IMPROVED PHOTOMETRY OF COMET TEMPEL 1 FROM THE DEEP IMPACT OBSERVATIONS.

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Introduction: We are currently reanalyzing the Tempel 1 data that were obtained by Deep Impact during its two-month approach phase. Our goals are to improve the precision of our photometry so that the rotation state can be analyzed in more detail, and to look for additional spontaneous outburst events. Results will help support the Stardust NExT mission, retargeted to encounter comet Tempel 1 in 2011.

Preliminary Lightcurve: Deep Impact (DI) monitored comet Tempel 1 for two months before its July 4, 2005 encounter. The Medium Resolution Instrument (MRI) obtained thousands of images, which were used to measure the comet's brightness variations in the days before encounter. Analysis of the lightcurve showed rotational variations with period of 1.701 day (Fig 1). Although this is a highly precise measurement, it is not consistent with a value of 1.713 day obtained from HST/Spitzer observations spanning a 40-day baseline in 2004 (Fig 2). The discrepancy suggests that the nucleus changed its rotation rate during the 15-month interval between the two measurements.

This result has important implications regarding the dynamics and activity of cometary nuclei. Furthermore, one of the goals of the Stardust NExT mission is to evaluate the changes in the comet from one orbit to the next, and the rotation state must be well-understood to improve the chances of reimaging part of the nucleus seen by DI.

Improved photometry:. We are returning to the data set to address some minor issues that, in the interest of producing a timely result, were neglected during the initial analysis, These corrections will reduce the amount of scatter and allow additional data, over a longer time baseline, to be included in the lightcurve. With these improvements a more detailed analysis of the rotation state can be performed, including an investigation into changes that may be occurring during the two-month monitoring period. It will also improve our ability to detect spontaneous outbursts in the lightcurve.

Issues that are being addressed include: 1) accounting for the effects of pixel rows being 1/6-pixel narrower at the horizontal boundary between the CCD quadrants; 2) removal of electronic noise (few DN) that produces a horizontal striping in the image; 3) a programming error that affected some centering determinations; and 4) resolution of a discrepancy between the science and navigation measurements obtained using different "clear" filters.

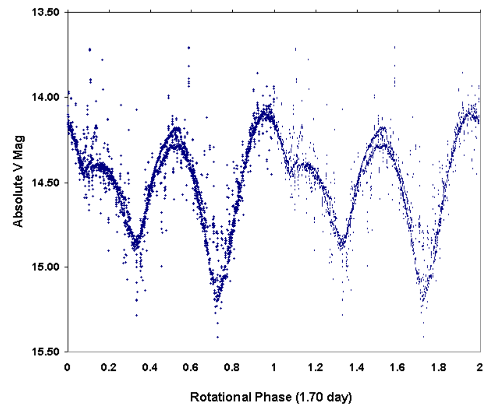

Figure 1. Lightcurve obtained from the DI observations, phased to a rotation period of 1.701 day.

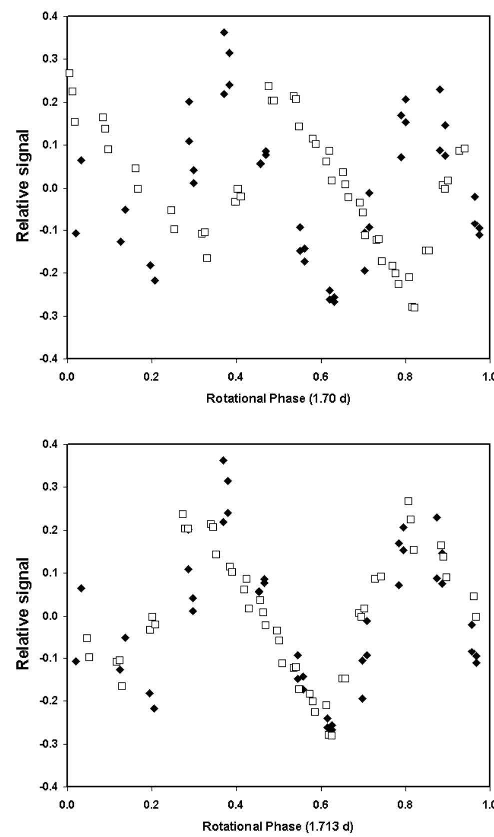

Figure 2. Spitzer (filled diamonds) and HST (open squares) observations obtained ~40 days apart in 2004. The top panel shows that the data are not consistent with the DI period obtained 15 months later. The phasing in the bottom panel indicates the rotation period was 20 minutes longer in 2004 than in 2005.