

## UV-to-NIR spectroscopy of 1996 FG3

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### Abstract

The sample-return MarcoPolo-R space mission has been selected for an assessment study within the ESA Cosmic Vision 2015-2025 timeframe. The main target of the mission is the C-type, binary object, (175706) 1996 FG3. The knowledge of the global surface composition of potential targets of space missions is of course of fundamental importance to maximize the scientific return of the mission, and an observational campaign to study 1996 FG3 has been carried out worldwide. As part of this effort, we observed 1996 FG3 with the X-Shooter instrument (ESO-VLT), which is capable to acquire spectra from the ultra-violet to the near-infrared in a single shot, hence allowing a more reliable compositional analysis of the investigated surfaces. Further visible spectroscopy has been carried out at the TNG telescope. We will present and discuss our results.

### 1. Introduction

The European Space Agency, in the framework of the Cosmic Vision 2015-2025 timeframe, selected the MarcoPolo-R space mission – a sample return mission from a primitive Near Earth Asteroid – for an assessment study, with launch in 2021-2022. The baseline target of MarcoPolo-R is the NEA (175706) 1996 FG3, a primitive (C-type) and binary (hence allowing a direct determination of the mass and the collection of more pristine material if the sampling is performed at the poles) asteroid. The physical characterization of the asteroid targets of space missions is fundamental for the optimization of the mission operations; however, an usual uncertainty when studying the surface composition of the small bodies is due to the combination of different spectral bands acquired at different epochs and therefore at different observational conditions and rotational phases.

### 2. X-Shooter

The X-Shooter spectrograph at the Very Large Telescope of the European Southern Observatory overcame this problem. X-Shooter is in fact at present the only available instrument covering in a single exposure the spectral range from the ultraviolet to the near-infrared. This way, spectra of the small bodies are acquired with the same observational conditions (rotational phase, aspect angle, phase angle, airmass, etc.) over the whole spectral range, allowing a more reliable assessment of the composition of the observed small bodies.

### 3. Observations

As part of a large worldwide observational campaign to investigate the physical properties of 1996 FG3, we observed the target of MarcoPolo-R using the X-Shooter spectrograph in January 2012, to retrieve one complete spectrum (0.3-2.5  $\mu\text{m}$ ) of this primitive object. Further spectroscopic data in the visible range have been acquired in February 2012 at the Telescopio Nazionale Galileo (TNG) using the DOLORES instrument.

### 4. Results

The X-Shooter results show a spectrum of 1996 FG3 quite redder than those in the literature in the visible range, but with a flat behaviour in the near infrared, in agreement with other works. No clear absorptions nor thermal tail are seen in the spectrum. The visible data acquired at TNG seem consistent with the visible part of the X-Shooter spectrum, confirming a spectral variation with respect with previous bluish spectra in the visible for this object. Within the Bus-DeMeo taxonomy, 1996 FG3 results as a primitive body, with X-type as the most likely classification, and T, D, C classes also possible.