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A comprehensive survey on small NEOs: the NEOShield-2 legacy

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Abstract

Up to now, we have discovered more than 20,000 Near-Earth Objects (NEOs). However, we have physically characterized only a small percentage of them, and the overall majority of the uncharacterized ones belong to the small (D <300 m) NEO population. The investigation of such small-sized NEOs is crucial to constrain the asteroidal contribution to the delivery of prebiotic elements on early Earth; moreover, they poses a major risk in terms of impacts with our planet.

The EU NEOShield-2 project was essential to improve the current knowledge of such population, characterizing more than 300 individual NEOs using complementary techniques (color indexes, spectroscopy, phase curve analysis) and focusing in particular on NEOs with absolute magnitude H > 20. The latest constrain, assuming an average albedo of 0.14, considers objects with an estimated diameter D < 300 m. We will present the latest findings we have obtained analyzing such large comprehensive dataset.

1. Introduction

Near-Earth Objects (NEOs) are a crucial topic in modern planetology, due to the fact that 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 answer fundamental questions about the presence of water and organics on the early Earth, and last but not least, life itself. Recent astrobiological studies invoke comets and NEOs as the main actors of the influx of water and organics on early Earth [1,2].

The study of the physical characteristics of NEOs is also compelling in view of the potential hazard posed to our planet [3,4]. Unfortunately, NEOs show a great variation in terms of mitigation-relevant quantities (size, albedo, composition, etc.) and less than 15% of them has been characterized to date. Their increasing discovery rate (currently 2.000 objects/year) makes the situation progressively worse. There is therefore an urgent need to undertake a comprehensive characterization of 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.

2. Observations and results

In the framework of the EU NEOShield-2 project we obtained BVRIz photometric [5] and visible spectroscopic characterization [6] for more than 300 NEOs. Data were reduced and used to asses the taxonomic class for each object according to the latest taxonomy [7]. We also characterized the opposition effect for 20 NEOs studying their phase curve. Finally, the whole sample of NEOs was analyzed together, in order to establish a robust sample that is statistically strong and ideally not affected from observational biases. This is particularly important for dark and faint NEOs, which are usually underestimated from spectrophotometric surveys.
While an overall majority of silicate S-complex NEOs has been found, in agreement with literature [8], few taxonomical classes show a peculiar distribution in the small "sizes", resulting in an

abundance of A- [9] and D-types [10] respect to larger NEOs. Moreover, the exact contribution of small carbonaceous C-complex bodies to the NEO population is far from being determined. While the presence of an observational bias cannot be easily excluded at this stage, we also suggested some physical explanations.

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References

[1] De Marcellus, P., Meinert, C., Nuevo, M. et al. 2011, APJ Letters, 727, L27

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

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

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

[5] Ieva, S., Dotto, E., Mazzotta Epifani, 2018, A&A, 615, 127

[6] Perna, D., Barucci, M. A., Fulchignoni, M. et al. 2018, P&SS, 157, 82

[7] DeMeo, F., Binzel, R., Silvan, S. et al. 2009, Icarus, 202, 160

[8] Binzel, R., Reddy, V., Dunn, T. 2015 in Asteroids IV, 243

[9] Barucci, M. A., Perna, D., Popescu, M. et al. 2018, MNRAS, 476, 4481

[10] Popescu, M., Perna, D., Barucci, M. A. et al. 2018. MNRAS, 477, 2786