AFTER DART: spectroscopic characterization of the Didymos system in the aftermath of the DART event

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The NASA Double Asteroid Redirection Test (DART) mission has been approved to be the first demonstration of kinetic impactor as an asteroid hazard mitigation. The DART spacecraft successfully crashed on the secondary member of the Didymos system (Dimorphos) on September 26th 2022 at 23:14 UTC. Hosted as a piggyback and released fifteen days before the DART impact there was also **the Light Italian Cubesat for Imaging of Asteroids (LICIACube)**, a 6U cubesat space mission supported by the Italian Space Agency (ASI). LICIACube with its two scientific cameras (LUKE & LEIA) has testified the impact and characterized the system and the ejecta plume in the aftermath of DART event with an incredible level of detail.

Taking advantage of the unprecedented brightness of Didymos near the DART collision and close approach in 2022 (Vmag=14.7) we decided to characterize the system with spectroscopic ground-based observations at different rotational phases, in analogy to what we performed in the visible in 2021 (Ieva et al. 2022, PSJ 3, 183). New data were particularly needed in the near-infrared, where the only spectrum available in literature showed an unusual shallower spectrum compared to a typical silicate asteroid. In the framework of a large worldwide campaign of characterization we obtained a series of NIR spectra from Telescopio Nazionale Galileo (TNG) with NICS, and a series of complete UVNIR spectra taken at VLT, with X-Shooter.

Using spectra collected during 8 nights between August and November 2022 (Tab. 1) we determine:

- The surface of the Didymos system in the NIR looks mostly homogeneous when comparing spectra taken before and after the DART impact (Fig. 1).
- This similarity is confirmed even when comparing spectra taken at different rotational phases during multiple nights (See Fig. 2).
- Spectra taken in 2022 are also in remarkable agreement with De Leon et al. 2006, taken 18 years in advance.
- Ejecta characterization looks pretty similar to the main body spectroscopy (Fig. 3).
- Laboratory comparisons confirm once again its similarity with L/LL ordinary chondrites.

This could indirectly assess that Dimorphos is roughly similar in composition with respect to Didymos, as suggested by binary formation models (Walsh & Jacobson, Ast. IV, 2015).

Night (UT)	Telescope/ Instrument	Phase angle (°)
4 August 2022	TNG/NICS	21.9
5 August 2022	TNG/NICS	21.7
30 September 2022	TNG/NICS	59.5
24 October 2022	VLT/X-Shooter	76.0
3 November 2022	TNG/NICS	71.6
21 November 2022	TNG/NICS	56.7
22 November 2022	VLT/X-Shooter	55.7
26 November 2022	TNG/NICS	51.5

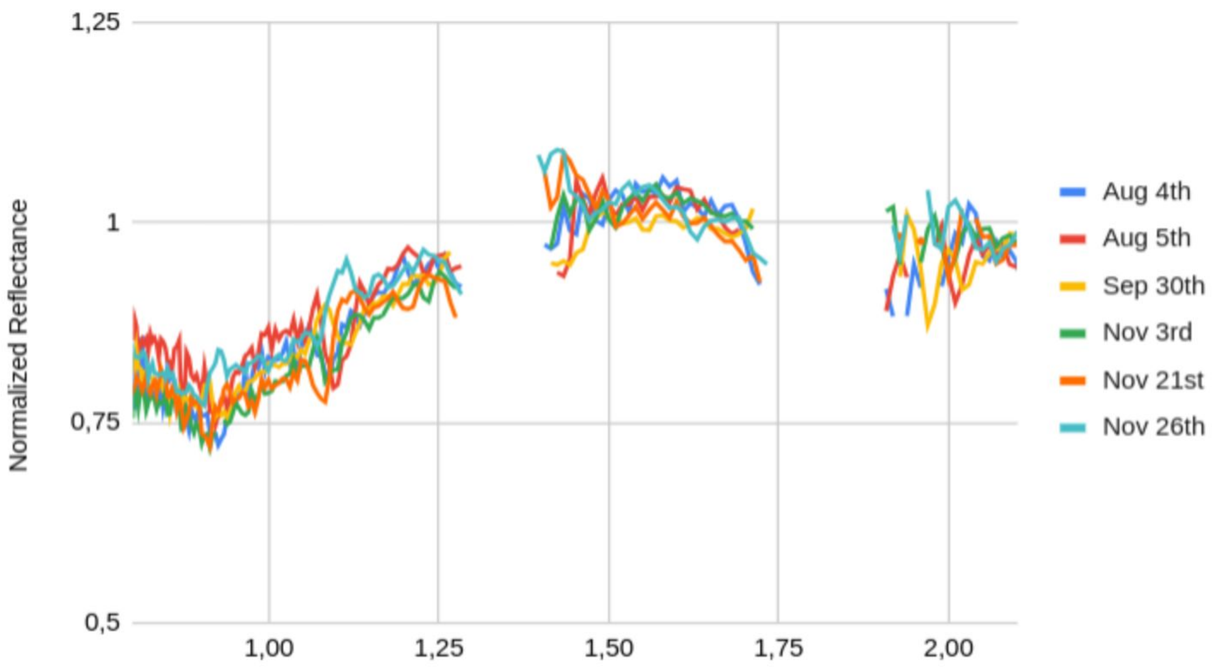
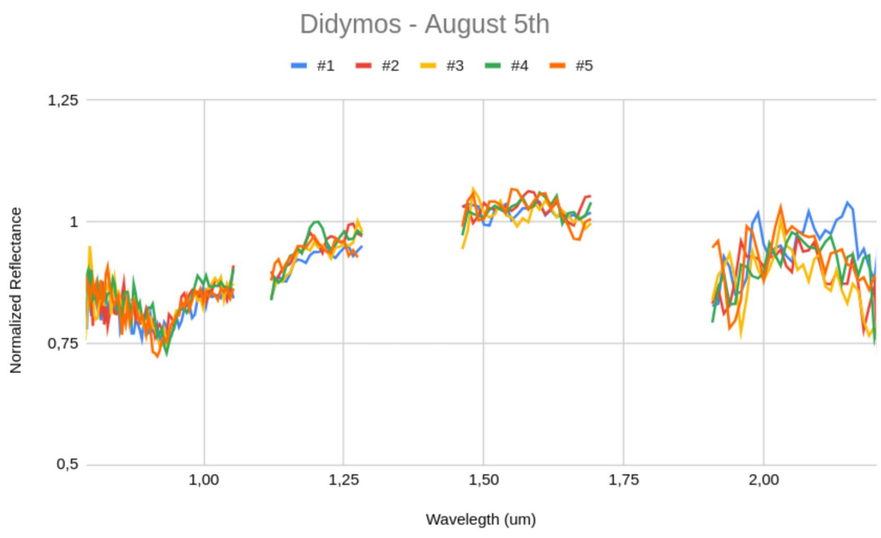
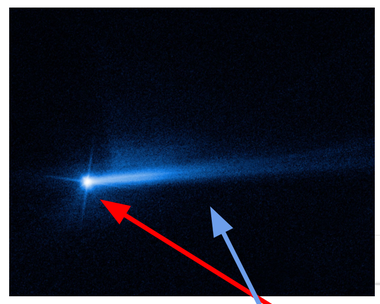


Fig. 1 - The average spectrum obtained from TNG during 6 different nights between Aug-Nov. 2022.





Credits: NASA/ESA/Jian-Yang Li (PSI) /Joe DePasquale (STScI)

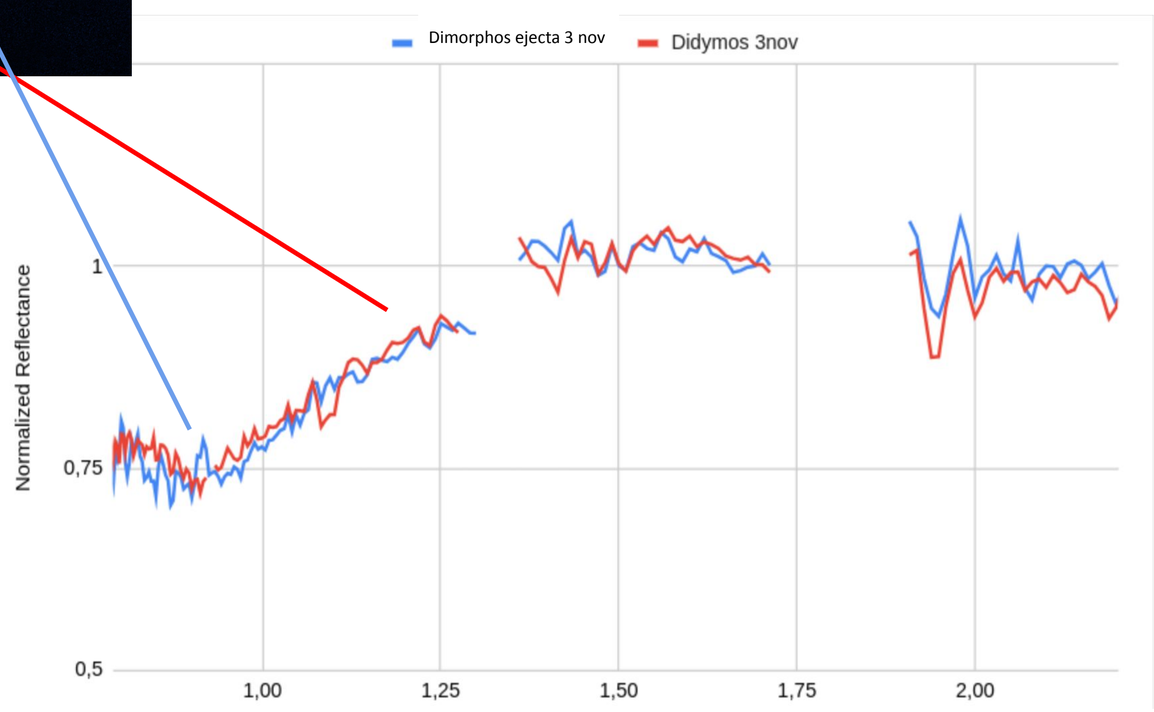


Fig. 3 - Comparison between spectra of the main body and the ejecta tail during the night of November 3rd 2022.

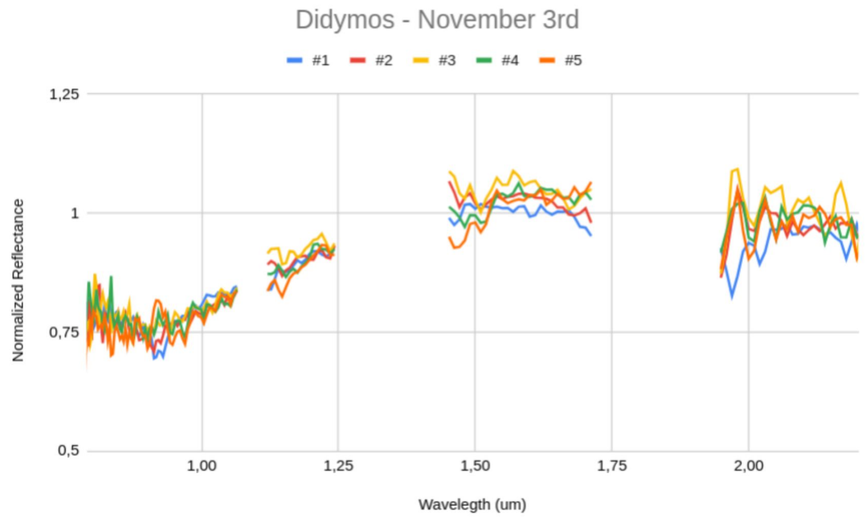


Fig. 2 - Comparison between spectra taken at different rotational phases for the night of Aug. 5 (PRE) and Nov. 3rd (POST-DART impact).

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