PHOTOMETRY OF 4 VESTA FROM ITS 2007 APPARITION. L. A. McFadden[1], G. Emerson[2], E. M. Warner[1], U. Onukwubiri[1], J.-Y. Li[1]

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Introduction: Discovered on 29 March 1807 by H. Olbers, Vesta, along with Ceres, Pallas and Juno were thought to be planets for a short while until more and more asteroids were discovered in the latter half of the 1800s. Since its discovery, Vesta has been observed often. Early photometric (visual) observations include those made at Harvard College Observatory (22 observations between 1880-82) and the Observatoire de Toulouse in 1909. Later on photoelectric and photographic techniques were employed. By the 1950s, the lightcurve for Vesta had been observed well enough that a 5.3 hour rotation rate had been determined [1].

In the early years, Vesta's rotation period was in question because its lightcurve represents both its shape and albedo variations on the surface [2].

In late 1994, the first detailed images of Vesta's surface were made using the Hubble Space Telescope's Wide Field and Planetary Camera 2 (WFPC2). A month later, more detailed images were obtained using HST's Faint Object Camera. A set of WFPC2 observations were also made in 1996. HST observations were again made in May 2007 in support of the Dawn mission [3].

Goal: We initiated a dedicated Vesta observing campaign covering the 2007 opposition of Vesta in order to have a complete, precise and accurate photometric study of Vesta for the purposes of calibrating the albedo maps of Vesta acquired by the Hubble Space Telescope, and to plan and calibrate orbital sequences for the Dawn mission which is scheduled to orbit Vesta in April 2011. The long time base-line continuous monitoring provided by the campaign will help us study the change of the shape of the rotational lightcurve from pre-opposition to post-opposition. It will complement the HST mapping observations with a large range of illumination and viewing geometry.

Data: Taken through B, V, R and I filters, our data consists of time resolved, color lightcurves and phase functions.

Hardware. Observations were made with a 20cm, f/4 schmidt-camera using an SBIG ST-10XE which yielded a FOV of about 64x43 arcmin. The observations were collected with an automated system.

Circumstances. Observations were made from early April through June 2007 covering the opposition on 31 May. The magnitude varied from 6.7 to about 5.4 at opposition and the phase angle ranged from 24 degrees down to the minimum at about 3 degrees then back up to 17 degrees, as shown in Fig. 1.

Processing. Data reduction involved bias and dark subtraction and dividing out the flatfield. Using MaximDL, the data was then processed to obtain the differential photometry. The relative uncertainties of these measurements is about 0.02 mag as estimated from the scattering of data points in lightcurves.

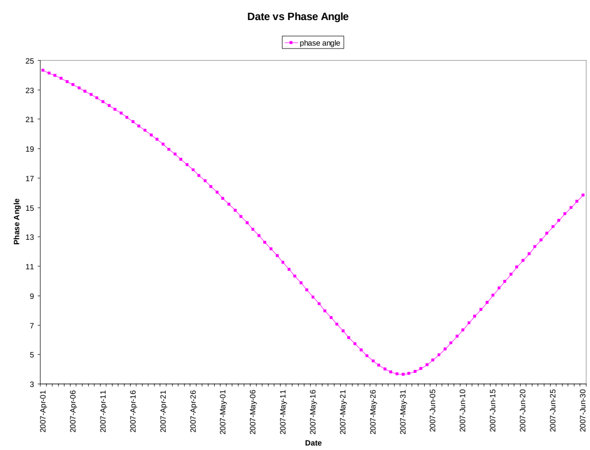

Fig. 1: Phase angle vs date (covering range of observing dates)

Early conclusions: We first looked at the lightcurves of Vesta from these data. Lightcurves from all filters exhibit similar shape (Fig. 2-4), indicating small color variations on Vesta's surface. The shape of the lightcurves change as the observing geometry changes, but the amplitude of the lightcurves remain around 0.1 magnitude with little change. The amplitude is consistent with historical ground-based observations and the most recent HST observations [4]. The lightcurves are single peaked, consistent with an albedo driven origin. Therefore the change of the shape of lightcurve should be caused by albedo features non-uniformly distributed over the surface of Vesta.

In the next step we will compare the shape of lightcurves with historical ground-based observations, such as the Asteroid Photometric Catalog archived in PDS. The lightcurves obtained at similar geometries will be compared.

Finally, we will finish the absolute photometric calibrations for the data from all dates, so that a complete phase function can be constructed. It will be used to compare with historical phase functions, and modeled for photometric parameters.

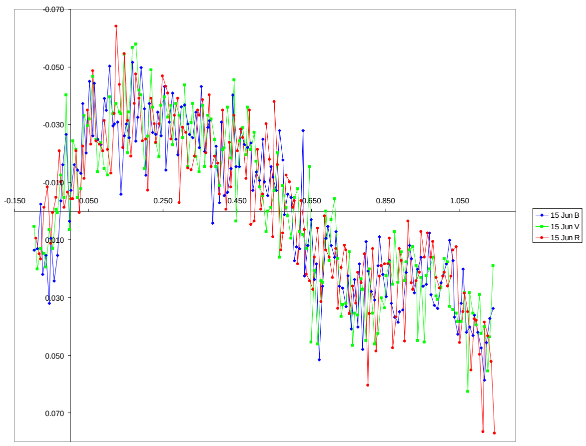

Fig. 2: Lightcurve from 15 June through 3 filters

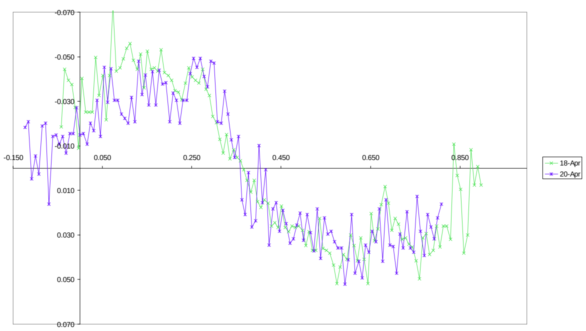

Fig. 3: Pre-opposition lightcurves done on 18 and 20 April through the V filter

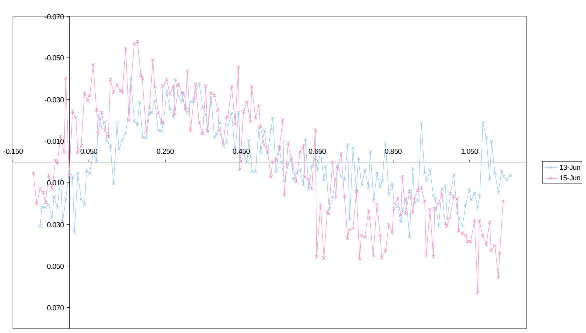

Fig. 4: Post-opposition lightcurves done on 13 and 15 June through the V filter.

References: [1] Stephenson C. B. (1951) *ApJ, 114*, 500. [2] Degewij J. et al. (1977) *Bull. Am. Astron. Soc., 9*, 431. [3] Russel C. T. (2004) *35th COSPAR*, 679. [4] Li, J.-Y. et al. (2008) *39th LPSC.*