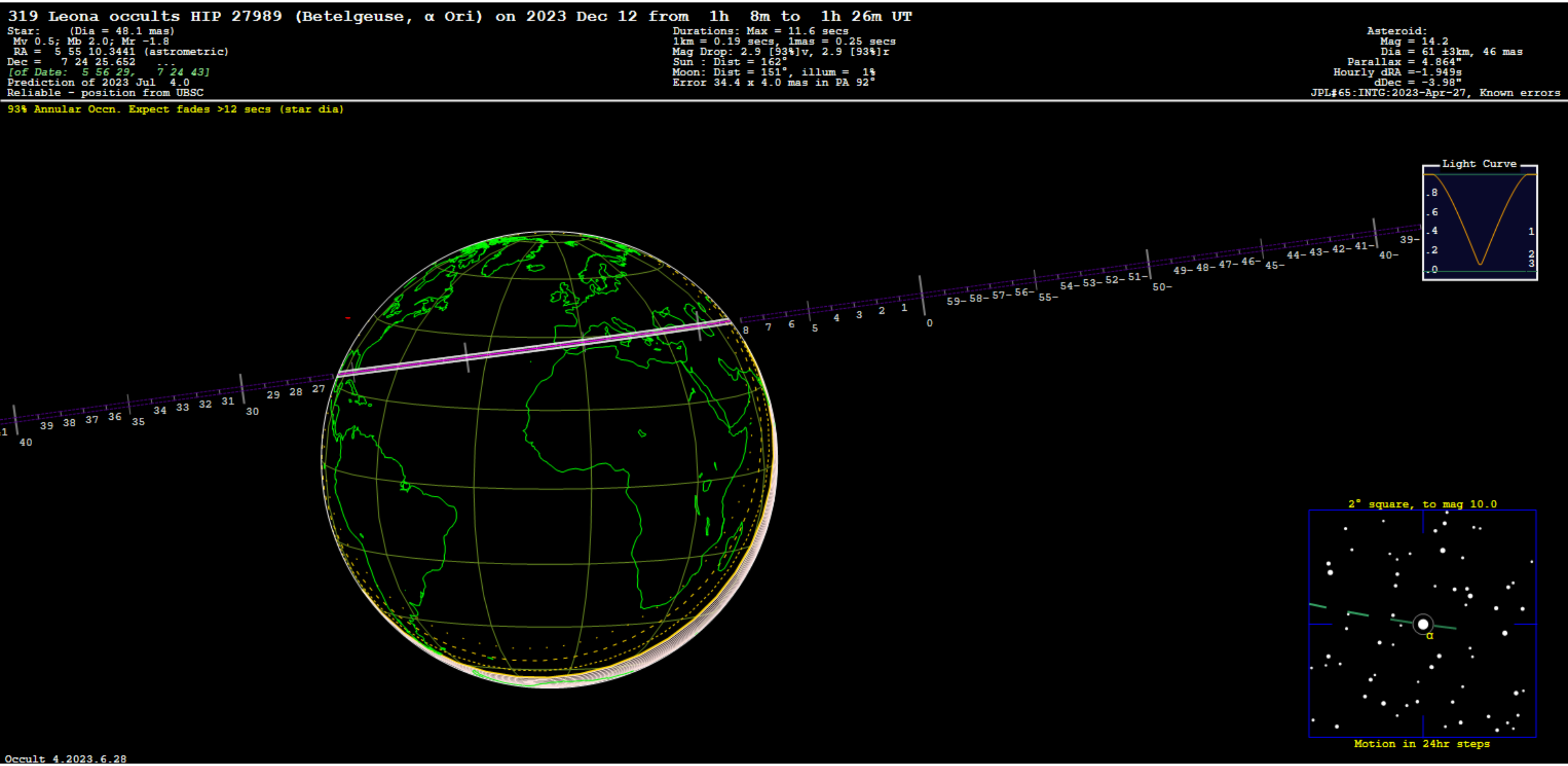
It will pass 400 kilometers away from the south of Algiers.

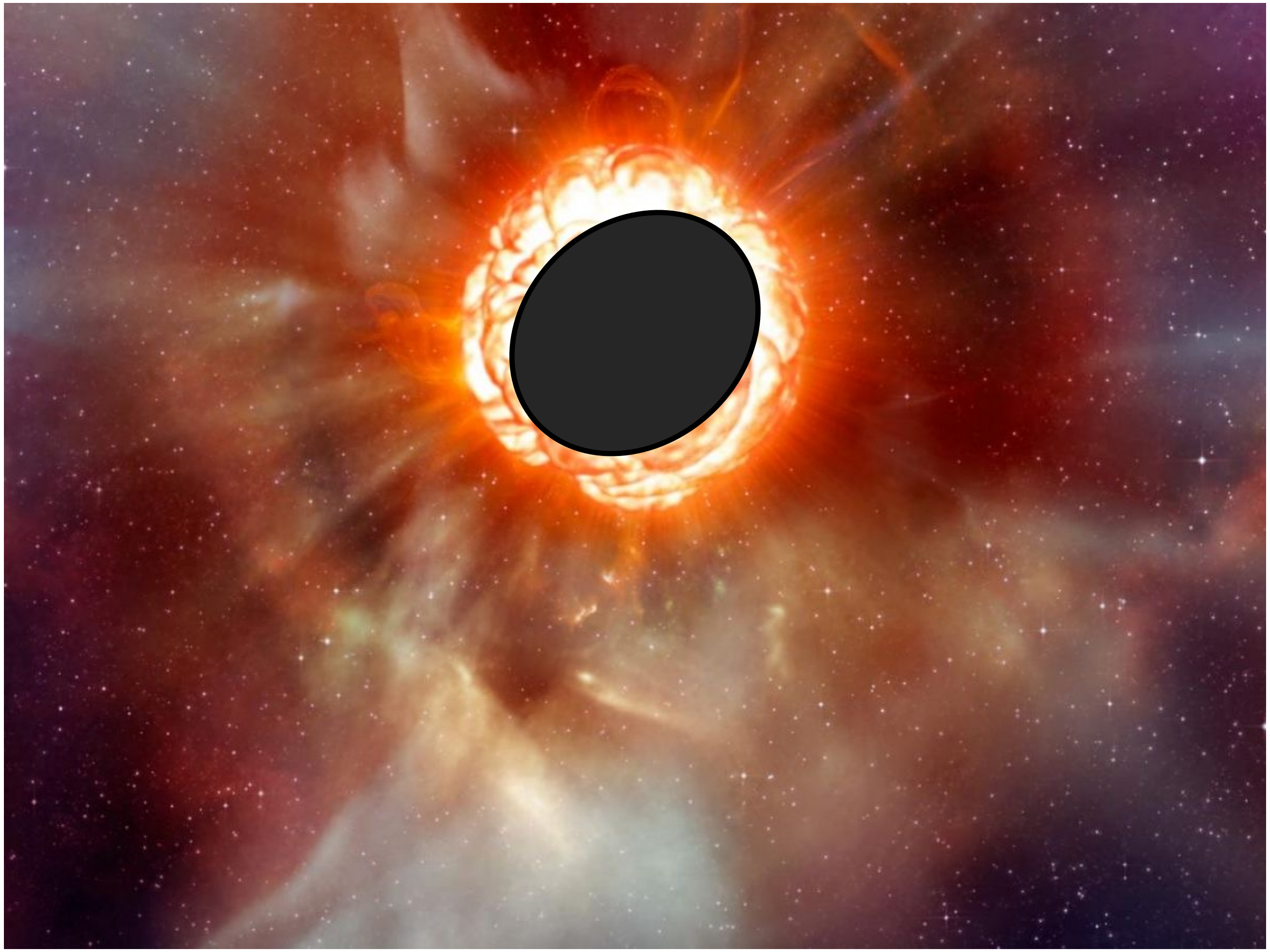
In fact, we are programming to go to the Sahara for observing this astronomical event.



The great occultation of Betelgeuse by (319) Leona on december 12th 2023

The **GREAT occultation of the star BETELGEUSE** of Orion by the asteroid (319) Leona on December, 12th 2023





According to the latest studies, the apparent diameter of the asteroid (319) Leona is much smaller than the apparent diameter of the star Betegeuse. The occultation will in fact be like an annular eclipse, with may be no significant drop in brightness.

We are in contact with the Spanish team to organize this great observation.

We would like to travel to the south of Spain with **9 Canon 800 D cameras with tripods** to take a video of the Betelgeuse occultation and using the Android application **Occult Flash Tag**.

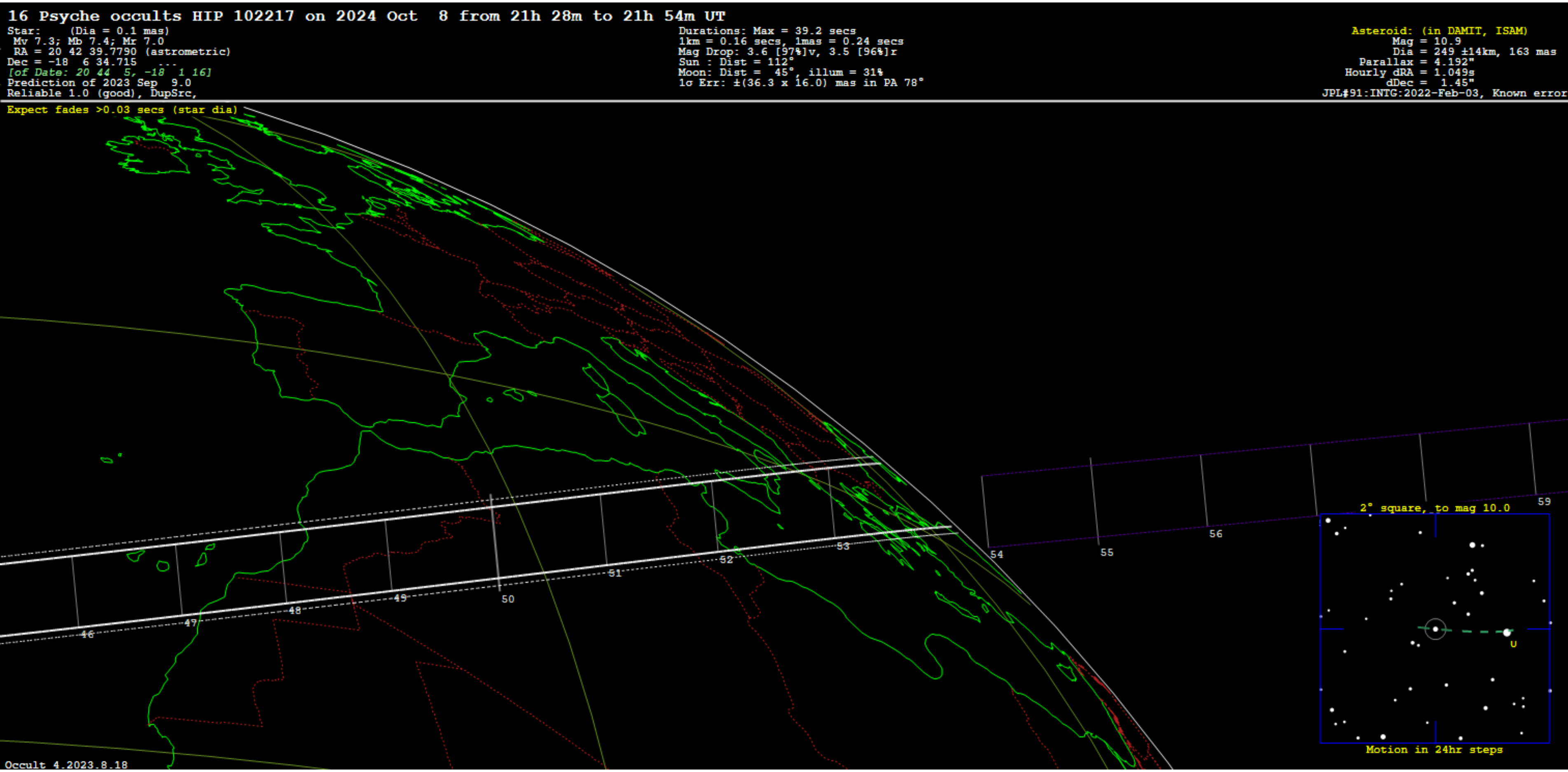
New future prospects in 2024

- Observation of stellar occultations by famous Trans Neptunian Objects, Trojans and Centaurs whose occultation bands pass through Algerian territories.

- Observation of stellar occultations by famous Near-Earth Asteroids whose occultation bands pass through Algerian territories.

- **Participative astronomy observation of the stellar occultation by (16) Psyche on 8 October 2024**.

The stellar occultation by (16) Psyche on 8 October 2024 in Algeria



Asteroid (16) Psyche has a density of 7.7 and is considered to be the densest celestial body in the solar system.

The study of Psyche could reveal crucial information about the origins and **composition of the metal cores of planets**, including the **Earth**, helping us to better understand the formation of our solar system.

The US space agency NASA will be sending a probe on October, 5th 2023 for orbital insertion in August 2029.

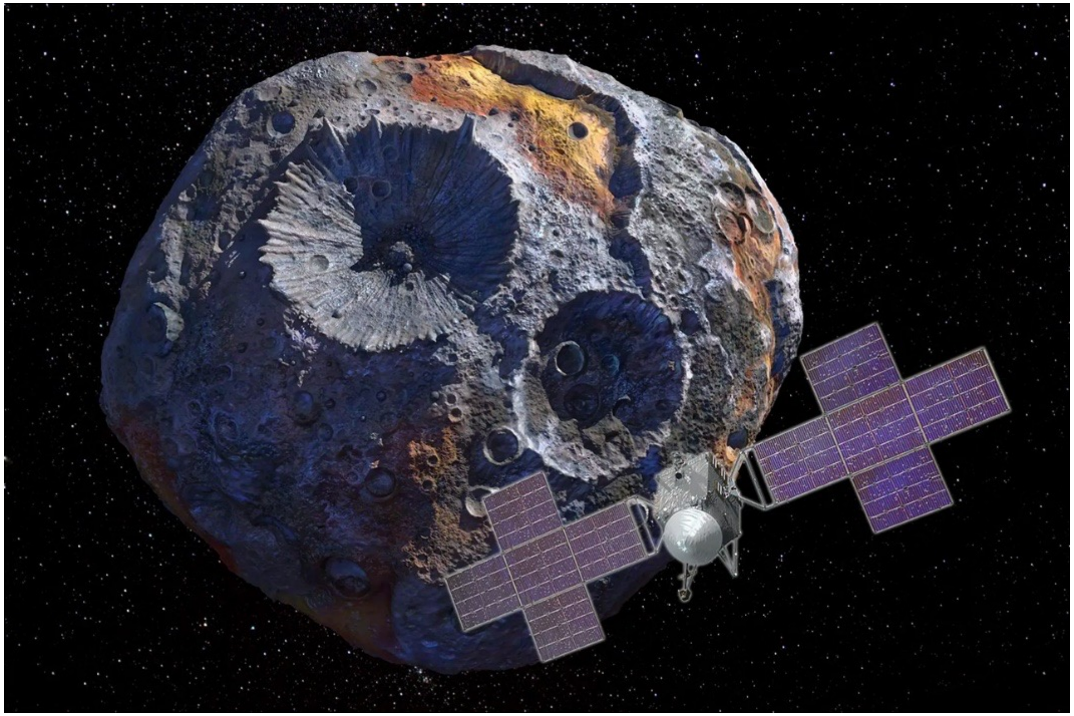
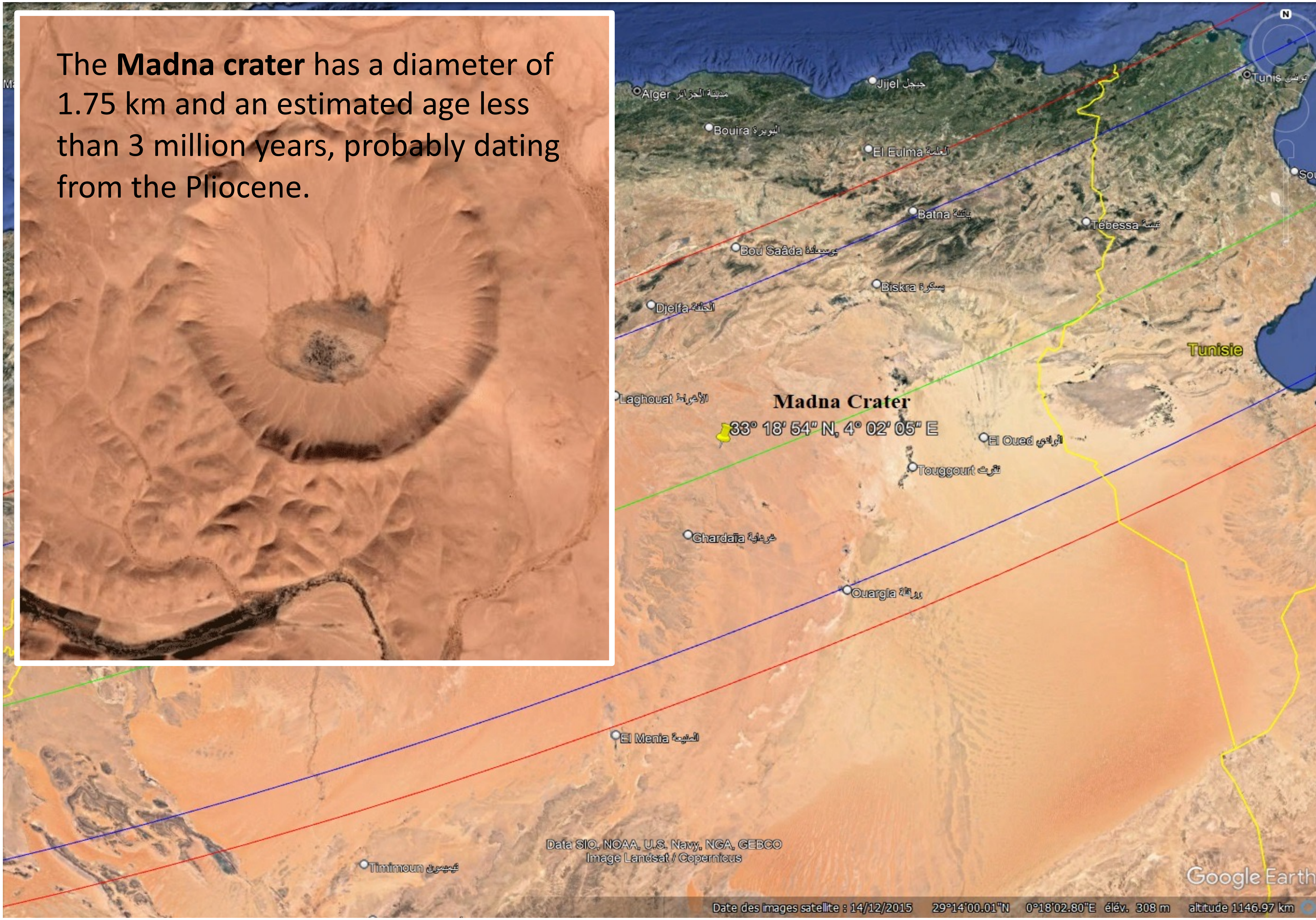


Illustration of the Psyche NASA Probe

The 13th National Meeting to observe stellar occultation by 16 Psyche, Tuesday, October 8th 2024

We hope it will become a Maghreb meeting and why not an international one.


The **Madna crater** has a diameter of 1.75 km and an estimated age less than 3 million years, probably dating from the Pliocene.
Alger
Jijel
Bouira
El Eulma
Tunis
Sous
Batna
Tebessa
Bou Saâda
Biskra
Djelfa
Tunisie
Laghouat
Madna Crater
33° 18′ 54″ N, 4° 02′ 05″ E
El Oued
Touggourt
Ghardaïa
Ouargla
El Menia
Timimoun
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat / Copernicus
Google Earth
Date des images satellite : 14/12/2015 29°14'00.01"N 0°18'02.80"E élév. 308 m altitude 1146.97 km

Summary

We are interesting to study more stellar occultation by asteroids as NEA (Near-Earth Asteroids) and TNO (TransNeptunian Objets).

We intend in the near future to expand the team by recruiting another persons to develop this discipline in Algeria.

In parallel, we develop the Algerian Occultation Amateurs Astronomers Network to observe firstly more easy stellar occultations by asteroids visually which follows the works of Participative Astronomy in Algeria.

In the near future, we would like to team up with people who can create an IOTA network in Africa or the Arab countries.

Finally, we wish to create a relationship with other partners around the world and especially from IOTA in order to develop this research in Algeria.

Thank you for your attention