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Developing algorithms for Phase Curve analysis

USING DP03 SIMULATED DATA

in the LSST era

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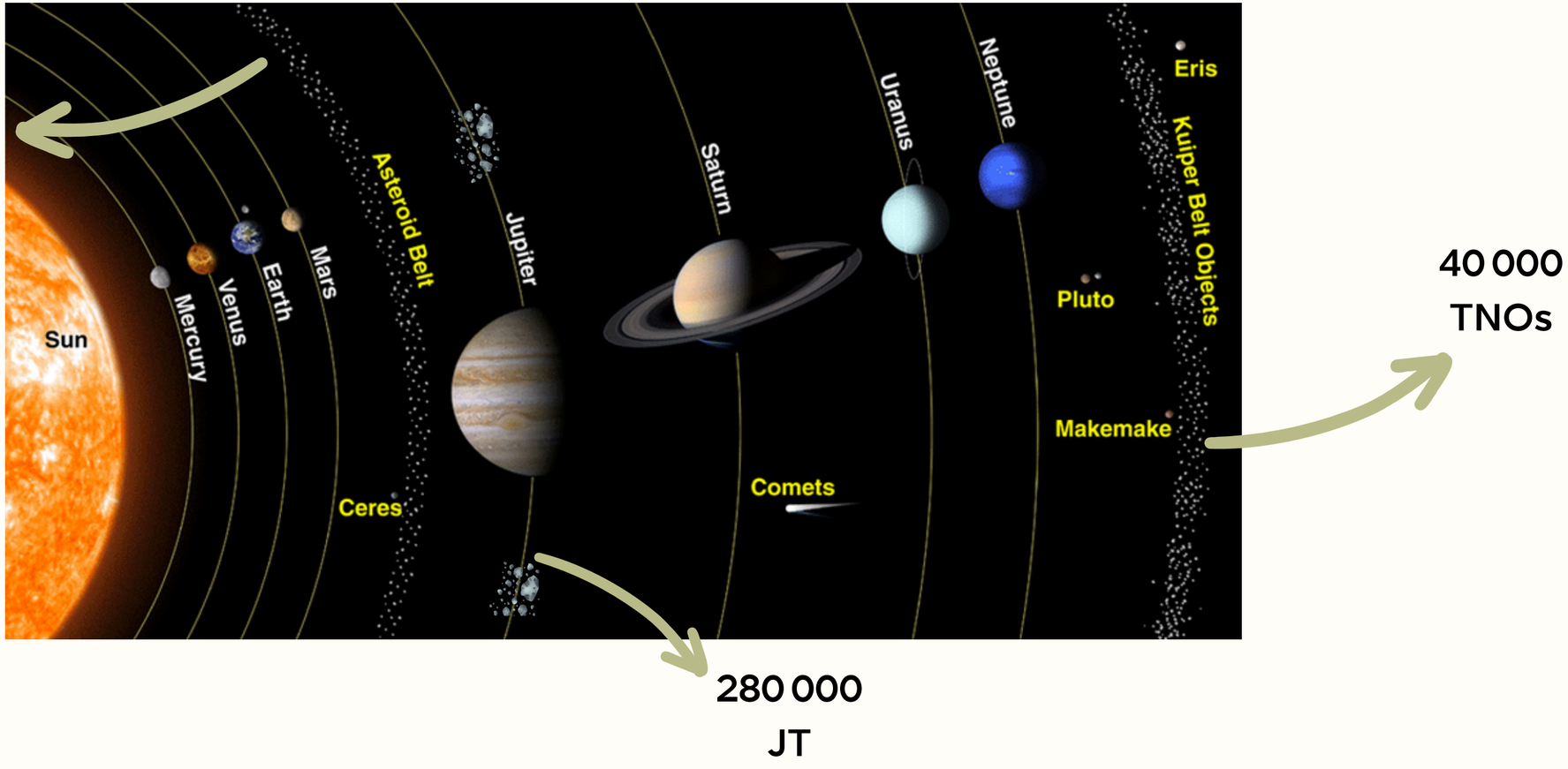
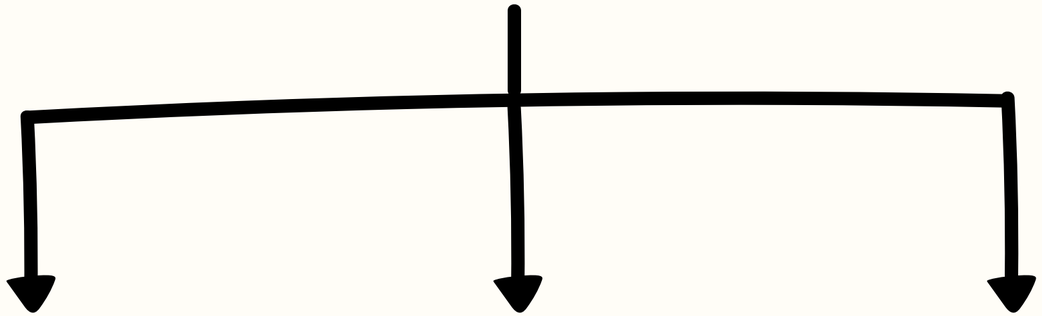
The Vera C. Rubin Observatory Legacy Survey of Space and Time (LSST) will discover 6 million solar system planetesimals, providing over a billion photometric and astrometric measurements in 6 broad-band filters (Schwamb et al., 2021).



The Data Previews



DP0

simulated data generated by the Dark Energy Science Collaboration

DP0.2

simulated LSST-lik data products containing extragalactic and galactic objects.

DP0.3

only contains simulated Solar System objects, and is completely independent of the simulated DP0.2.

MPCORB

MPC-style information for injected solar system objects

DiaSource

Astrometric and photometric measurements

SSSource

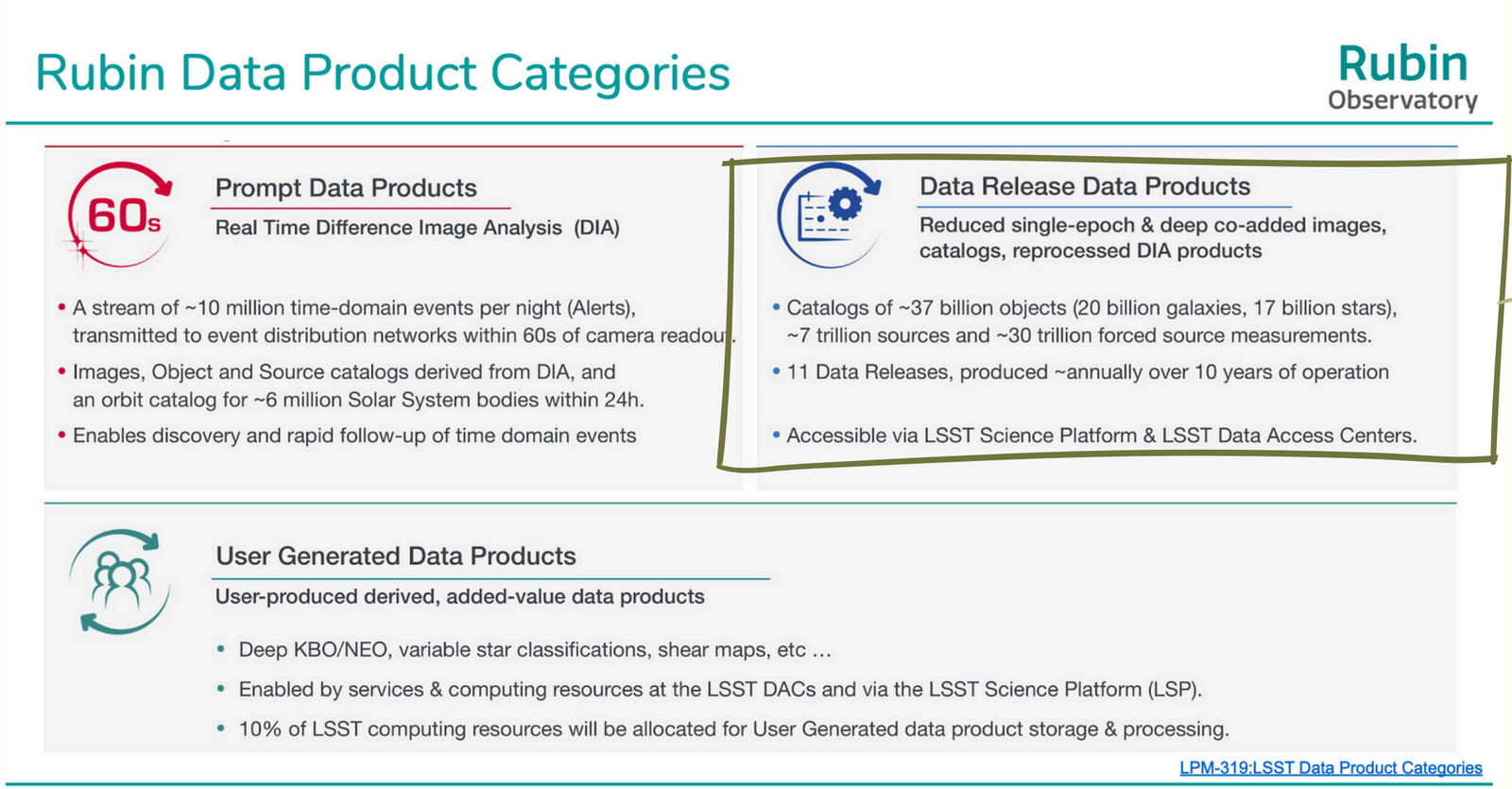
2-d (sky) coordinates and 3-d distances and velocities

SSObject

Measured properties such as absolute magnitudes

We have all the information in <u>one</u> place!!

The Data Products

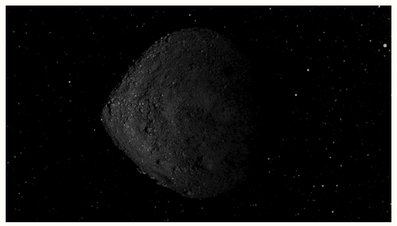


Data Release
End 2026

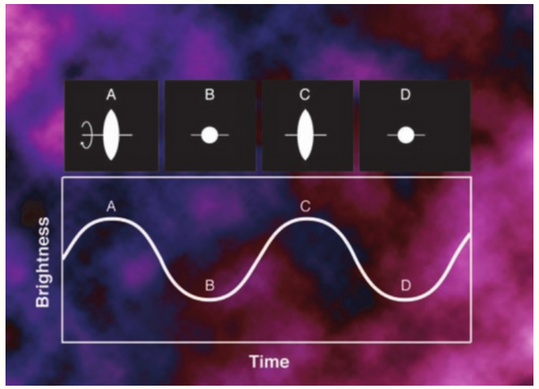
Research Focus

Asteroid phase curves

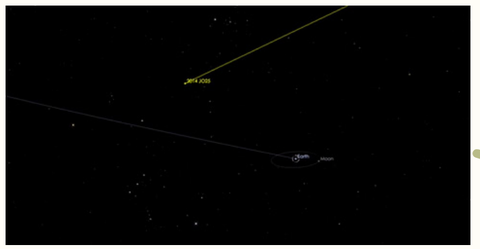
Rotation



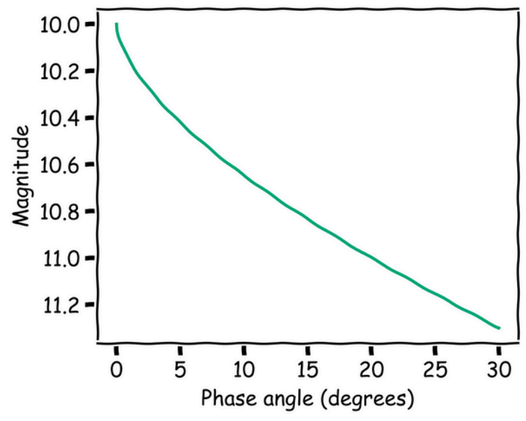
Light curves



Orbital motion



Phase curves

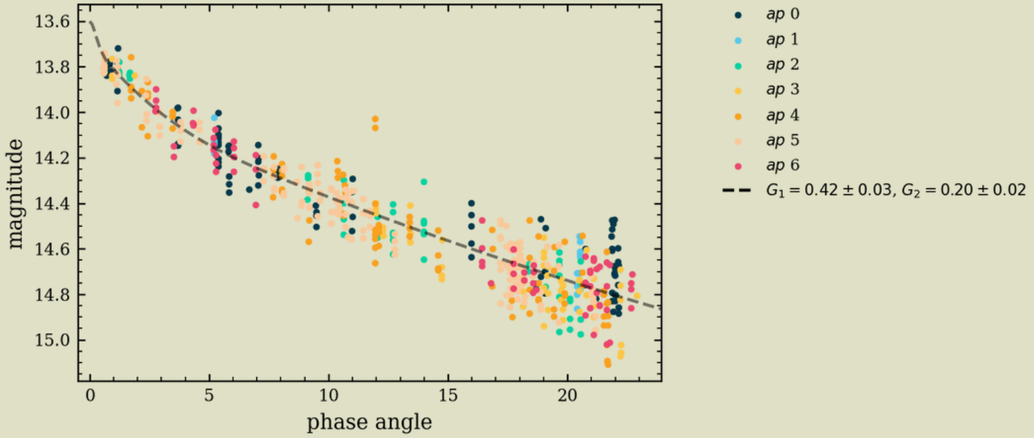


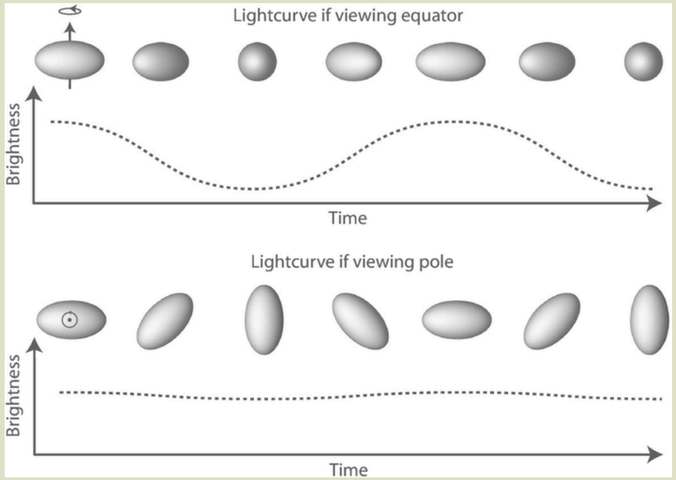
Already done

ATLAS data version 2

Phase curve fitting codes for very big databases

$$10^{-0.4V(\alpha)} = \sum_{i=1}^{N} 10^{-0.4H_i} \left[G_1\phi_1(\alpha) + G_2\phi_2(\alpha) + (1 - G_1 - G_2)\phi_3(\alpha)\right]$$





Shepard, Michael K. 2017.

Research Focus

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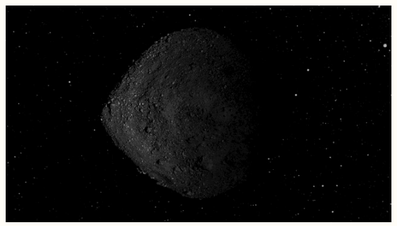
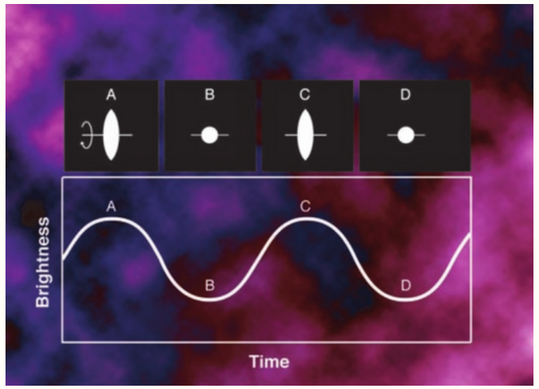
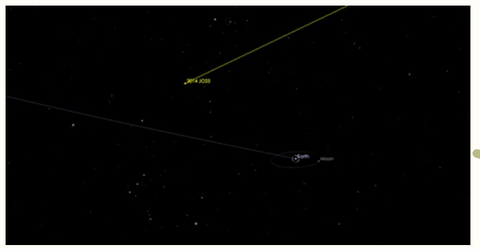
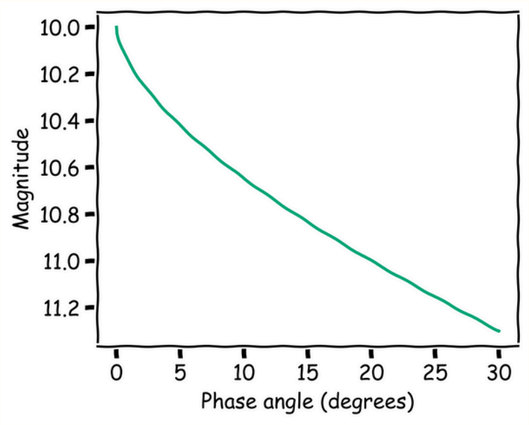


Light curves



Orbital motion





Already done

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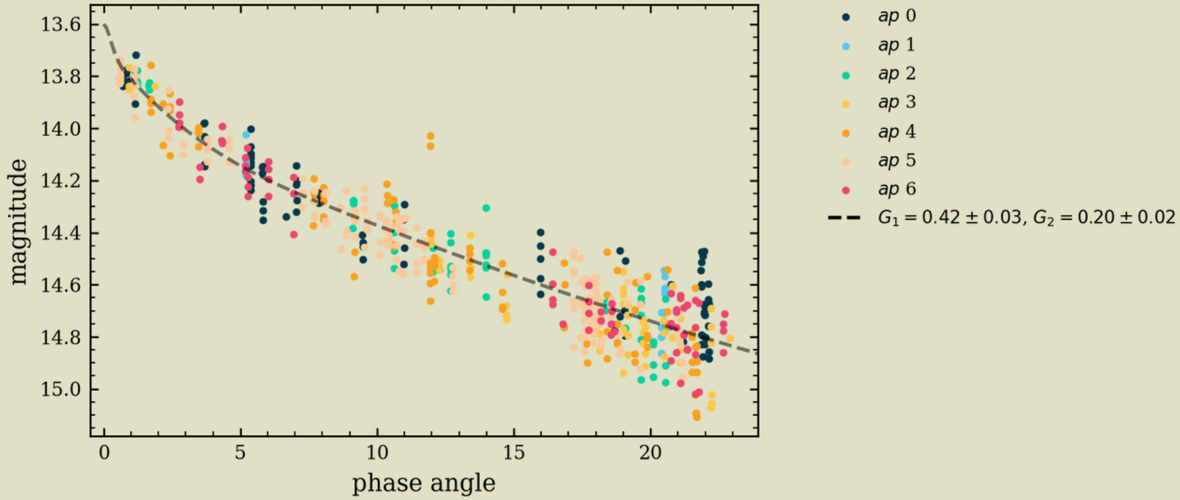
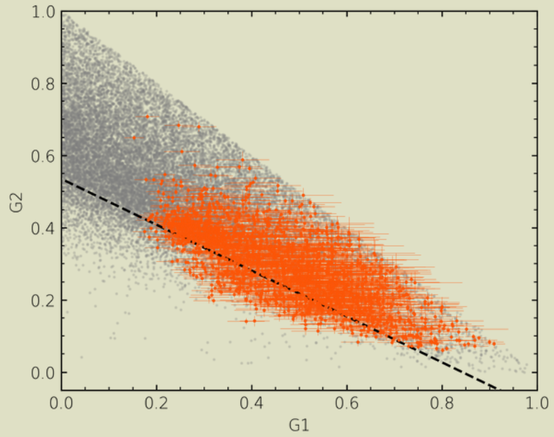
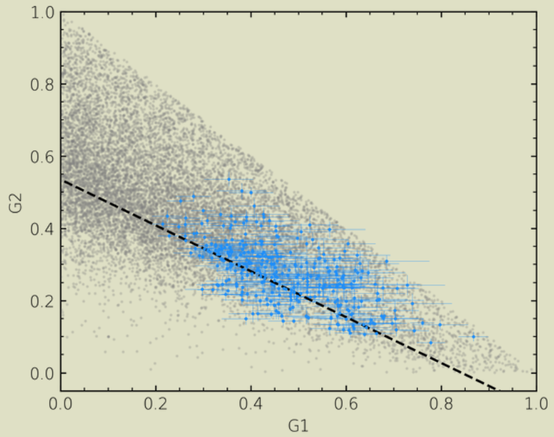
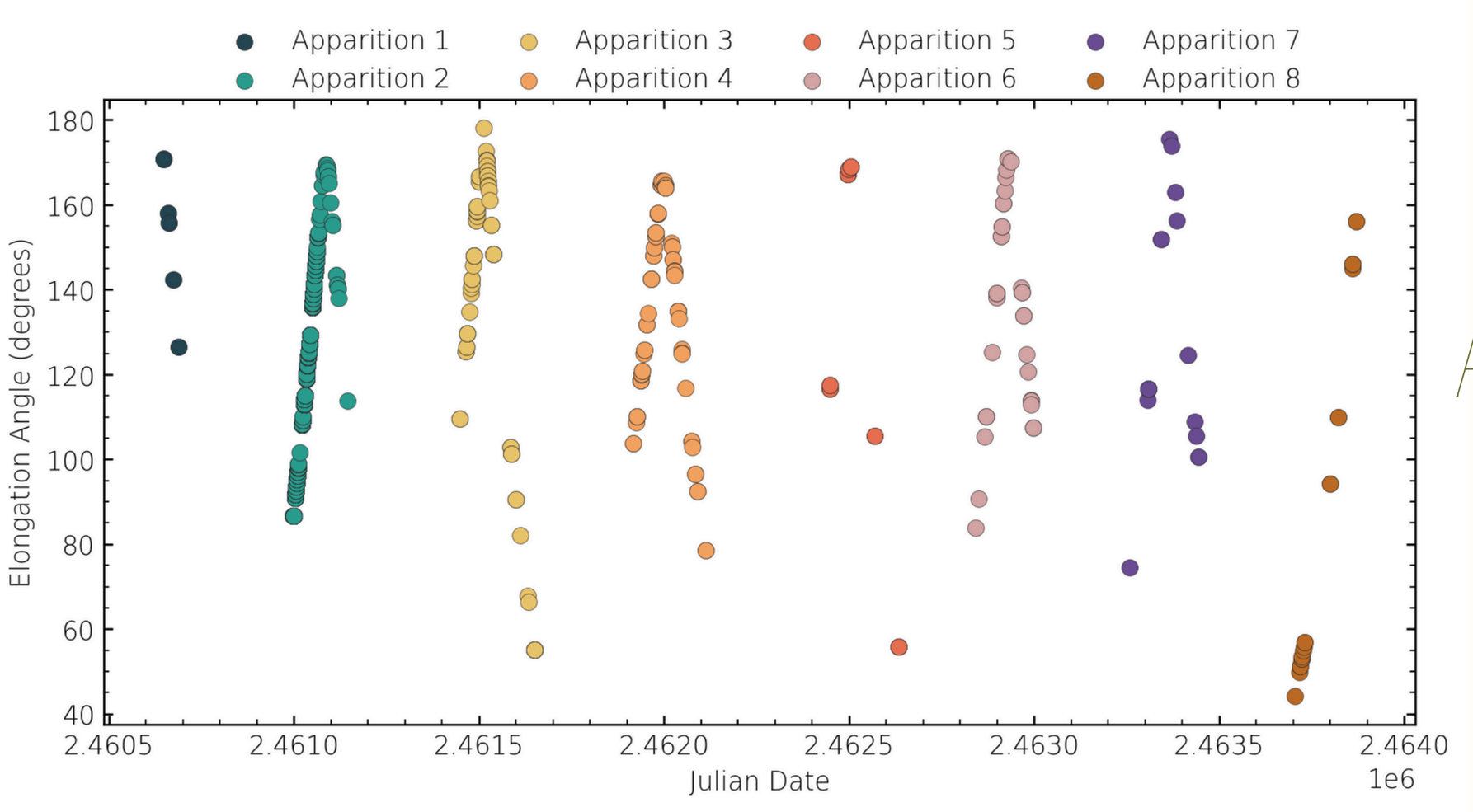




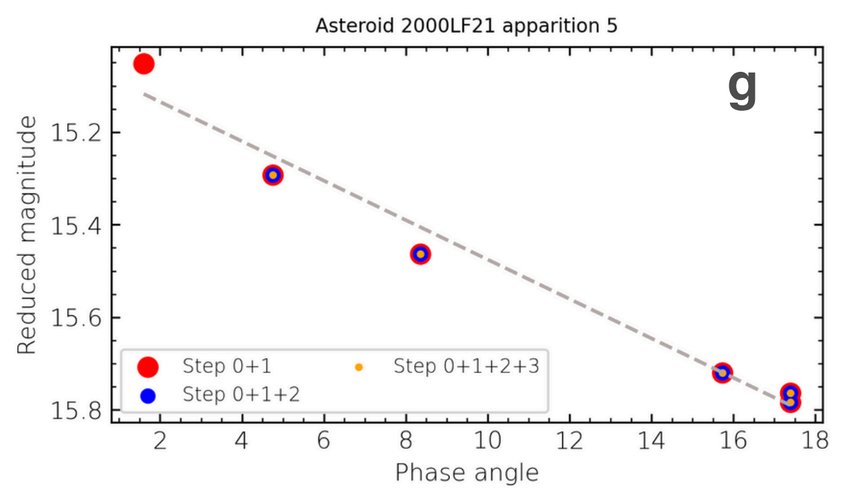


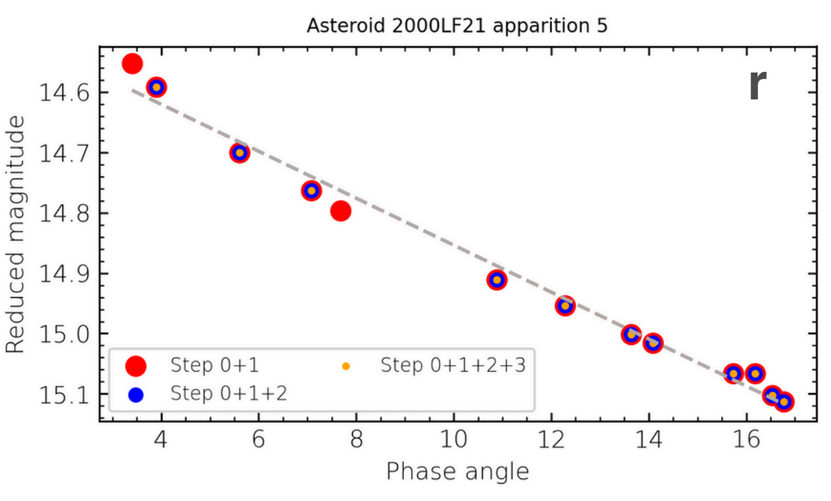
Our codes are general enough to be readapted and applied to other databases. Let's try with the LSST data!

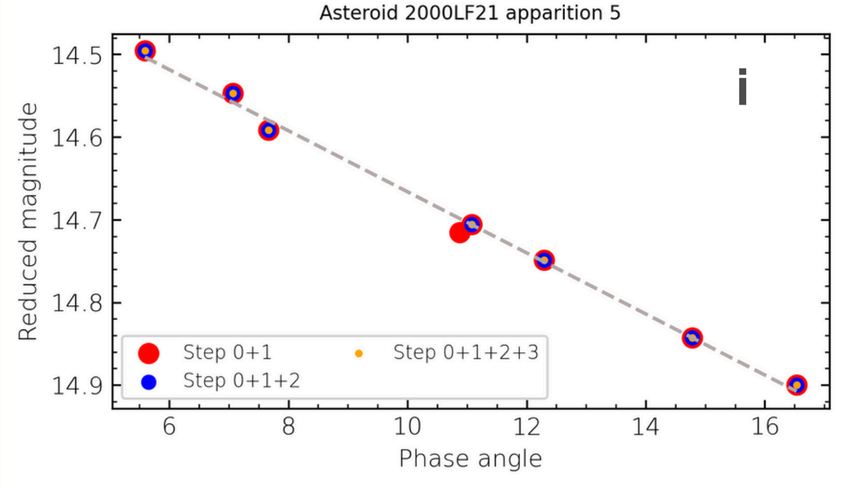


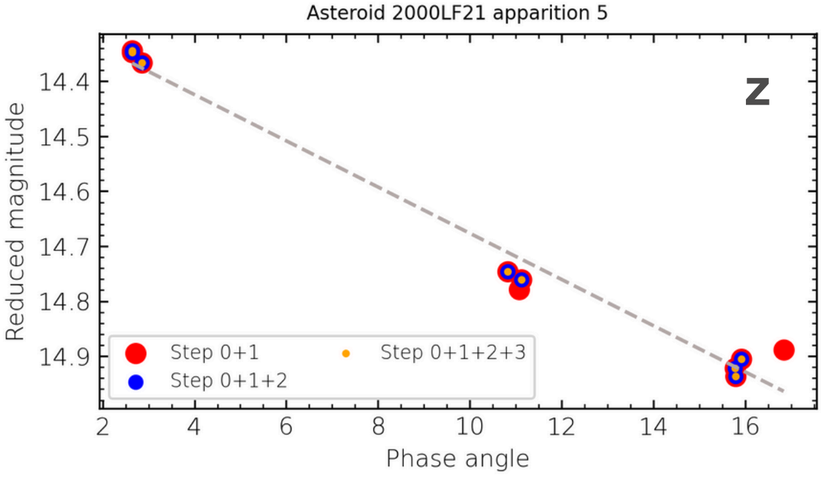
Apparitions

2000 LF21









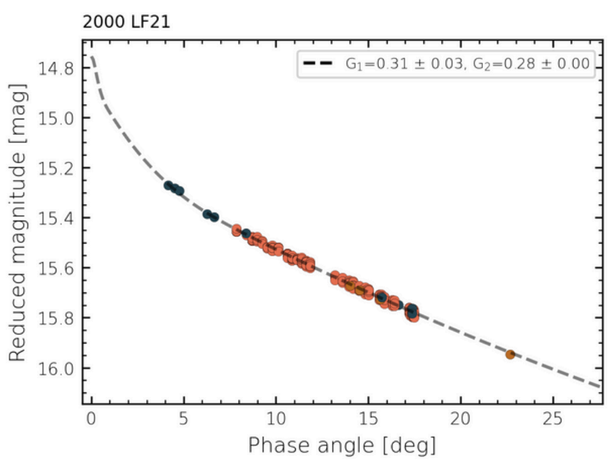
Outliers rejection

2000 LF21

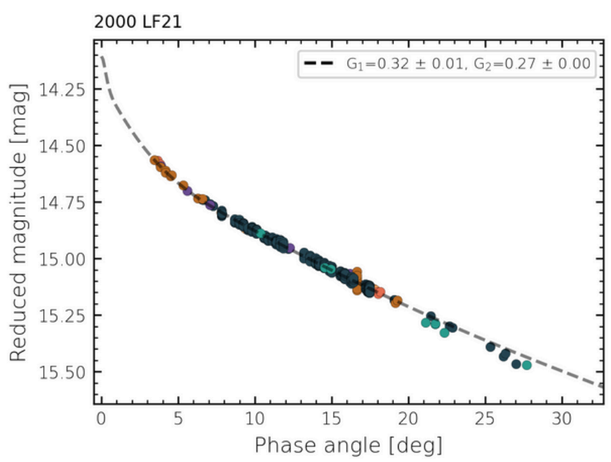
Phase Curves

2000 LF21

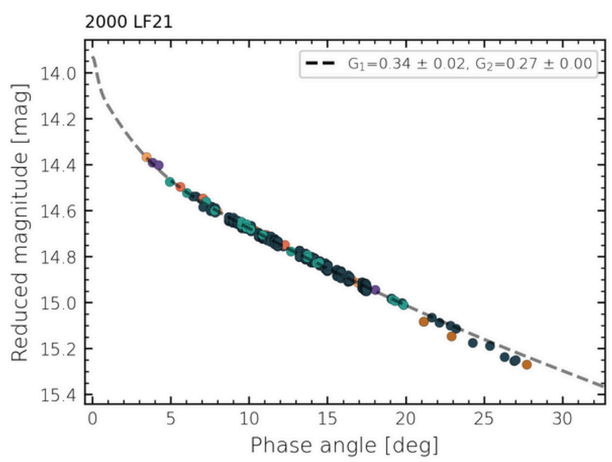
g



r



i



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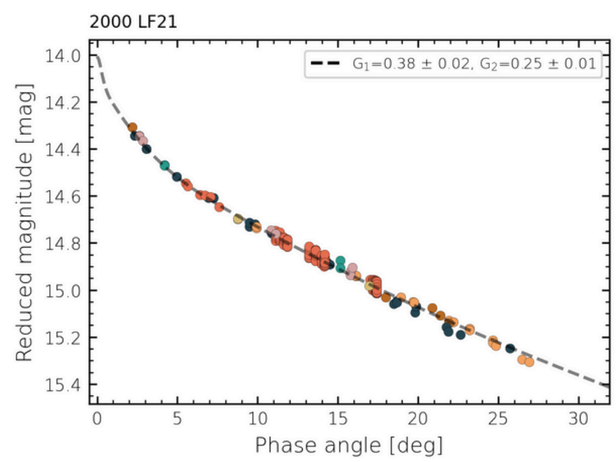
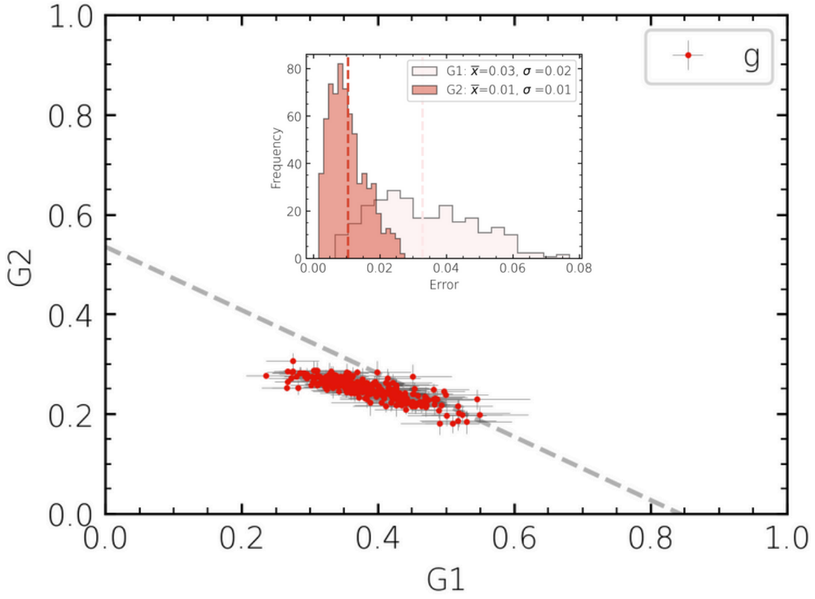
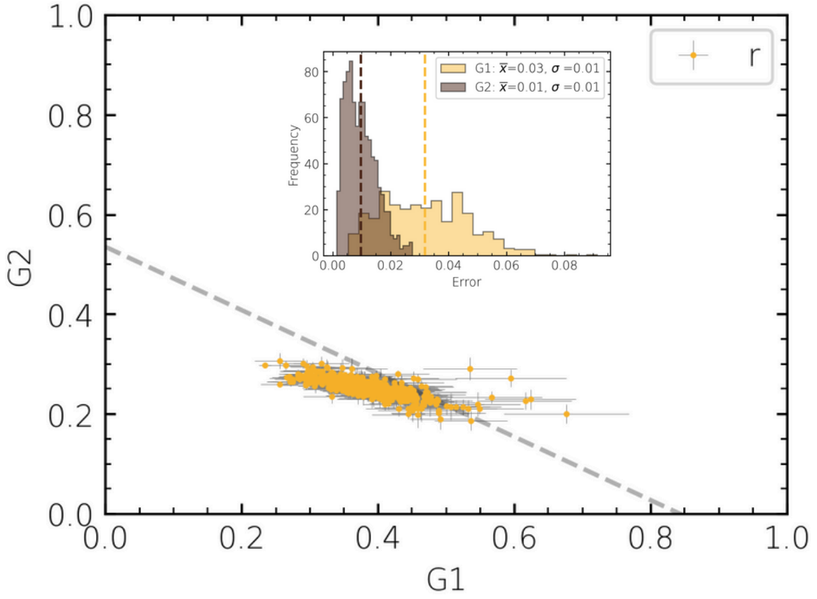


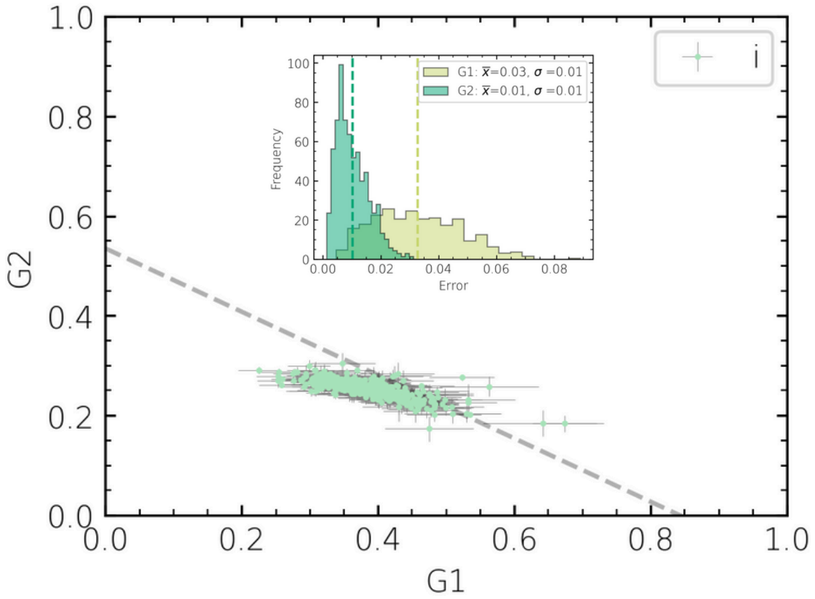
There will be two more filters, u and y, but they are not available in DP0.3.

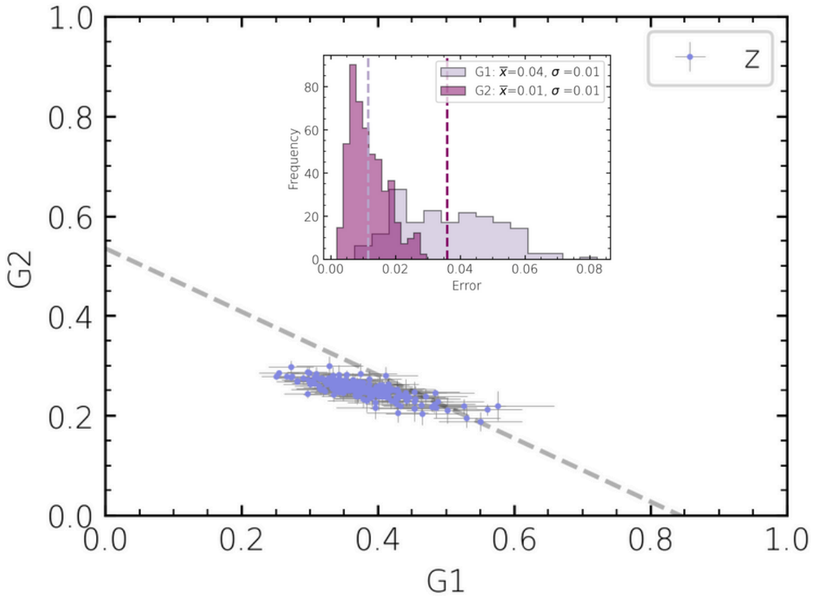
Parameters

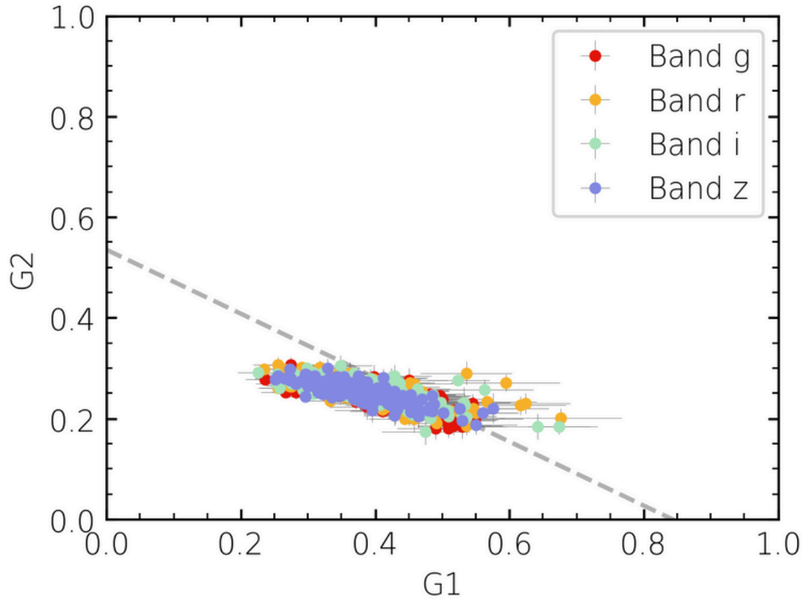
Sample of ~300 asteroids











Final Thoughts

- We've already developed the algorithms, so we have about two years to test and improve them.
- There are many methods out there with different complexities and computational costs. Our next step is to analyze the relationship between complexity, precision, and computational cost.
- We also need to examine the combination of SDSS and SkyMapper data before the LSST is released.
- Thanks to the different filters, we can study many other aspects such as taxonomy, phase reddening, and more.
- And soon, with the arrival of LSST data, we'll be ready for exciting new discoveries!

Gracias!

I would like to thank Jamie Robinson and Meg Schwamb for their valuable support regarding DP0.3.