Application of the Palomar Transient Factory (PTF) project: The opposition effect on Solar System objects

Y. Cheng[1], C. Chang[1], W. Ip[1,2,3], and J. Jhu[1]

[1]Institute of Astronomy, National Central University, Taiwan
[2]Institute of Space Science, National Central University, Taiwan
[3]Space Science Institute, Macau University of Science and Technology, Macau

The Palomar Transient Factory (Law et al. 2009; Rau et al. 2009) is a synoptic surveying project which is designed for discovering time-domain transient events like gamma-ray bursts, supernovae, and other variables. The survey field is specified on some selected area which is covered and can be well calibrated by the SDSS catalog (York et al. 2000). A wide-field camera system is mounted on the Palomar 48-inch Schmidt telescope with about 7.3-deg FOV and using the g', R, and H-alpha filters for this survey. A typical 60-s exposure can reach the limiting magnitude ∼20.6 (5-sigma) under 1" sky conditions (Law et al. 2009). The high-cadence observation area and precise photometric data provide a good opportunity to study a passing asteroid.

The opposition effect can characterize the physical properties of an asteroid's surface and the chemical composition. The two-parameter H,G system (Bowell et al. 1989) is a widely-used method to estimate the absolute brightness of an asteroid. The G value varies depending on the taxonomy so we can roughly identify the surface properties of an asteroid (Lagerkvist and Magnusson 1990). The linear relation between phase (α) and apparent brightness (so-called phase coefficient β) above $\alpha > 7$ degree is also an identifier to estimate the surface reflectance (Belskaya and Shevchenko 2000). In this work, we extract the PTF detections on some specific asteroid family (Hungaria, Hilda, etc.) to analyze the long-term multi-phase variation, and the H,G parameters and phase coefficient (β) to study the behavior of the opposition effect. In our preliminary result, Hungarians have relatively low phase coefficients (β = 0.22, 37 samples) compared to the Hilda population (β = 0.35, 26 samples). The larger β refers to a higher albedo. Our result is corresponding to the WISE albedo survey (Masiero et al. 2011) that Hungarians mostly consist of high-albedo E-type asteroids.

Acknowledgements: This program is supported by National Science Council under NSC 101-2119-M-008-007-MY3.

References: N. M. Law, S. R. Kulkarni, R. G. Dekany, et al., PASP v121 886, 1395–1408, 2009; D. G. York, J. Adelman, J. E. Anderson, et al., AJ v120, 1579, 2000; A. Rau, S. R. Kulkarni, N. M. Law, et al., PASP v121 886, 1334–1351, 2009; E. Bowell, B. Hapke, D. Domingue et al., Asteroids II, Univ. of Arizona Press, 524–556, 1989; C. I. Lagerkvist and P. Magnusson, A&As v86, 119–165, 1990; I. N. Belskaya and V. G. Shevchenko, Icarus v147, 94–105, 2000; J. R. Masiero, A. K. Mainzer, T. Grav, et al., ApJ v 741, 68, 2011.