



# Precise timing with digital cameras using the Timebox II

Cesar VALENCIA GALLARDO, Ph.D.

TimeBox II by Shelyak

Ecole de photométrie et d'analyses de données 2025

05 Juillet 2025



# To correctly perform an asteroid occultations you need:

- Prediction (Occult, OccultWatcher, Steve Peston website, Euraster, etc.)
- Telescope.
- Camera (analogic/digital) ☐ Produce linear photometry (Raw/untreated images).
- **Method to correctly date your recording with a standard time base ☐ UTC = Universal Time.**

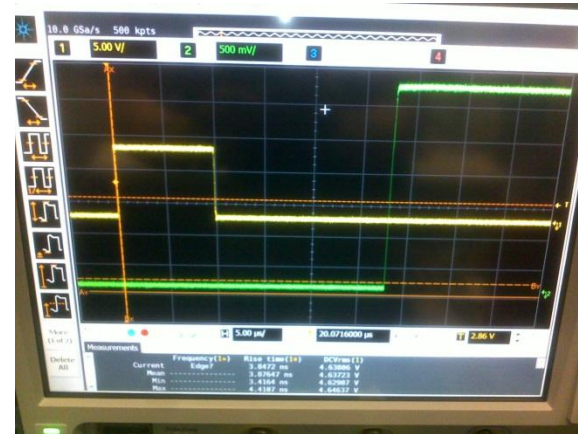
# UTC time in astronomy

Get the UTC (Coordinated Universal Time) from GPS satellites with great precision (**>100nSec UTC, 1PPS**).

## Astronomy

- Astrometry.
- PHEMU's.
- Occultations (Asteroid, TNO, Planets and Moon)
- Pulsar timing.

PC time synchronization.



*SYRTE (CNRS, Observatoire de Paris) Atomic Clock tests.*

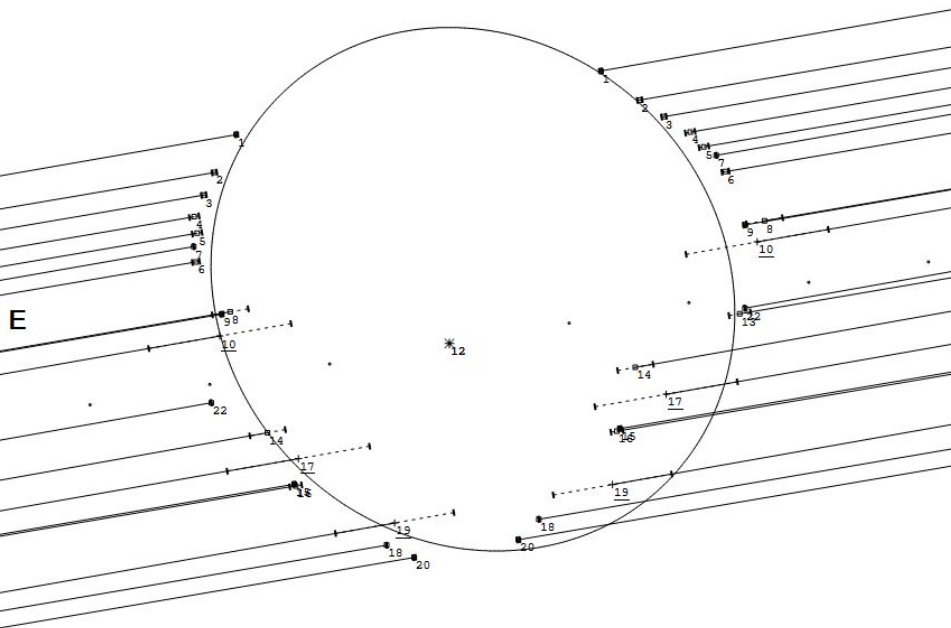
# Issues with the Analog recording:

- **Availability** of latest sensitive and low noise image sensors (Sony STARVIS, sCMOS, EMCCD, etc.).
- Bit depth of 8 bits compared to digital **12-16 bits**.
- Lower **frame rates and recording parameters** ☐ Binning, Gain/EM Gain, ROI, etc.
- Possible image quality **degradation** before digitalization (cabling).


# Bad timing can be catastrophic!

(80) Sappho 2018 Sep 16  $70.0 \pm 3.5 \times 63.9 \pm 2.2$  km, PA  $225.2^\circ \pm 26.6^\circ$   
Geocentric X  $-4207.6 \pm 0.9$  Y  $3071.7 \pm 1.6$  km

N

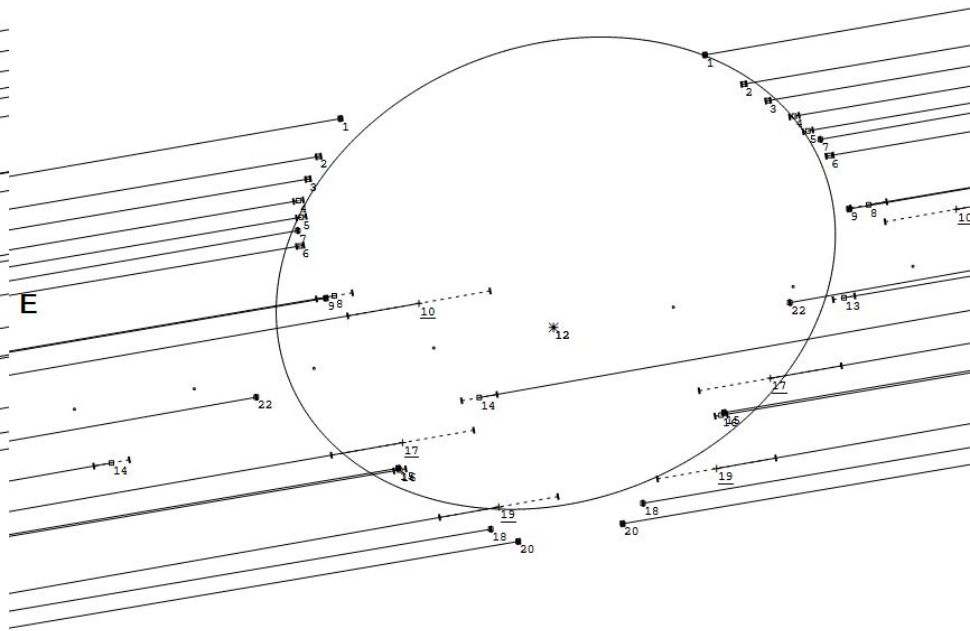


Corrected

Occult 46120 

(80) Sappho 2018 Sep 16  $73.5 \pm 3.7 \times 58.1 \pm 5.9$  km, PA  $111.8^\circ \pm 28.3^\circ$   
Geocentric X  $-4207.5 \pm 1.5$  Y  $3072.2 \pm 2.3$  km

N



Original

Occult 46120 

# Timebox II: 10 years of innovation



2015



2019

Prototypes, v0  
Lasercut and 3D  
printing



2021

Partnership with  
Shelyak  
Instruments,  
Timebox I



2025

Developpement of  
the Timebox II with  
Shelyak  
Instruments

# Timebox II: Latest version 2025

## Offer precise, easy dating

The TimeBox II solution has two major advantages : it's **easy to setup** , and it's **inexpensive**. Of course, it provides sufficient precision to observe most events of this type (a few milliseconds compared with absolute time). These two advantages will make these measurements accessible to as many people as possible, which will profoundly transform asteroid research in the coming years.

Our aim at Shelyak Instruments, in making this equipment available to you, is therefore simple and ambitious: to greatly increase the number of observers worldwide, in order to bring a 'new tool' (the amateur astronomy community) to the scientific community.

During discussions with experts in this field – the measurement of star occultations – I came to realise that there really is strength in numbers. The more observers there are spread across the country, the more concerted observations we can make, and the more data we can contribute to science. The more experienced the observers, the more 'ambitious' observations can be made (e.g. of smaller objects with short occultation times and whose orbits are less well known).



186,00 € incl. VAT - 155,00 € excl. VAT

Scientific Article:

## **The Shelyak Timebox, a device allowing multi-mode accurate UTC time recordings for digital video cameras**

Cesar VALENCIA GALLARDO<sup>1,2</sup>, Dave GAULT<sup>3</sup>, Thierry MIDAVAIN<sup>2</sup> and Hristo PAVLOV<sup>4</sup>

<sup>1</sup>TimeBox UTC. Paris, FRANCE.

<sup>2</sup>Club Eclipse. Paris, FRANCE.

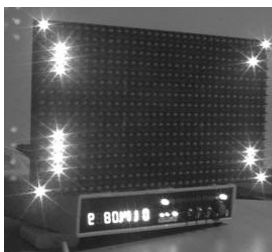
<sup>3</sup>Kuriwa Observatory. Hawkesbury Heights, AUSTRALIA.

<sup>4</sup>IOTA-ES. Karlovo, BULGARIA.

**Journal for Occultation Astronomy, Vol. 11, No. 1, p. 22-31.  
January 2021**

# Shelyak TimeBox II allows accurate timing of recordings

SEXTA device



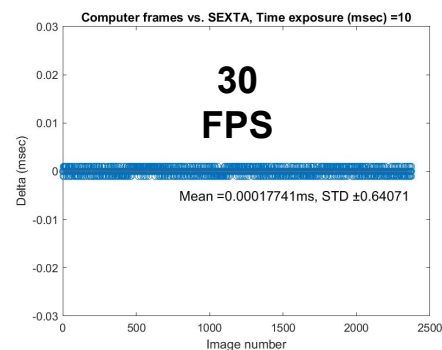
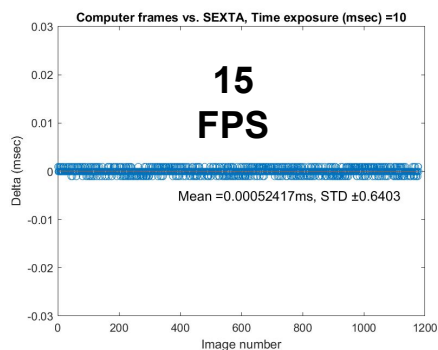
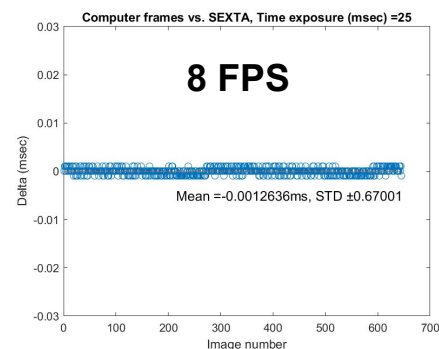
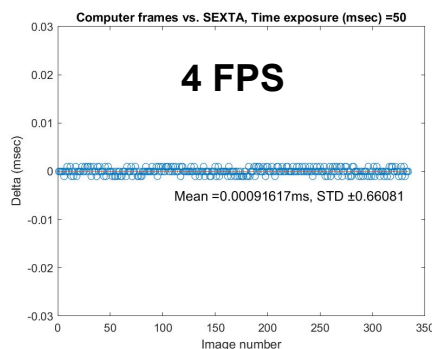
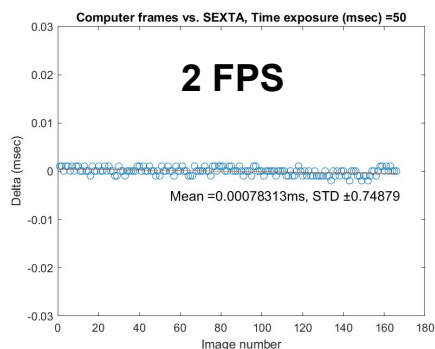
Genika

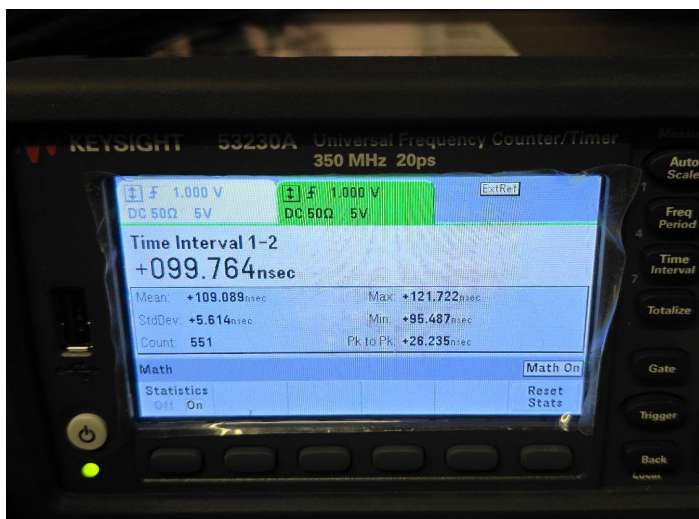


ZWO ASI183MM-PRO



TimeBox II





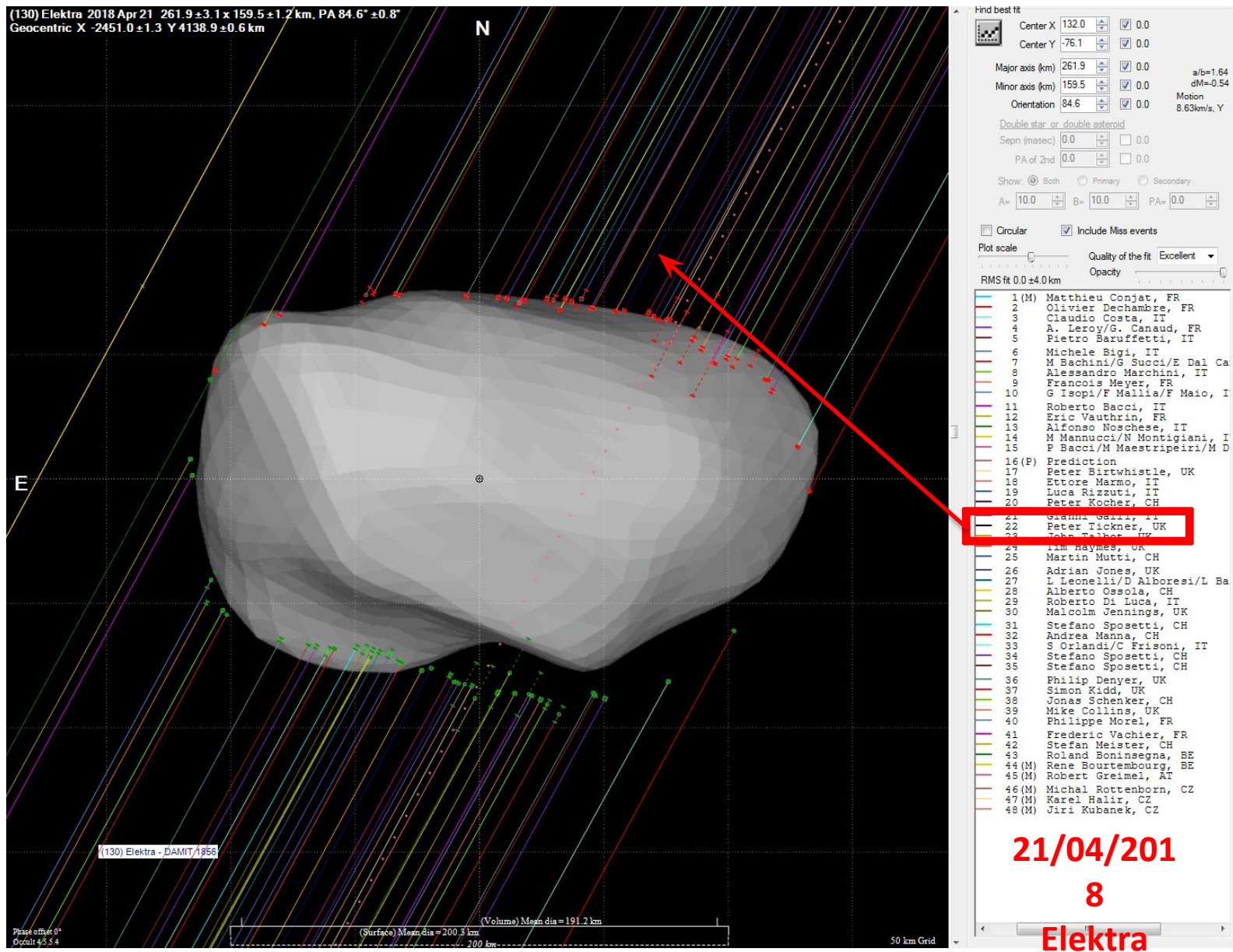
## Results:

Less than  $100 \pm 5$  nsec delay between the Timebox II GPS PPS signal and the UTC-OP.

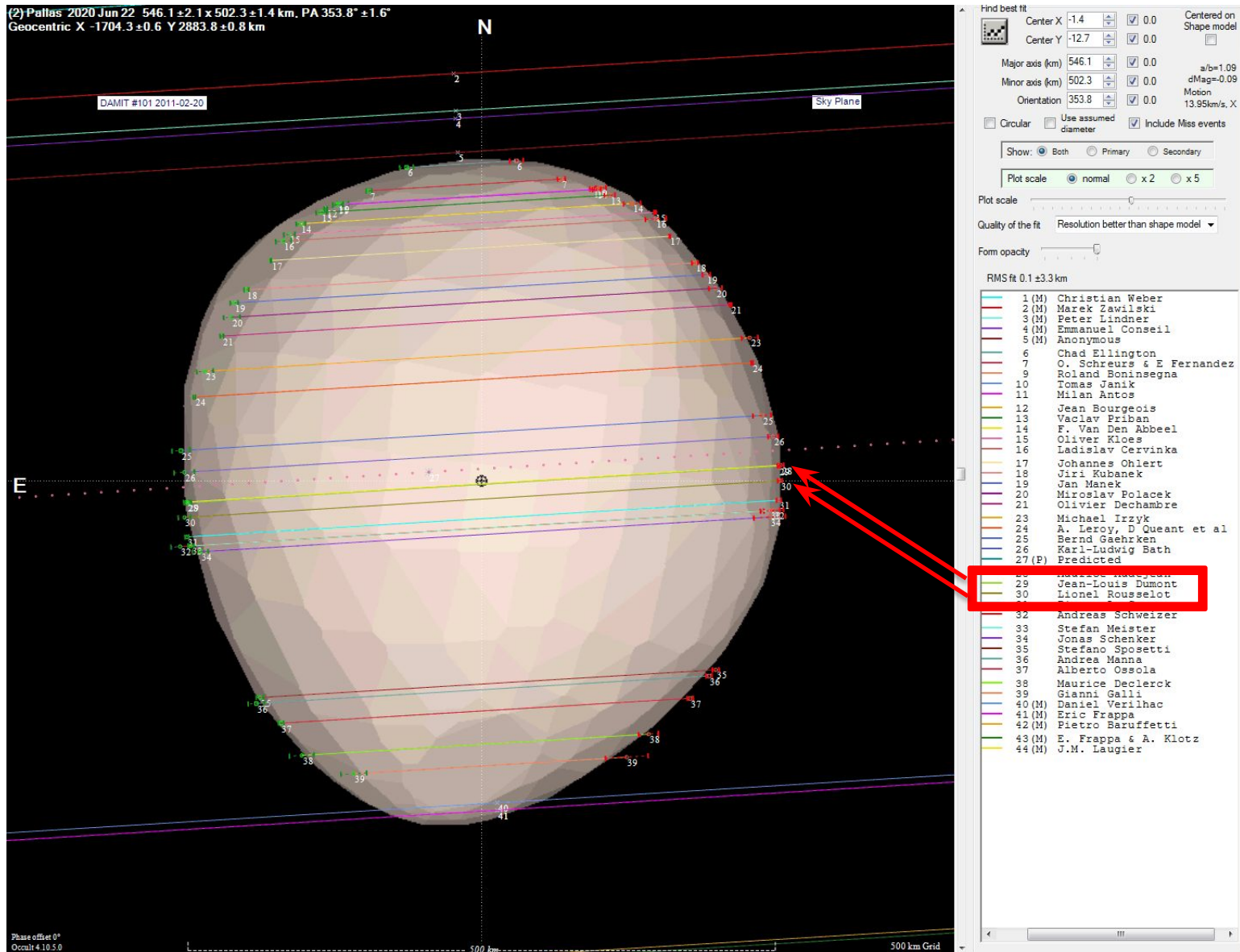
Delay of 5-10  $\mu$ sec between the Timebox II GPS LED firing and the UTC-OP.

# On the Sky occultations

# Peter TICKNER, Elektra 2018



# Jean-Louis DUMONT and Lionel ROUSSELOT, Pallas 2020

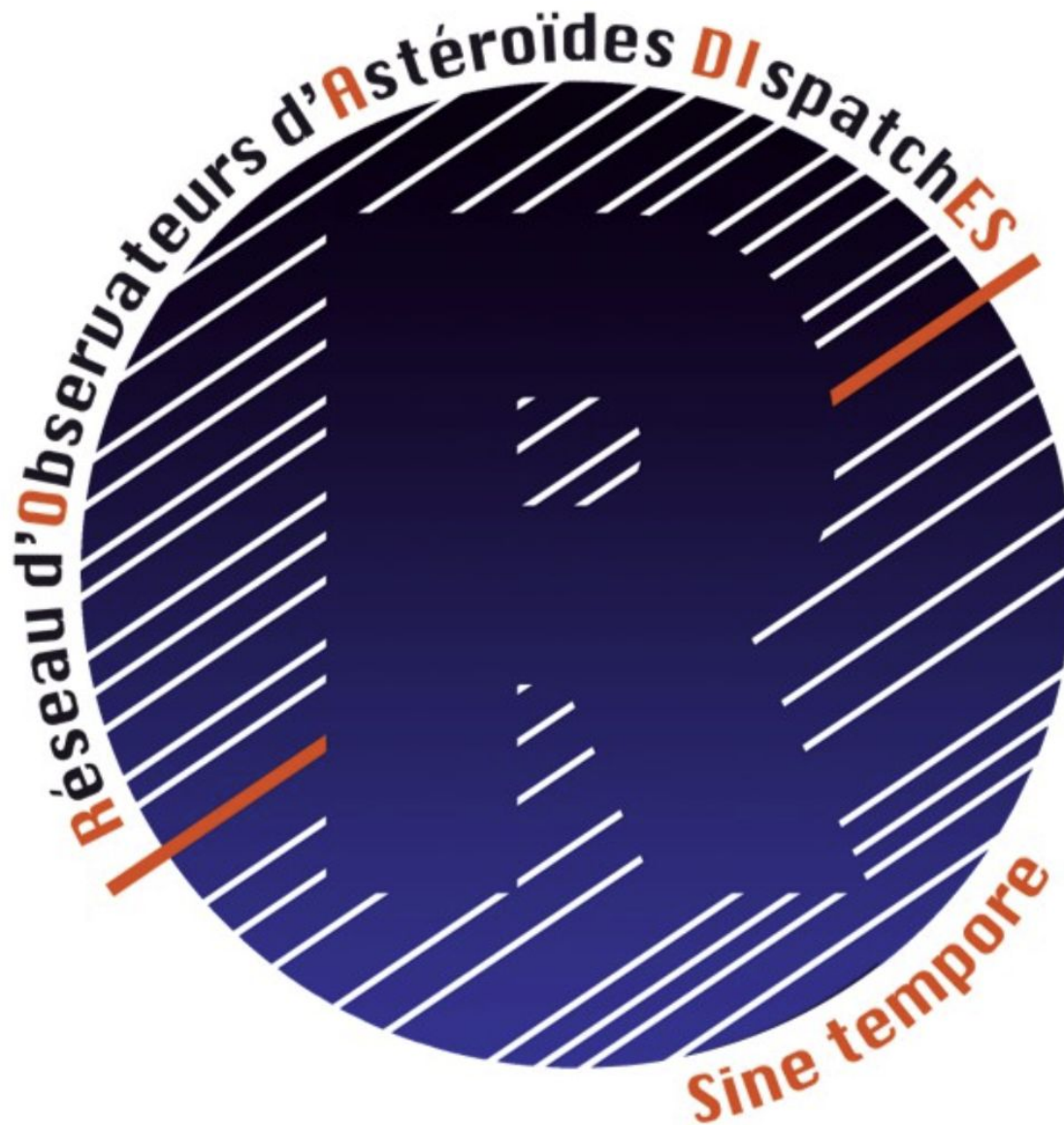




# MISSION LUCY

Campagne France 2022





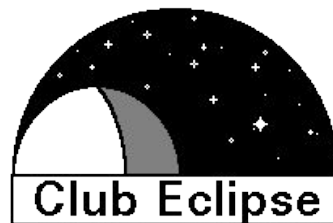
# They use the Shelyak TimeBox:



Laboratoire d'Études Spatiales et d'Instrumentation en Astrophysique



INAF-Osservatorio di Astrofisica e Scienza dello Spazio



Club Eclipse (IOTA/ES), FRANCE

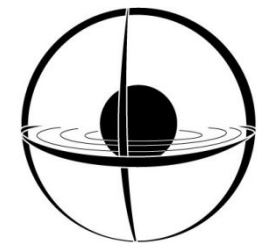


Reading Astronomical Society, UK



Société Astronomique de  
Touraine, FRANCE

## Among many others...



Club Repères Astro, FRANCE