Lightcurve Photometry and Analysis on CCD Images of Asteroids and Comets

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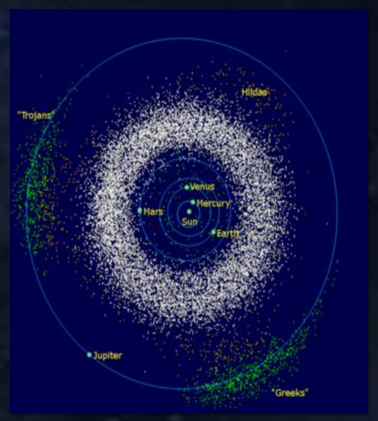
Why study Space Rocks?

A current hypothesis suggests the sporadic meteoroid background was produced by cometary breakups, rather than sublimation of ice and dust from comet surfaces. It is possible to verify this hypothesis by monitoring active comets for increases in magnitude, which are the indicators of unusual activity or disruptions.



Since NASA's new direction also includes a human mission to a Near Earth Object (asteroid), it is important to establish a resource pipeline of data.

Photometry Primer

Lightcurve photometry is the process of measuring the variations in brightness (magnitude or flux versus time) of a specific object, such as a comet or asteroid.

Lightcurve analysis of comets and asteroids can reveal many traits including rotation rate, rotation axis, shape, and composition (when imaged in multiple colors).

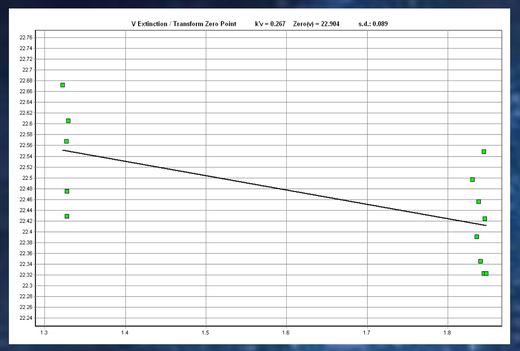
Methodology

We utilized the software tools of MPO Canopus and MPO PhotoRed to find transforms, first and second order extinctions, and generate lightcurve data for several targets, imaged with the .5 meter RCOS telescope at New Mexico Skies observatory.

Targeting Rocks in Space

One of our primary targets was the asteroid 21 Lutetia, chosen as an excellent calibration model thanks to the wealth of data collected from the Keck telescope and the Rosetta mission.

Determining filter transforms

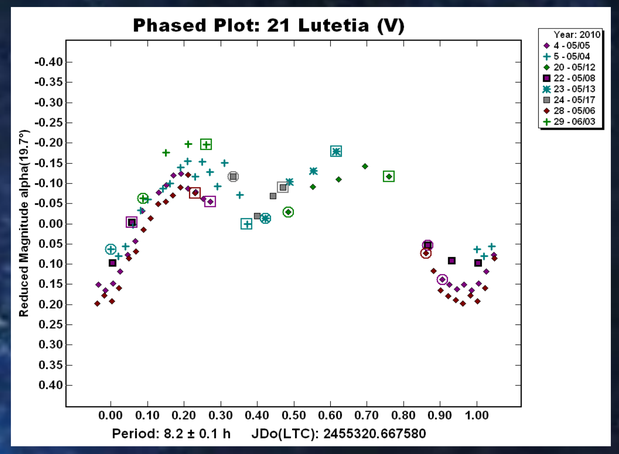


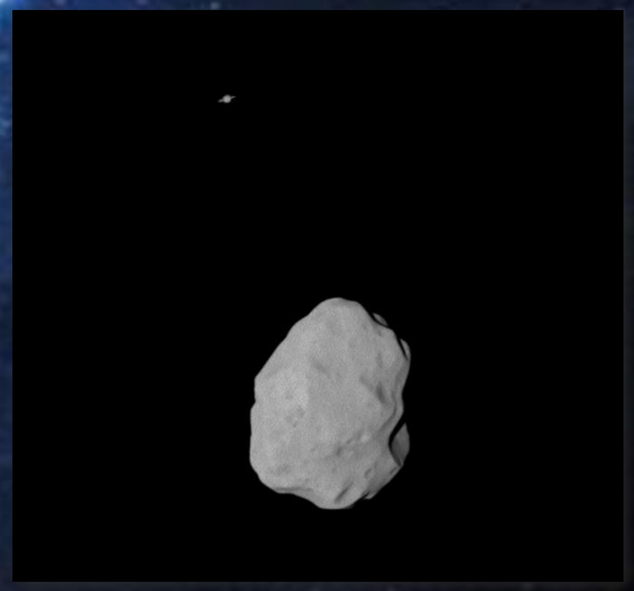
V Filter Extinction / Transform Zero Point plot based on Landolt Standard fields (SA 100 and SA 101)

Results

Using MPO Canopus, a lightcurve of asteroid 21 Lutetia was constructed. From the lightcurve plot of 21 Lutetia, we were able to ascertain:

- A period of roughly 8.2 h, in correspondence with actual period measurements (8.168 h).
- An amplitude (averaged) of roughly .26 m, agreeing with the established lightcurve amplitude ($0.^{m}25$).





Asteroid 21 Lutetia

ESA

Results (continued)

Early on, we discovered a problem with our Apogee camera.

This surface residual image (SRI) or 'ghosting' effect was caused by oversaturation, or charge being trapped in the CCD chip, then bleeding from one image to the next. These SRIs negatively affect photometric measurements.

After several attempts to fix the problem, we swapped our camera out with an SBIG ST-10XME and set the autofocus procedure on a dimmer star. This eliminated most SRIs from the field.

Conclusion

Through our analysis of 21 Lutetia and several other asteroids and comets, we have established a data pipeline for the NASA Meteoroid Environment Office.

Our pipeline has the potential to increase the body of knowledge for these objects, and could prove useful in target selection for future NASA missions.

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