Lightcurve-based search for main-belt comets with the PTF survey

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Cometary activity in main-belt asteroids remains poorly-understood but has profound implications for our understanding of solar system formation (e.g., Hsieh & Jewit 2006, Science 312). Two methods to detect activity are (1) morphological, i.e., measuring extendedness on a per-observation basis, and (2) photometric, i.e., measuring intrinsic brightness variation over time. Waszczak et al. (2013, MNRAS 433) described initial results on method (1); we now present progress on method (2). We extracted 7.2 million observations of 395,000 asteroids from 5 years (2009–2014) of Palomar Transient Factory (PTF) survey data (Law et al. 2009, PASP 121; Rau et al. 2009, PASP 121). Of these, we fit 2.2 million observations of 63,000 asteroids to a lightcurve model incorporating rotation with 2nd-order Fourier coefficients and the IAU phase-function parameter G. Each fit includes $\geq$15 observations within a single opposition and filter (92 % r-band, 8 % g-band; multiple fits exist for 4,900 objects seen in multiple oppositions and/or both filters). As a sample, the RMS scatter and reduced χ^2 of our lightcurves are a factor of two smaller than those produced by the fiducial model used by JPL's HORIZONS and the MPC (i.e., no rotational correction and a fixed $G = 0.15$). We describe a statistical search for cometary contributions in the residuals of these lightcurves.