Photometric observations of Didymos in 2003–2017, and outlook for observations in 2019 and beyond

Petr Pravec[1], Petr Scheirich[1], and Didymos observer team[2]

[1] Astronomical Institute AS CR, Ondřejov, Czech Republic
[2] Observatories around the world

contact e-mail: *petr.pravec@asu.cas.cz*

We will review the photometric observations of Didymos that we obtained from 9 stations in 2003, 2015 and 2017. The binary discovery observations taken from 2003-11-20 to -12-04 were of a high quality with the rms residual 0.008 mag, while the further data had rms residuals from 0.012 to 0.034 mag; the latter is a very marginal quality for that mutual events between the binary system components are only $\sim$ 0.05 mag deep. We will present decompositions of the lightcurve data into the primary rotational and the orbital components. We will compare the primary rotational lightcurves with synthetic lightcurves from the preliminary primary shape model by Naidu&Benner, showing a sub-optimal match, and we will discuss possible reasons and implications. We will analyze what observations we will need to obtain in the next two (prior to DART) apparitions around the Didymos oppositions in March 2019 and February 2021. Particularly challenging will be a detection of the secondary's rotational lightcurve, which we need to derive P_s and estimate a_s/b_s, that will probably require high-quality data with errors < 0.008 mag while Didymos will be $V \sim 19.8$ and 18.9 in March 2019 and February 2021, respectively. Finally, we will analyze what we can obtain from photometric observations taken when "dust settles and fog clears" after the DART impact, say, from mid-October 2022 to April 2023, with only minimal constraints from the pre-DART system parameters. We will estimate with what accuracy we will be able to derive a new $P_{\rm orb}$ and P_p by April 2023, assuming only that the primary and orbit poles do not change by more than a couple degrees and that the mutual orbit eccentricity remains < 0.03. In particular, we will NOT assume that the primary's shape and surface albedo distribution remain unchanged after the DART impact; the new $P_{\rm orb}$ and P_p determination will be independent to a considerable degree to the pre-impact system parameters.