

ASSESSMENT OF D-TYPE ASTEROIDS ACCESSIBLE FOR A SPACE-MISSION RENDEZVOUS

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Context: In the framework of the NEOShield-2 observational campaign we present new results concerning the D-type asteroids candidates for a sample return mission. These asteroids are believed to be the most primitive ones in the solar system. Their low albedo and the linear featureless reddish spectrum in the 0.45-2.45 microns suggest a content abundant in organics and volatiles, which may hold clues regarding the planetary processes that preceded life on Earth (e.g. [1]).

A sample-return mission to a D-type asteroid will provide a major breakthrough for understanding the early history of the Solar System and the processes that led to the formation of planetary systems [2]. The selection of the candidates is difficult as there are very few asteroids classified as D/T types which satisfy the ΔV requirements: $\Delta V < 7$ km/s for a rendez-vous [3], and $\Delta V < 6$ km/s for a sample-return mission.

Results: We identified new D/T-type mission candidates as a by-product of the NEOShield-2 survey. This program aims to characterize the small near-Earth asteroids (NEAs)[4]. The observations were performed with the EFOSC2 instrument on NTT telescope. Within the 128 observed objects, we found eight D-types and another six T-types NEAs. The classification was made based on Bus-DeMeo taxonomy using the mean square error.

There are four D-type and five T-type asteroids with $\Delta V < 7$ km/s. This sample more than doubles the existing number of D/T types mission candidates (Table 1). Among these, 2009 DL46 (Fig. 1) and (52381) 1993 HA [5] require a ΔV below 5.5 km/s making them the best candidates currently known for a sample-return mission to a D-type primitive asteroid.

We complemented our set using the data existing in the EARN database. We searched for asteroids unambiguously classified as D or T types and with low-albedo (when it was available). Thus, we found another three D-types and two T-types (Table 1).

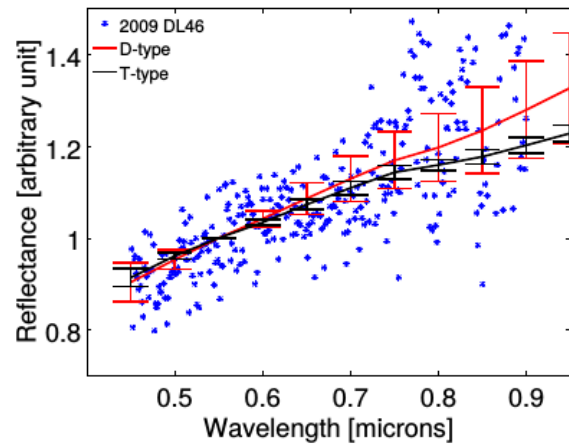


Figure 1. Visible spectrum of 2009 DL46 compared with the D and T templates.

| Object | ΔV | Spec. | Tax. | H |
|------------|------------|-------|------|------|
| 2009 DL46 | 5.080 | v* | D | 22.0 |
| 1993 HA | 5.302 | v*+n* | D | 20.1 |
| 2002 AT4 | 5.548 | v | D | 21.0 |
| 2001 SG286 | 5.604 | v+n | D | 20.8 |
| 2015 LN21 | 6.354 | v* | D | 23.0 |
| 2015 LH14 | 6.863 | v* | D | 20.1 |
| 2009 CV | 4.262 | v* | T | 24.3 |
| 2001 SK162 | 5.568 | v | T/D | 17.8 |
| 2015 TZ237 | 5.634 | v* | T | 24.3 |
| 2001 YE1 | 5.837 | v | T | 20.5 |
| 2015 JJ2 | 6.419 | v*+n | T | 21.9 |
| 2008 JV19 | 6.477 | v* | T | 20.7 |
| 2016 PN38 | 6.607 | v* | T | 21.2 |
| 2005 JE46 | 6.644 | n | X/T | 17.8 |

Table 1. D/T type candidates for a space-mission rendezvous. The spectral interval available is given (v – visible, n–near-infrared). The asterisk (*) shows the data obtained by NEOShield-2 survey.

Acknowledgments: This work was supported by the NEOShield-2 project (European Commission's Horizon 2020 program, contract No. PRO-TEC-2-2014-640351).

References:

- [1] Hiroi T. et al. (2001), Science, 293, pp. 2234-2236; [2] Barucci M. A. et al. (2012), ExA, 33, pp. 645-684; [3] Binzel R. P. et al. (2004), M&PS, 29, p.351-366; [4] Barucci M. A. et al. (2016)

this issue; [5] Perna D. et al. (2016), A&A,
a2016arXiv:1610.00896.