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Additional spectra of binary asteroid 1996 FG3, primary target of the ESA MarcoPolo-R mission

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Abstract

Near-Earth asteroid (175706) 1996 FG3 is the primary target of the ESA MarcoPolo-R mission, which has been selected for the assessment study phase of ESA M3 missions. This is a primitive (C--type), binary object, with a fast rotating (3.6h) small primary (1.4 km), and a satellite of about 400m. Previous spectra of this object show significant differences among them [1]. Here we present new visible and near-infrared spectra of the asteroid. The spectra are again different from any of those previously published. We will try to find a plausible explanation for this difference.

1. Observations

Visible and near-infrared spectra were obtained using the 3.5m Telescopio Nazionale Galileo, located in the island of La Palma, in the "El Roque de los Muchachos" Observatory. Visible spectrum of 1996 FG3 was taken using a 2" slit and the LR-R grism (2.61 Å/pixel, 0.50-0.95 μm) of the DOLORES instrument, on the night of January 2, 2012. The resulting spectrum is shown in Fig. 1, compared to the only visible spectrum currently available [2]. Both spectra are normalized to unity at 0.55 μm.

Near-infrared spectrum was taken using NICS and the Amici prism (50 Å/pixel, 0.8-2.5 μm), on the night of 23-24 December 2011. The spectrum is shown in Fig. 2, and compared to the near-infrared spectra obtained by [1], [3], [4], and [5]. All the spectra are normalized to unity at 1.0 μm.

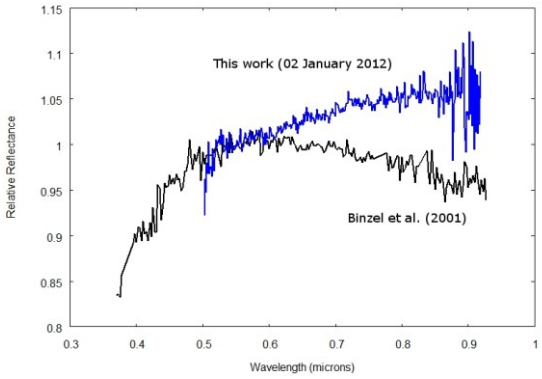

Figure 1. Visible spectrum (blue) presented in this work, compared to the spectrum published by [2]. Both spectra are normalized to unity at 0.55 μm.

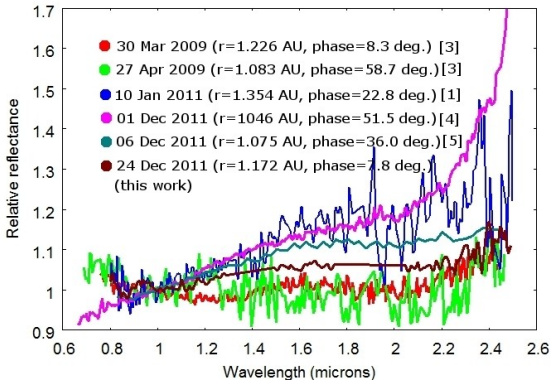

Figure 2. Near-infrared spectra obtained on the night 23-24 December 2011, compared to previously published spectra. The information includes distance to the Sun and solar phase angle at the time of observation.

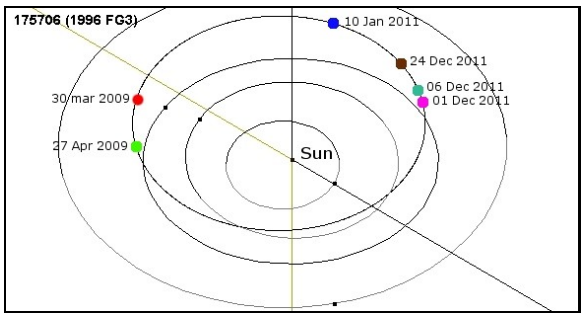

Figure 3. Orbital positions of 1996 FG3 at the moment of acquisition of the near-infrared spectra shown in Fig. 2.

2. Discussion

There is a significant slope variation in the visible spectra of 1996 FG3. This could be caused by the difference in the solar phase angle between the two observations. While the data from [2] was obtained in January 26, 1998, with a phase angle of 3.0 degrees, the visible spectrum presented in this work was taken at a phase angle of 18.0 degrees. In the case of near-infrared spectra, we find also a significant variation in the spectral slope. Looking at the asteroid orbital position at the moment each spectrum was acquired (see Fig. 3), one might be tempted to establish the following correlation: the smaller the distance to the Sun (r), the redder the spectral slope. Our spectrum from December 24 2011 seems to be in agreement with this trend. However, the spectrum from January 10, 2011, obtained at the largest r, does not satisfy this hypothesis, being as red as that from December 1st, 2011.

3. Conclusions

We found a significant variation both in the visible and the near-infrared spectra of binary asteroid 1996 FG3. Apparently, while the change in the spectral slope seems to be originated by the change in the solar phase angle, the variation in the near-infrared spectra cannot be simply explained by means of the phase angle or the asteroid's distance to the Sun. We still do not have a satisfactory explanation. The presence of the secondary might have an important role, so spectral information should be put in common with the rotational lightcurve of this binary asteroid.

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