2002 GT: A 2020 Future Deep Impact Flyby Target

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Abstract

2002 GT was first discovered in April 03, 2002 by Spacewatch (JPL Small Body Database). It has recently been of interest for a flyby from the Deep Impact spacecraft that is scheduled for January 04, 2020 (Chelsey et al. DPS 2012). In June 2013, the asteroid 2002 GT flew within 0.012 AU of the Earth, prompting many organizations to turn their telescopes in that direction. As part of the CURE group, we observed this asteroid the 12th, 13th, 18th, 20th,and 23rd of May and the 6th of July in colors and in R band up at the 0.6 m telescope at the Table Mountain Facility. We also observed our target on the 05th of June on the P200 at Palomar. Preliminary examination of our light curve data determines a rotational period of 3.77 hours. The asteroid type can be determined by looking at the color measurements taken, of which our data at TMO determined it to be an S-family asteroid. The P200 at Palomar helped us narrow it down to a Sq type. This means that it is of a stony composition, with olivine and pyroxene features.

Introduction

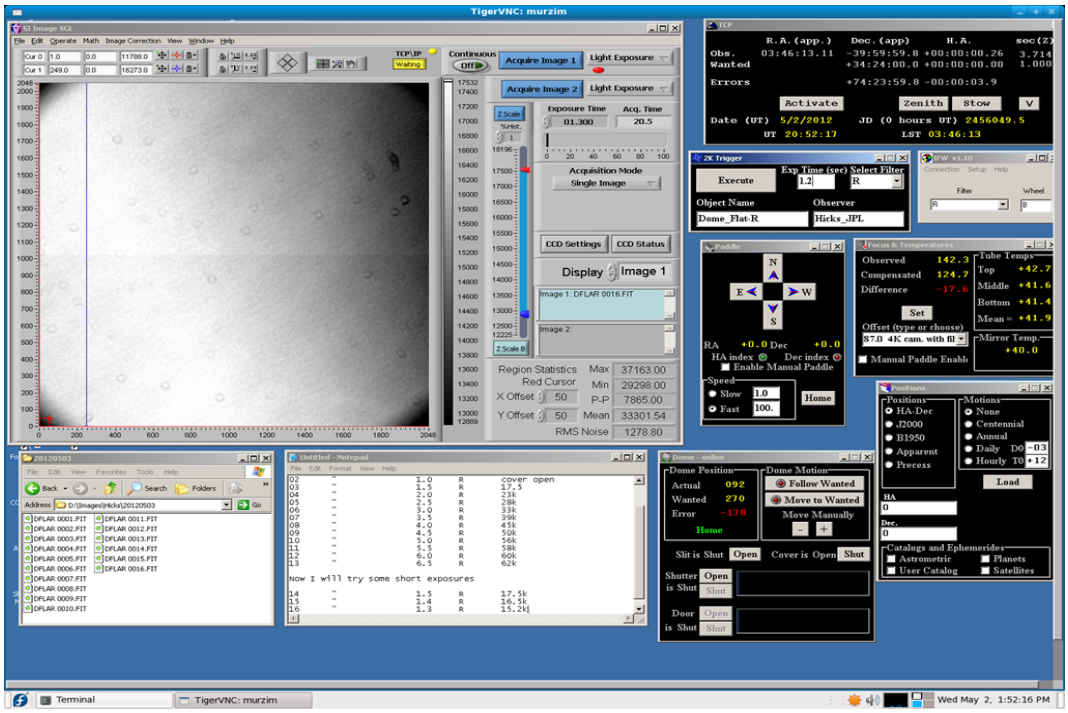
A Potentially Hazardous Asteroid (PHA) is an asteroid that passes within 0.05 AU of the Earth's orbit and is at least 140 meters in size. These asteroids are close enough that eventually they could hit, while also being large enough to go through the Earth's atmosphere and cause great damage. Luckily, they all are tracked and none have a crash course planned at the moment. 2002 GT is one such PHA, and until recently, that was the only interesting fact about it. Recently, though, it has been picked as a flyby target for the Deep Impact mission from 2005.

Methods

We do our observations at a 0.6 meter telescope on the Table Mountain Observatory near Wrightwood, CA. The telescope is a coude focus Ritchey-Chretien reflector and is mounted equatorial. At the eyepiece is an SI2k CCD camera that sends the image digitally to our computer. The camera is cooled electrothermally. We usually work in pairs overnight in a room that is adjacent to the telescope.

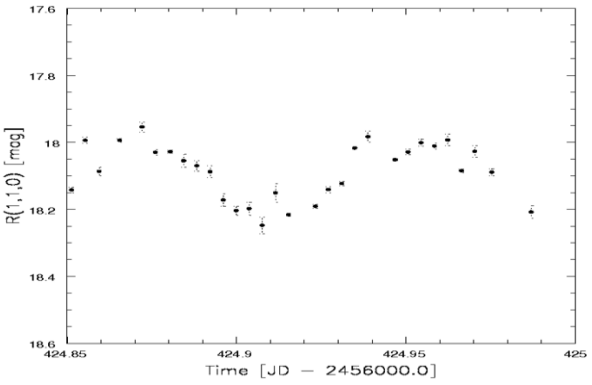
Our computer setup for a night is called Murzim. We put in the right ascension and declination of the asteroid at a specific time, along with the change of the coordinates over time. This is needed because an asteroid doesn't follow the path of the stars as the Earth rotates. After this we put in the exposure time along with the name of the asteroid and the filter being used. Our telescope has four filters that we use to collect photometric data, they are BVRI. Once all that is in, we hit execute and put in the information for the image into a log for the night. Once the image is done, it pops up in a viewing program and then we start on the next image. We average around 300 images a night.

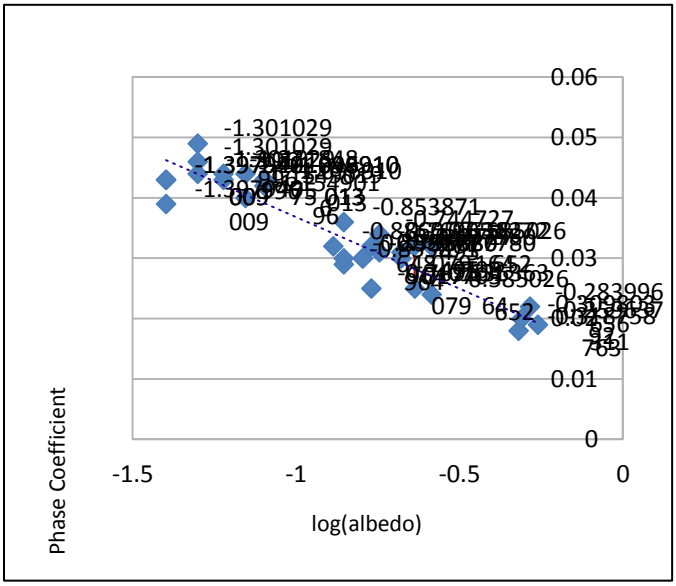
The 0.6 m telescope



Murzim

Once we have the images from a night, we have to run the images through programs to help us find out more about that asteroid. The main program we use is Image Reduction and Analysis Facility (IRAF). The first thing we use IRAF for is to find the period of an asteroid. This is done by looking at the light curve over many hours. Asteroids can have a period from less than an hour to several days. The period for 2002 GT was measured at 3.77 hours per rotation. The next thing we would try to find is the type of asteroid that we are looking at. This takes even more data, luckily we had a night on the 200 inch at Palomar. The Palomar has spectroscopes that we used to help find its type. Along with that, we took the slope of the graphed solar phase angle vs magnitude and plotted that slope with the log(albedo). Asteroid types are bunched together and 2002 GT was no exception. The end type of 2002 GT was Sq, which means it is made of mostly iron with some magnesium silicates.

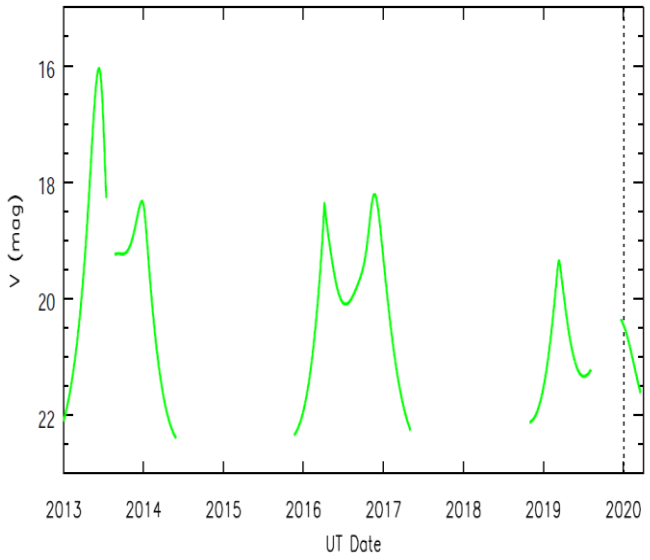




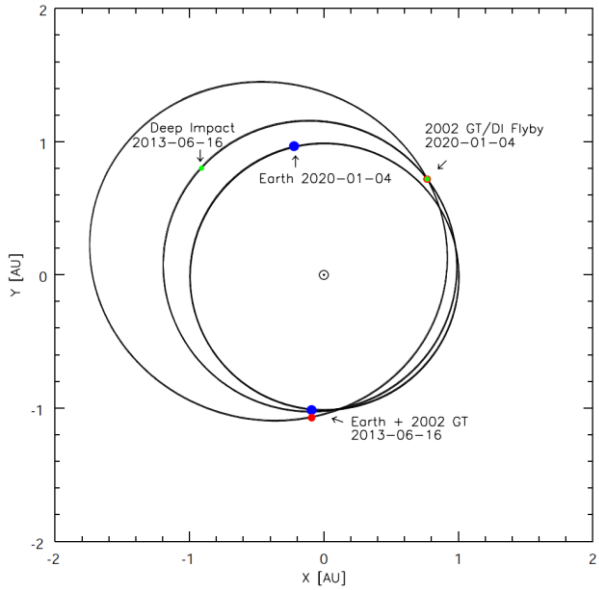
Period

Shows Sq type

Now many would ask, “What's important about 2002 GT?” The main importance is that this asteroid is scheduled for a flyby from the Deep Impact spacecraft that was sent up in 2005. Deep Impact's main mission was to shoot an impactor into a comet nucleus to collect data on the composition of comets. That mission was a success and scientists still use that data today. Afterward the University of Maryland took over and focused on extrasolar planets and flyby targets. The spacecraft is almost out of fuel and one last target may be selected. After looking at the orbits of many NEO's, it was found that a flyby course could be set for the asteroid 2002 GT for 2020. That would work well because in 2020 our asteroid will be coming from the other side of the sun and be observable from Earth. So we have the opportunity to get close up views with Deep Impact and also to observe from here as well. The details are up in the air whether the flyby will actually happen, but if it does, this data will be invaluable in planning.



The dotted line indicates the flyby date and the green lines are observable times



Positioning during 2002 GT's close pass of Earth and of 2020 flyby

Future Work

As the table above shows, there will be a few more times over the next 6-7 years to observe 2002 GT. The closest pass of Earth was this year and that is where we got most of our data. So, future observations in 2016 and 2017, along with a quick observations in 2019 could be used to help our understanding of 2002 GT even more. Shape modeling of 2002 GT would be the next step, but we didn't have the necessary data to be able to create one. That could be remedied later with further observations. Also, the flyby of Deep Impact is still in the works and nothing has been set in stone yet.

There is still plenty of time to prepare for a flyby in 2020 so I'm hopeful things will work out.

Acknowledgments

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