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Introduction: The Asteroid Impact & Deflection Assessment (AIDA) collaboration [1], consists of two independent spacecrafts to test, for the first time, the kinetic impactor technique to deflect an asteroid and to study its consequences: the NASA's Double Asteroid Redirection Test (DART) and the ESA's Hera. The DART spacecraft [2] was designed and aimed at impacting the smallest (secondary) of the two objects in a binary system, and to change its trajectory through momentum transfer. Hera, a rendezvous mission, will arrive at the system four years after the impact and study it in detail [3].

The selected target was the binary near-Earth asteroid (65803) Didymos. It is composed of a 780m primary asteroid and a 171m secondary, named Dimorphos [4]. Lightcurve data obtained prior to the impact shows that the primary rotates with a period of 2.259 hours, and that Dimorphos' orbital period around the primary is about 12 hours [5]. Didymos is classified as an S-type asteroid based on visible and near-infrared data [6], which points to a composition similar to those of the most common meteorites found on Earth [7], in particular LL chondrites.

The ESO VLT observational campaign: The impact took place successfully on 26 September 2022, at 23:14 UTC. To monitor the system before, during and after the impact event, and to track changes in its physical properties from ground-based facilities, an observational campaign was coordinated to use, simultaneously, the four units of the ESO 8-m Very Large Telescope (VLT), located at Paranal Observatory (Chile).

In this work we present the results of our spectroscopic observations of Didymos using X-SHOOTER, a multi-wavelength (300-2500 nm), medium resolution spectrograph mounted at the Cassegrain focus of UT3 of the VLT. It consists of three spectroscopic arms, each with optimized optics, dispersive elements, and detectors: UVB (300-559.5 nm), VIS (559.5-1024 nm), and NIR (1024, 2480 nm). Each arm is an independent cross dispersed echelle spectrograph and the set-up is such that it allows the entire spectrum (UVB-VIS-NIR) to be obtained in one shot.

XSHOOTER Observations: We observed Didymos one night before the impact (Sep. 25-26, 2022) and three nights after the impact (Sep. 26-29, 2022). Observations before the impact spanned a total of 4 hours, with spectra acquired every 20 minutes, covering one full rotation of the primary and a full secondary eclipse. On the night of Sep. 26-27, 2022, we acquired the first spectrum about 3.5 hours after the DART impact, collecting a total of 14 spectra during 4 hours of observations. On the following nights, i.e., Sep. 27-28, 2022 and Sep. 28-29, 2022 we obtained two spectra at the beginning of the night (or as soon as the asteroid was above the local horizon, ~03:00 UT) and another two spectra at the end of the night, in order to monitor any changes in the spectra with the evolution of the impact ejecta.

Results: We present a detailed analysis of the observed changes in the spectral slope, both overall and separately on each of the wavelength regions (UVB, VIS, and NIR), as well as in the position and depth of the 1- and 2-μm absorption bands, associated with pyroxene. Particular attention is paid to the data collected during pre-impact, and to any changes potentially caused by the rotation of the primary or due to intrinsic differences of the secondary, that could lead to misinterpretation of the pre/post impact comparison.

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