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NEOROCKS: THE 2020-2023 EU PROGRAMME FOR PLANETARY DEFENCE

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Introduction: "NEOROCKS - The NEO Rapid Observation, Characterization and Key Simulations project" is an EU project funded in the framework of the Horizon 2020 - Work Programme 2018-2020 Leadership in Enabling and Industrial Technologies – Space. It includes 14 partners from 7 countries.

The project: The project started on January 2020 and ends on June 2023. It proposed a radically new approach to address the challenges posed by the NEO investigation for planetary defence: the dynamical and physical characterizations - two domains usually kept separate – were carried out in strict connection and the scientific/observational activity devoted to physical characterization has been driven by the theoretical work on orbital dynamics.

NEOROCKS proposes an innovative approach focused on:

a) performing physical observations and foster the related data reduction process, in order to keep the physical characterization up with the increasing NEO discoveries dominated by small-size objects;
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 ongoing 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) guaranteeing extremely high standards in the data dissemination through the involvement of the ASI-SSDC facility already operating in a European and international context.

Ambitions: The activity has been organized and carried out in order to address the following ambitions:

Ambition 1: Networking large aperture telescopes
Ambition 2: Advancing NEO physical properties modelling and simulations
Ambition 3: Improving the orbit determination process
Ambition 4: Addressing the imminent impactors monitoring
Ambition 5: Establishing a NEO physical properties data centre
Ambition 6: Fostering international cooperation for follow-up observations
Ambition 7: Raise the public awareness on NEO and impact hazard

Activity: The Activity is organized in 6 different WPs, as reported in Fig. 1.

Observations are carried out with a wide range of ground telescopes and techniques: photometry, spectrophotometry, spectroscopy, polarimetry. A Task is devoted to search of cometary-like activity. NEOROCKS includes also an activity of data mining focused on retrieving NEOs data from available sky surveys.

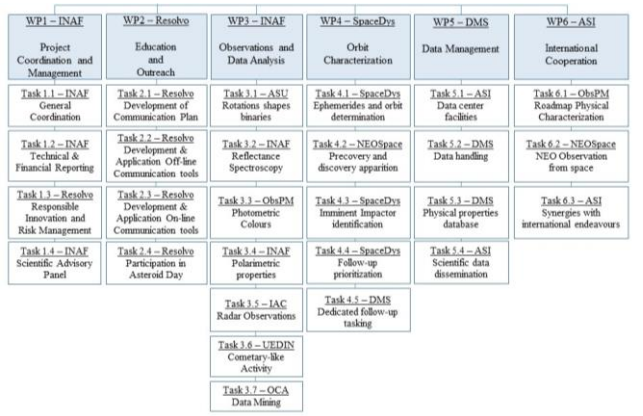

Fig. 1. *The NEOROCKS WBS*

The orbit characterization includes:

- Ephemerides and orbit determination
- Precovery and discovery apparition
- Imminent impactor identification
- Follow-up prioritization
- Dedicated follow-up tasking

Particular attention is devoted to Imminent Impactors. The discovery rate of NEOs is exponentially increasing and nowadays exceeds 3000 objects per year. Nevertheless, current discoveries mainly concern “small” NEOs close approaching the Earth that become bright enough to be studied in detail only for short time spans (≈ weeks) around their discovery during close approaches with the Earth, whereupon they could become too faint for years or even decades. The lack of dedicated, early-response physical observations is then causing the NEO characterization rate to fall further and further behind the discovery rate. In order to provide a proof-of-concept rapid response system, we performed an experiment: we have planned and executed experiments foreseeing the remote tasking of highly automatized robotic telescopes, and we have prioritized and coordinated quick follow-up observations either astrometric or physical. Profiting of the experience gained by the DEIMOS Sky Survey (DeSS) in providing space debris observations in an operational environment, we were able to timely carry out the physical characterization of a sample of objects, having response times on the order of days. We demonstrated that using European existing assets it is possible to set-up an integrated imminent impactor rapid response system encompassing both dynamical and physical characterization. The aim of this activity was to pave the way for the engineering developments needed to prototype a rapid response system capable of handling ground-based telescopes, by linking together for the first time physical and astrometric characterization follow-up observations.

We also realized the NEOROCKS Technical Web Portal (Fig. 2) in order to fulfill the Ambition 5 of our programme, having a unique NEO Physical Properties database to host data products resulting from different sources of NEO observations and to ensure an efficient data products dissemination, long-term data storage and data availability. The functionalities of this Technical Web Portal have been progressively implemented: it initially encompassed only the basic functionalities needed to immediately support the observational activity (priority lists, data repository), then a requirements definition activity has been performed in order to evolve the database toward its final configuration (full set of observation support tools, physical characterization database). Its migration into the ASI Space Science Data Center will complete the activity towards its long-term maintenance/evolution.

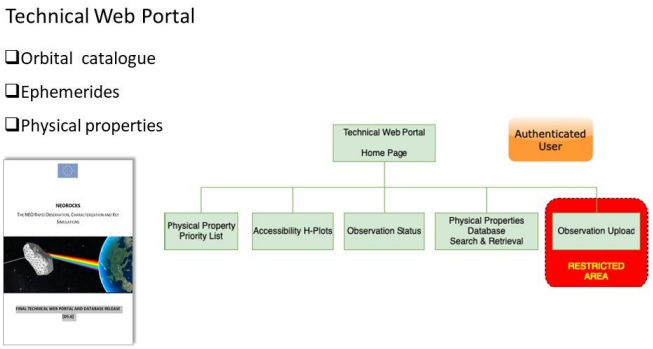

Fig. 2. *The NEOROCKS Technical Web Portal*

The NEOROCKS legacy: NEOROCKS has been a very ambitious programme and very important is the legacy that it leaves to the Planetary Defence community: the outcome of the observational activity, at all level of processing, is permanently stored and made available through the Technical Web Portal, in order to maximize data exploitation also in the future, well beyond the end of the project.

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