

N E O



The NEO Physical Observations and Properties Simulation



The **NEO** Physical **O**bservations and **P**roperties **S**imulation (NEOPOPS)

An EU funded project for planetary defense

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European Union

Implemented by



What are the NEOs ?

Near-Earth Objects (NEOs) are known for their potential to cause catastrophic impacts on Earth that have shaped the history of biodiversity.



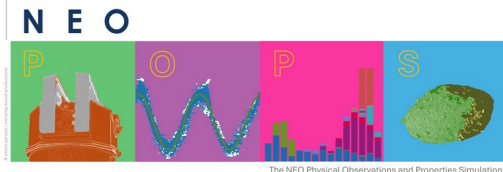
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A famous example : Cretaceous-Paleogene event

Consequences :

- Extinction of more than 75% of animal species
- Drastic climate changes



What are the NEOs ?

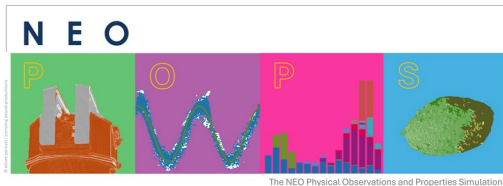
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More recently : Chelyabinsk fall February 2013

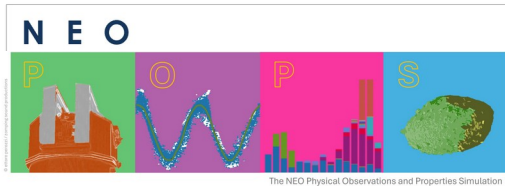
Consequences :

- Population injuries
- Material damages



What are the NEOs ?

NEOs are fragments of larger asteroids and comets that provide insights into the primordial structure of planetesimals. Their study is crucial in two distinct ways :

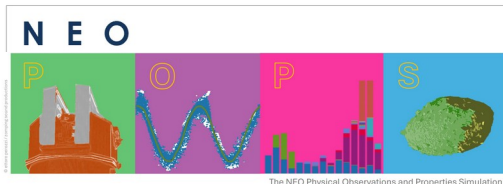


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Science perspective

- Information on the compositional gradient of the Solar System
- Information on the delivery of water and organic material to Earth
- Constraints on non-gravitationnal effects (Yarkovsky - YORP)



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Planetary defense perspective

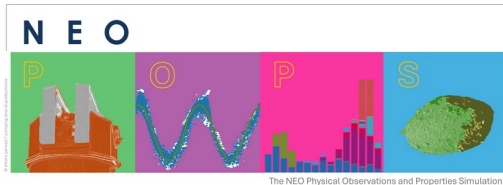
- A role in past mass extinctions (K-Pg event)
- Understanding impacts from small-sized (< 100m) objects
- Development of mitigation measures in the event of an impact



The role of NEOPOPS

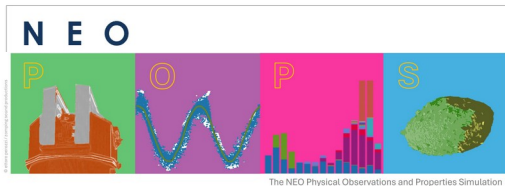
In this context, the NEOPOPS project was established, building on the success of previous international research programs dedicated to the study of NEOs (NEOShield 1 & 2, NEOROCKS, ...)

NEOPOPS is an European project funded by the European Union's Horizon Europe Programme for the 2025-2028 period and implemented by the European Space Agency (ESA)



Objectives

- Organization of follow-up astronomical observations of NEOs
 - Acquisition of data to derive physical properties



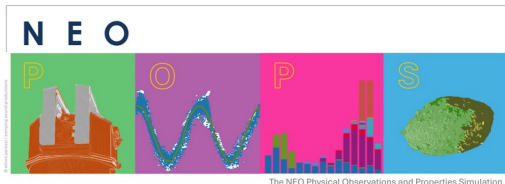
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- Improvement of statistical analyses of NEOs and numerical simulations
 - Improving knowledge of the physical nature of NEOs, particularly small-sized objects (< 100 m)



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- Fostering European and international cooperation in NEO characterization
 - Development of roadmaps and scenarios for mitigation measures



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- Fostering European and international cooperation in NEO characterization
 - Development of roadmaps and scenarios for mitigation measures
- Collaboration with ESA for the communication of results
 - Improved understanding and perception of asteroid hazards



Organization

The team is organized into 6 Work Packages (WPs) across 4 countries, employing complementary observational techniques to fully characterize NEOs

WP1 : Project Office (INAF-OAR)



WP Leader

E. Dotto

Tasks

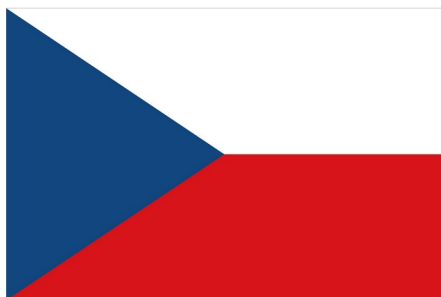
- Project management
- Risk management
- Scientific Coordination
- Networking
- Data dissemination
- Second level Interface



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WP2 : Lightcurves (ASU)



WP Leader

P. Pravec

Tasks

- Observations, Planning and Execution
- Rotations and shapes
- Binary Objects investigation



1.54 m Danish telescopes
(La Silla, Chile)



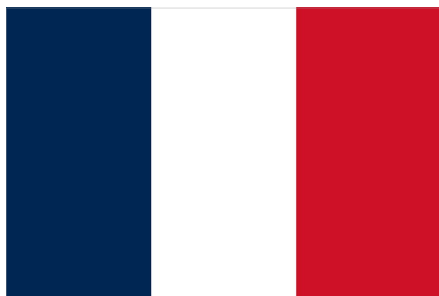
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WP3 : Photometry (LIRA)

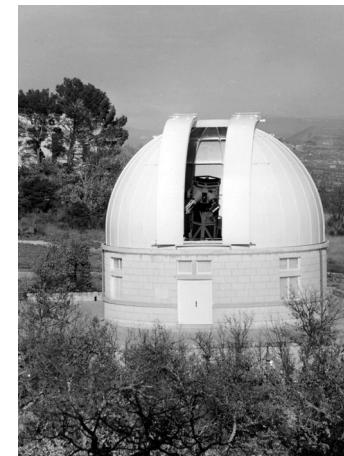


WP Leader

M. A. Barucci

Tasks

- Observations, Planning and Execution
- Surface colors determination
- Preliminary taxonomy



OHP T120
(Saint-Michel l'Observatoire, France)



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WP4 : Spectroscopy (INAF-OAR / UniPD)

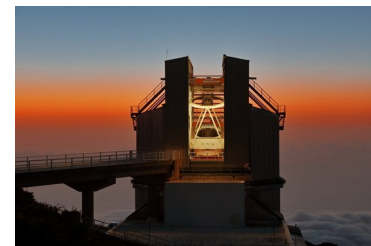


WP Leader

S. Ieva

Tasks

- Observations, Planning and Execution
- Spectral Analysis
- Taxonomic classification
- Observations and analysis with small telescopes



3.58 m TNG
(La Palma, Spain)



1.82 m Copernico
(Asiago, Italy)



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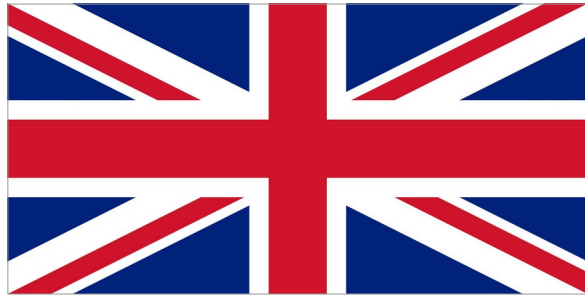
WP5 : Polarimetry (AOP)

WP Leader

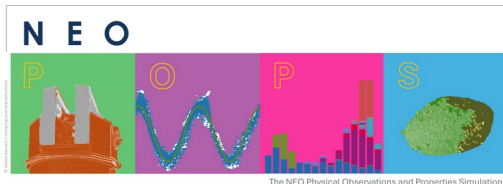
S. Bagnulo

Tasks

- Observations, Planning and Execution
- Geometric Albedo determination



1.0 m C2PU
(Calern, France)



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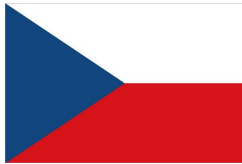
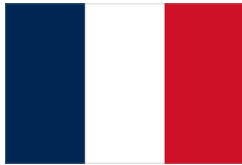
WP6 : Rapid Response (INAF-OAR / ASU / LIRA / AOP / UniPD)

WP Leader

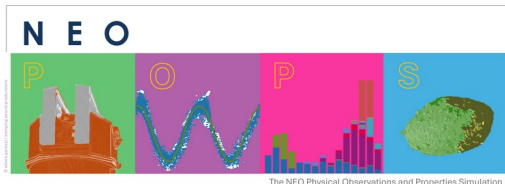
S. Ieva

Tasks

- Planning and coordination with ESA
- Implementation
- Lightcurves / Photometry / Spectroscopy / Polarimetry
- Small telescopes rapid exploitation



8.20 m VLT
(Cerro Paranal, Chile)
... and all the other telescopes



How do we choose our targets ?

We select our targets as follow:

- 1) Virtual impactors (i.e. with an orbit that intersect the one of Earth)
- 2) Objects with low Minimum Orbit Intersection Distance (MOID) (< 0.05 au)
- 3) Recently discovered objects (within a month prior to the observing night)



Some statistics from the first year of the project

WP2 : Lightcurves

- **18** nights of observations
- **33** NEOs observed

WP3 : Photometry

- **12** nights of observations
- **45** NEOs observed

WP4 : Spectroscopy

- **17** nights of observations
- **62** NEOs observed

WP5 : Polarimetry

- **18** nights of observations
- **14** NEOs observed

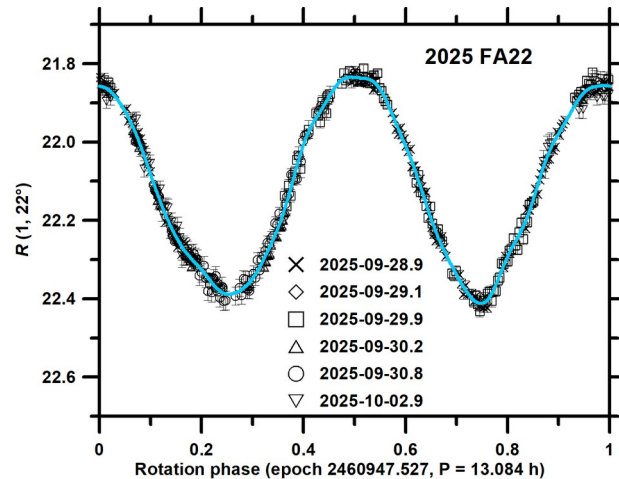
WP6 : Rapid-Response

- Involvement for the observation campaign of **2024 YR4**
- Involvement for the observation campaign of **2025 FA22**
- **3** other NEOs observed

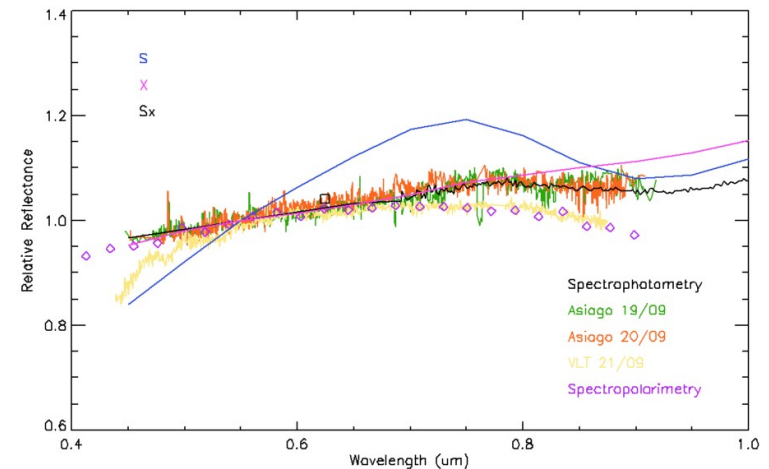


The case of 2025 FA22

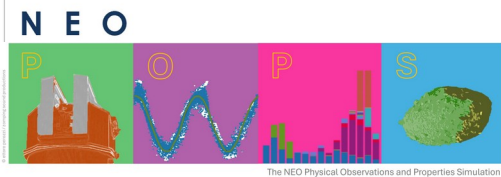
Within the framework of WP6 and following the alert issued by IAWN August 22nd 2025, we observed this object using multiple telescopes.



Lightcurves



Spectroscopy, Spectropolarimetry,
Spectrophotometry



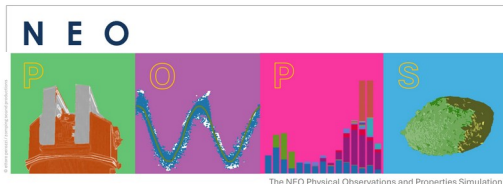


The case of 2025 FA22

Results from our observations

H	D (m)	ρ_v	Period (h)	Tax.
21.5 +/- 0.09	162 +/- 21	0.17 +/- 0.04	13.084 +/- 0.007	S - X - Sx

Publication in progress, stay tuned !



Take-away information

- NEOPOPS is an European project led by INAF – OAR
- It is dedicated to the physical characterization of Near-Earth Objects (NEOs)
- Through the different Work Packages, we perform monthly multi-techniques ground-based observations
- We prioritize targets such as potential impactors and newly discovered NEOs
- During the 1st year of the project, approximately 207 NEOs were observed at least once
- We are also involved in international observing campaigns (from IAWN or ESA).

Acknowledgements : The NEOPOPS observations were funded by a program of the European Union and implemented by ESA (agreement No.4000147191/25/D/MRP)

