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The Remote Observing Working Group for the Asteroid Impact and Deflection Assessment (AIDA)

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Abstract

The Asteroid Impact and Deflection Assessment (AIDA) mission concept is designed to conduct a kinetic impactor demonstration at the asteroid 65803 Didymos, launching in 2020 and impacting in 2022. Ground-based observations are an integral part of AIDA, as the deflection should be easily visible in lightcurve observations. The AIDA Remote Observations Working Group is conducting observations during the pre-impact apparitions and planning for the impact apparition.

1. Introduction

The Asteroid Impact & Deflection Assessment (AIDA) is a joint ESA-NASA mission concept currently under study [1,2]. AIDA has two components: the Double Asteroid Redirect Test (DART) is the US component designed to demonstrate a kinetic impactor, while the Asteroid Impact Mission (AIM) spacecraft is on station to do a thorough pre- and post-impact survey of the Didymos system.

Members of the DART and AIM Investigation teams have been organized into several joint and independent working groups, including groups addressing the dynamical and physical properties of the Didymos system, modeling the outcome of the impact and fate of the ejecta, proximity operations for AIM, and Earth-based observations of the Didymos system in preparation for, during, and after the 2022 impact. While there is overlap in subject matter and membership between the groups, we focus here on the activities of the Observing Working Group.

2. Purview of Working Group

The Observing Working Group has two overall goals. First, to characterize the Didymos system pre-impact. The interpretability of the impact outcomes are vastly improved as the characterization becomes more detailed. The presence of AIM is of great utility, but data in the pre-launch period provides additional constraints on variations due to "natural" dynamical conditions. Details of the binary orbit, system composition, and pole of the system are primary goals of this period, along with providing other necessary inputs to the other working groups for their efforts. The abstract by Richardson et al. in this volume [3] and a paper by Michel et al. [1] summarize the best current values for the basic properties of the Didymos system, including work by members of this working group.

3. The 2015 and 2017 Apparitions

The first work by the group was undertaken during the spring of 2015, before DART entered Phase A. During this period Didymos made an apparition reaching roughly V~20.5 in brightness, and our top priority was constraining which of two very different pole positions for the Didymos system was correct. Several telescopes in the 2-4m aperture range around the world attempted observations. While smaller telescopes were unable to reach the needed S/N on a short enough cadence, a spate of bad weather at stations with larger telescopes limited good data to an observing run by Moskovitz and Thirouin on the 4.3-m Discovery Channel Telescope at Lowell Observatory in April. An observed mutual event allowed the one pole position to be ruled out. Didymos is now thought to be a low-obliquity,

retrograde rotator, similar to many other asteroid binary systems and consistent with expectations from a YORP-driven origin for the satellite.

We have also undertaken observing during the 2017 apparition, which occurred in the first half of the year. There were four goals for this apparition: 1) Confirming the preferred retrograde pole position, 2) Gathering data to allow BYORP-driven changes in the mutual orbit to potentially be determined by later observations [4], 3) Establishing whether or not the secondary is in synchronous rotation with the primary, 4) Constraining the inclination of the satellite orbit.

At this writing, observations of Didymos have been successfully made from telescopes in Arizona, Chile, Spain, and South Africa. Data reduction and analysis is underway, and an overview of results from the 2017 apparition will be presented along with an initial assessment of priorities for the 2019 apparition and a look toward the 2022 impact apparition.

References: [1] P. Michel et al. (2016) *Adv. Sp. Res. 57*, 2529-2547. [2] Cheng, A. F. et al. (2016) *Plan. Space Sci., 121,* 27-35., [3] Richardson, D. et al. (2016) *LPS XLVII.* [4] McMahon J. W. et al. (2016) *LPS XLVII*, [5] D. Jewitt et al. (2015) *Ap. J., 798,* art #109.