Physical characterization of 2024 YR4

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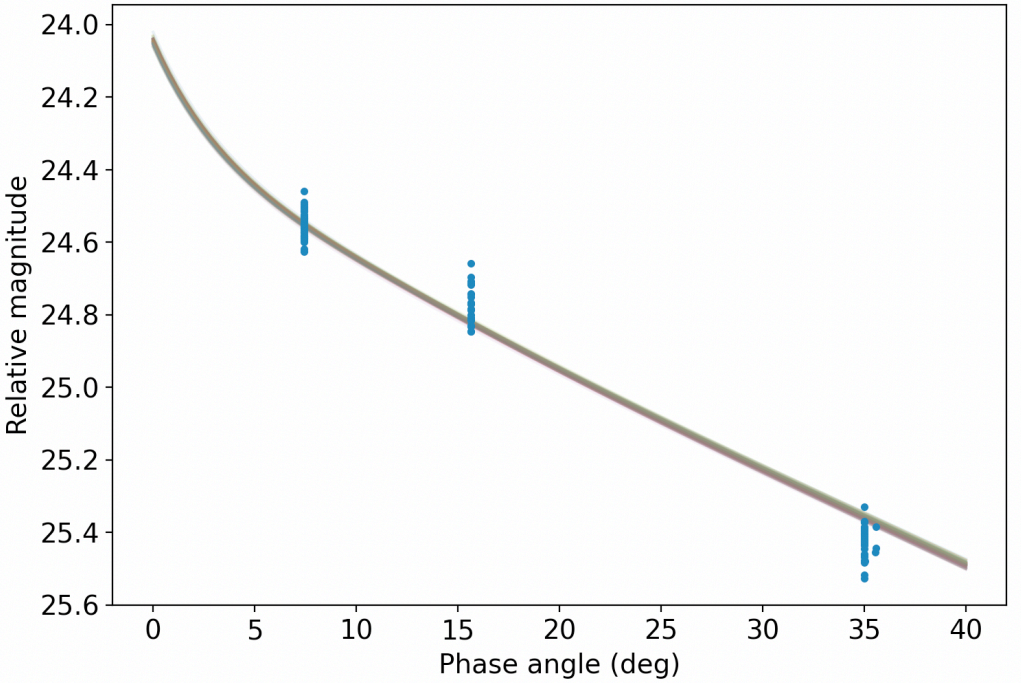
H magnitude

MPC	23.94
JPL	23.96 ± 0.27
NEOCC	23.9

These estimates are obtained through the regular automated pipelines from each institutions considering all the observations submitted to the MPC. Potential issues can arise when combining observations obtained in different filters, calibrated using different catalogs and with poor photometric accuracy.

Using consistent data from Danish 1.54m telescope*, Petr Pravec obtains H = 24.02 ± 0.13 mag

From VLT (8.2m), LDT (4.3m), and Catalina I52 (1m) telescopes covering phases from 35° to 7.2° (minimum of the observable phase during this apparition) and correcting for the rotation lightcurve we obtain H = 24.05 ± 0.15 mag

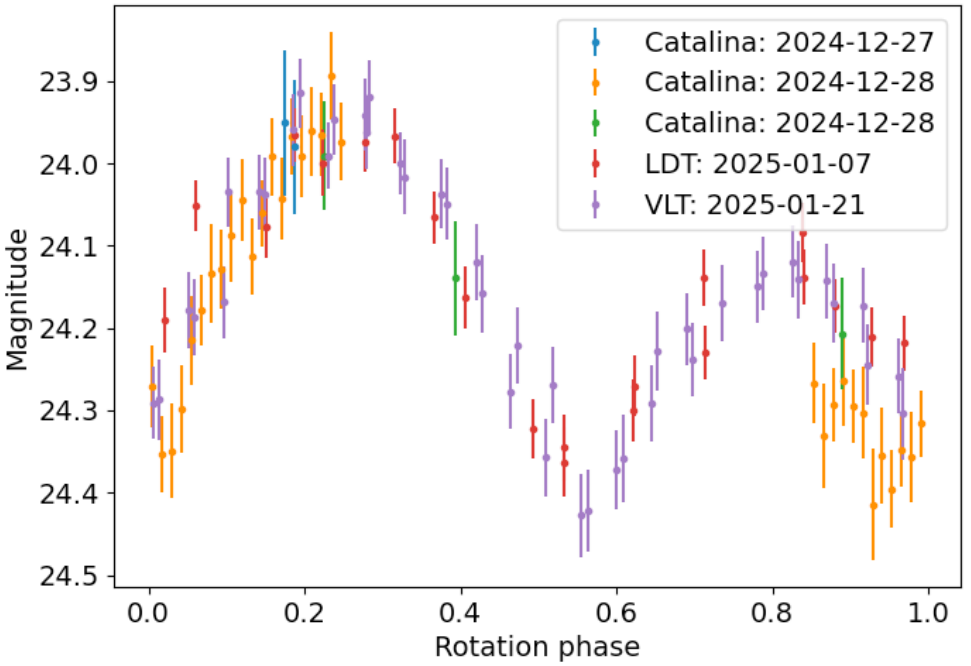


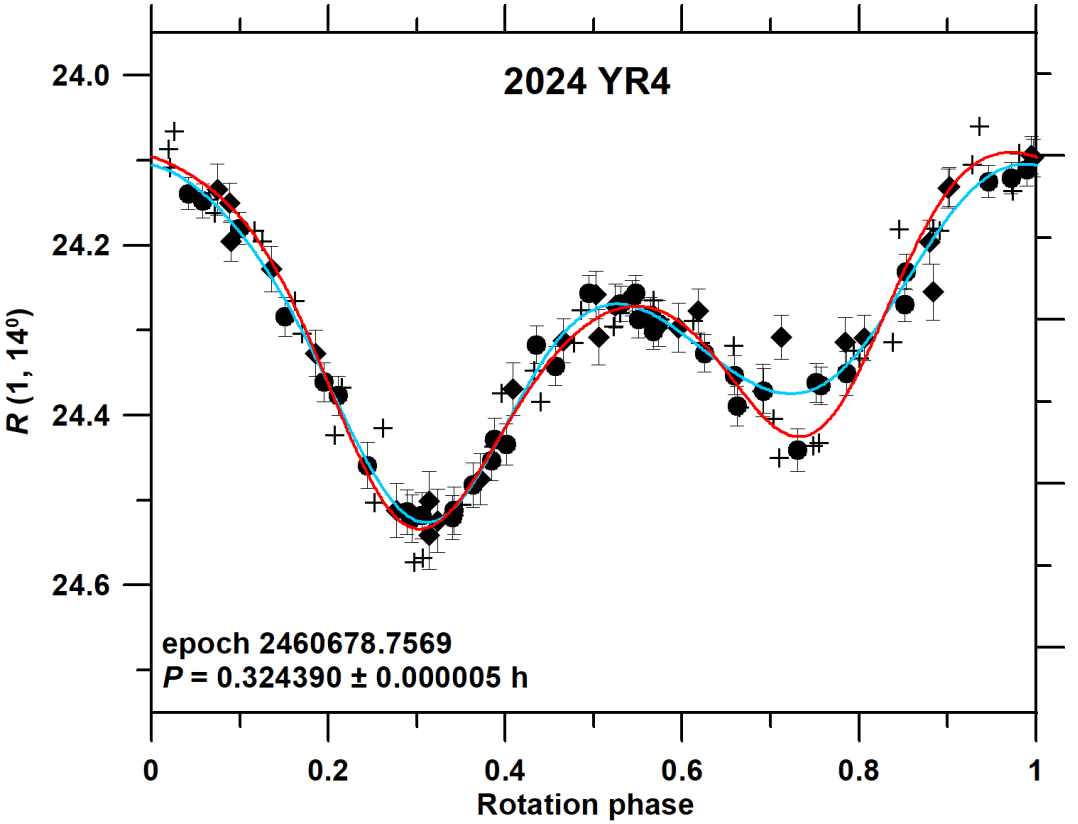
*The observations with the 1.54-m Danish telescope at the La Silla station of the European Southern Observatory were supported by *Praemium Academiae* award to P. Pravec by the Academy of Sciences of the Czech Republic

Lightcurve and rotation period

Period = 19.4634 ± 0.0003 minutes
Amplitude = 0.4 mag

Partial lightcurve also recovered from Catalina Sky Survey I54 observations





DK154: P. Pravec

VLT: O. Hainaut, M. Devogele, M. Micheli

Shape

Not much information about the shape.
Lightcurve suggest a moderate to highly elongated shape depending on the aspect at which the object is observed.

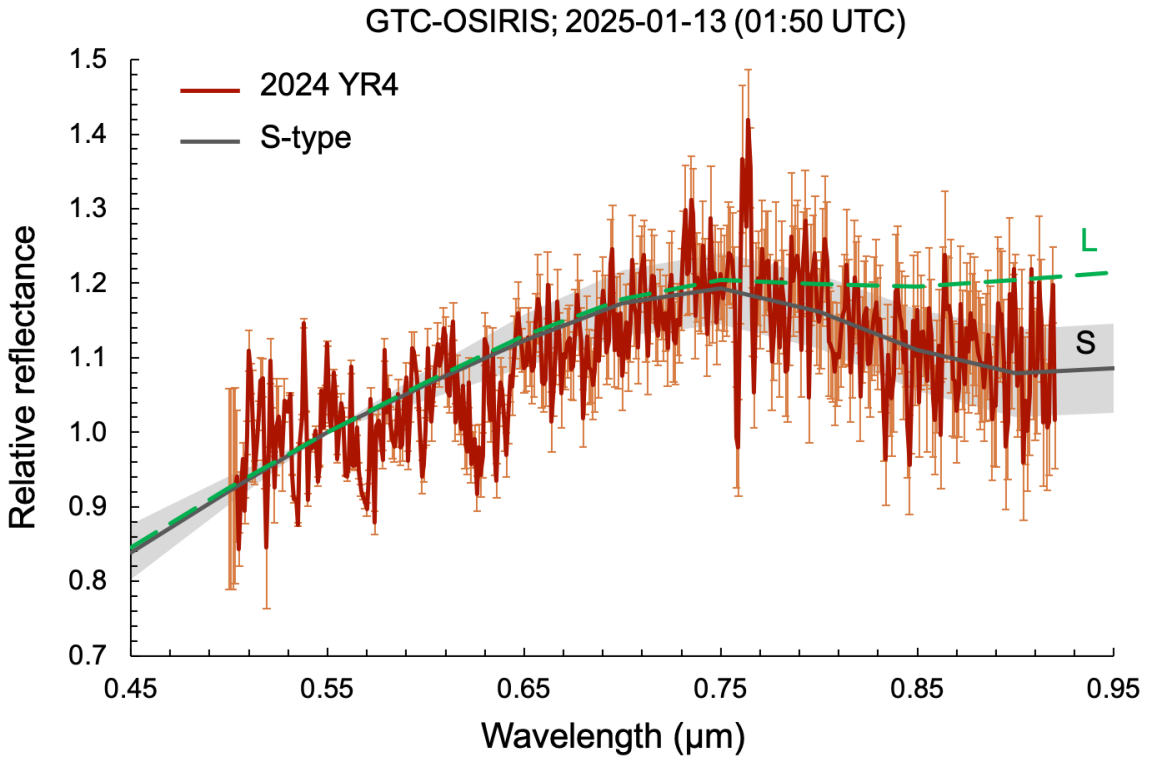
a/b > 1.4
c axis unconstrained

Aspect on the sky almost identical for the whole dataset, it is very hard to gain any constrain on the shape

Composition/taxonomy

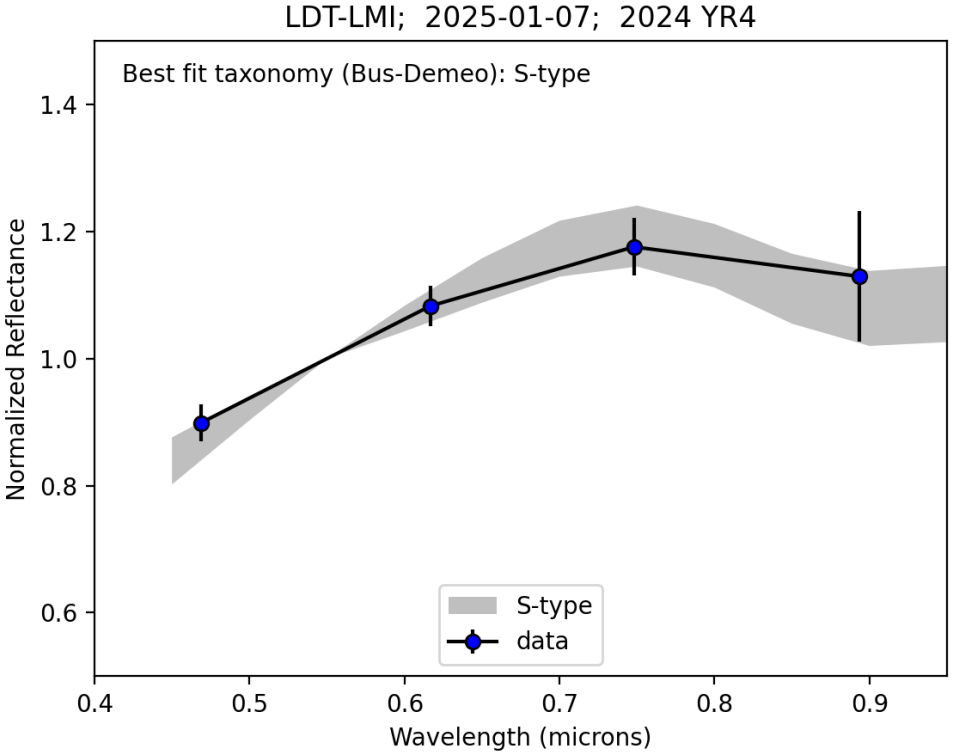
Most probably an S-type asteroid, but other taxonomic classes (L-type, K-type) cannot be excluded

J. DeLeon spectrum with 10.4m GTC



Data source: observational program GTC16-24B (PI J. de León).

N. Moskovitz colors from 4.3m LDT



N. Moskovitz & T. Kareta (Lowell Observatory)
NASA YORPD grant 80NSSC21K1328 awarded to the Mission Accessible Near-Earth Object Survey (MANOS)

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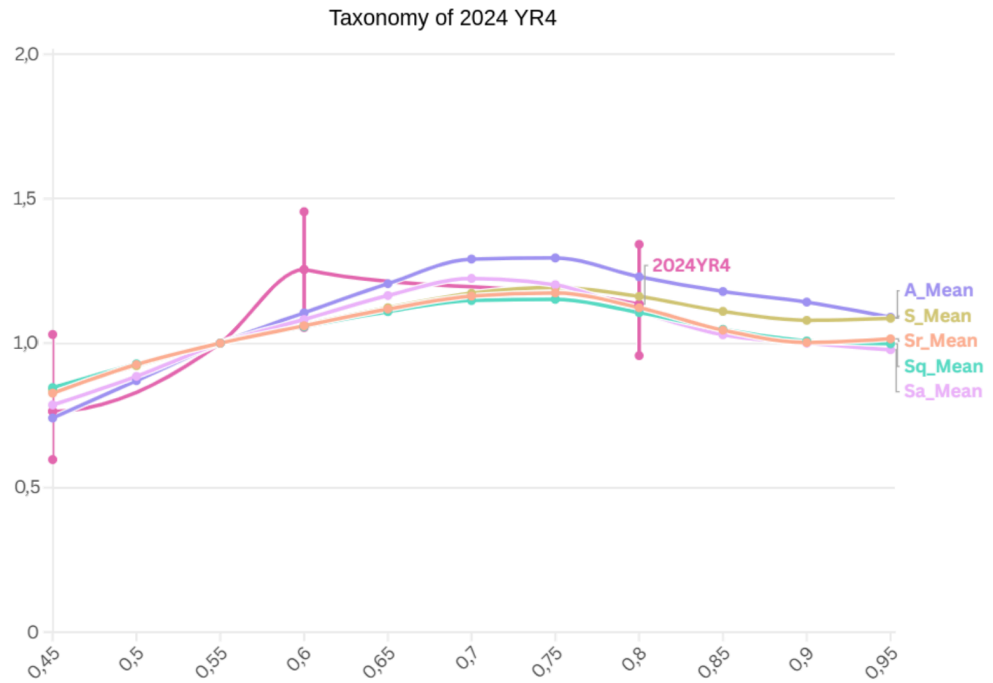
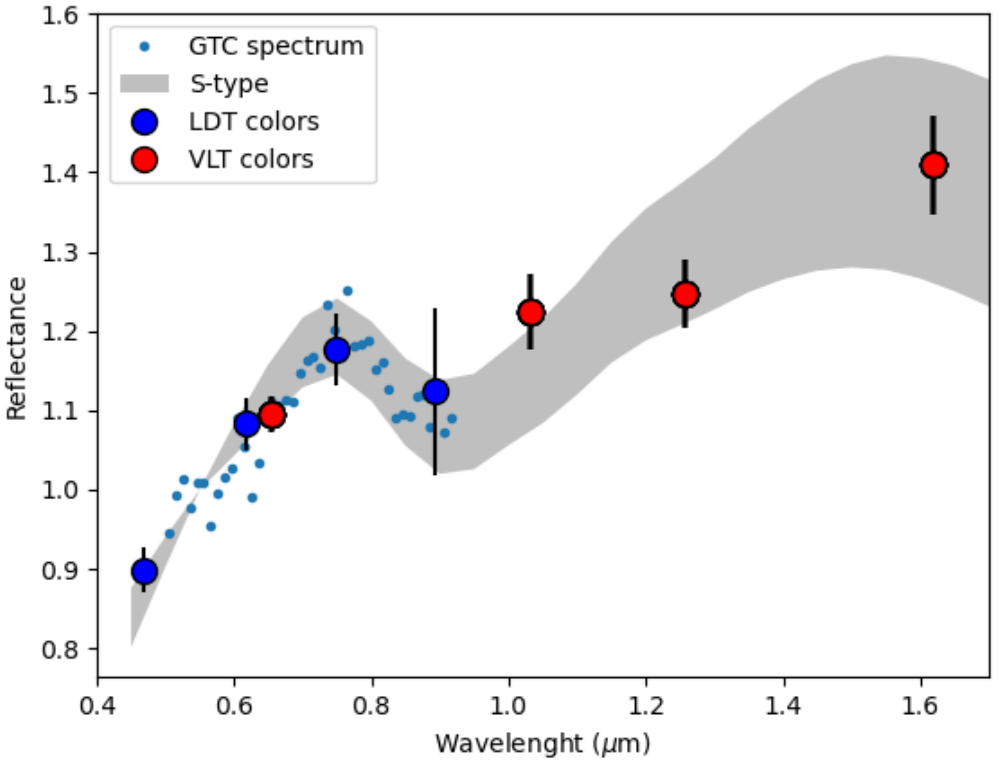
S. Ieva, E. Dotto and NEOPOPS team* colors with 3.6m TNG



NIR colors from VLT (O. Hainaut, M. Devogele

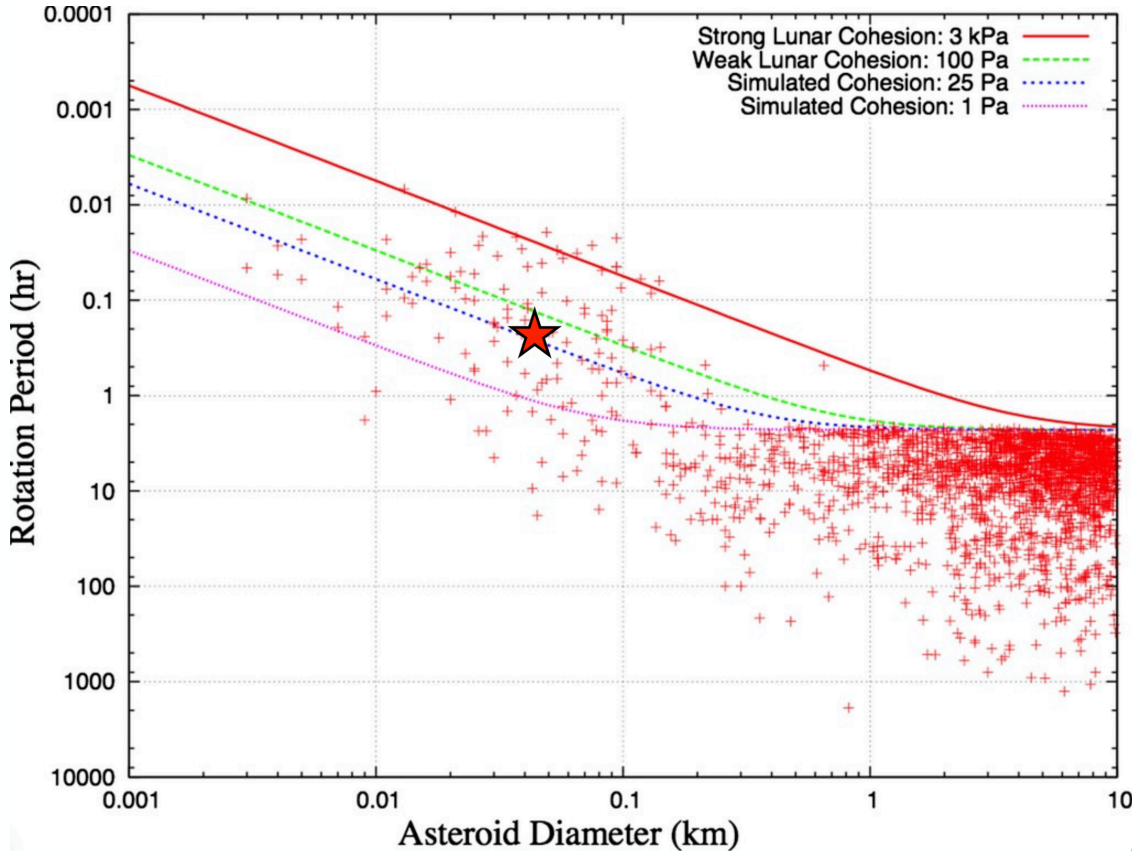


DDT proposal to ESO

NEOPOPS them is funded by HE-NEO-01 which is a project funded by the Horizon Europe Programme of the European Union and implemented by ESA.

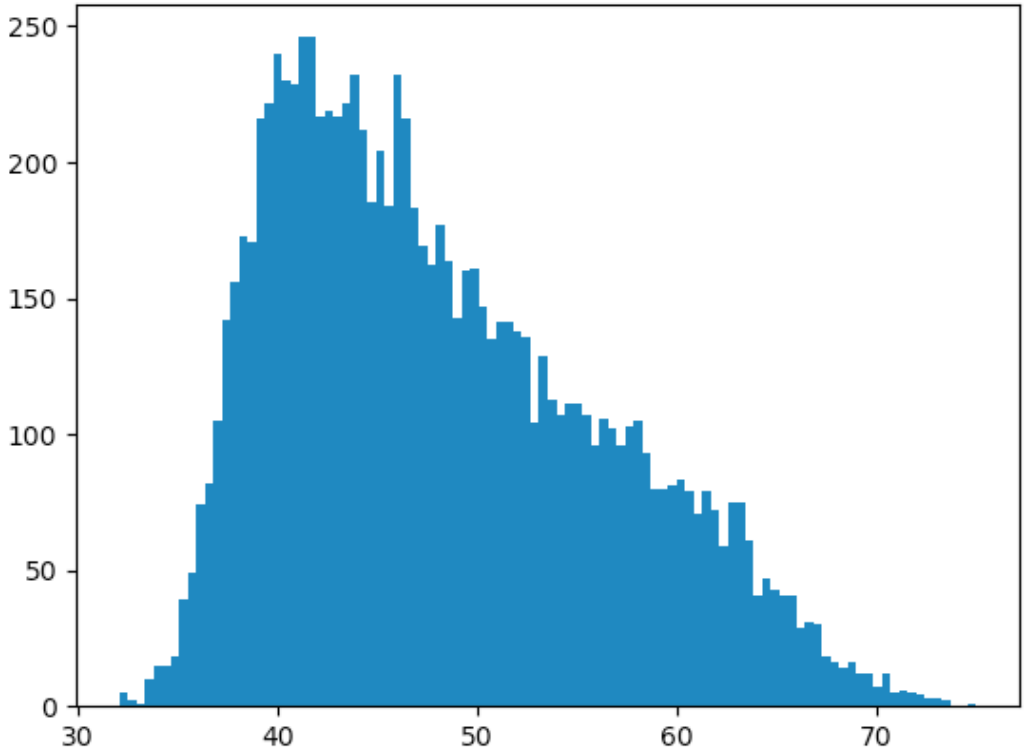
Cohesion

2024 YR4 is a fast rotators, but it is not expected to need much cohesion to be able to hold its shape. It thus can be a rubble pile and doesn't need to be monolithic.



Diameter

Right now it is not possible to constrain the diameter (JWST observations would be needed)
Assuming H = 24.02 +- 0.13 and a uniform distribution for the albedo between 0.1 and 0.3



Range of possible diameters
between 35 and 75m
Peak of probability around 40m

Possible future observations

Lightcurves from 8m class telescopes?

The viewing geometry doesn't change, but extending the "arc" of lightcurve observations could potentially help determining the pole orientation and shape when the object is observed again in 2028. Linking a 20 min rotation period with multi-year gap will leave a lot of uncertainties in the spin axis solution.

JWST observations to constrain the size

2024 YR4 enters the JWST observing window in March until 20 May 2025

JWST can constrain the diameter to ~10% and with multi-epoch observations the thermal inertia and regolith properties

A JWST proposal has been submitted by the planetary defense community

Acknowledgments

- The observations with the 1.54-m Danish telescope at the La Silla station of the European Southern Observatory were supported by Praemium Academiae award to P. Pravec by the Academy of Sciences of the Czech Republic
- N. Moskovitz & T. Kareta (Lowell Observatory) NASA YORPD grant 80NSSC21K1328 awarded to the Mission Accessible Near-Earth Object Survey (MANOS)
- Based on observations made with the Italian Telescopio Nazionale Galileo (TNG, AOT50TAC_31) operated on the island of La Palma by the Fundación Galileo Galilei of the INAF (Istituto Nazionale di Astrofisica) at the Spanish Observatorio del Roque de los Muchachos of the Instituto de Astrofisica de Canarias
- NEOPOPS them is funded by HE-NEO-01 which is a project funded by the Horizon Europe Programme of the European Union and implemented by ESA.
- Based on observations made with two 8.2-m units from the ESO Very Large Telescope Observatory located in Paranal, Chile
- Observations at the GTC were obtained through the observational program GTC16-24B (PI J. de León).