The Physical Properties of the Near Earth Asteroid 2001 SG286

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ABSTRACT

The near-Earth asteroids (NEA) have become important targets for the space exploration because some of them could be easily accessible in terms of ΔV budget. From the scientific point they can provide key information about the early stages of the Solar System, while from the practical point they can serve as in-situ resources.

We aim to make a detailed characterization of the NEA 2001 SG286, which may represent a possible target for a sample-return mission. The estimated delta-V budget for it is 5.6 km/s. The existing spectral data (e.g. Binzel et al. 2004) indicate a peculiar composition, a D-type asteroid. This object is also catalogued as a potentially hazardous asteroid (PHA).

We obtained spectroscopic data using the 10.4m Gran Telescopio Canarias equipped with the OSIRIS spectrograph and photometric observations covering 8 nights during two nearby runs with the 2.5m Isaac Newton Telescope equipped with the Wide Field CCD camera and Sloan R photometric filter.

DATA REDUCTION AND ANALYSIS

The acquired images were calibrated using optimized IRAF scripts.
For photometry data reduction we used the PHOTOMETRYPIPELINE developed by Michael Mommert [4] and the MPO CANOPUS software. The nightly zero points were found to be consistent up to ~0.1 magnitudes.

MPO Canopus was also used for the rotation period analysis, using the FALC (Fourier Analysis of Light Curves) algorithm[3]. The light-curve plot is shown in Figure 2. The "Reduced Magnitude" on the Y axis represents the Sloan r magnitude values that have been corrected from sky magnitudes to unity distance by applying $-5 * \log(rR)$ to the initial measurements, where r is the Earth-asteroid distance and R is the Sun-asteroid distance. The X axis represents the rotational phase [5].

The spectroscopic data reduction followed the standard procedures. This included bias subtraction, flat field correction, extraction of two dimensional spectra to one dimensional spectra and wavelength mapping. The IRAF *apall* package was used. The high quality spectroscopic data enabled us to make a precise taxonomic classification of 2001 SG286.

INT – WFC

We used *The Wide Field Camera* CCD4 mounted on the 2.5m Isaac Newton Telescope with a Sloan R filter for imaging photometry. It has an array of 1821 x 1821 pixels, with a field of view of 10.14 x 10.14 arcminutes at a sampling rate of 0.33 arcseconds per pixel.
The data was captured in two successive observing runs: 5 nights from 7th to 13th of October and 4 nights from 25th to 28th October during the 2020 approach.
The observing strategy consisted in continuous image acquisition during several hours as long as the asteroid is in a favorable position for observation. Depending on the target's apparent magnitude and the general sky conditions, the individual exposures were set between 50-120 seconds long, for a minimum target SNR of 10.

The Wide Field Camera installed on the 2.5m Isaac Newton Telescope

GTC- OSIRIS

The Gran Telescopio Canarias (GTC) equipped with *Optical System for Imaging and low Resolution Integrated Spectroscopy* (OSIRIS) instrument allows to obtain low resolution visible and near-infrared spectra (in the range of 0.5 – 0.95 μm) for targets with an apparent limit magnitude of ~23.
This instrumentation was used to capture a very good quality, high SNR spectrum of our target on October 8th 2020.

The Gran Telescopio Canarias with the OSIRIS instrument

CONCLUSIONS

Our spectrum (Figure 1) indicates that 2001 SG286 is an S-type asteroid according to Bus-DeMeo taxonomy, a result which is not in agreement with the previous reports [1][2].
The rotational period resulted from the photometric observations is about 12.3 hours (Figure 2).
According to the current data, 2001 SG286 appears to be a small diameter slow rotator (Figure 3).

Spectral analysis

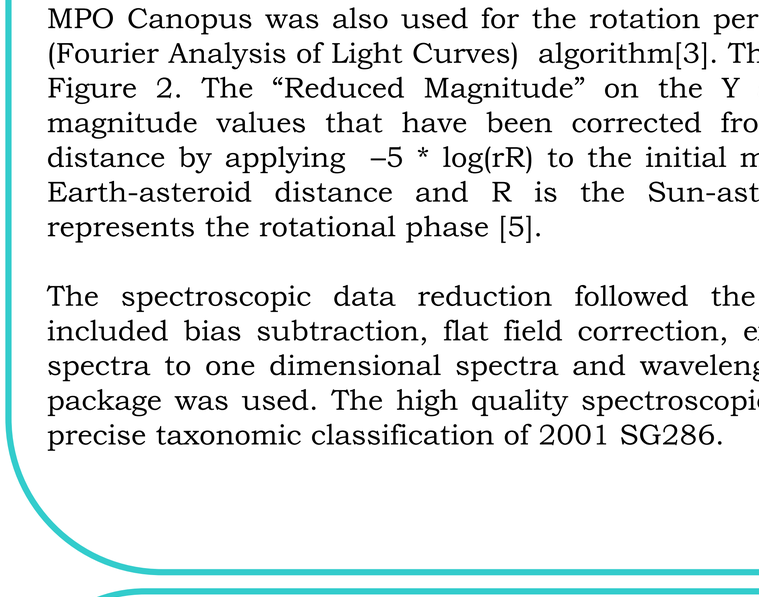

Figure 1 *The spectrum of 2001 SG286 is consistent with an S-type asteroid spectrum according to Bus-DeMeo taxonomy*

Light curve analysis

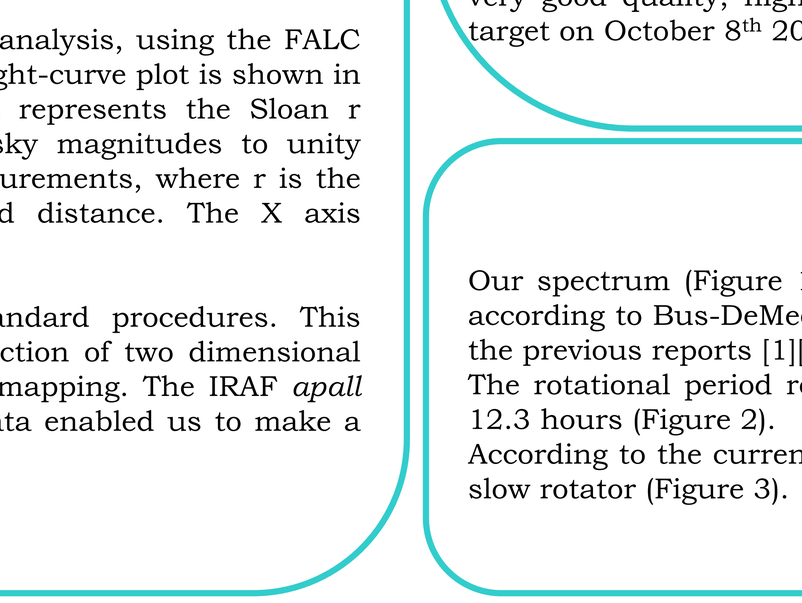

Figure 2 *The light curve of 2001 SG286 indicates a rotation period of 12.3 hours*

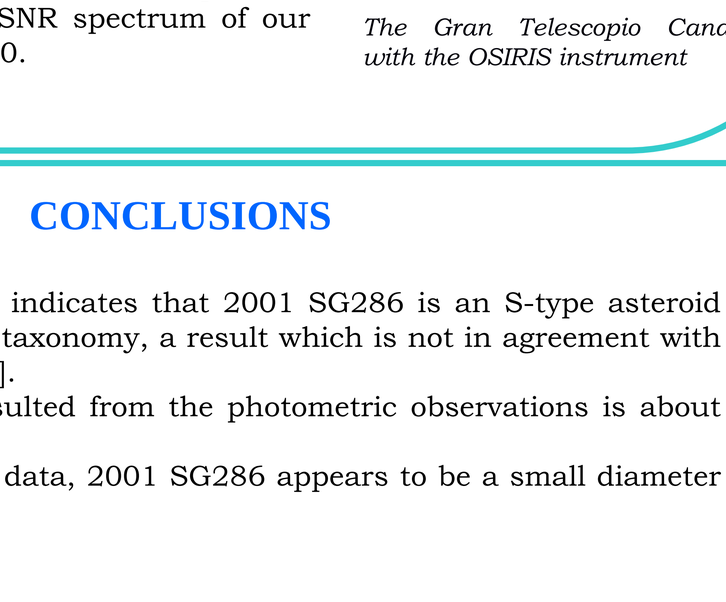

Figure 3 *Plot of asteroids spin rate vs. diameter. The values of 2001 SG286 are shown in blue. The data from LCDB (Asteroid Lightcurve Database, http://www.minorplanet.info/lightcurvedatabase.html) are shown in grey in the background.*

References: [1] Binzel et al., Dynamical and compositional assessment of near-Earth object mission targets, Meteoritics & Planetary Science 39, Nr 3, 351–366 (2004); [2] Popescu, M. et al., Spectral properties of eight near-Earth asteroids, A&A 535, A15 (2011); [3] Harris et al., "Photoelectric Observations of Asteroids 3, 24, 60, 261, and 863." Icarus 77, 171–186 (1989); [4] Mommert, M; Astronomy and Computing, 01/2017;
[5] MPO Canopus and PhotoRed Reference Guide www.bdwpublishing.com/Manuals/Canopus_PhotoRedV10.pdf ;

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