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Visible spectra of near-Earth asteroids obtained with Isaac Newton Telescope: setting up the framework and first results

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ABSTRACT

About 12,000 objects are catalogued today as near-Earth asteroids (NEAs) and this number is increasing thanks to the dedicated surveys. Nevertheless, only for less that 10% of the NEAs sparse physical properties could be found in the literature. This is due to the fact that the small diameters of these objects restrict significantly the suitable geometries for telescopic observation. The suitable observing conditions occur only several times per century, in the case of a close approach to the Earth, when the apparent magnitude decreases by several magnitudes.

The characterization of asteroids surface composition can be made based on visible and near-infrared reflectance spectra. Within the EURONEAR group, we started a program to obtain the visible spectra of NEAs using Isaac Newton Telescope equipped with IDS instrument. The results are used to provide information about surface composition, thus improving the poor statistics of these objects (Fig. 1). A secondary goal is to complement the NIR spectra already obtained by the MIT-MINUS survey (which is the main contributor for NEAs spectral data). Merging visible to NIR spectra allows a comprehensive study of the surface mineralogy.

Our program started in 2014A semester, when we observed for about 30 hours spread in seven sessions. Typically, we covered the 0.45-0.9 µm spectral interval using R150 or R300 gratings in conjunction with RED+2 or EEV10 CCDs. For asteroids that were at brightest magnitudes (<17), R150 allows to cover 0.4 – 1 µm interval (Fig. 2).

We obtained 22 visible asteroid spectra corresponding to 20 NEAs as shown by Table 1. Five of these objects are PHA, eight require a delta-V lower than 7 km/s, and one is on a cometary orbit. Two of the observed asteroids have spectra similar with Vesta, and seven NEAs have spectra which are characteristic for primitive objects. The results are made available via M4AST interface [1].

We developed a planning tool to select the objects for observations. The tool takes into account the limit magnitude of the instrument and the observing geometry. This tool is available online (http://euronear.imcce.fr/tiki-index.php?page=LongPlanning) and can be used for any telescope. From the objects list provided by planning tool, priority was given than to Potentially Hazardous Asteroids and those that require low delta-V budget for a possible space-mission.

We developed an automated pipeline for data reduction. We target to process and to make available the spectral results within a few days of the observations. The spectra are made available to the community using M4AST, which allows also the spectral analysis via the web interface.

Our observing program continue during 2014B and 2015A semester and we hope to transform it in a long term program.

References:

[1] – Popescu, M. et al, A&A, Volume 544, id.A130, 2012

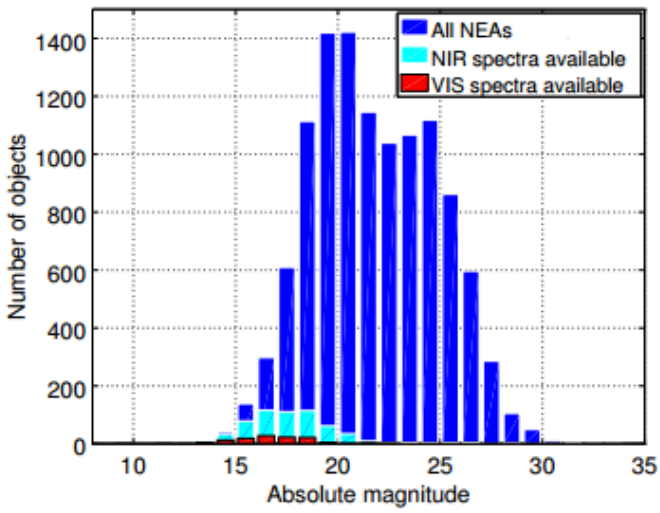

Fig 1. Statistics of existing spectral data for NEAs.

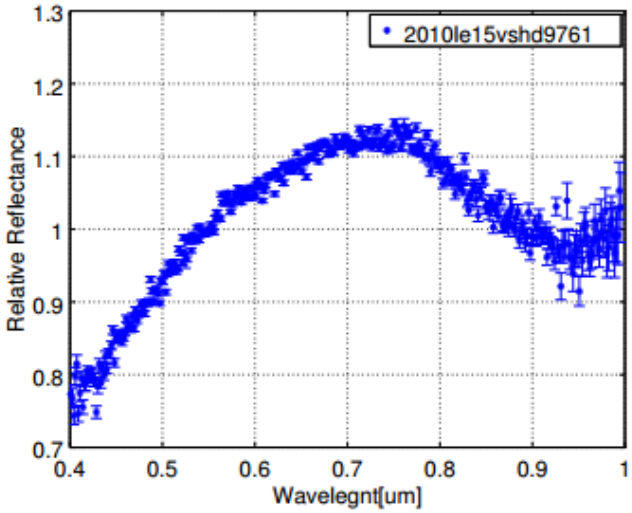

Fig 2. Example of a visible spectra obtained with INT-IDS in the configuration R150V grating and RED+2 camera: the spectrum of the potentially hazardous asteroid (398188) 2010 LE15

Object No.	Object desig.	Orbit Type	Notes	Date[yyyy-mm-dd]	UT	V	Taxonomy
381677	2009 BJ81	Amor	-	2014-02-12	05:15	18.0	Q
-	2009 QF31	Amor	-	2014-02-12	03:50	17.9	Sv
-	2010 SL13	Amor	-	2014-02-12	00:00	17.5	Cg
249595	1997 GH28	Amor	-	2014-02-12	01:10	16.9	B
25916	2001 CP44	Amor	-	2014-02-12	06:10	17.4	Sq
68031	2000 YK29	Amor	-	2014-02-12	02:20	17.1	O,Q
25916	2001 CP44	Amor	-	2014-05-14	04:55	15.1	A, L,Sv,S
16636	2000 NR3	Amor	-	2014-07-18	02:05	17.4	Sr,Sq
391033	2005 TR15	Amor	-	2014-07-18	00:15	17.8	Sv,S,Sr
90075	2002 VU94	Apollo	PHA	2014-07-28	05:22	17.6	Q,O
398188	2010 LE15	Aten	PHA	2014-07-28	04:50	16.5	Sq,Sr
276049	2002 CE26	Apollo	-	2014-08-13	02:55	17.2	Cg/Cgh
285944	2001 RZ11	Amor	-	2014-08-21	00:50	13.1	V
333578	2006 KM103	Apollo	PHA	2014-08-21	01:35	17.0	Sr,Sq,S
68063	2000 YJ66	Amor	-	2014-08-21	04:25	17.5	Q,Sq
-	2013 WT67	Apollo	PHA	2014-09-02	21:05	17.1	Cg
276049	2002 CE26	Apollo	-	2014-09-03	00:15	14.2	C, Ch, Cgh
275611	1999 XX262	Amor	-	2014-09-03	01:00	17.9	B
-	2008 RG1	Apollo	PHA	2014-09-03	01:50	16.9	V
399307	1991 RJ2	Amor	-	2014-09-03	02:30	17.8	X, Xc, Xk
190208	2006 AQ	Amor	-	2014-09-03	03:15	18.1	Cg
-	2008 OB9	Apollo	PHA	2014-09-03	04:45	18.1	Xc, Xk

Table 1. Objects observed with INT IDS. Taxonomic classification was made using M4AST

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