Comparative analysis of the absolute magnitudes of asteroids with MPC, Pan-STARRS, and PTF datasets

Vasilij Grigorijevich Shevchenko$^{1,2}$, Olga Ivanovna Mikhalchenko$^{1,2}$, Irina Belskaya$^{1,2}$, Vasilij Chiorny$^1$, Yurij Krugly$^1$, Ivan Slyusarev$^{1,2}$, Tetiana Hromakina$^1$, Anatoliy Dovgopol$^1$, Maria Gritsevich$^3$, Karri Muinonen$^{3,4}$, and Antti Penttilä$^4$

$^1$Institute of Astronomy of V.N. Karazin Kharkiv National University, Kharkiv, Ukraine (shevchenko@astron.kharkov.ua)
$^2$Department of Astronomy and Space Informatics of V. N. Karazin Kharkiv National University, Kharkiv, Ukraine (shevchenko@astron.kharkov.ua)
$^3$Finnish Geospatial Research Institute FGI, Geodeetinrinne 2, FI-02430 Masala, Finland (maria.gritsevich@helsinki.fi)
$^4$Department of Physics, P.O. box 64, FI-00014 University of Helsinki, Finland (antt.i.penttila@helsinki.fi)

At present, the main database of asteroid absolute magnitudes is the Minor Planet Center (MPC). The MPC receives asteroid magnitudes from many observatories in different spectral bands of different photometric systems, but calculates absolute magnitudes for V band of the Johnson photometric system using the HG-function [1]. A comparison of the MPC absolute magnitudes ($H_{\text{MPC}}$) with the dataset of high-quality absolute magnitudes obtained by Pravec et al. [2] revealed systematical differences between these datasets. The new HG$_1$G$_2$ function was recommended by Muinonen et al. [3] to be used for more precise calculating the asteroid absolute magnitudes. This function was calibrated according to good measured magnitude-phase dependences, and the average parameters for major taxonomic classes of asteroids were obtained [4, 5]. Using these average values, it is possible to calculate the absolute magnitudes of asteroids from individual observations at different phase angles. For sparse photometric data, it was suggested to use the two-parameter HG$_{12}$ system [3, 4, 6].

Recently, large-scale survey programs such as Pan-STARRS and Palomar Transient Factory (PTF) [7, 8] performed new observations, within which absolute magnitudes of asteroids have also been derived. Both datasets are homogeneous, but they were obtained mostly in the Sloan system and then transformed to the Johnson system. Comparison of these datasets of absolute magnitudes with the MPC data showed systematical deviations [7, 8]. It should be noted that the absolute magnitudes of asteroids in the Pan-STARRS and PTF surveys [7, 8] were obtained in the new HG$_{12}$ system. In addition, the work is continued to obtain the asteroid absolute magnitudes in the new system for PTF and Pan-STARRS datasets [9]. To check the reliability of these datasets and identify systematic deviations, an independent set of high-quality data on absolute magnitudes is required. Thus, we initiated an observational program to determine the absolute magnitudes of several hundred asteroids. Here we present preliminary results of our program.

For our dataset, we used first the data of the asteroid magnitude-phase dependences collected at the Institute of Astronomy of V. N. Karazin Kharkiv National University [5, 10–12]. We also used observational data of asteroids from our other programs and performed new observations of some asteroids [13–14]. We calculated our absolute magnitude dataset in the Johnson V band with a
correction for lightcurve variations using the HG,H system according to its extension to low-accuracy data [4]. In such manner, we obtained a homogenous dataset of absolute magnitudes of about 300 asteroids in the range from 6.5 to 16 mag. Fig. 1 shows the correlations of the absolute magnitudes from the MPC, Pan-STARRS (Hps), and PTF (Hptf) datasets with those of the Kharkiv dataset (HKh).

Figure 1: Absolute magnitudes of MPC (HmPC), Pan-STARRS (Hps), and PTF (Hptf) vs. those of the Kharkiv dataset (HKh).

We observe a high correlation between our dataset and the other three datasets. There are small differences in the constant terms and slopes that point out some systematical deviations especially for the MPC and the PTF datasets.
Figure 2: Histogram of the absolute magnitude deviations between the Kharkiv and Pan-STARRS datasets.

Figure 3: Histogram of the absolute magnitude deviations between the Kharkiv and MPC datasets.
For the MPC dataset, we found a systematical deviation of about 0.1 mag (Fig. 3). It is less than that obtained in [2] and close to that obtained in [7]. The smallest deviations were found for the Pan-STARRS dataset. This is confirmed by the histogram of absolute magnitude deviations between the Kharkiv and Pan-STARRS datasets presented in Fig. 2. The solid line is a fit to the data using the Gaussian function.

We prepared a preliminary comparative analysis of the asteroid absolute magnitudes between the Kharkiv dataset and the MPC, Pan-STARRS, and PTF datasets. The analysis has shown that the absolute magnitude dataset obtained from the Pan-STARRS survey project is closest to our dataset and can be the most suitable for the determination of diameters or albedos of asteroids.

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References