ASTEROID ROTATION PERIODS FROM THE PALOMAR TRANSIENT FACTORY SURVEY.

D. Polishook[1], O. E. Ofek[2], A. Waszczak[3] and S. R. Kulkarni[3], [1]Massachusetts Institute of Technology (Cambridge MA, davidpol@mit.edu), [2]Weizmann Institute of Science (Rehovot Israel), [3]California Institute of Technology (Pasadena CA).

Introduction: The Palomar Transient Factory (PTF) is a synoptic survey designed to explore the variable sky. We use PTF observations of fields that were observed multiple times per night, for several nights, to find asteroids, construct their lightcurves and measure their rotation periods. Here we briefly present our pipeline and preliminary results from a pilot program. We estimate that implementing our search for all existing high cadence PTF data will be able to establish the rotation periods for thousands of minor planets.

Observations: The PTF is a fully-automated, wide-field survey aimed at a systematic exploration of the optical transient sky [1]. Operating daily, the survey uses 11 4Kx2K CCD array with 7.26 deg^2 field of view assembled on the 1.2-m Oschin Telescope at Palomar Observatory. With an exposure time of 60s the survey reaches a depth of ~21 mag. The PTF survey samples the fields of view in a variety of cadences to match the scientific goals of different programs such as the search for supernova. Here we use fields that were observed with ≈ 20 min cadence.

Method: An automatic pipeline was written [2] and is used on fields with >10 images per night to search for moving sources in different rates. The detected objects are identified using the web service: http://dotastro.org/PyMPC/PyMPC/. For each asteroid we construct the lightcurve using relative photometry methods [3,4] and calibrate the magnitude against the Sloan Digital Sky Survey. The lightcurves are corrected for light-travel time and the rotation periods are found using two-harmonies Fourier series fitting.

Results: Our pilot run included four nights on February 2010. All together, we covered an area of 27.7 deg^2 on the ecliptic and detected 944 asteroids, 230 of them were unknown (~24%). For example, a single field of view is presented in Fig. 1. Asteroids with diameters as small as hundreds of meters are visible. The lightcurves of 131 objects have enough quality to measure their rotation periods (examples in Fig. 2). Limits on the rotation periods derived for another 96 asteroids. Three of the asteroids have lightcurves that are characteristic of binary asteroids.

Conclusion and discussion: The PTF is an efficient survey for studying known, as well as unknown asteroids. Using the entire archive of the PTF we predict our automatic pipeline will find ~10^5 asteroids while thousands of rotation periods will be derived. The PTF data could also be used to find binary asteroids by identifying eclipses or occultations in their lightcurves, extreme cases of fast or slow rotators and tumbling asteroids. The large volume of data is useful for lightcurve inversion methods to construct asteroid shapes and poles of rotation. In addition, dust and gas ejection, caused by cometary activity or by a colilisional event, are searched for in the PTF images [5].

References: [1] Law N. M. et al. (2009) *PASP*, *121*, 1395. [2] Polishook D. et al. (2012) *MNRAS*, in press. [3] Ofek E. O. et al. (2011) *ApJ*, *740*, 65. [4] Ofek E. O. et al. (2012) *PASP*, *124*, 62. [5] Waszczak A. et al. (2011) *CBET*, *2823*, 1.

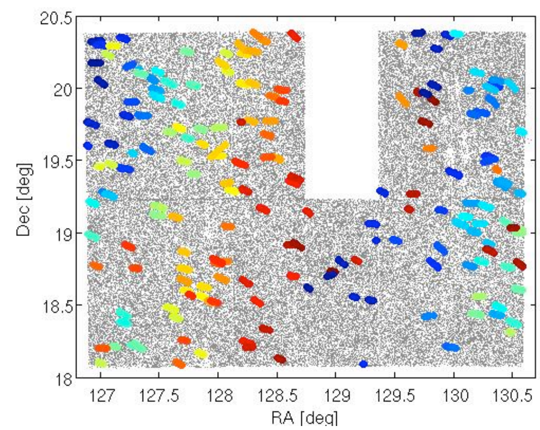

Fig. 1: A single field of view of the PTF. Asteroid tracks (colorful circles) are marked over the background stars (black points). The empty rectangle is a malfunction CCD.

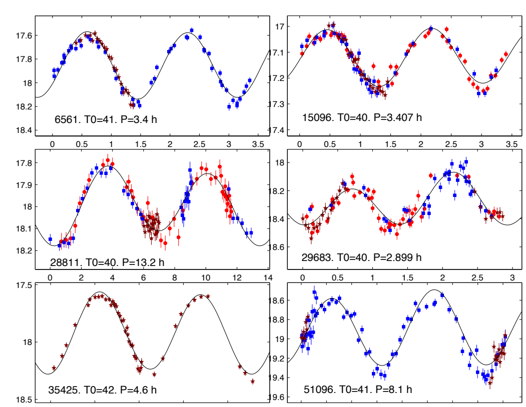

Fig. 2: Six lightcurve examples from the PTF. Different colors represent different observing nights. Epoch=2455200 + T_0. Each subplot contains the asteroid designation, T_0 and rotation period.