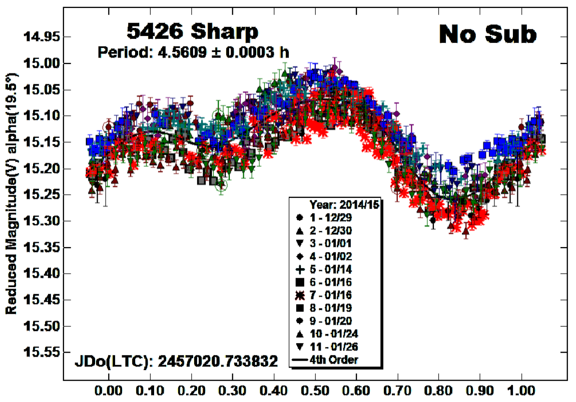
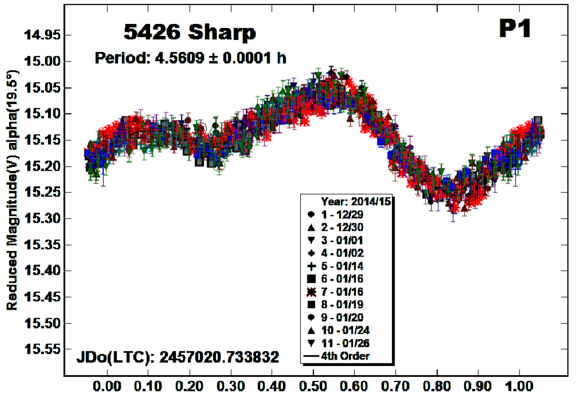
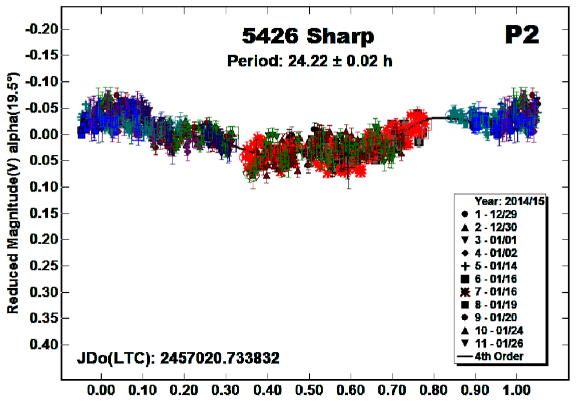
In cases where the initial primary period is not well constrained, some of the alternative periods are used to find the first guess for the secondary period. If this leads to a significantly different result than with the first results, it's an indication that the data set may not be sufficient to find a secure solution. If all initial primary periods lead to about the same secondary period, which then leads to a single primary period, the result is considered as secure as the data set allows.







The "P2" lightcurve shows only a slowly varying amplitude with no significant deviations, which would indicate *mutual events, i.e.,* occultations and/or eclipses. Lacking these, it is not possible to give a size estimate of the satellite and to suggest only that the long period lightcurve represents a satellite that is tidally locked to it orbital period of about 24 hours.

Perhaps future observations will find definitive proof of a satellite. If nothing else, these results strongly recommend a collaboration involving stations located at two widely-separated longitudes. A third station, also well removed from the other two would be better. For example, in this case, having observations from India or Japan would have been a considerable help. Unfortunately, the asteroid was too far north for observers in, for example, Australia or Chile.

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ROTATIONAL PERIOD OF 5685 SANENOBUFUKUI

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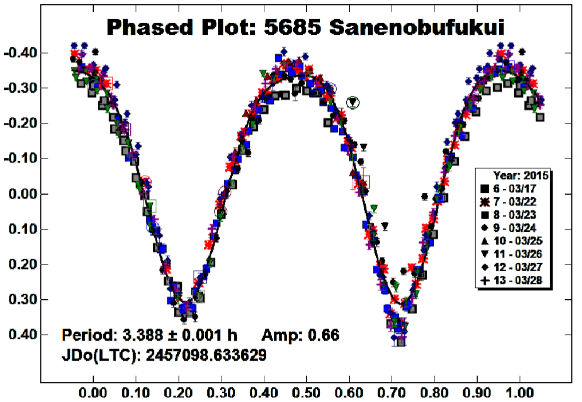
The asteroid 5685 Sanenobufukui was observed over eight nights in 2015 March in order to determine its previously unknown rotational period. Lightcurve analysis yielded a bimodal trend with a period of 3.388 ± 0.001 hours.

The main-belt asteroid 5685 Sanenobufukui, also called 1990 XA, was discovered by T. Nomura and K. Kawanishi at Minami-Oda. It is named after the astronomer Sanenobu Fukui. The orbit of 5685 is characterized by a 4.69 year period, an eccentricity of about

0.09, and a semi-major axis of 2.8 AU (Minor Planet Center, 2015). Additionally, the asteroid has an absolute magnitude of H = 11.6 and currently does not have a measured diameter.

The observations were made at the Etscorn Campus Observatory (ECO, 2015) from 2015 March 17-28. Data were collected using a 0.35-m Schmidt-Cassegrain telescope with an SBIG STL-1001E CCD camera. Image resolution was 1024x1024 with 24-micron pixels, yielding a 22x22 arc minute field-of-view. The telescope was controlled with Software Bisque's *TheSky6* (SB, 2014) and the camera with *CCDsoft* V5 (SB, 2014).

The images were taken with a 5-minute exposure time and were adjusted using a series of darks and flats. The flats were taken using the sky as a background about a half-hour after sunset. These images were then combined into a master flat by using a normalized median tool within *MPO Canopus* version 10.4.1.0 (Warner, 2012). The multiple nights of data were then combined with the FALC algorithm (Harris *et al.*, 1989) within *MPO Canopus* in order to calculate the synodic period.



The resultant lightcurve displays a well-defined, bimodal trend with a period of 3.388 ± 0.001 hours and an amplitude of 0.66 ± 0.07 mag.

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SHAPE MODELS OF ASTEROIDS AS A MISSING INPUT FOR BULK DENSITY DETERMINATIONS

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To determine a meaningful bulk density of an asteroid, both accurate volume and mass estimates are necessary. The volume can be computed by scaling the size of the 3D shape model to fit the disk-resolved images or stellar occultation profiles, which are available in the literature or through collaborations. This work provides a list of asteroids, for which (i) there are already mass estimates with reported uncertainties better than 20% or their mass will be most likely determined in the future from Gaia astrometric observations, and (ii) their 3D shape models are currently unknown. Additional optical lightcurves are necessary to determine the convex shape models of these asteroids. The main aim of this article is to motivate the observers to obtain lightcurves of these asteroids, and thus contribute to their shape model determinations. Moreover, a web page *https://asteroid-obs.oca.eu*, which maintains an up-to-date list of these objects to assure efficiency and to avoid any overlapping efforts, was created.

The motivation for studying density of asteroids is the fact that it belongs to the most important characteristics of asteroids, which is also one of the least constrained. By comparing with densities of meteorites, which can be considered as remnants of collisionally disrupted asteroids that survive entry through the Earth's atmosphere, we can deduce also the nature of asteroid interiors. These physical properties of asteroids reflect the accretional and collisional environment of the early solar system. Moreover, because some asteroids are analogs to the ancient material that formed the terrestrial planets 4.56 Gyr ago, the density and internal structures of minor bodies inform us about the formation conditions and evolution processes of planets and the solar system as a whole.

To determine the bulk density, we need both the mass and the volume of the object. In the following, we briefly describe several methods for asteroid volume estimates, summarize the current knowledge of asteroid densities and masses, and provide a list of asteroids, for which new photometric data need to be obtained in order to derive their shape models.

The most frequent method to determine the size (and volume) of an asteroid is fitting the thermal data observations (typically from IRAS, WISE, and AKARI satellites) by simple thermal models that assume a spherical shape model (e.g., the Near-Earth Asteroid Thermal Model; Harris, 1998). The reported size uncertainties for individual asteroids are usually very small (few percent), however, they are not realistic. Indeed, the uncertainties are dominated by the model systematics – the spherical shape assumption is too crude and also the role of the geometry is neglected (e.g., the spin axis orientation). In the statistical sense, the sizes determined by thermal models are reliable, but could be easily off for individual objects by 10–30%. This implies a volume uncertainty of 30–90%!