**POLARIMETRIC OBSERVATIONS OF THE BINARY ASTEROID 1999 KW4.** Maxime Devogèle[1], Alberto Cellino[2], Galin Borisov[3,4], Philippe Bendjoya[5], David Vernet[6], Jean-Pierre Rivet[5], Petr Pravec[7], Nicholas Moskovitz[1]. [1]Lowell Observatory, 1400 W. Mars Hill Road, Flagstaff, AZ 86001, USA, mdevogele@lowell.edu., [2]INAF – Osservatorio Astrofisico di Torino, Pino Torinese, Italy, [3]Armagh Observatory and Planetarium, Armagh, UK, [4]Institute of Astronomy and National Astronomical Observatory, Bulgaria Academy of Sciences, Sofia, Bulgaria, [5]Université Côte d'Azur, Observatoire de la Côte d'Azur, CNRS, Laboratoire Lagrange UMR7293, Nice, France, [6]Universite Côte d'Azur, Observatoire de la Côte d'Azur, UMR7293 CNRS Laboratoire Optique, Bv de l'Observatoire, Nice, France., [7]Astronomical Institute, Academy of Sciences of the Czech Republic, Ondřejov, Czech Republic.

**Introduction:** The Near-Earth Object 1999 KW4 is a kilometer size body discovered in May 1999 by LINEAR [1]. Radar observations obtained in May 2001 showed that it is a binary system with a primary body of 1.3 km and a secondary (satellite) of 0.5 km [2]. The secondary orbits the primary on a circular 2.5 km orbit with a period of 17.44 hours [3]. The primary display a rotation period of 2.7645 hours while the secondary is tidally locked. The primary body show a top-shaped shape characteristic of fast spinning asteroids close to the disruption spin limit [4] while the secondary body is more elongated (b/a = 0.8 and c/b = 0.75).

In May-June 2019, the 1999 KW4 system, experienced a close fly-by to the Earth. It was the subject of an exercise organized by the NASA Planetary Defense Coordination Office intended to simulate the community's observational response to a real Earth impactor. As part of this large observational campaign we obtained polarimetric observations of 1999 KW4.

**Observations:** We obtained polarimetric observations of 1999 KW4 from May 29 to June 7 2019 using the Torino Polarimeter (ToPol) [5] at the Calern observatory station in the South of France (MPC: 010). ToPol is mounted on the Cassegrain focus of the West 1m telescope from the C2PU (Centre Pédagogique Planète et Univers) facility. The observations spanned solar phase angles from 75.2° to 69.4°.

**Results:** We report here the phase-polarization curve of 1999 KW4. The polarization varies from 6.38 ± 0.06 % to 5.55 ± 0.11% at phase angles from 75.2° to 69.46° respectively (Fig. 1).

Due to the high values and small range of phase angles, it was not possible to derive a reliable polarimetric slope for the positive polarization branch. However, assuming a typical inversion angle of ~20°, we obtain a polarimetric slope of 0.11%/°, which is characteristic of S-complex asteroids [6] and is in accordance with spectral observations, both existing [7] and new obtained during this campaign. Using the polarization/albedo relationship [8] we find that the albedo of 1999 KW4 is 0.19 ± 0.05. This value is in agreement with the 0.18 ± 0.04 value derived by [9].

Based on a linear fit, we corrected the polarization phase curve of 1999 KW4 for the phase angle dependance (Fig. 1). We then phase folded the observations according to the spin period of the primary and the orbital period of the secondary (Fig. 1). Due to the fast rotation of the primary and the long integration time needed to obtain sufficient SNR, no periodic variation of the polarization could be found for the primary body. However, variation of the polarization seems to be correlated with the orbital/spin period of the secondary. Due to the long rotation period of P=17.44 hours, and the short observation window of 1999 KW4, we only obtained a few observations at repeat rotational phases to confirm this correlation, thus it should be viewed as suggestive and not a definitive detection.

If this putative variation is real, it could be interpreted in several ways. First, the primary and secondary bodies might display different polarimetric properties (due to albedo or grain size differences). While the secondary and the primary are rotating, the effective area seen by the observer varies. If the phase-polarization of the two bodies is different this would induce a modulation of the total observed polarization. Second, the surface of the secondary could be inhomogeneous. As the secondary orbits the primary it presents different parts of its surface to the observer introducing a modulation of the total observed polarization.

**Conclusions:** We obtained polarimetric

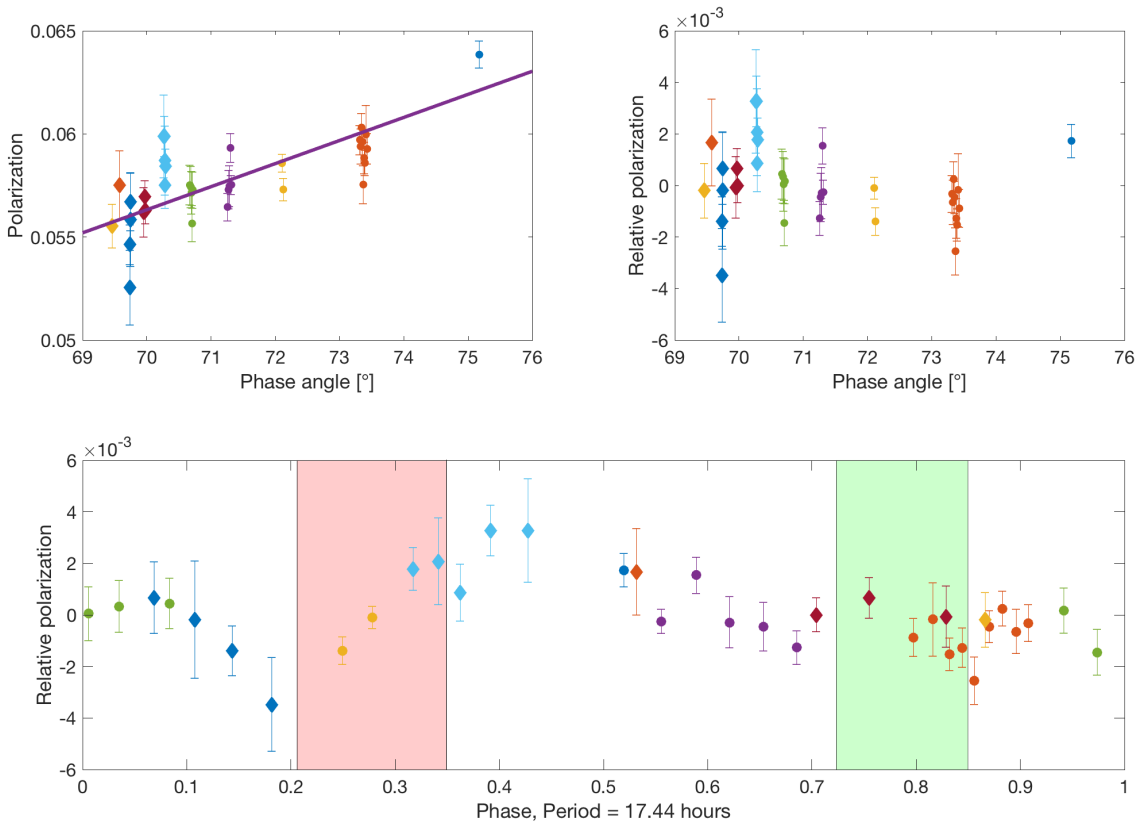


Figure 1. Upper left: Phase-polarization curve of 1999 KW4. The linear fit corresponds to the modeled variation of the polarization as a function of the phase angle considering an inversion angle at 20°. Upper right: Phase-polarization curve corrected for phase angle variation. Lower figure: Polarization corrected for phase and then folded to the orbital/spin period of the secondary. The green and red shaded areas correspond to expected mutual events. For the three figures, each set of symbols/colors corresponds to a different night.

observations of 1999 KW4 using the Torino Polarimeter at the Calern Observatory station from May 29 to June 7, 2019. These observations were part of a large planetary defense campaign for rapid physical characterizations of 1999 KW4. We report a phase-polarization curve characteristic of S-complex asteroids. Variation of the polarization can be detected and seems to be correlated with the spin/revolution period of the secondary. These variations could be explained by either different polarimetric properties (e.g. due to grain size or albedo) of the primary and secondary bodies or by surface inhomogeneities on the secondary body.

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