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NEOShield-2 project: Phase effects in NEA visible spectra

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Abstract

The analysis of about 180 spectral observations of 137 small Near Earth Asteroids, obtained in the framework of the NEOShield-2 project and made in a wide range of phase angles, allows to estimate phase reddening of the visible spectral slope (0.44-0.65 μm) for different asteroid types.

1. Introduction

In the framework of the NEOShield-2 observational campaign, we obtained about 180 new spectra for 137 small NEA objects. A number of 29 asteroids with diameters less than 100 meters and 71 with diameters between 100 m and 300 m were characterized (Perna et al., this issue).

The NEOShield-2 project has been funded by European Commission (2015-2017) in the framework of the EU H2020 program following the first NEOShield (2012-2015) which principal aim was to investigate the most promising mitigation techniques of an asteroid impact risk. One of the main objectives of the NEOShield-2 project is to provide physical and compositional characterization of a large number of NEOs in the hundred-meter size range. An extensive observational campaign involving complementary techniques was undertaken in Europe. Our team at LESIA is the leader of the entire observational program. Priority was given to potential space mission targets, optimized for mitigation or exploration missions

Spectral observations of NEAs are typically made at larger phase angles than main-belt asteroids and need to be corrected for the phase reddening effect before comparison of their spectra. According to [1] the increase in spectral slopes caused by phase reddening can be comparable to space weathering and could lead to an ambiguous taxonomic classification. Up to now our knowledge of phase reddening effect for NEAs is rather limited [2-4]. With our new spectral observations of 180 NEA spectra we make an attempt to estimate phase reddening of the visible spectral slope (0.44-0.65 μm).

2. Observation and results

Our team obtained a GTO program at ESO with an allocation of 30 observing nights at NTT telescope to characterize the composition of the small population of asteroids. Up to now we have obtained 180 spectra of NEOs for 137

objects. The observations were performed with EFOSC2 instrument at NTT telescope in the wide range of phase angles from 2 to 92 deg. We covered the wavelength interval 0.4-0.92, with a resolution of R=~200. We classified each spectrum by performing curve matching with the 25 classes defined by Bus-DeMeo taxonomy.

As a result of the limited spectral range we grouped together certain classes into broader complexes (C-, S-, and X-complex). For all observed objects we calculated the spectral slope in the range of 0.44-0.65 μm and found the phase-angle dependence within the particular type. The largest phase reddening is seen for the A and Q-types (Fig.1). Asteroids of the S-complex also show phase reddening but the data scatter is larger, probably because of less homogeneous composition.

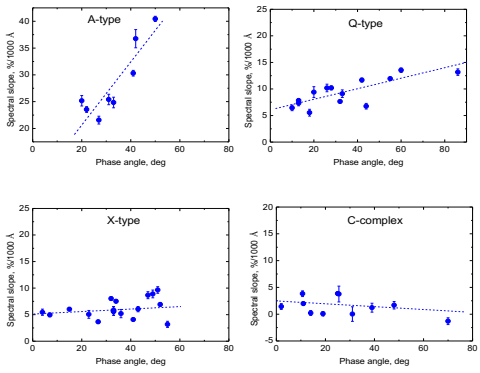

Figure 1: The phase reddening in the visible spectral slope (0.44-0.65 μm) for different asteroid types.

Conversely to silicate rich asteroids, the C-complex do not show phase reddening but hints of spectral blueing at large phase angle.

The dispersions in spectral slopes of the X-type asteroids at large phase angles can be explained by different phase angle behaviours for P, M, E-types.

3. Conclusions

The visible spectral slope of the measured NEAs revealed strong dependence on phase angle. The largest phase reddening is inherent for olivine-rich A and Q-type asteroids. We found a phase blueing for the C-complex asteroids. If blueing effect is confirmed, it will give a way to distinguish low albedo NEAs from the X-complex.

Acknowledgements

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