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Spectroscopic Classification of NEOs Using the Las Cumbres Observatory Robotic Telescope Network

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Abstract

Spectroscopic characterization of asteroids is one of the only ways to determine an object's compositional properties short of *in situ* measurements [1]. This information is especially important for Near Earth Objects (NEOs), as spectroscopy can help determine the source region of the object as well as suggest possible mitigation strategies for potentially hazardous asteroids. However, such observations can be difficult for NEOs as many of them are quite small and therefore tend to only be visible for short windows of time during a close approach. In some cases rapid spectroscopic follow up of a target is desired to determine a taxonomy which may be difficult to accomplish with classical observing methods. Las Cumbres Observatory (LCO) maintains a network of robotic telescopes that are operated through an agile scheduling program that allows for flexible and last minute scheduling of targets. We have extended the capabilities of LCO to include spectroscopy of moving targets and present the first resulting taxonomic classifications from this effort.

1. Introduction

Asteroids are often grouped together into taxonomies based upon the shapes of their spectra. Such classification schemes have been around for many years and are useful for broad characterization of an asteroid's surface composition and potentially its evolutionary history as well. Many of these taxonomies can be tied to terrestrial meteorite samples which allows for a more precise compositional determination [4]. Ultimately, spectroscopic measurements can result in a substantial amount of information being learned about an object that can improve our understanding of an object's past, its place in the evolution of the Solar System, and even what potential risks the object poses for Earth [2].

1.1. The Role of LCO

Las Cumbres Observatory is a global network of automatically scheduled robotic telescopes that specializes in rapid response and time domain astronomy. In addition to its network of 1m and 0.4m telescopes, LCO operates two 2m telescopes (one at Haleakala, Hawaii, the other in Siding Spring, Australia) each of which has a FLOYDS spectrograph. This instrument is a low resolution spectrograph with broad wavelength coverage ($\sim 320 - 1000$ nm) that we have begun to use for automated spectroscopy of non-sidereal objects. These spectra, along with observations of nearby Solar Analogs, are then used to determine a taxonomic classification for the target using the Bus-Demeo classification scheme [3].

2. Observations

Due to the unique scheduling procedures for LCO facilities, there are certain benefits and challenges to moving object spectroscopy. One benefit is the possibility for rapid follow up of a target of interest. If the target is visible and brighter than $\sim$ 18th magnitude, the telescopes can be pointed at our target within minutes of the observation being requested. Another advantage of LCO is the possibility of long term, sparse follow up with infrequent observations taken over a long period of time being simple.

Some challenges of such autonomous observations include the fact that it can be difficult to acquire particularly fast moving or faint targets within the slit. Additionally, as the asteroid must be scheduled independently of the solar analogs used to determine its taxonomy, it is possible that the two targets can be observed at different airmasses; alternatively one or the other may not be observed at all. We are working hard to overcome these challenges and improve our success rate for a wide range of different targets.

3. First Results

Here we present our first results for spectroscopy and taxonomic classification for asteroids using the LCO FLOYDS spectrographs. At the time of abstract submission, we have completed several proof of concept observations for various asteroids of known taxonomies. Examples of these can be seen in Figures 1 and 2. The next step will be the preliminary classification of NEOs with unknown taxonomies.

4. Figures

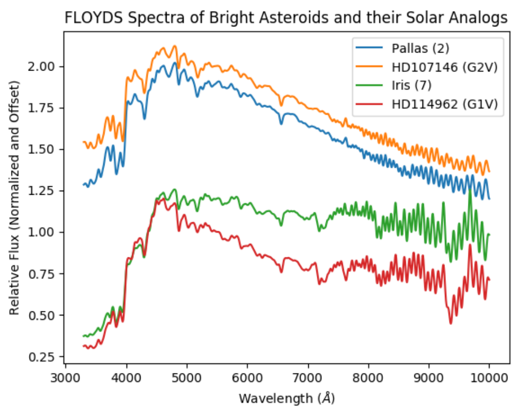

Figure 1: An example of FLOYDS spectra for 2 bright Main Belt targets and corresponding solar analogs. The spectra have been normalized and offset from each other for convenience. The top two spectra were observed on 2019-04-24 while the bottom two were observed 2019-04-23.

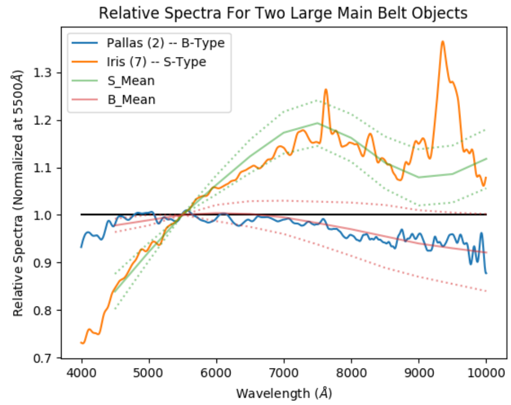

Figure 2: These are the relative reflectance spectra created using the spectra shown in Figure 1. Also shown are the corresponding standard spectra from [3] with their envelopes that can be used for classification.

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References

[1] Bus, S. J.; Vilas, F.; Barucci, M. A.: Asteroids III, W. F. Bottke Jr., A. Cellino, P. Paolicchi, and R. P. Binzel (eds), University of Arizona Press, Tucson, p.169-182, 2002.

[2] Chapman, Clark R.: Meteoritics & Planetary Science, Volume 31, Issue 6, pp. 699-725., 1996.

[3] DeMeo, Francesca E. et al.: Icarus, Volume 202, Issue 1, p. 160-180., 2009.

[4] Gaffey, M. J.; McCord, T. B.: Space Science Reviews, Volume 21, Issue 5, pp.555-628: 1978.