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The "small" NEA population: results of a spectroscopic survey in the framework of the NEOShield-2 project

D. Perna (1,2) and the NEOShield-2 Team
(1) INAF – Osservatorio Astronomico di Roma, Italy, (2) LESIA – Observatoire de Paris, France (davide.perna@oa-roma.inaf.it / davide.perna@obspm.fr)

Abstract

One of the main aims of the NEOShield-2 project, financed in 2015-2017 by the European Commission in the framework of the H2020 program, is to undertake a comprehensive investigation of the physical properties of the "small" near-Earth asteroid (NEA) population. Here we report the results of a visible spectroscopic survey of 137 small (H≥20) NEAs, performed in the framework of NEOShield-2. These data significantly increase the available literature in this size range, and show a peculiar distribution of spectral types for such small NEAs.

1. Introduction

The impacts of small asteroids may have played an important role in the emergence of life on our planet, with the "gentler" delivery of water and organics to the early Earth [e.g., 9]. Moreover, objects in the few-hundred-meter size range might represent the most probable hazard in the near future, with impact frequencies of the order of ~10^3 yrs and sizes large enough to cause extensive damage at regional level in the event of impact [e.g., 7].

In the framework of the NEOShield-2 project, we managed a 30-night Guaranteed Time Observations (GTO) programme at the ESO-NTT telescope (La Silla, Chile). Visible spectroscopic observations were performed between April 2015 and February 2017, using the EFOSC2 instrument, to undertake – for the first time ever – a comprehensive characterization of the surface properties of the small NEA population.

2. Data Analysis

We obtained good quality spectra of 137 NEAs with absolute magnitude H≥20. We classified each spectrum by performing curve matching with the visible part of the classes defined by the Bus-DeMeo taxonomy [4], using the M4AST webtool [10]. Because of the limited spectral range (0.4-0.92 μm) available, we grouped together certain classes into broader complexes (C-complex, S-complex, X-complex). The few data available in the literature for these objects (i.e. 10 objects have NIR spectra and the albedo is known for six of them) confirm our classification.

The distribution of the equivalent diameters of our targets – computed by taking into account the mean albedo [6] of the assigned taxonomic class – is reported in Fig. 1. Twenty-nine NEAs with diameters smaller than 100 m (more than the double of the previous literature for this size range) and 71 with diameters in the range 100-300 m were characterized.

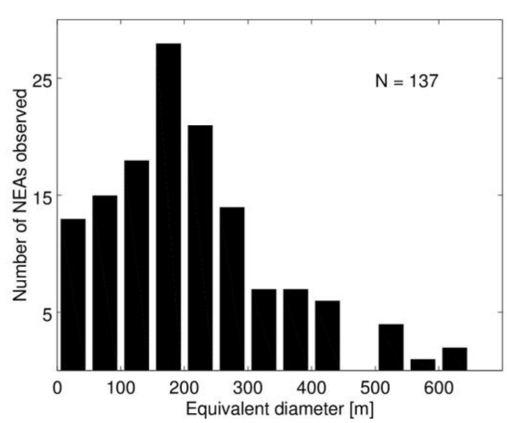

Figure 1: Distribution of the sizes (shown as equivalent diameter) of the observed NEAs.

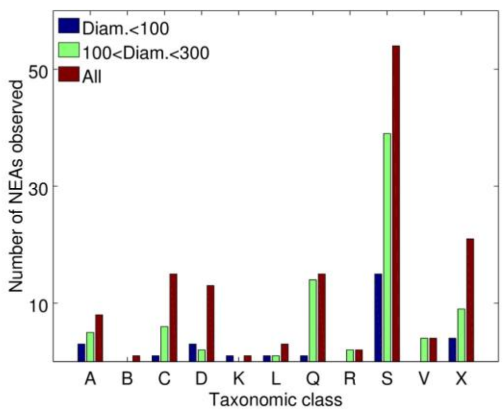

Figure 2: Taxonomical types distribution of the observed NEAs. The distribution of objects smaller than 100 m, and of objects with diameter between 100 m and 300 m, are shown separately.

3. Results and Conclusions

The taxonomic distribution of the observed NEAs is shown in Fig. 2. This distribution is dominated by the S-complex (Sq-, Sr-, Sv- and S-types) at all sizes.

Compared with the literature studies of larger NEAs [e.g.: 2,8], we note the relative abundance within the small NEA population of rare taxonomical types: we found 8 olivine-rich A-types, as well as 13 primitive (organics- and volatiles-rich) D-types.

The large majority of the Q-types we identified (13 out of 14 objects), which are associated to a resurfacing of S-type asteroids during close approaches with terrestrial planets [3,5], have a size larger than 100 meters.

Our observations, spanning solar phase angles in the range 2-92 degrees, allowed us to evidence distinctive phase reddening for different spectral types [1].

Acknowledgements

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References

[1] Barucci, M. A., Perna, D., Belskaya, I., et al.: NEOShield-2 project: Phase effects in NEAs visible spectra, this issue.

[2] Binzel, R. P., Rivkin, A. S., Stuart, J. S., et al.: Observed spectral properties of near-Earth objects: results for population distribution, source regions, and space weathering processes, Icarus, 170, 259 (2004).

[3] Binzel, R. P., Morbidelli, A., Merouane, S., et al.: Earth encounters as the origin of fresh surfaces on near-Earth asteroids, Nature, 463, 331 (2010).

[4] DeMeo, F. E., Binzel, R. P., Slivan, S. M., and Bus, S. J.: An extension of the Bus asteroid taxonomy into the near-infrared, Icarus, 202, 160 (2009).

[5] DeMeo, F. E., Binzel, R. P., and Lockhart, M.: Mars encounters cause fresh surfaces on some near-Earth asteroids, Icarus, 227, 112 (2014).

[6] Mainzer, A., Grav, T., Masiero, J., et al.: NEOWISE Studies of Spectrophotometrically Classified Asteroids: Preliminary Results, ApJ, 741, 90 (2011).

[7] Perna, D., Barucci, M. A., Drube, L., et al.: A global response roadmap to the asteroid impact threat: The NEOShield perspective, P&SS, 118, 311 (2015).

[8] Perna, D., Dotto, E., Ieva, S., et al.: Grasping the Nature of Potentially Hazardous Asteroids, AJ, 151, 11 (2016).

[9] Pierazzo, E. and Chyba, C. F.: Amino acid survival in large cometary impacts, M&PS, 34, 909 (1999).

[10] Popescu, M., Birlan, M., and Nedelcu, D. A.: Modeling of asteroid spectra - M4AST, A&A, 544, A130 (2012).