NEO ROCKS

Near Earth Object Rapid Observation, Characterization and Key Simulations

NEOROCKS - The NEO Rapid Observation, Characterization and Key Simulations

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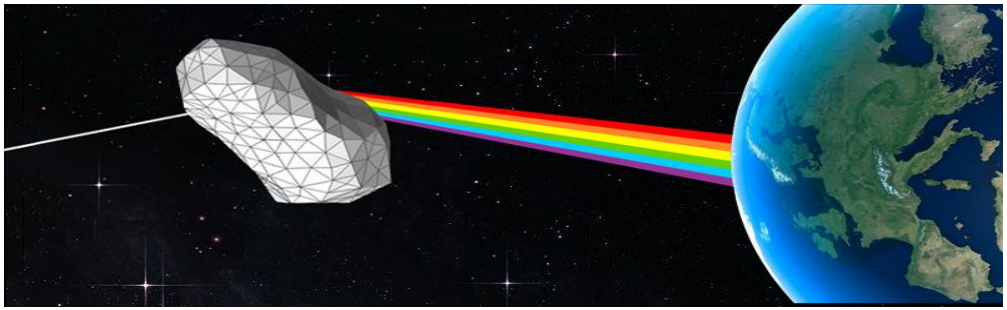
Osservatorio Astronomico di Roma

INAF – Audizioni RSN3 27-28 Maggio 2021

NEOROCKS - The NEO Rapid Observation, Characterization and Key Simulations



Programme: Horizon 2020 - Work Programme 2018-2020
Leadership in Enabling and Industrial Technologies – Space
Call: SU-SPACE-23-SEC-2019 – Advanced research in Near Earth Objects (NEOs) and new payload technologies for planetary defence
(European Commission Decision C(2018)4708 of 24 July 2018)

"Each proposal shall address one or two of the following three sub-topics:

a) *Maturation or adaptation to specific use cases of existing modelling capabilities.*
b) *Development of instruments, technologies and associated data exploitation models in support of missions to asteroids.*
c) ***Improvement of our knowledge of the physical characteristics of the NEO population."***

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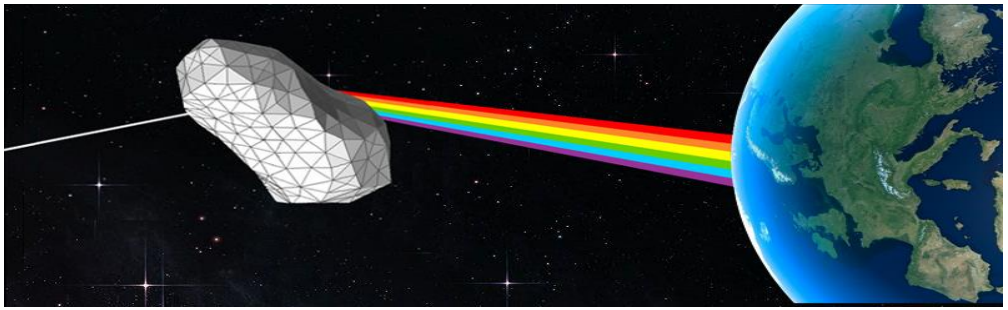

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Timeline:

Start: 1st January 2020
KOM: 20th January 2020
End: June 2022 (under negotiation June 2023)

Grant amount: 2.1 Meuro (44% in Italy)

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NEOROCKS - The NEO Rapid Observation, Characterization and Key Simulations

Participant organisation name	Country
Istituto Nazionale di Astrofisica (coordinator)	Italy
Agenzia Spaziale Italiana	Italy
University of Padova	Italy
LESIA-Observatoire de Paris	France
Observatoire de la Cote d'Azur	France
University of Edinburgh	UK
Astronomical Institute of the Czech Academy of Sciences	Czech Republic
Instituto de Astrofisica de Canarias	Spain
SpaceDyS s.r.l.	Italy
DEIMOS Space s.l.u.	Spain
DEIMOS Space s.r.l.	Romania
DEIMOS Castilla La Mancha	Spain
NeoSpace sp z.o.o	Poland
Resolvo Srl	Italy

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Near Earth Object Rapid Observation, Characterization and Key Simulations

The goal

- **NEOROCKS** addresses the challenge of improving our knowledge on the physical characterization of Near Earth Objects and of the implications for their origin and evolution as well as for planetary defense.

- This goal is achieved by linking up the expertise in performing small body astronomical observations and the related modelling needed to derive NEOs dynamical and physical properties to the pragmatic approach of planetary defense.

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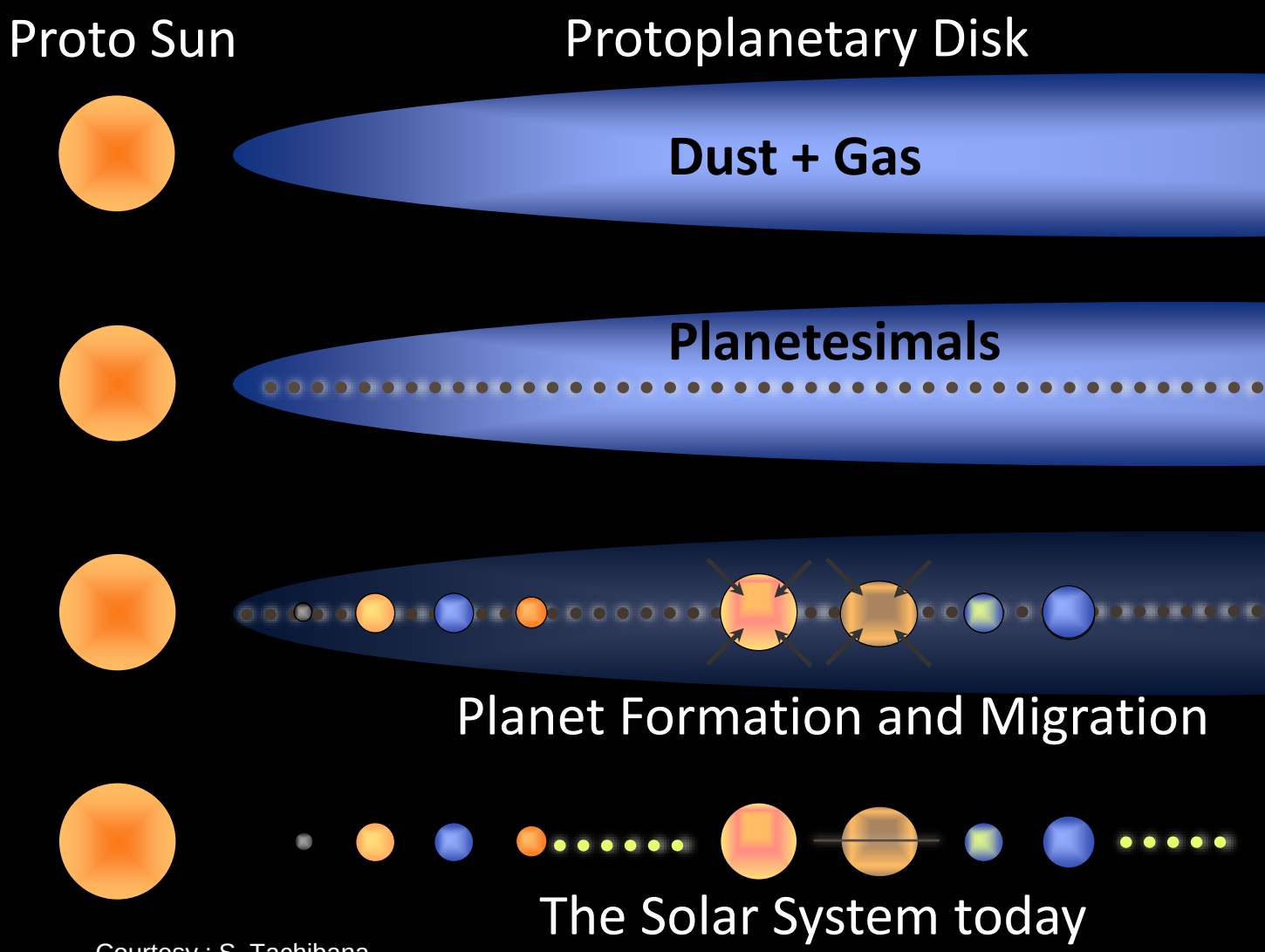
Near Earth Object Rapid Observation, Characterization and Key Simulations

Why small bodies?

They are witnesses of the early solar system



Courtesy : S. Tachibana

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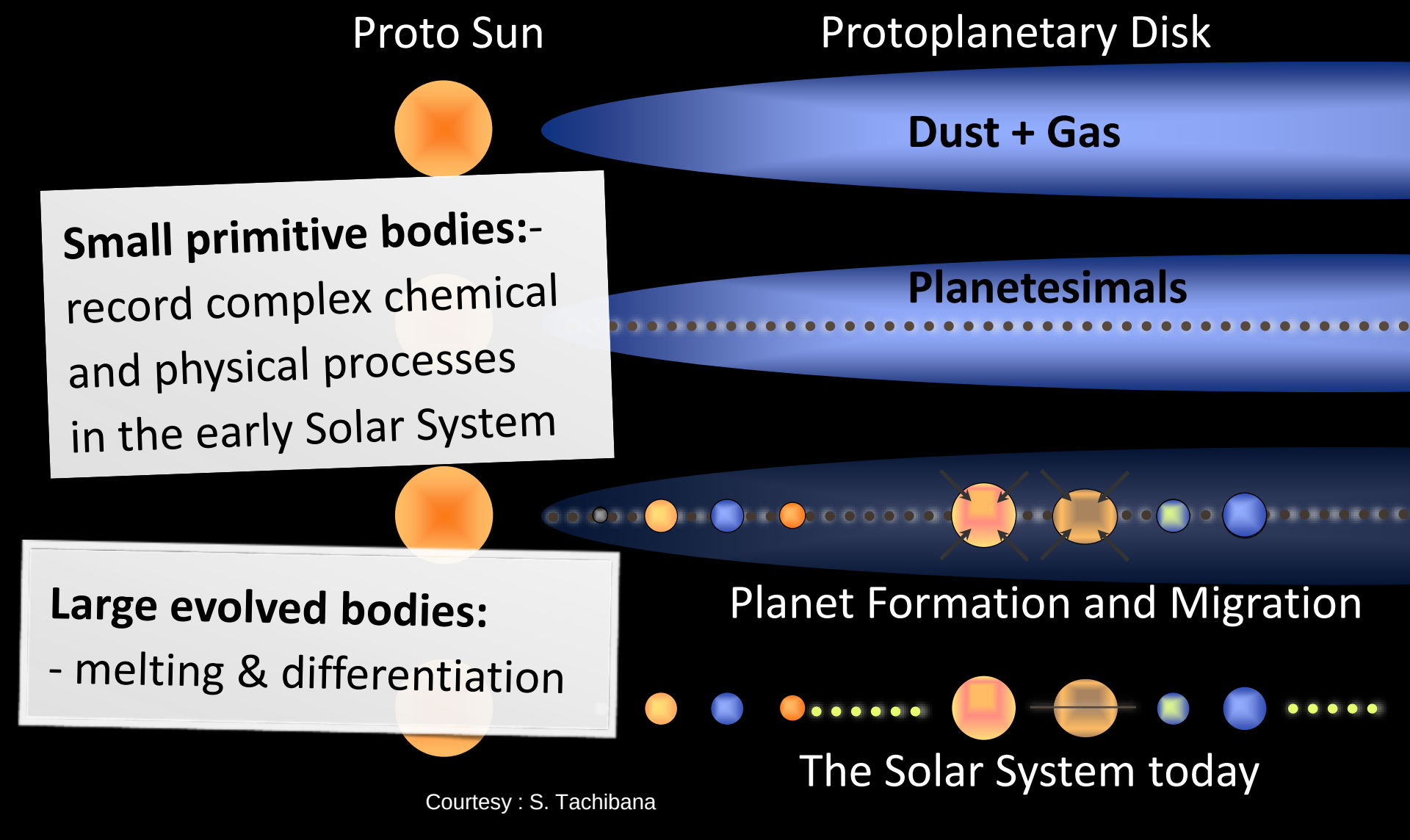
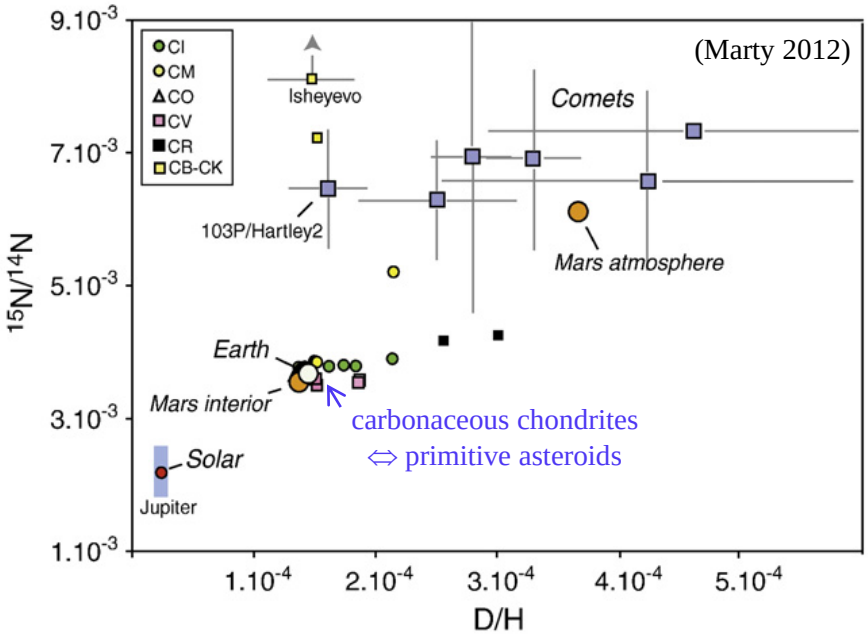


Courtesy : S. Tachibana

Primitive asteroids:

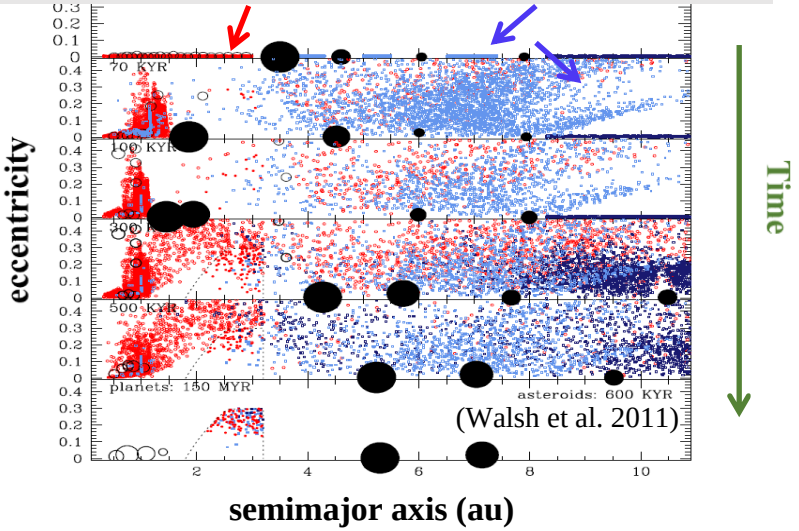
the most probable source of prebiotic material



Planetary migrations → planetesimal mix

thermally evolved / primitive

(volatile-depleted) (volatile-rich)



Both:

- **isotopic ratio measurements**
- **dynamical simulations**

point towards a major delivery by water- and organic-rich primitive asteroids

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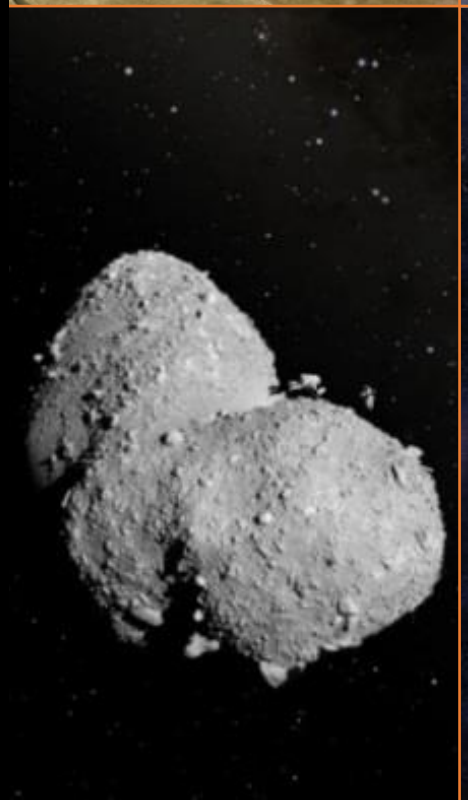
Why Near-Earth Objects?

They are the closest building blocks of the solar system.

They are relevant:

- to investigate the origin of prebiotic material on the early Earth
- as water/mineral resources
- for Planetary Defense

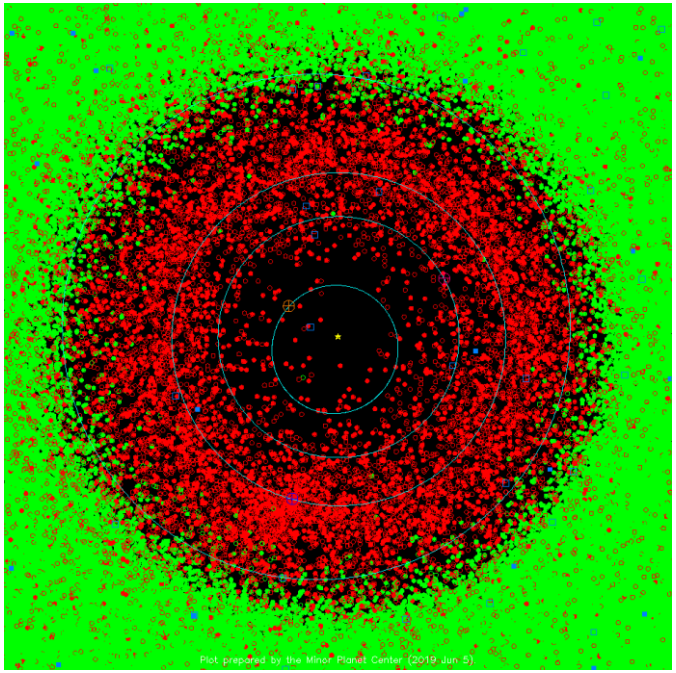
Carbonaceous meteorites contain: macromolecular carbon, biomolecules, hydrocarbons, nanoglobules…

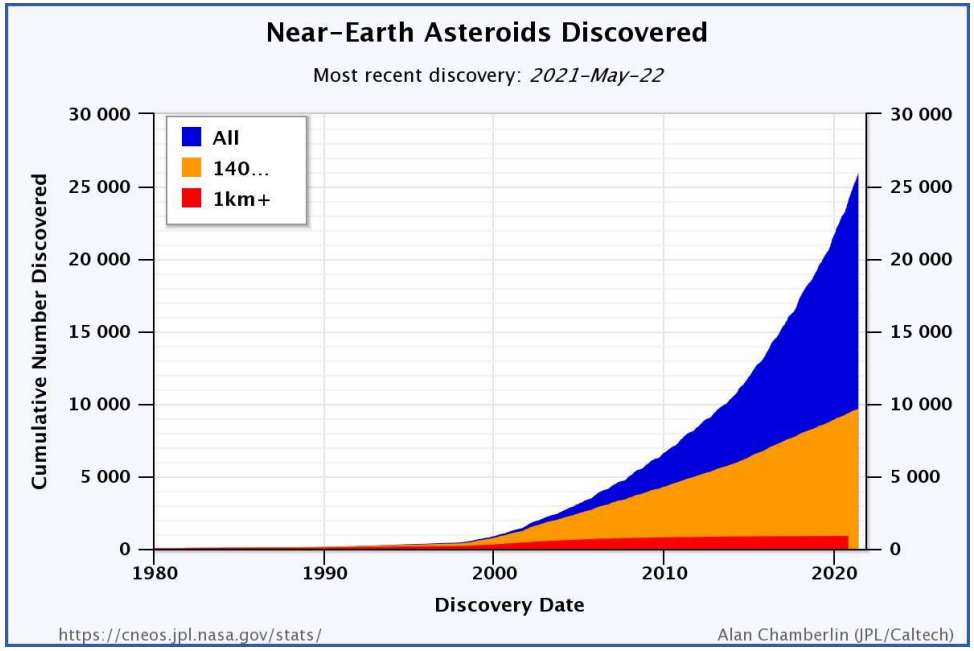


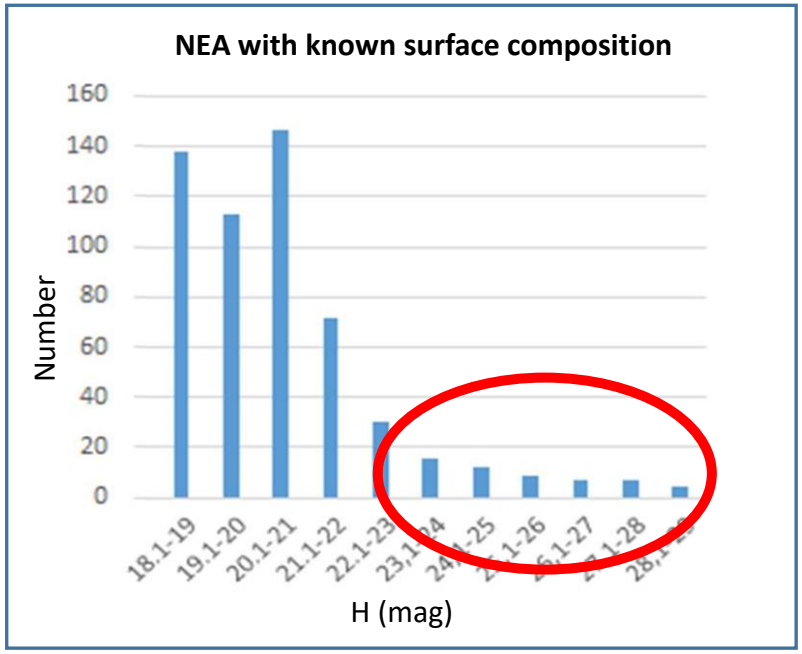
NEO population

26000 objects so far known

- Current discovery rate:
  - ✓ >6 objects/night
  - ✓ Mostly “small” asteroids







NEOROCKS proposes an innovative approach focused on:

a) performing **high-quality physical observations** and foster the related **data reduction process**;

b) investigating the strong relationship between the **orbit determination of newly discovered objects and the quick execution of follow-up observations** in order to face the threat posed by the "imminent impactors";

c) profiting of the European industrial expertise in on-going Space Situational Awareness initiatives to **plan and execute breakthrough experiments foreseeing the remote tasking of highly automatized robotic telescopes**, in order to provide a proof-of-concept rapid response system;

d) guarantee extremely **high standards in the data dissemination** through the involvement at agency level of a data centre facility already operating in a European and international context.

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Near Earth Object Rapid Observation, Characterization and Key Simulations

Scientific Advisory Panel
&
Security Advisory Board

The NEOROCKS participants are assisted by a **Scientific Advisory Panel** and a **Security Advisory Board**, composed by prominent exponents of the international NEO community.

The role of the **Scientific Advisory Panel** is to supervise the activities, giving their expert advice on the project work flow and on possible improvements.

The role of the **Security Advisory Board** is mainly devoted to:

- review the project deliverables;
- assess whether they include any security sensitive information;
- propose measures for preventing the misuse of such information.

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Near Earth Object Rapid Observation, Characterization and Key Simulations

Work Package Breakdown

WP1 – INAF Project Coordination and Management	WP2 – Resolvo Education and Outreach	WP3 – INAF Observations and Data Analysis	WP4 – SpaceDys Orbit Characterization	WP5 – DMS Data Management	WP6 – ASI International Cooperation
Task 1.1 – INAF General Coordination	Task 2.1 – Resolvo Development of Communication Plan	Task 3.1 – ASU Rotations shapes binaries	Task 4.1 – SpaceDys Ephemerides and orbit determination	Task 5.1 – ASI Data center facilities	Task 6.1 – ObsPM Roadmap Physical Characterization
Task 1.2 – INAF Technical & Financial Reporting	Task 2.2 – Resolvo Development & Application Off-line Communication tools	Task 3.2 – INAF Reflectance Spectroscopy	Task 4.2 – NEOSpace Precovery and discovery apparition	Task 5.2 – DMS Data handling	Task 6.2 – NEOSpace NEO Observation from space
Task 1.3 – Resolvo Responsible Innovation and Risk Management	Task 2.3 – Resolvo Development & Application On-line Communication tools	Task 3.3 – ObsPM Photometric Colours	Task 4.3 – SpaceDys Imminent Impactor identification	Task 5.3 – DMS Physical properties database	Task 6.3 – ASI Synergies with international endeavours
Task 1.4 – INAF Scientific Advisory Panel	Task 2.4 – Resolvo Participation in Asteroid Day	Task 3.4 – INAF Polarimetric properties	Task 4.4 – SpaceDys Follow-up prioritization	Task 5.4 – ASI Scientific data dissemination	
		Task 3.5 – IAC Radar Observations	Task 4.5 – DMS Dedicated follow-up tasking		
		Task 3.6 – UEDIN Cometary-like Activity			
		Task 3.7 – OCA Data Mining			

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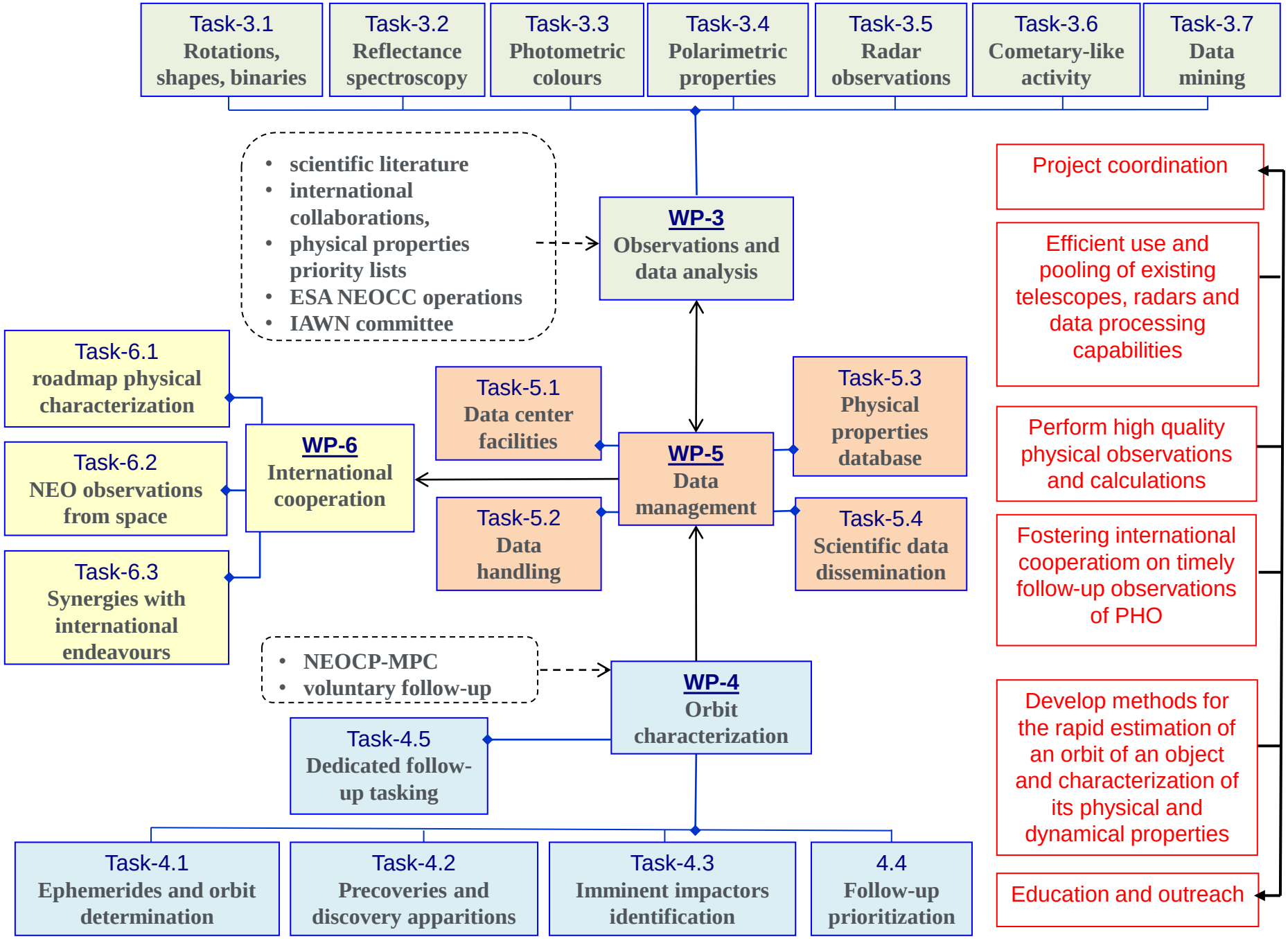
Task-3.1 Rotations, shapes, binaries
Task-3.2 Reflectance spectroscopy
Task-3.3 Photometric colours
Task-3.4 Polarimetric properties
Task-3.5 Radar observations
Task-3.6 Cometary-like activity
Task-3.7 Data mining
scientific literature
international collaborations,
physical properties priority lists
ESA NEOCC operations
IAWN committee
WP-3 Observations and data analysis
Project coordination
Efficient use and pooling of existing telescopes, radars and data processing capabilities
Perform high quality physical observations and calculations
Fostering international cooperatiom on timely follow-up observations of PHO
Develop methods for the rapid estimation of an orbit of an object and characterization of its physical and dynamical properties
Education and outreach
Task-6.1 roadmap physical characterization
Task-6.2 NEO observations from space
Task-6.3 Synergies with international endeavours
WP-6 International cooperation
Task-5.1 Data center facilities
Task-5.2 Data handling
WP-5 Data management
Task-5.3 Physical properties database
Task-5.4 Scientific data dissemination
NEOCP-MPC
voluntary follow-up
WP-4 Orbit characterization
Task-4.5 Dedicated follow-up tasking
Task-4.1 Ephemerides and orbit determination
Task-4.2 Precoveries and discovery apparitions
Task-4.3 Imminent impactors identification
4.4 Follow-up prioritization

Outreach: Project Material

- Leaflet
- Poster
- Roll up

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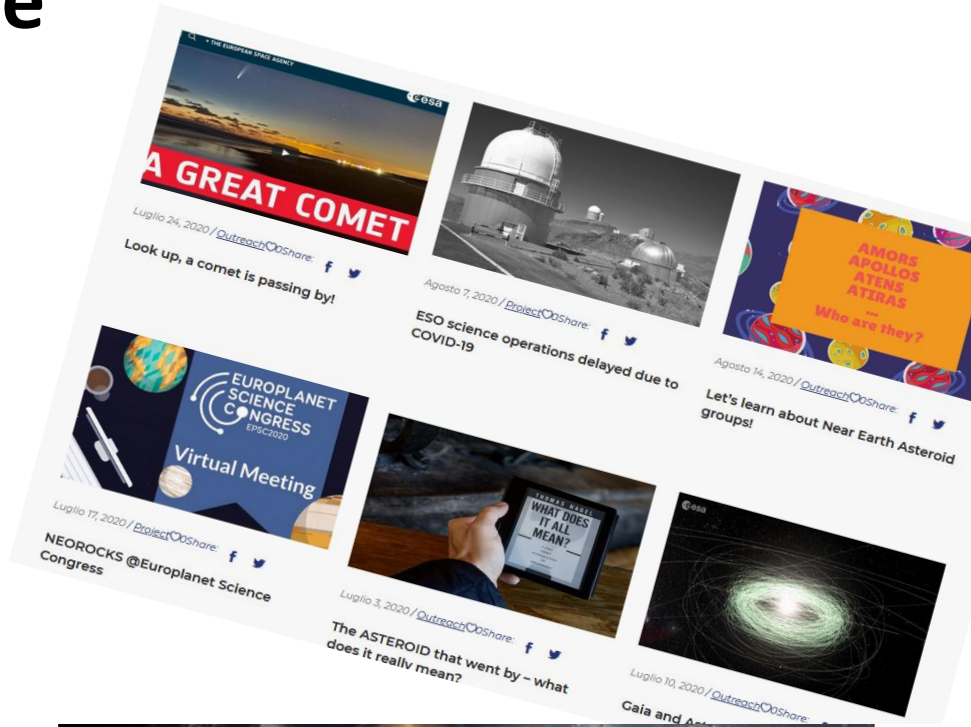
Outreach: Project Website

Maggio 14, 2020 / Project, Team

Last NEO observations before lockdown

Our Neorocker, Astronomical Institute of the Czech Academy of Sciences (CAS), was at the European Southern Observatory just before it was temporarily shut down, due to the global health emergency.

CAS had an observing run at the 1.54-m Danish telescope on the La Silla station of the European Southern Observatory in Chile from March 16 to 23. They took rich photometric observations for several Near-Earth Asteroids (NEAs).



- Linked to
- Updated with news related to Space/Asteroids
- Updated with articles and videos shared by partners
- Updated with information on presentations delivered

Giugno 28, 2020 / Outreach

Doing anything for Asteroid day?

NEOROCKS is!

ASTEROID DAY
30 JUNE

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Data hosting and dissemination

- ❑ Orbital catalogue
- ❑ Ephemerides
- ❑ Physical properties

Physical Parameters	Objects
Color information	149
Diameter/Albedo	1100
Magnitude/Slope parameter	286
Radar observation	589
Spectral Observation	566
Rotational Period/Amplitude	942
Spin vector	40
Taxonomy	733

Table 4: EARN data statistics

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Synergies with International Endeavours

Probing the engagement of European and international partners in a proactive contribution to the detection and observations of NEO.

- **Analyse the European and international initiatives and the potential collaborations at an institutional level**

- **Identify the opportunities of data-sharing with other projects (e.g. ESA NEOCC, NASA CNEOS, UNOOSA, EU, others)**

- Highlight the possibility of continuing and further extending the network of observational assets, the contribution to the NEO physical properties database and the rapid response system scenario established during the project.

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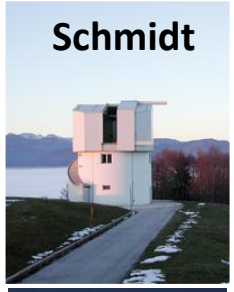
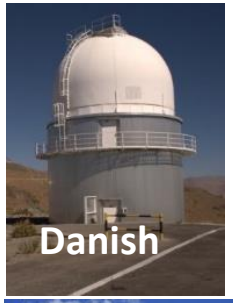
Observations and data analysis (INAF)





Task 3.1 – Rotation, shapes, binaries (Task Leader: ASU)

Task 3.2 – Reflectance spectroscopy (Task Leader: INAF)

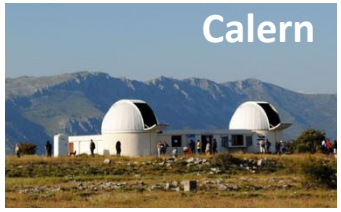
Task 3.3 – Photometric colours (Task Leader: ObsPM)

Task 3.4 – Polarimetric properties (Task Leader: INAF)

Task 3.5 – Observational support to the Arecibo Planetary Radar Program (Task Leader: IAC)

Task 3.6 – Cometary-like activity (Task Leader: UoE)

Task 3.7 – Data mining (Task Leader: OCA)



Conclusioni - Criticità

NEOROCKS è un progetto finanziato dall'EU, che **nasce dalla ricerca di base:**
Il team INAF, coordinatore, ha una lunga esperienza e fama internazionale **nello studio e nella modellizzazione delle proprietà fisiche** dei piccoli corpi del Sistema Solare (NEO, asteroidi, Centauri, Oggetti Trans-Nettuniani) a partire da **osservazioni da Terra.**

I **piccoli corpi** del Sistema Solare, e i **NEO** in particolare, sono un **tema strategico** in Europa, per le connessioni con l'astrobiologia e per le attività legate alla Planetary Defence (cubesat ASI LICIACube).

Necessità di continuità nel finanziamento di questa attività di base.

Politica di arruolamento – necessità di un piano di assunzione di:
- **personale scientifico**, per garantire la continuità.

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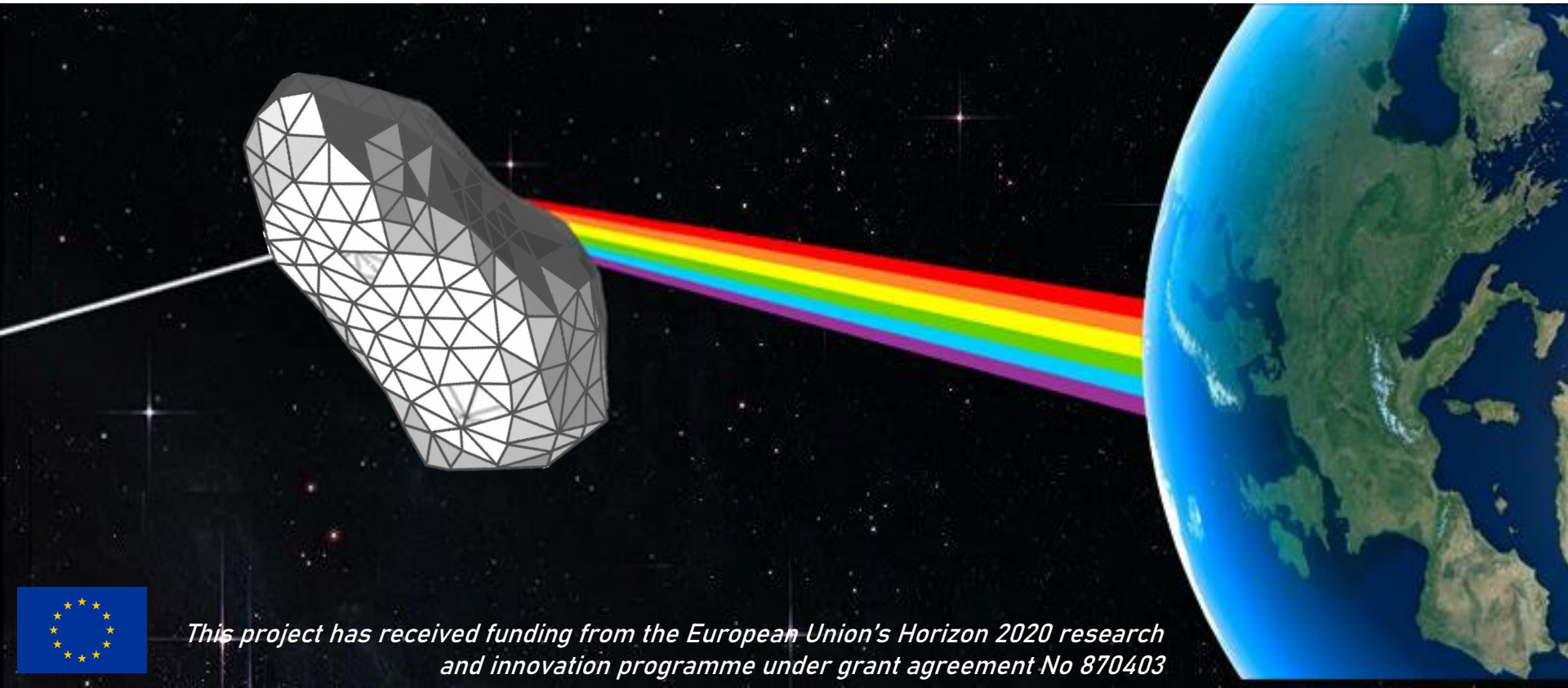
THANK YOU!



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