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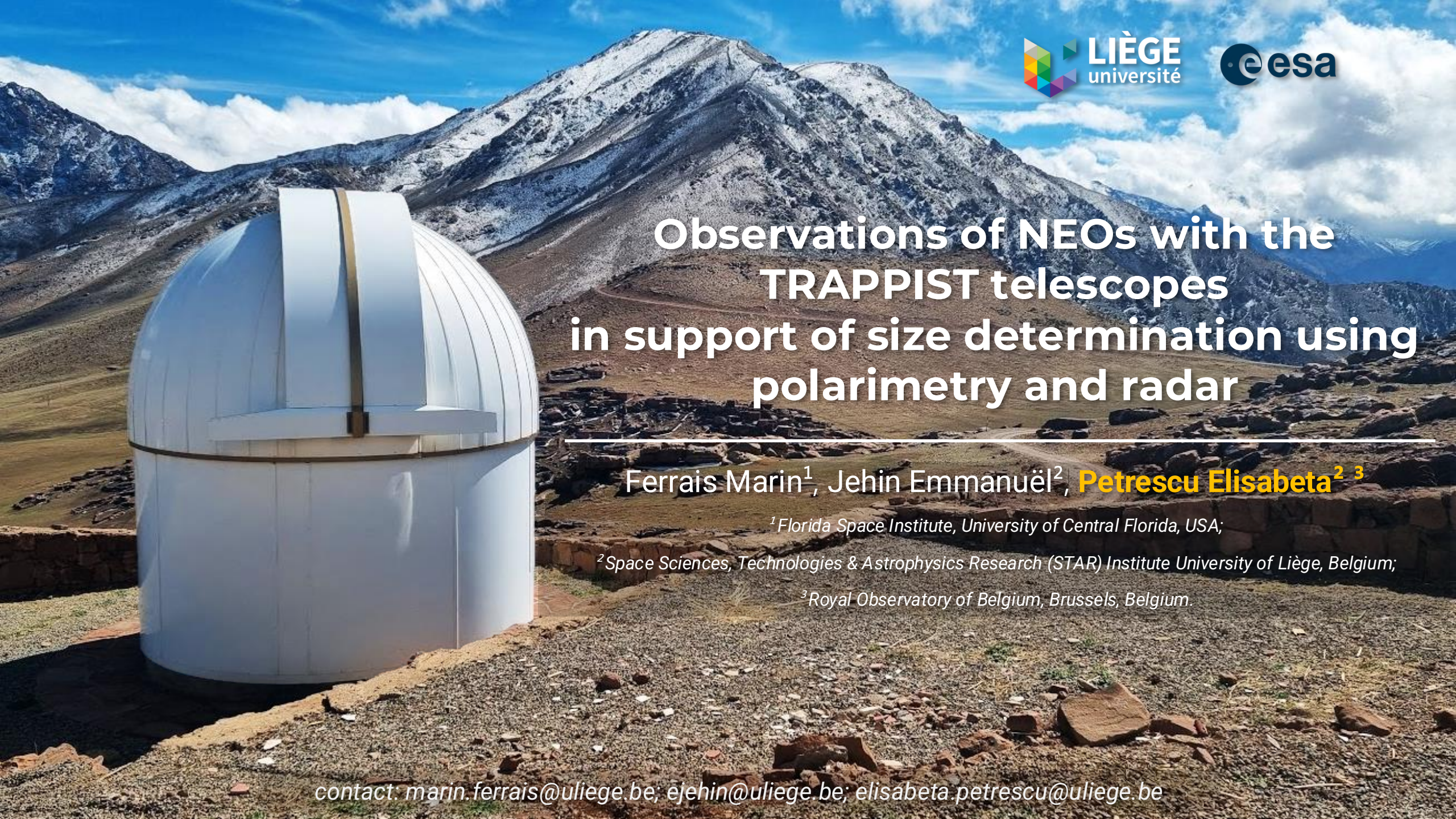

Observations of NEOs with the TRAPPIST telescopes in support of size determination using polarimetry and radar

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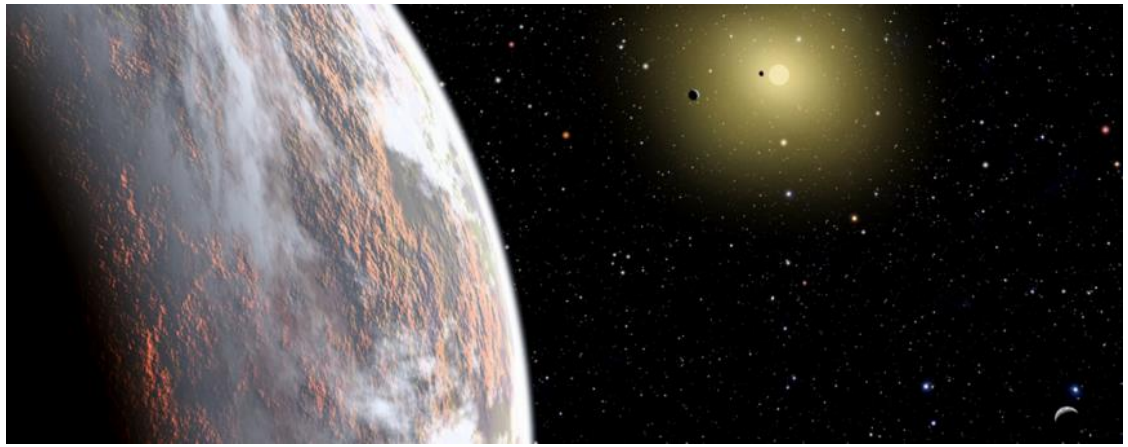
TRAnsiting Planets and Planetesimals Small Telescope

What do we have in common?

The love for astronomy

TRAPPIST

Robotic telescopes to study planetary systems



https://www.trappist.uliege.be/

Credit background: Basile Fauconnier

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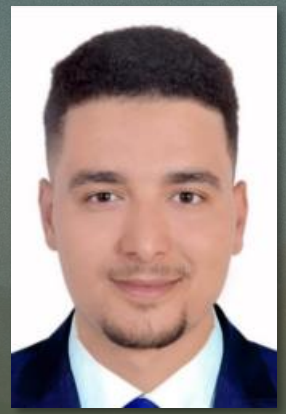
TRAPPIST

MEET THE TRAPPIST TEAM – COMETS AND ASTEROIDS

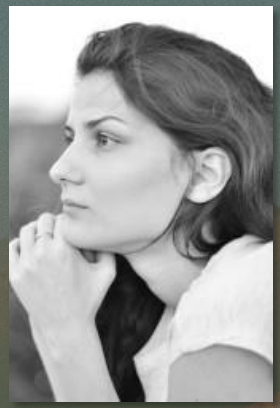
Emmanuël
Principal Investigator

Sandrine
IT Manager

Mathieu - Ph.D



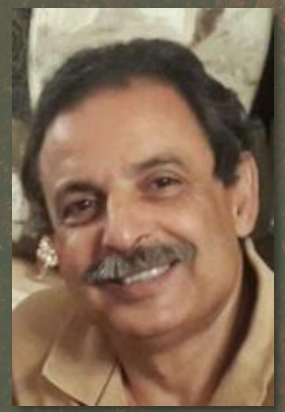
Said - Ph.D



Elisabeta - Ph.D

Damien

Jean
Co-Investigators



Zouhair

Aravind - Postdoc

Amine - Ph.D

Marin - Postdoc

Credit background: Basile Fauconnier

TRAPPIST – SOUTH

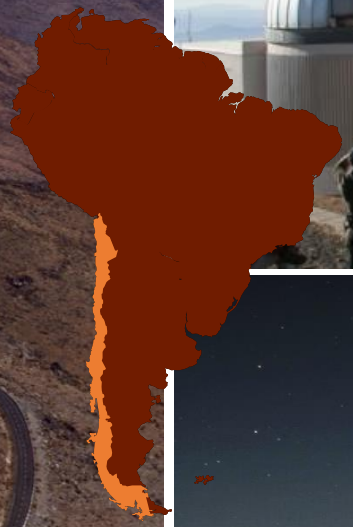
Inaugurated: 8 June 2010

Site: Chile – La Silla

Altitude: 2315 m

Weather: 275 clear nights/year

Funded by: ULiège & FNRS



Credit image: ESO

Credit image: Emmanuël Jehin

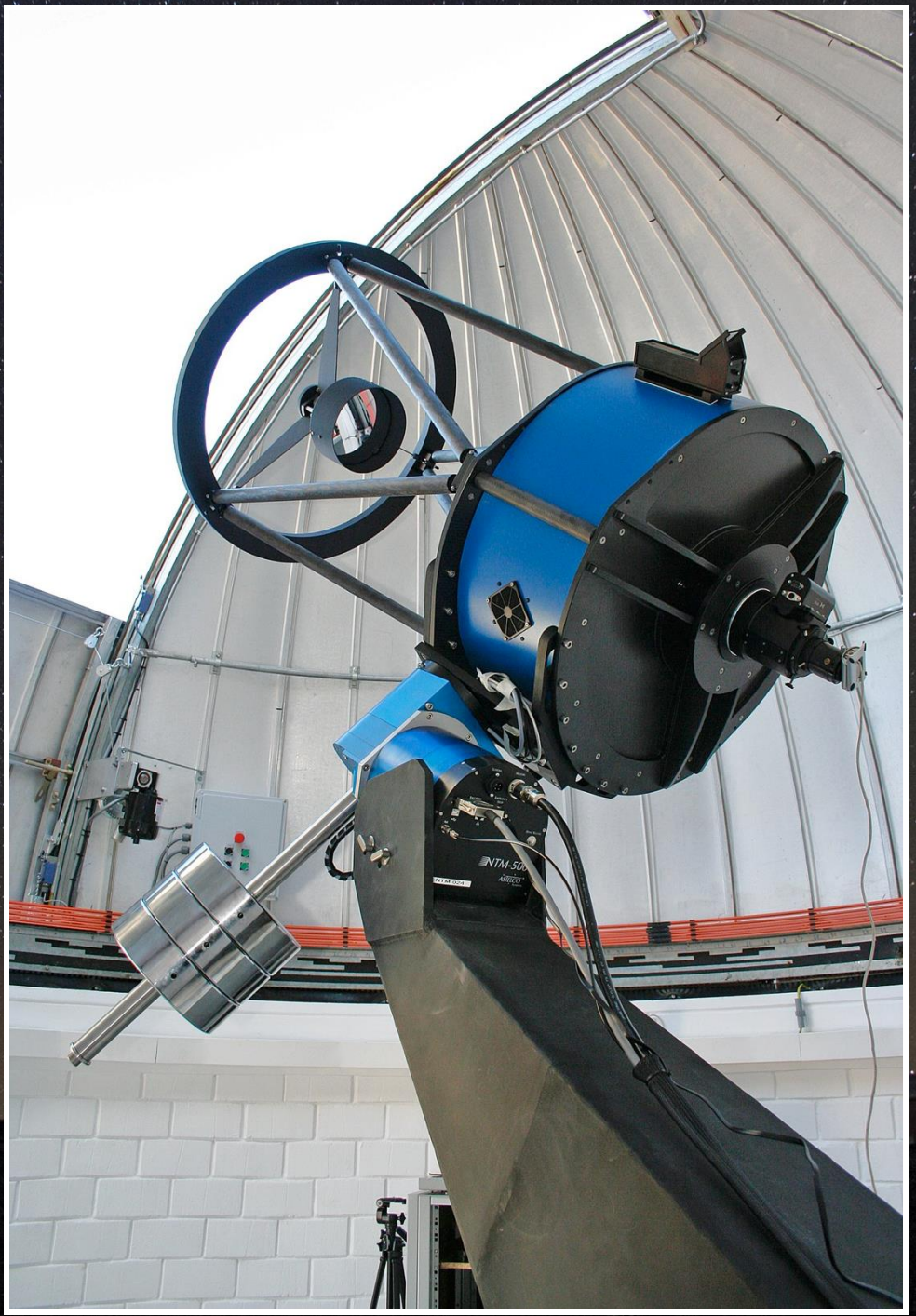
Credit image: Emmanuël Jehin

TRAPPIST – SOUTH

Telescope MPC: I40
Telescope design: Ritchey-Chrétien
Diameter: 600 mm
Focal length: 4800 mm

Mount: Astelco NTM-500 (German equatorial)
Pointing altitude: 5 degrees
Tracking accuracy: 1”/4 min

Camera: FLI ProLine PL3041-BB
FOV: 22´ x 22´
Pixel size: 15 um
Pixel scale: 0.64 arcsec/px
Filter wheel 1: B, V, R_c, I_c, V+R, I+z, Solan z, NaI, $H2O^+$
Filter wheel 2: OH, NH, CN, C_3, C_2, CO^+, BC, GC, RC



Credit background: ESO
Credit image right: Emmanuël Jehin

Reference: Jehin E. et al 2011

TRAPPIST – NORTH

Inaugurated: 6 October 2016
Site: Morocco – Oukaïmeden
Altitude: 2751 m
Weather: 220 clear nights/year
Funded by: ULiège & FNRS

Credit image: Basile Fauconnier

TRAPPIST – NORTH

Telescope MPC: Z53
Telescope design: Ritchey-Chrétien
Diameter: 600 mm
Focal length: 4800 mm

Mount: Astelco NTM-500 (German equatorial)
Pointing altitude: 5 degrees
Tracking accuracy: 1”/4 min

Camera: Andor IKONL BEX2 DD
FOV: 20´ x 20´
Pixel size: 13.5 um
Pixel scale: 0.60 arcsec/px
Filter wheel 1: B, V, R_c, I_c, V+R, I+z, Solan z, NaI
Filter wheel 2: OH, NH, CN, C_3, C_2, Hα, BC, GC, RC

Credit background: Basile Fauconnier
Credit image right: Emmanuël Jehin

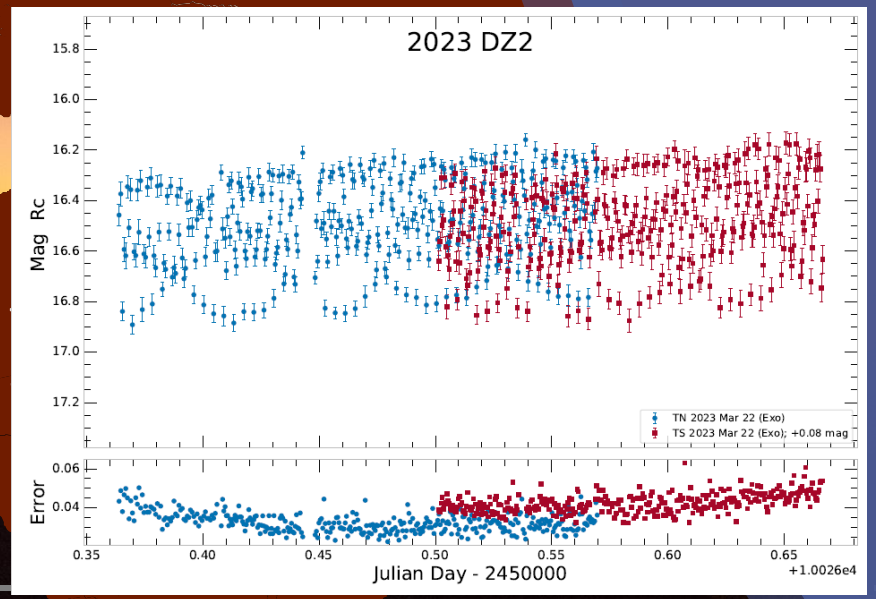
Reference: Jehin E. et al 2011

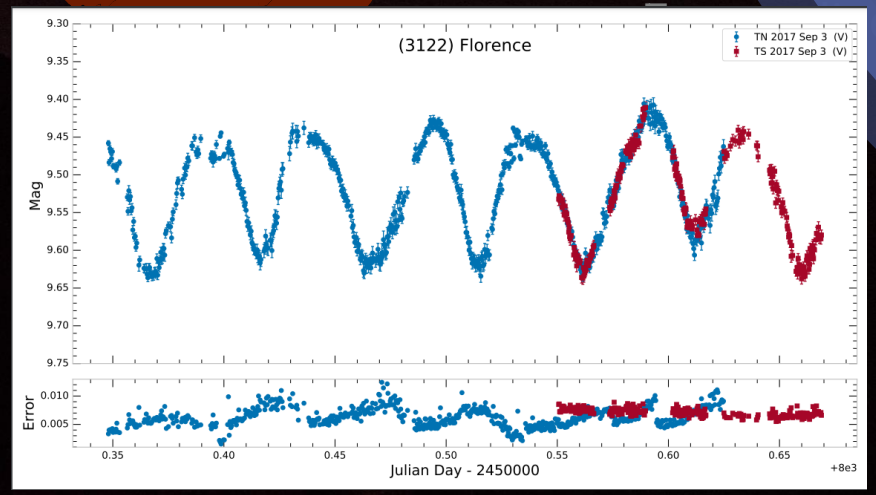
TRAPPIST – SOUTH

Standard time: UTC - 4 hours

Daylight saving: UTC -3 hours

Meridian line

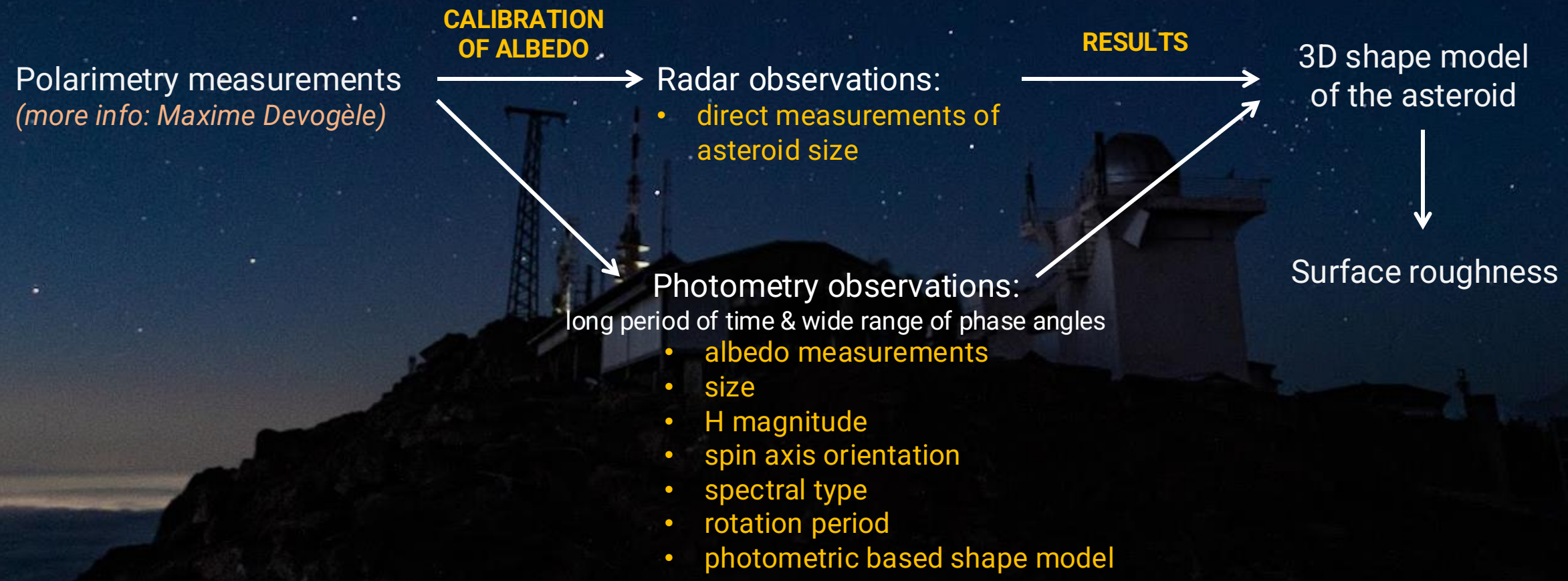




Credit background: Basile Fauconnier

NEAs observed by TRAPPIST that have radar observations, and to support polarimetry measurements

The degree of linear polarization is inversely proportional to the albedo of the scattering surface (Umov law, 1905).



Reference: Devogèle M. et al. – "Surface Heterogeneity, Physical and Shape Model of NEA (52768) 1998 OR2" (including Ferrais M., Jehin E.) PSJ February 2024

(52768) 1998 OR2 – PHA

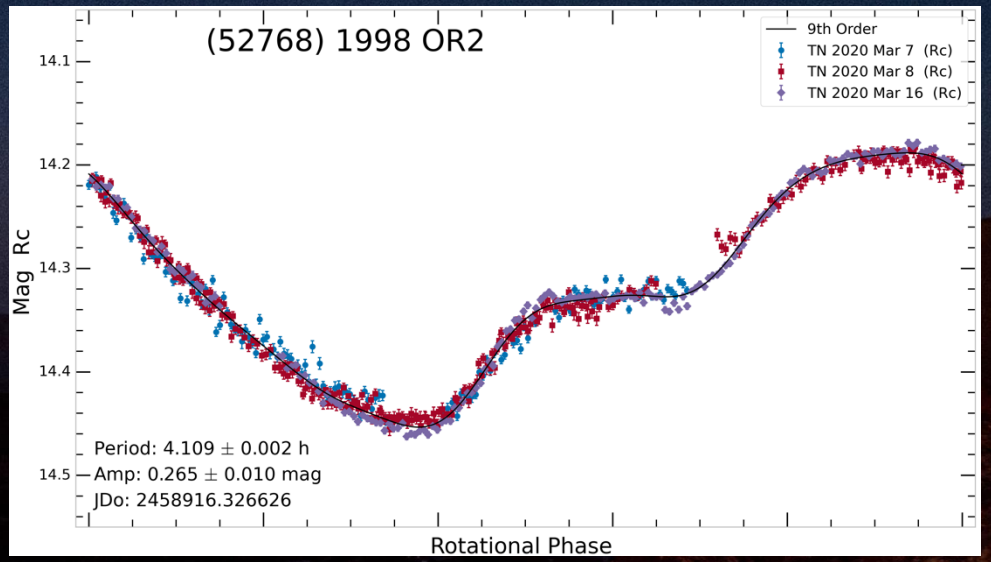
Close approach: 2020 April 29 at 16.4 LD; H = 16.04

Past characteristics:

- Rotational period values:
  P= 3.198 ± 0.006 hr; A = 0.29 ± 0.01 mag.
  Betzler & Novaes (2009);
- Classification:
  Xk type – using spectrophotometric observations / Xn type - using visible and IR spectroscopy *Bus & Binzel 2002; Battle et al. (2022)*

New characteristics:

- H = 16.17
- Rotational period: P = 4.10872 ± 0.00001
- Classification:
  M type – using photometry and radar
- Photometric and radar shape model: 2.08 ± 0.10, 1.93 ± 0.10, 1.60 ± 0.03 km
- Diameter: 1.80 ± 0.10 km
- Polarimetric observations and thermal lightcurve: heterogeneous surface



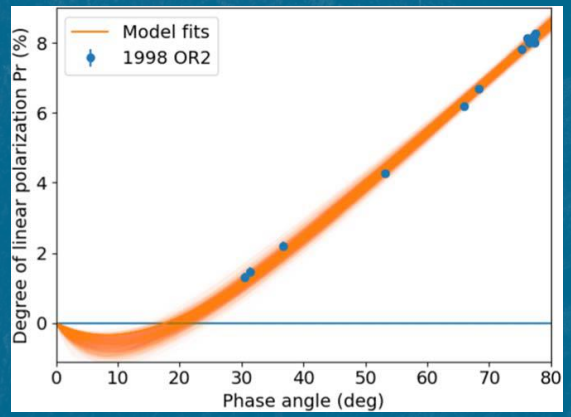
Light-curve of 1998 OR2 from TRAPPIST-North
P= 4.109 ± 0.002 hr A = 0.265 ±0.010 mag

2020 fly-by using optical polarimetry, photometry and radar.

Torino Polarimeter (ToPol) on a 1.04m telescope 2020 February – April, solar phase angle 30° to 78°.

Photometric campaign: 22 telescopes, photometric filters. Observed during different apparitions between 2020 – 2022.

Radar from Arecibo Observatory 2020 April 13 – 23.



Ferrais M. et al. – "Optical polarimetry and radar as a tool for Planetary Defence", poster.
Devogèle M. et al. – "Surface Heterogeneity, Physical and Shape Model of NEA (52768) 1998 OR2" (including Ferrais M., Jehin E.) PSJ February 2024

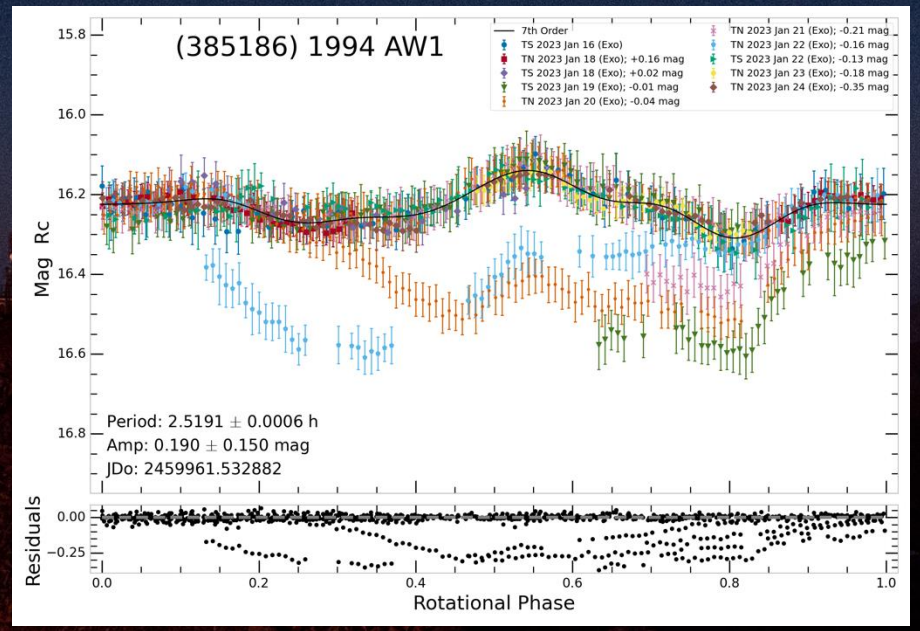
(385186) 1994 AW1 – PHA

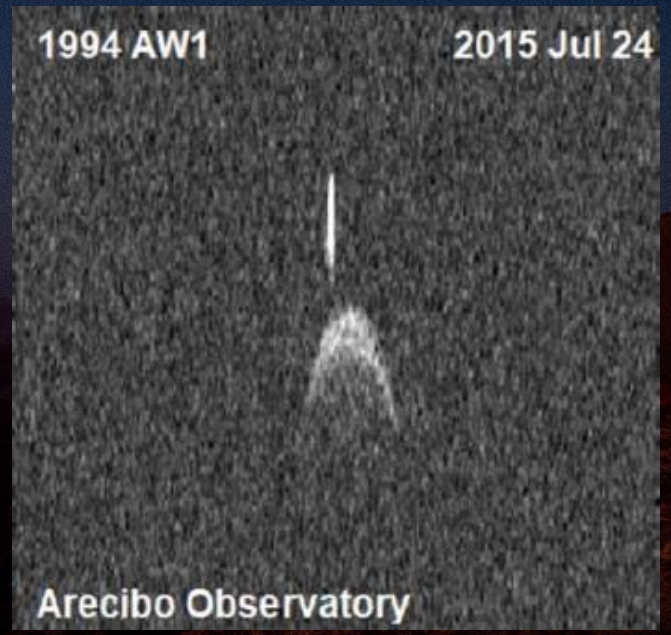
Close approach: 2015 July 15 at 23.3 LD; 2022 July 09 at 43.5LD; 2023 January 01 at 86.89LD

Characteristics:

- Binary asteroid = mutual events present
- Rotational period values:
  P1= 2.6 hr; diameter= 730m;
  P2= ~22 hr; diameter = ~300m.
- Classification: L type;

Fig. 1: Convex shape model from lightcurve inversion.
Fig 2: Shape modelling of the primary with the lightcurves + radar data.





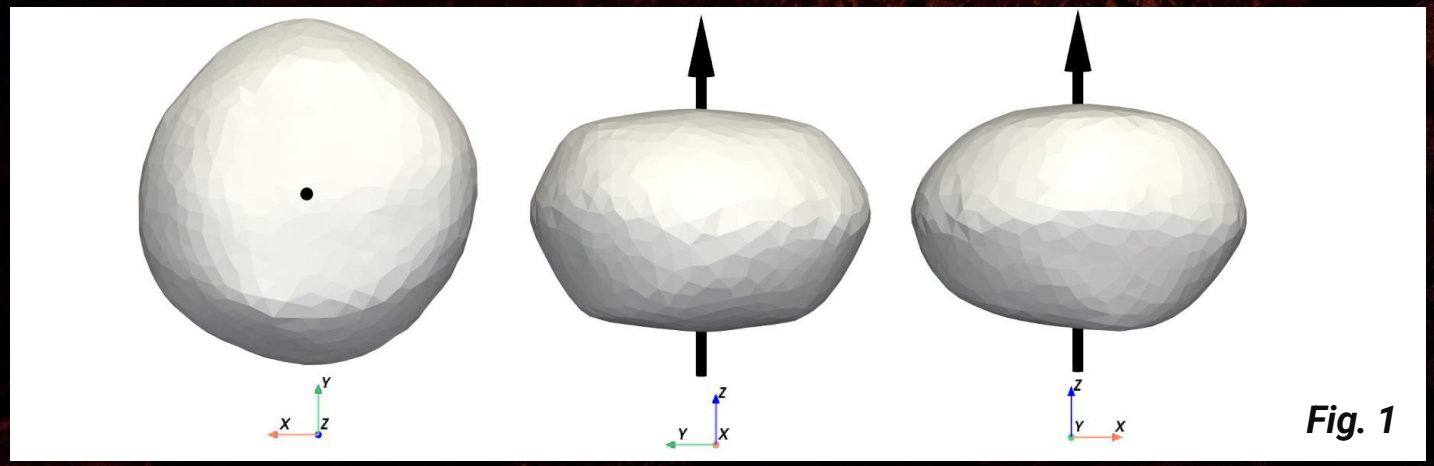
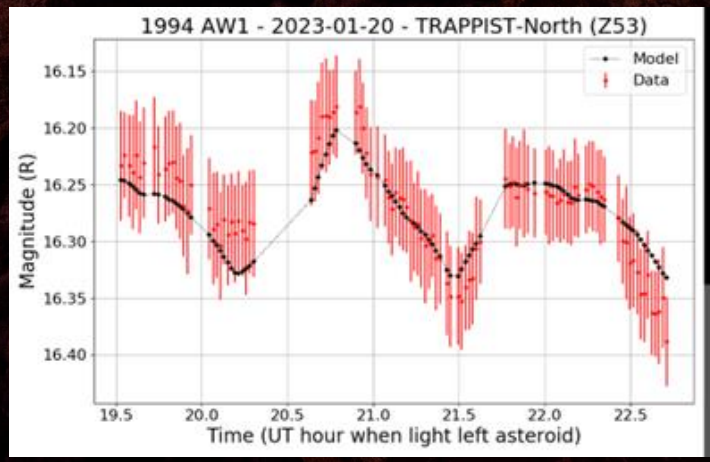


Fig. 1



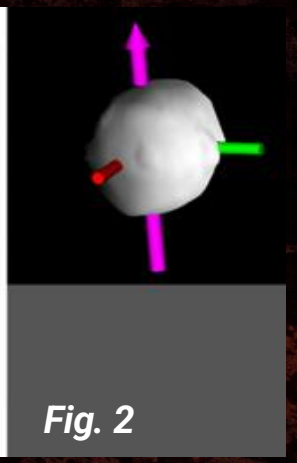
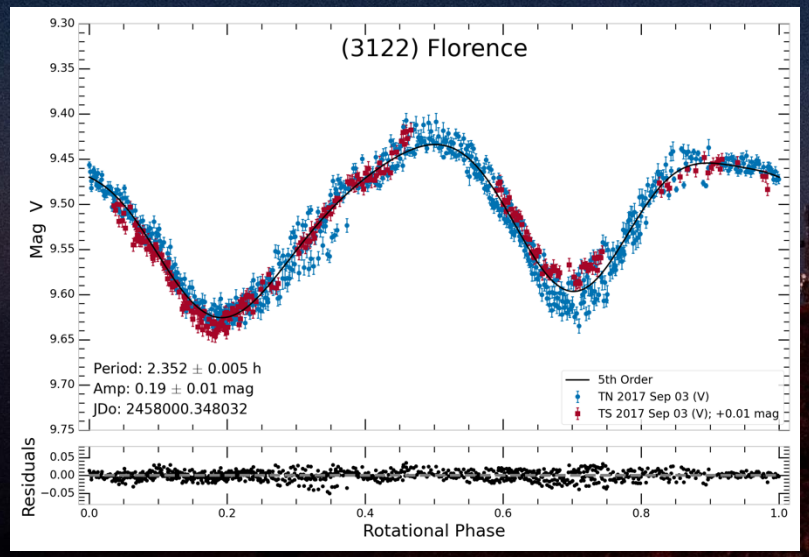


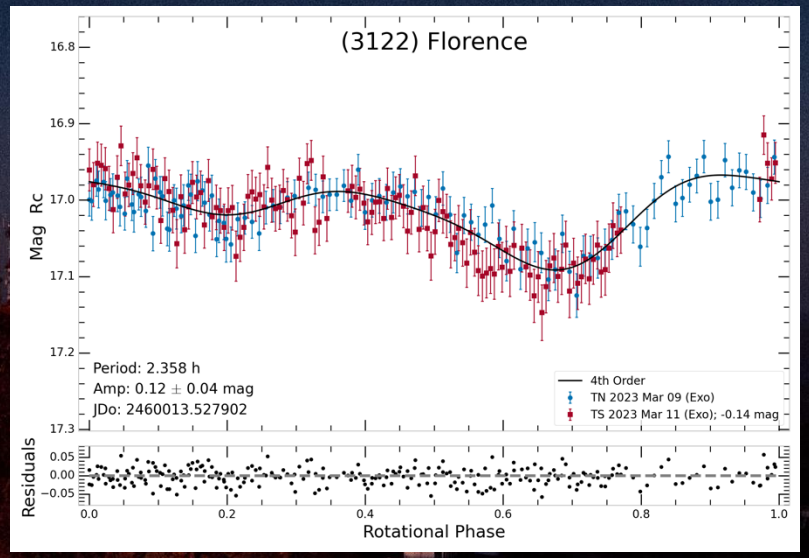
Fig. 2

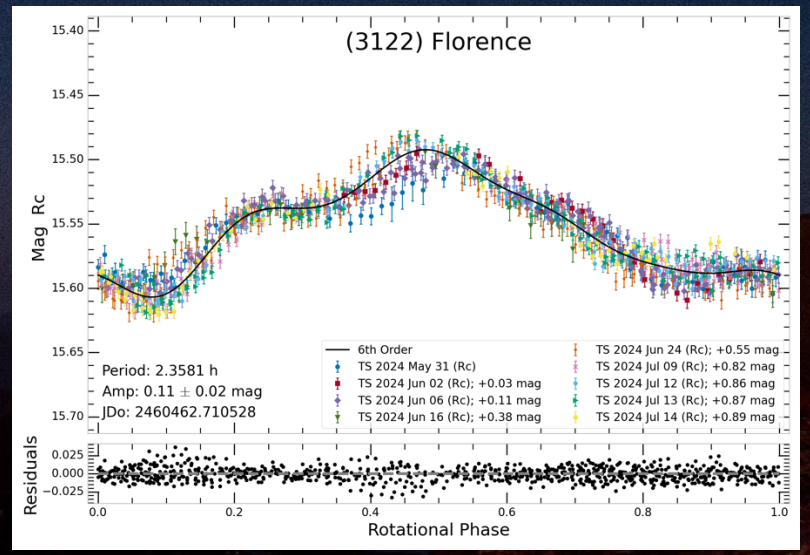
Ferrais M. et al. – "Shape model of the binary NEA 1994 AW1 from 2015 radar observations and long term lightcurve dataset", (including Devogèle M., Jehin E.), in progress.

(3122) Florence – PHA

Close approach: 2017 September 01 at 18.3 LD; 2024 October 01 at 148.5 LD





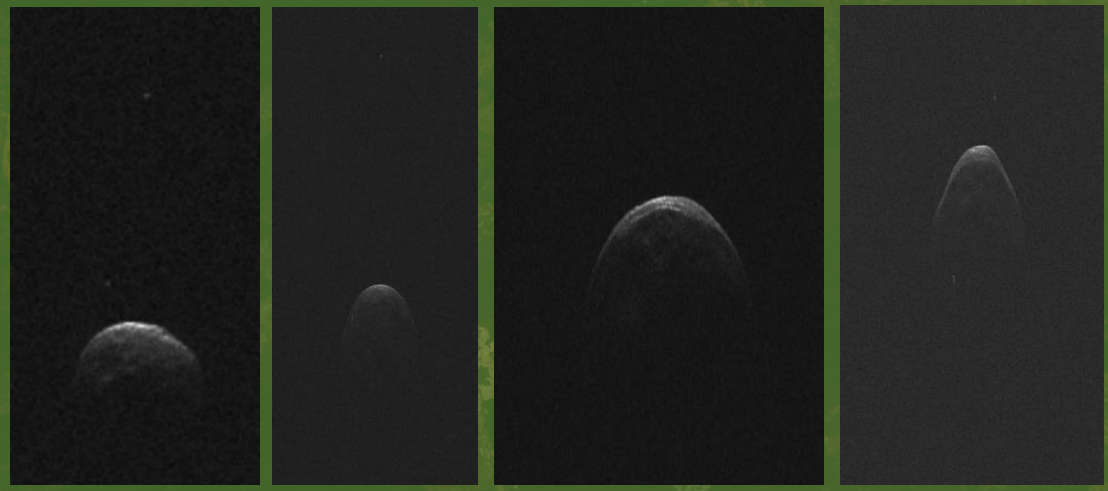


Florence, a triple system seen from TRAPPIST

Observed during three apparitions, different viewing geometries:

- 2017 September 3: A= 0.19 ± 0.01 mag
- 2023 March 09, 11: A= 0.12 ± 0.04 mag
- 2024 June 02 – July 14: A= 0.11 ± 0.02 mag

Shape model in progress



Arecibo Observatory, 3122 Florence asteroid between 2017 April 2 - 5

(5189) 1990 UQ – PHA

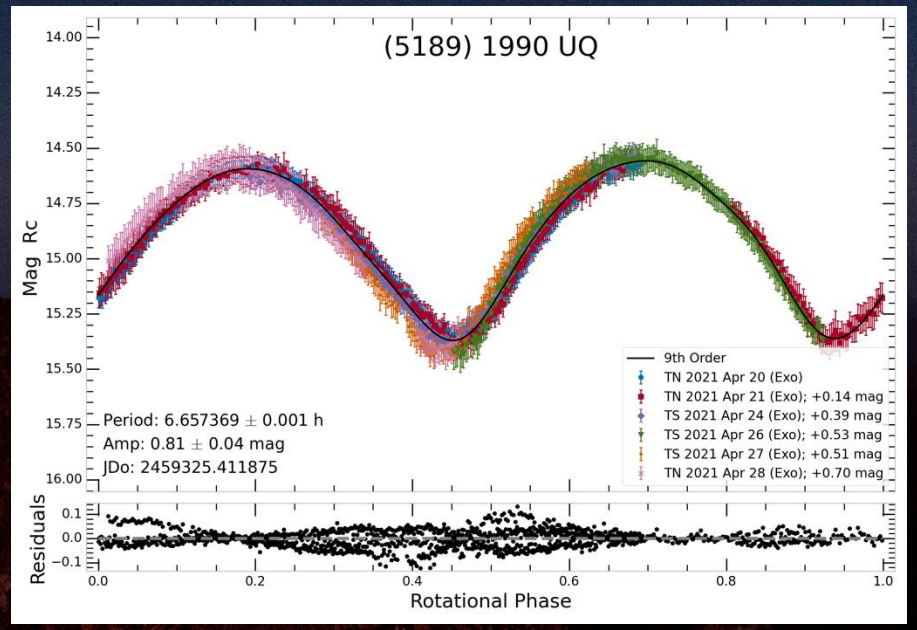
Close approach: 2021 May 06 at 26.5 LD; 2022 July 09 at 43.5LD; 2023 January 01 at 86.89LD

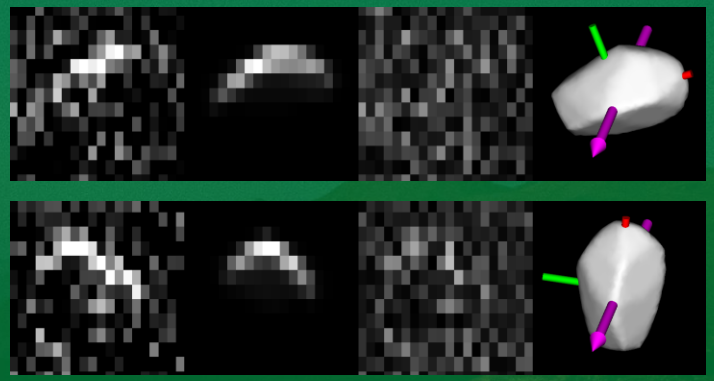
Characteristics:

P= 6.657 ± 0.001hr
A=0.81 ± 0.04

Observed in 2021 April 20-28, Exo filter.

Elongated object.

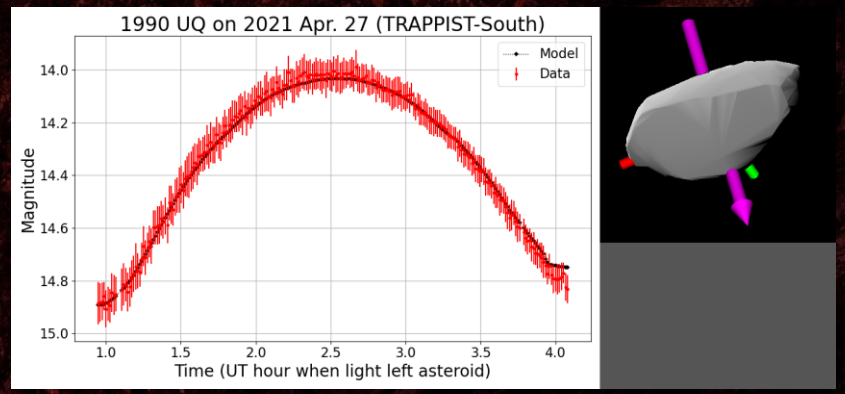


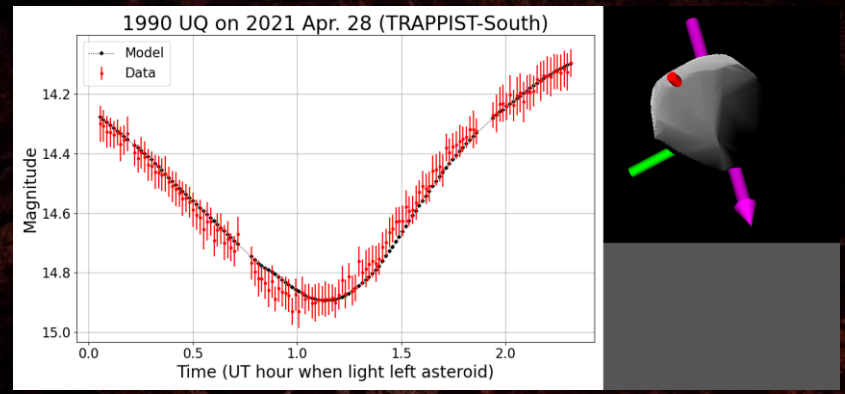


Radar data from Goldstone Observatory, 1990 UQ asteroid observed in 2021 June, and radar shape mode.

Shape model from the lightcurve inversion –Xavier Inosencio (UFC)

Size: 600 m
Albedo: 0.4
work on going

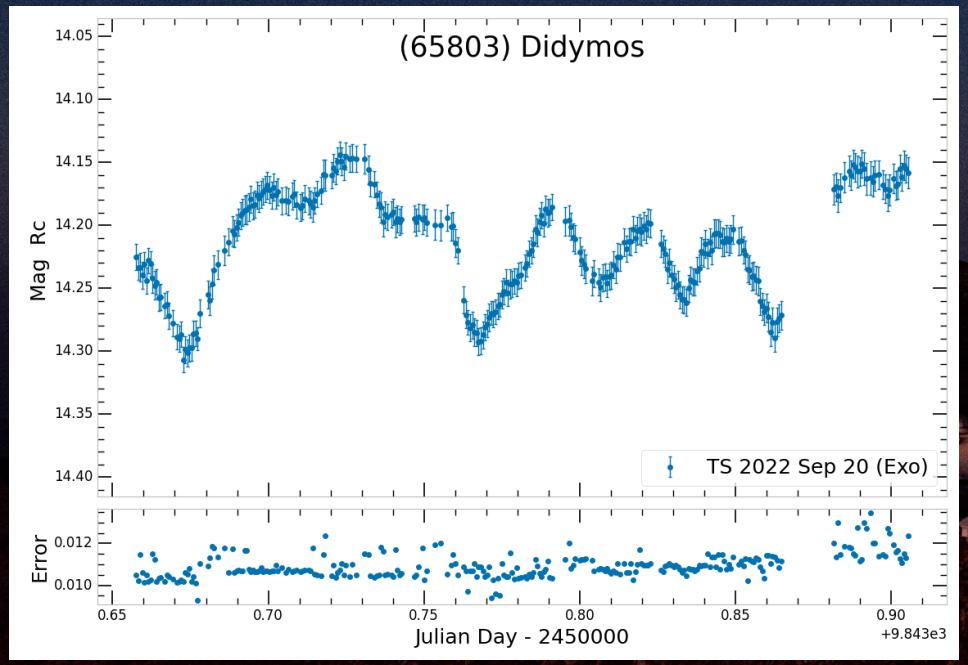


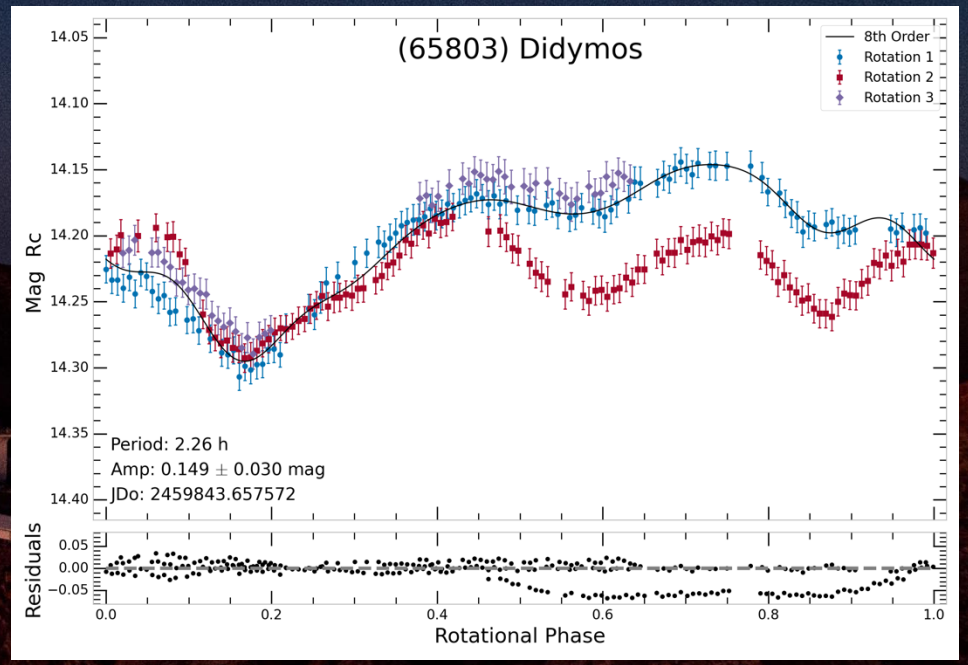


Reference: Xavier I. et al. – "Characterizing Earth's Mini-Moon 2022 NX1 through its Analogous, 1990 UQ", (including Devogèle M., Ferrais M.), presentation.

65803 Didymos – PHA

Close approach: 2022 October 04 at 27.57LD



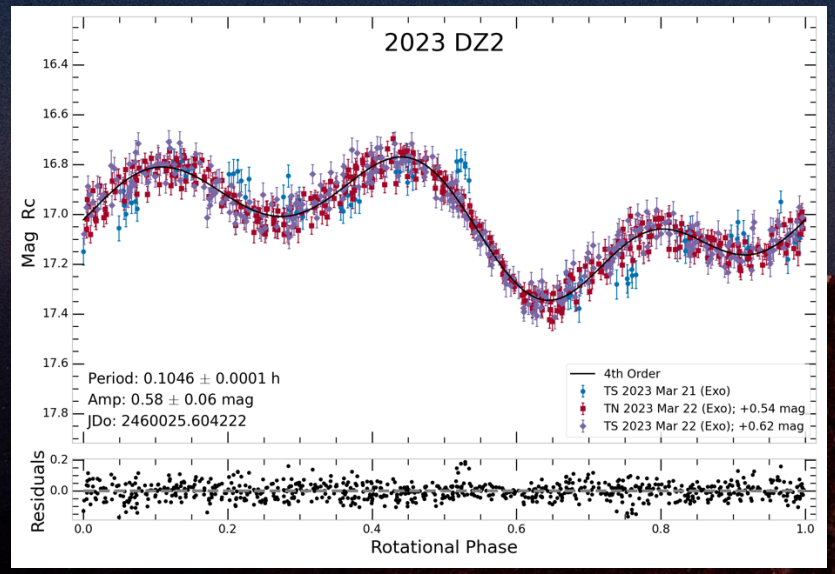


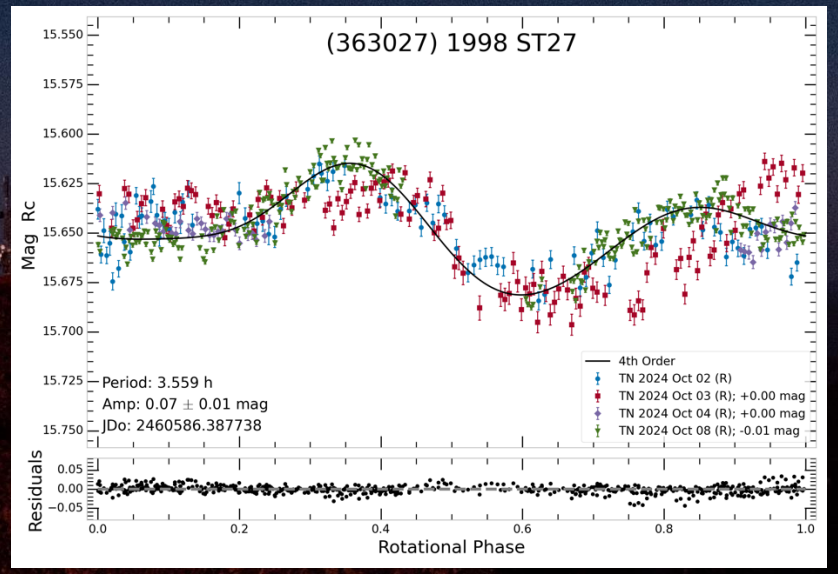
65809 Didymos – binary system – mutual events
P1=2.26h P2=11.92h
Observed in R, I, B, V filters.

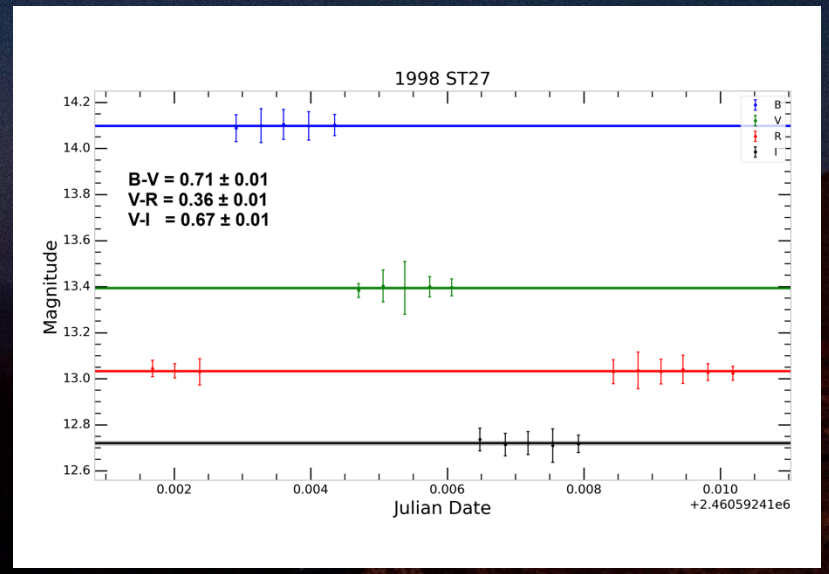
TRAPPIST-N: 2022 September – 2023 January
TRAPPIS-S: 2022 September – 2022 November

Phased curve on 2.26hr
Secondary eclipse
Dimorphos goes in the shadow of Didymos.

NEO lightcurves with TRAPPIST twins







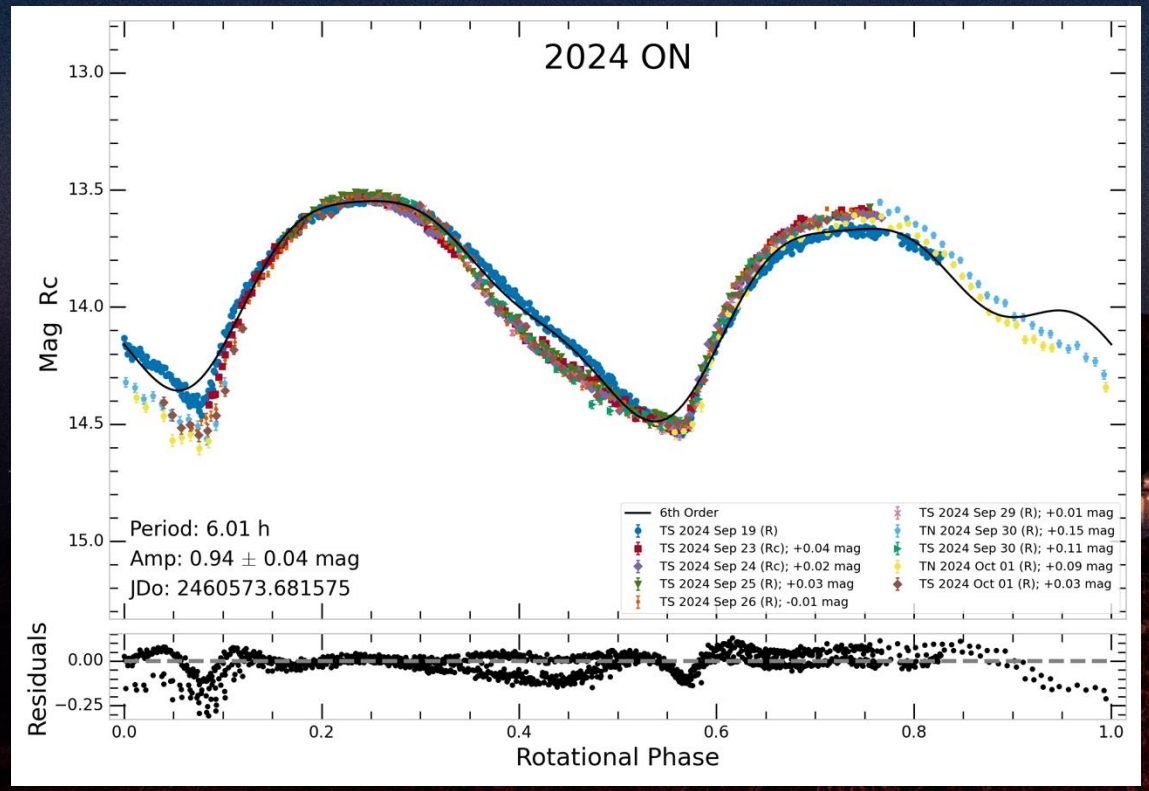
2023 DZ2 (PHA) – fast rotator: 6 min
IAWN campaign
Close approach: 2023 March 25 (0.45LD)
Observed in R filter.

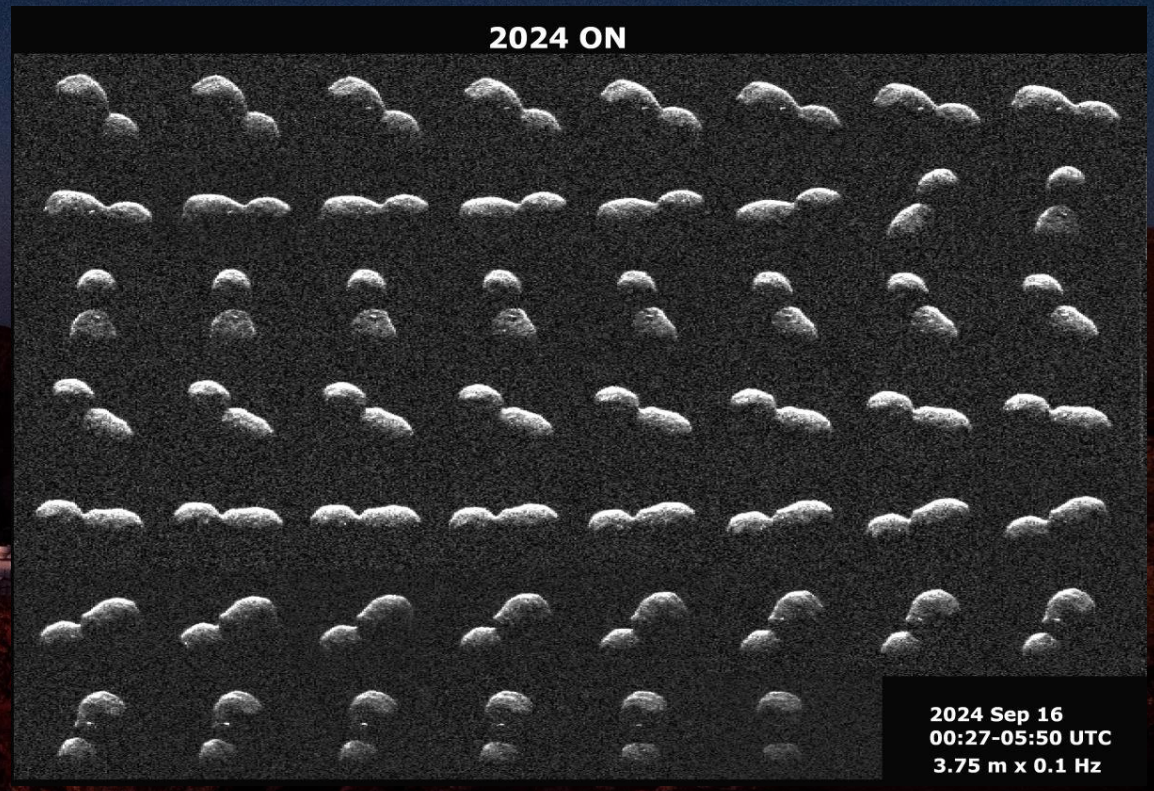
Reddy. et al – "2023 DZ2 PD Campaign" (including Ferrais M., Jehin E., Petrescu E.) PSJ June 2024

1998 ST27 (PHA) – triple asteroid: 3.5 hr
Close approach: 2024 October 24 (9.26LD)
Observed in R, I, B, V filters.

Petrescu. E et al – "Lightcurves of 2024ON, 2024 MK and 1998 ST27 from TRAPPIST" (including Ferrais M., Jehin E.) In preparation.

NEO lightcurves with TRAPPIST twins



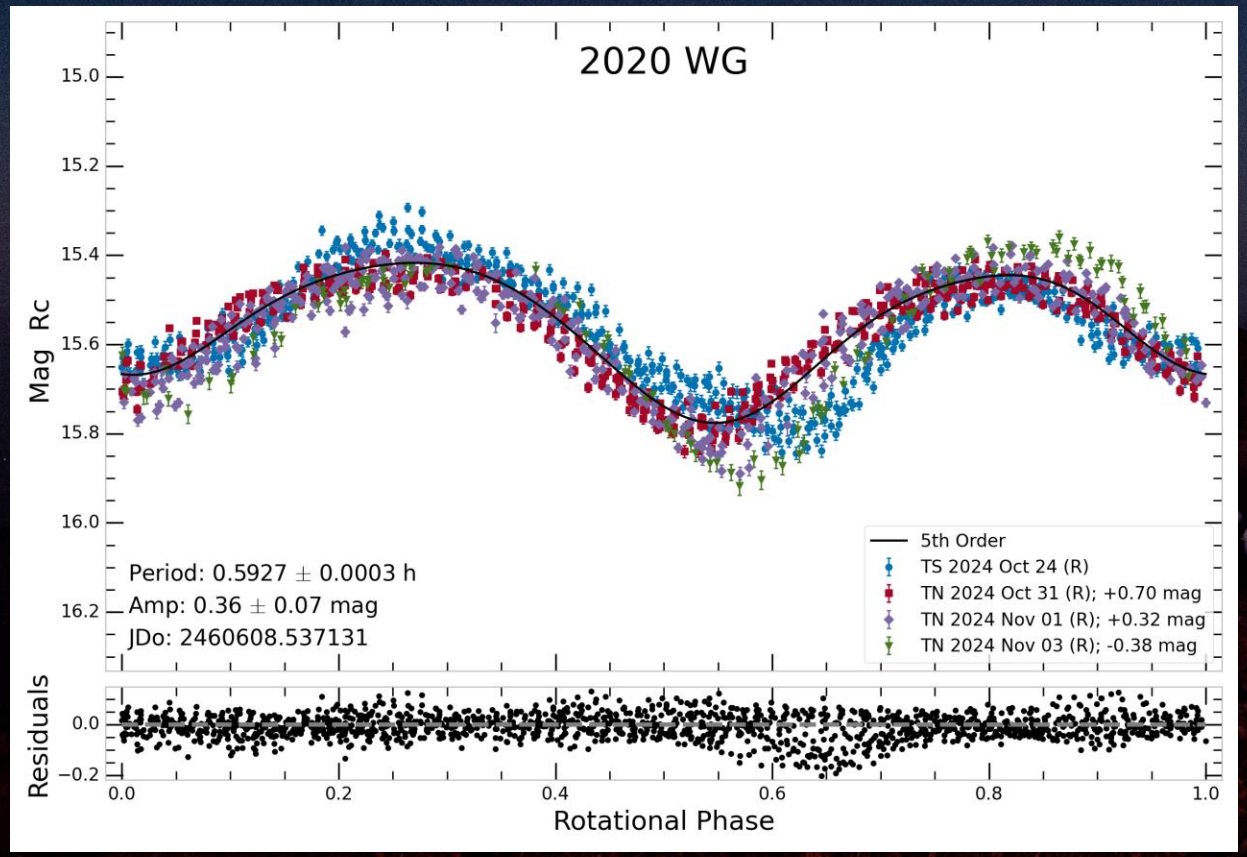


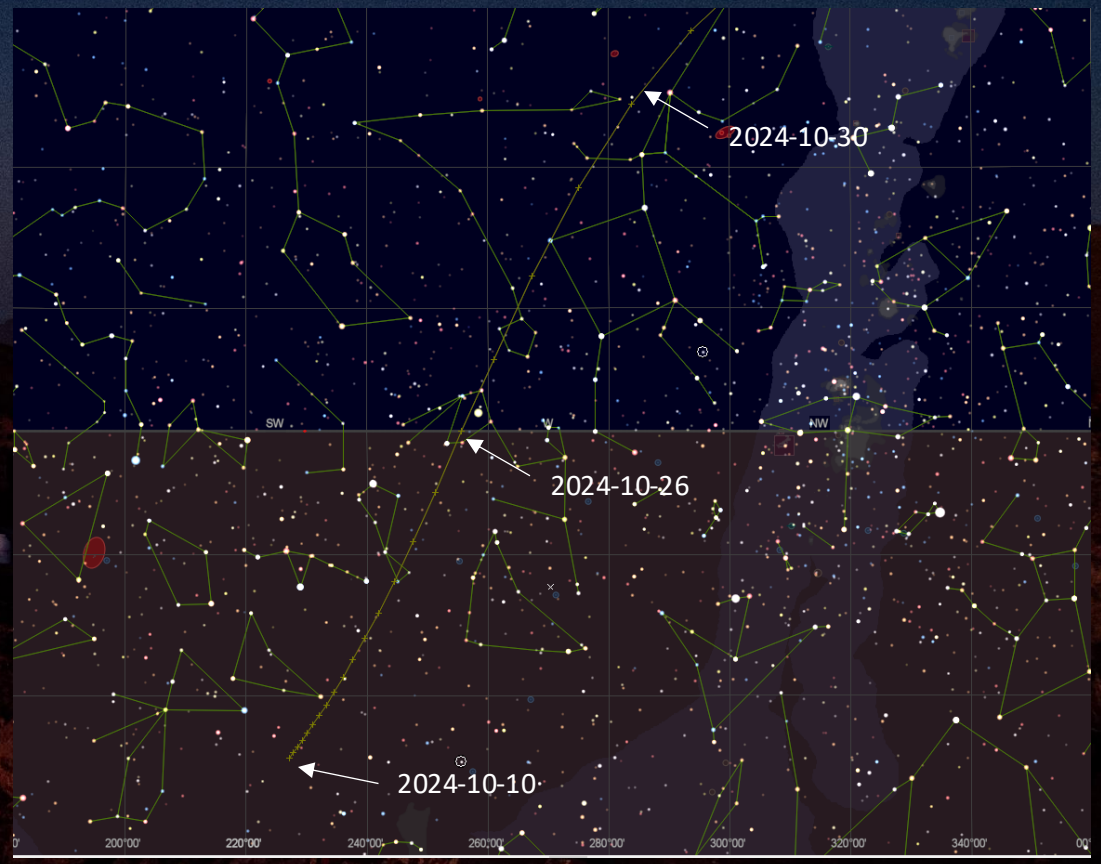
2024 ON (PHA) – contact binary P=6.01h
Close approach: 2024 October 24 (2.59LD)
Observed in R, I, B, V filters.

Radar data from Goldstone

Petrescu. E et al – "Lightcurves of 2024ON, 2024 MK and 1998 ST27 from TRAPPIST" (including Ferrais M., Jehin E.) In preparation.

NEO lightcurves with TRAPPIST twins





2020 WG (PHA), P=0.59 h
Close approach: 2024 October 28 (8.65LD)
Observed in R, I, B, V filters.

Trail of 2020 WG seen
from TRAPPIST-N location.
Chart made with Cartes du ciel.

TRAPPIST – “The paparazz

unofficial nickname

laborate

n – *ejehin @uliege.be*