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**TOPIC: NEO Characterization**

**The ACROSS network:  
coordinating observation campaigns for occultations by Dydimos**

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**ABSTRACT**

The ACROSS initiative (Asteroid Occultation Research via Occultation Systematic Survey) is a collaboration coordinated by Observatoire de la Côte d'Azur and University of Thessaloniki. It was established with financial support by the European Space Agency, starting by the end of 2021.

The goal of ACROSS is to enable and promote the observation of stellar occultations by small Near Earth Asteroids, and in particular by (65803) Didymos, the target of the DART (NASA) and Hera (ESA) missions. In the case of Didymos, we intend more specifically to secure occultation astrometry at an accuracy level close to Gaia, to detect the heliocentric deviation caused by the DART impact and measure the corresponding *beta* factor.

Stellar occultation events by asteroids 1 km in size and smaller represent a specific challenge due to the extreme astrometric accuracy required to make the prediction reliable. In the case of NEAs the problem is further enhanced by the short event duration (due to the high tangential velocity of the occulting object relative to the observer). In order to succeed, all aspects involved in the process must be optimized and coordinated: the gathering, processing, selection of accurate astrometry; orbit refinement; event prediction and selection; choice of observing site; equipment deployment; occultation data processing.

At the start of our efforts on Didymos, its orbit was far from permitting reasonable deployment of observers (1-sigma uncertainty >30 times the path width). Our first task was to reprocess observations collected by the ground based physical characterization team of the DART and Hera missions, to obtain new astrometry. This data set nearly doubled the available astrometry at beginning of 2022. With the new observation season of Didymos occurring before the DART impact, including

some astrometry from radar ranging, the uncertainty collapsed to a few 100s m, i.e. the order of the target size.

Just before the impact two campaigns were organized by ACROSS in Portugal/Spain/Algeria (32 telescopes deployed) and in the Emirates/Oman (12 telescopes) for two favorable events (on August 25 and September 10, 2022). Both failed to detect the occultation, and were and heavily affected by adverse weather or technical problems, however the negative chords permitted to optimize the orbit solution further. Other early attempts in the USA and Japan had the same results.

At the DART impact, navigation data were exploited by JPL (S. Chesley), thus reaching the best possible accuracy for predictions.

In the meantime, the efforts started to pay off, with 12 positive observations obtained in October and November 2022. Eventually, also the satellite Dimorphos was seen by occultations.

With the present observation season finished at the beginning of 2023, ACROSS will focus on other NEA targets, on secondary targets of the Hera mission, and look forward to new occultations of Didymos coming in summer 2024.