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Extended photometric survey of Near-Earth Objects

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Abstract

More than 85% of the 18,000 NEOs discovered up to now lack a physical characterization. The situation is even more dramatic for the small NEO population (D < 300 m). We conducted photometric observations for a large collection of uncharacterized NEOs in order to design future space missions towards them and assess the consequences of a possible impact on Earth. We discovered that carbonaceous C-complex NEOs deserve particular attention, since they are sometimes located in orbits that are challenging from a mitigation point of view, but also because the lack of carbonaceous material might not be due to an observational bias alone.

1. Introduction

The study of the near-Earth object (NEO) population is important because they represent the most accessible vestiges of the building blocks that formed the solar system approximately some 4.5 billion years ago. Furthermore, NEOs can help us answer fundamental questions about the presence of water and organics on the early Earth, and last but not least, of life itself. Recent astrobiological studies suggest that it is plausible that comets and NEOs are responsible for the delivery of organic and prebiotic molecules to the Earth [2].
The study of the physical characteristics of NEOs is also compelling in view of the potential hazard posed to our planet. NEOs are linked with all kinds of meteorite falls, from the recent Chelyabinsk event [4] to the occasional catastrophic impact events (like the K-T event, [5]). Unfortunately, NEOs have a great variation in terms of mitigation-relevant quantities (size, albedo, composition, etc.) and less than 15% of them have been characterized to date. Their increasing discovery rate (currently almost 2.000 objects/year) makes the situation progressively worse. There is therefore an urgent need to undertake a comprehensive characterization of the NEO population, particularly for the small NEO population (with a diameter below a few hundred meters), given that:
- there are many more of them than larger objects;
- their small sizes make them intrinsically fainter and therefore harder to study;
- they could cause severe regional damage [3].

In the framework of a 2-year Long-Term Program at the Telescopio Nazionale Galileo (TNG, La Palma, Spain) we carried out visible photometry of NEOs, with a focus on the small population, in order to derive visible color indexes and the taxonomic classification for 191 NEOs previously uncharacterized. To the same purpose, we also made use of the Italian Asiago Schmidt telescope and the Large Binocular Telescope (LBT, Arizona, US), observing a final sample of 226 objects. Finally, we obtained phase curve characterization for several high-profile NEOs using the the Campo Imperatore telescope (L'Aquila, Italy) and the Observatório Astronômico do Sertão de Itaparica (Nova Itacuruba, Brazil).

2. Results

The overall majority of NEOs characterized in our survey belong to the S-complex [1], although the most dangerous objects in our sample are represented by porous C-complex targets with a low MOID and on high inclination (>10 deg) orbits. The design of a mitigation mission toward these objects could be particularly challenging since the ΔV for these objects is greater than current technological capabilities.

Moreover, our size analysis has pointed out that there seems to be a lack of carbonaceous asteroids going to smaller sizes (D < 300 m). While it is possible that observational selection effects are at play, we suggest that a physical phenomenon could also be responsible for the lack of smaller carbonaceous NEOs [6]. However, more observations of the small NEO population at different wavelength ranges are needed in order to settle the question of what is causing these selection effects.

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References

[1] Ieva, S., Dotto, E., Mazzotta Epifani, E., et al. 2018, accepted in A&A https://doi.org/10.1051/0004-6361/201732154

[2] Izidoro, A., de Souza Torres, K., Winter, O. C., Haghighipour, N., ApJ, 767, 54, 2013

[3] Perna, D., Barucci, M. A., Drube, L., et al. 2015, Planet. Space Sci., 118, 311

[4] Popova, O. P., Jenniskens, P., Emel'yanenko, V., et al. 2013, Science, 342, 1069

[5] Rehan, S. M., Leys, R., & Schwarz, M. P. 2013, PLoS ONE, 8, e76683

[6] Scheeres, D. J. 2018, Icarus, 304, 183