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Low-phase-angle photometry of some Themis-family members and other asteroids

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Abstract

Preliminary results are presented of several BAA observing campaigns conducted during 2009-2012 aimed at determining accurate phase curves of some 32 main-belt asteroids belonging to a range of taxonomic families. In particular, five of the objects studied are classed as Themis-family asteroids, namely;

(24) Themis, (62) Erato, (379) Huenna**,**
(996) Hilaritas, (2264) Sabrina

ranging in size from 34-177 km [1], of which (24) Themis is the largest, and has been reported to exhibit spectral features characteristic of H_2O ice on its surface [2,3]. One aim of these studies is to compare the Opposition Effect (OE) of the five Themis-family objects to establish if the presence of H_2O ice alters the OE exhibited by (24) Themis.

1. Observational challenges

Two issues dominate the task of deriving accurate phase curves for asteroids which pass through very low phase angles (viz. <0.2°) at opposition:

(a) *Having sufficient cadence of observations that the true form of the opposition effect can be determined in sufficient detail*. Many asteroids pass through very low phase angle (PhA) within just 1-2 days and so observations from around the world are essential if gaps in coverage are to be avoided. Fortunately in recent years a good number of remotely-controlled telescopes have become available making this task feasible, and many amateurs have joined the various observing campaigns organised by the Asteroids and Remote Planets Section (ARPS) of the BAA enabling a wealth of data to be accumulated.

(b) *Determining the absolute magnitude of a target which continually moves across the sky to an accuracy of ±0.03 mag or better*. This is the primary and most difficult challenge. Most observations were performed using a Johnson V filter, or its equivalent, since this is generally most widely available and is the standard passband for the asteroid H-G system. Initially, suitable photometric star catalogues were limited to Hipparcos and transformation of CMC-14 r' data using J-K colour indices sourced from the 2MASS photometric catalogue. Recently, the AAVSO Photometric All-Sky Survey (APASS) became available with the current Date Release 7 now containing data on more than 50 million objects covering 97% of the sky [4]. APASS will be used for the remaining photometric reductions.

2. Project Neilbone: Some first experiences in low-phase-angle photometry

For the 2009-2010 observing season 14 asteroids were selected of which all but one was observed were imaged at <0.2° PhA. One object, (384) Burdigala was previously thought to rotate with a period of 21.1 hr [5]. Our results prove it is a very slow rotator having a period of 406±6 hr and amplitude of 0.33 mag.

Asteroid (7102) Neilbone, named after the late Neil Bone, former Director of the BAA Meteor Section, was chosen because of its high orbital eccentricity of 0.252 and high inclination of 19°. Some 56 observing runs were carried out by two observers largely with the 2.0-m aperture Faulkes telescopes and SDSS-r' filter using the Sloan Digital Sky Survey as one reference photometric catalogue. The limiting OE, α for (7102) Neilbone was just 0.02±0.01 magnitudes superimposed on an unusually strong linear phase angle dependency of 0.055 mag/deg in SDSS-r' and 0.056 mag/deg in V.

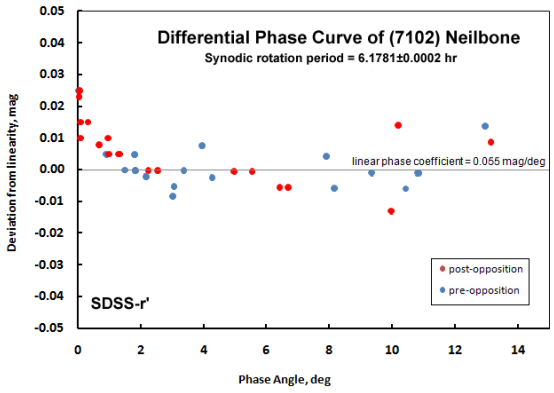

Figure 1: Tiny opposition effect of (7102) Neilbone. N.B. the large phase coefficient, β= 0.055 mag/deg

3. Project Themis: Preliminary results on five Themis-family asteroids

According to Ref. [1], the set of five Themis-family objects studied here exhibit a mean geometric albedo of 0.081±0.009; this remarkably narrow range tends to confirm their common origin. To date, only the images of (24) Themis obtained in 82 observing runs have been fully analysed (see for example Fig.2). The latest results will be presented at the meeting.

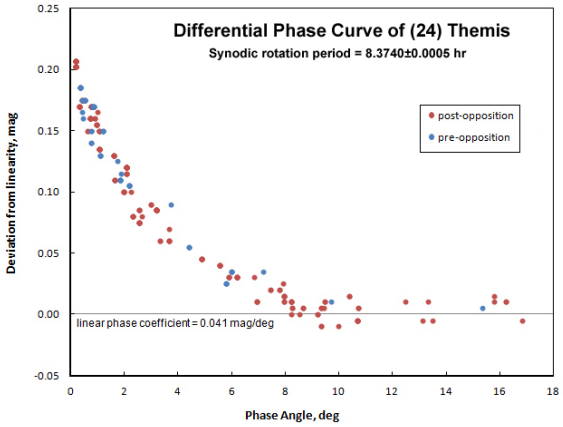

Figure 2: Opposition effect of (24) Themis.

Note that the limiting OE amplitude, α of 0.22±0.02 mag is unusually high for an asteroid of relatively low geometric albedo, 0.084 [1] and may be a consequence of the presence of H_2O ice in the surface regolith.

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References

[1] Asteroid catalog using AKARI (AcuA), http://darts.jaxa.jp/ir/akari/catalogue/AcuA.html, 2013.

[2] Campins, H., Hargrove, K., Pinilla-Alonso, N., Howell, E.S., Kelley, M.S., Licandro, J., Mothé-Diniz, T., Fernández, Y., Ziffer, J.: Water ice and organics on the surface of the asteroid 24 Themis, Nature, Vol. 464, pp. 1320–1321, 2010.

[3] Rivkin, A.S. and Emery, J.P.: Detection of ice and organics on an asteroidal surface, Nature, Vol. 464, pp.1322-1323, 2010.

[4] APASS: The AAVSO Photometric All-Sky Survey, http://www.aavso.org/apass, 2013.

[5] Harris, A.W. and Warner, B.D.: Asteroid Lightcurve Database. Revised 2013 March 1, http://www.minorplanet.info/lightcurvedatabase.html