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The latest spectral analysis on asteroids at NAO Rozhen

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Abstract. By virtue of the physical, chemical and dynamical characteristics of asteroids, researchers gain insight into the formation and evolution of our Solar system. Since these objects do not undergo any changes, or the changes during the Solar system evolution are insignificant, we are certain they carry important information regarding the formation of our planetary system and its evolution. Knowing the spectral class of an asteroid is crucial for determining its chemical properties. In our work the spectral classification was done on several asteroids by comparing their spectra with laboratory spectra. We determined spectral types of the asteroids by the overall shapes of the spectra between 450 nm and 700 nm. Increasing the number of asteroids with known rotation period, shapes and spectra enriches the asteroid database of physical and dynamical characteristics of asteroid population.

Keywords. minor planets, asteroids, techniques: spectroscopic, methods: laboratory

1. Introduction

Low dispersion spectroscopic observations of asteroids were taken at Bulgarian National Astronomical Observatory (NAO) Rozhen (Jockers *et al.* (2000)), during a period of 5 years. The first spectroscopic observation of asteroids was taken on 29 December 2013 (Bebekovska *et al.* (2017)), and the latest on 08 January 2019. In this contribution, the difference between the first and the latest results will be discussed.

2. Observations

Depending on asteroid's brightness, for each of the asteroids several images were taken with different exposure times. During the latest observations, we have observed the same solar analog star, as in the first one, (SSAS) HD 28099 and we used it to remove the solar lines in the spectrum. The wavelength interval of our first observations is from 450 nm to 900 nm, but because of the fringing we had to cut at 700 nm. The latest observations, using the new camera on the telescope, give possibility to decrease the fringing at the end of the spectrum, and be able to determine the spectrum through the whole visible wavelength and a small portion in the IR part, from up to 900 nm. The latest results were performed using a new camera Andor's iKon-L936 (13.5 μm pixel pitch).

We determined spectral types of the asteroids by the overall shapes of the spectra between 450 nm and 700 nm. In our spectral analysis we have used public software tool M4AST (Popescu *et al.* (2012)), which covers aspects related to taxonomy, curve

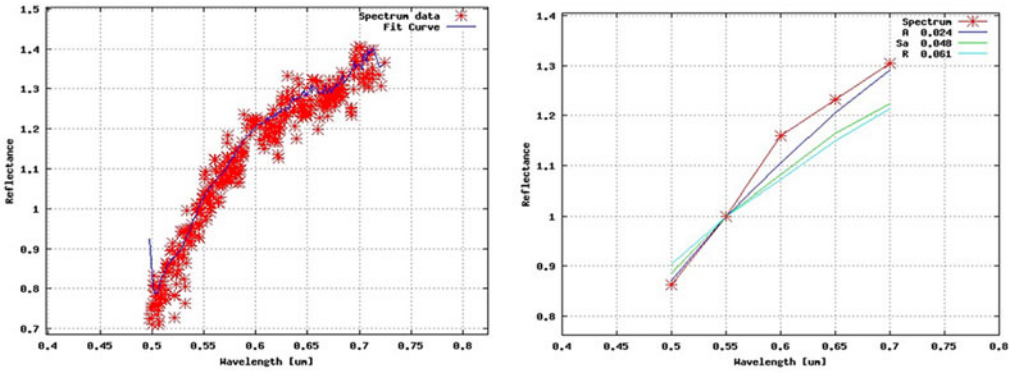

Figure 1. 590 Tomirys is an asteroid from the EOS family with unknown spectral classification. Using observations and spectral analysis we determined the spectral class of 590 Tomyris as A type or probably Sa.

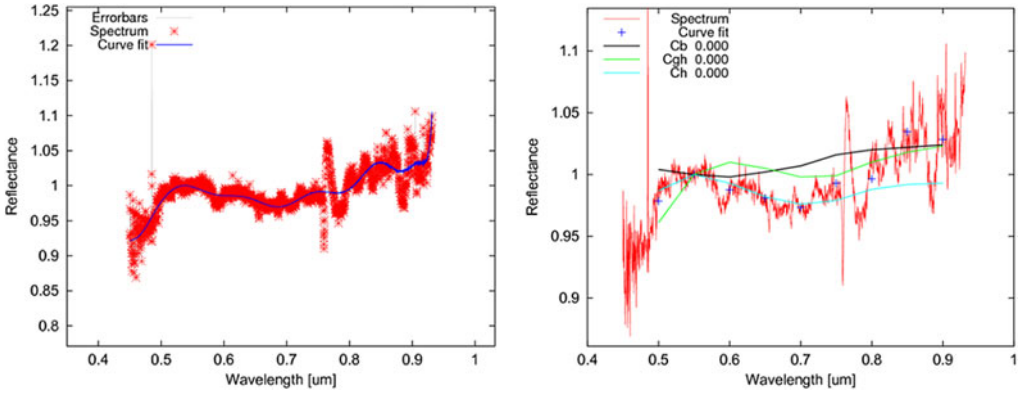

Figure 2. 84 Kilo is a main belt asteroid classified as Ch spectral class.

matching with laboratory spectra, space weathering models, and mineralogical diagnosis. Furthermore, for detailed analysis of the spectrum we have used mineralogical diagnosis with Reflectance Experiment Laboratory RELAB database of NASA. The wavelength calibration of the most recent asteroid spectra was made by measuring the pixel position of the lines in the spectrum of a neon calibration lamp and by fitting them with their laboratory wavelengths. In the process of determining the spectrum of the asteroid we have done several corrections to take into account the background sky, using the spectra along the slit, and extension. Both corrections were applied to the asteroid and to the solar analog star spectrum. The asteroid reflectivity was normalised to unity at 550 nm, in order to find the reflectance of the asteroid and to compare the spectra for different objects.

3. Results

The first spectrum analysis (Figure 1) was done on asteroids from different families with unclassified spectrum, till the moment of observations (Bebekovska *et al.* (2017)). The latest spectral observations of the asteroids were done on asteroids of the main belt with known spectrum, and the primary aim of this observation and data reduction was to confirm the procedure and the method of analysis we are using (Figure 2). The spectral classification was done according to Bus-DeMeo (Bus *et al.* (2012)), where the asteroid spectrum is plotted together with another three best matches standard spectra.

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Our latest spectral analysis confirms the spectral class of 84 Kilo, including the method we are using.

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