

Multifilter photometry of Solar System objects from the SkyMapper Southern Survey*

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ABSTRACT

Context. The populations of small bodies of the Solar System (asteroids, comets, and Kuiper Belt objects) are used to constrain the origin and evolution of the Solar System. Their orbital distributions and compositional distributions are both required to study the dynamical pathways from their formation regions to their current locations.

Aims. We aim to improve the sampled Solar System objects (SSOs) that have multiband photometry and compositional taxonomy.

Methods. We searched for missing objects in the SkyMapper Southern Survey. We used the predicted SSO positions, an object photometry and taxonomy from the SkyMapper Survey. We then applied a series of filters to select the missing Solar System objects. We finally used the new multiband photometry to assign a compositional taxonomy to objects.

Results. We found a catalog of 100 000 individual observations, consisting of 20 000 SSOs and unique SSOs. The catalog completeness is estimated to be about 97% for the SSOs in the range of 0.1–10 AU and the purity is higher than 99% for known SSOs. The new multiband photometry provides color data from all objects under the size of 0.1–10 AU. SSOs with a higher color index are more likely to be rocky and less differentiated.

Conclusions. The present catalog contributes significantly to the sample of objects with known surface properties (about 40% of new SSOs) and is used to study effects dependent on this. We will discuss some observations of SSOs with lower SkyMapper data volume.

Key words. comets; asteroids; taxonomy; photometry – catalogs

1. Introduction

The small bodies of our Solar System (asteroids, comets, Kuiper Belt objects) are the remnants of the building blocks that shaped our Solar System. Their orbital and compositional distributions hold the record of the events that shaped our planetary system (Lazzaro et al. 2006; Delisle & Carry 2016; Marchetti et al. 2019; Nespor et al. 2020).

While the present of known Solar System objects (asteroids, SMOs) has improved in recent decades, the discovery of SMOs with known composition remains limited. Spectroscopy is the most used way to find new SMOs and the discovery to search the compositions. The new sample remains small (around thousands, e.g., Jewell & Marsden 2002; Rubin et al. 2009; Pravec et al. 2010; Chesley et al. 2019; Brown et al. 2019). On the other hand, multiband photometry can be used to classify SMOs into broad compositional groups, providing lower detection limit sample size for several thousands of thousands, e.g., Jewell et al. 2004; Pravec et al. 2016; Nespor & Carry 2020).

We address here the images from the SkyMapper Southern Survey (South Phase 1) (MPC observations code 9750) which are a series of filters that is well adapted to asteroid spectroscopy observations (Fig. 1). Since the launch of the South Phase 1 Sky Survey (SPSS), the main source of astronomical observations from the Southern Hemisphere (Rubin et al. 2019; Nespor et al. 2020; Carry et al. 2020; Rubin & Carry 2021; Rubin et al. 2021, 2020; Pravec et al. 2020; Carry et al. 2020). While the SPSS completed its imaging survey in 2020, SkyMapper has started its operations in 2021 and is currently active.

The present article aims to increase the number of objects with multiband photometry and taxonomy for SkyMapper Survey SMOs in the SkyMapper system catalog. Our article is organized as follows. In Sect. 2 we summarize the characteristics of the SkyMapper Southern Survey. In Sect. 3 we describe how we select SMO observations from the SkyMapper photometric catalog, and we show the filters we applied to the sample to select Solar System objects in Sect. 4. The completeness and purity of the catalog is estimated in Sect. 5. We present the catalog of SMO colors in Sect. 6 and use it to classify the SMOs consistently with the Rubin et al. 2019 taxonomy classification in Sect. 7. We provide examples for SMOs with low S/N. Finally, we summarize the selected observed sample in Sect. 8.

* The catalogs are only available at the CDS via anonymous ftp at cds.u-strasbg.fr or cds.u-strasbg.fr. The data are also available at the CDS via anonymous ftp at cds.u-strasbg.fr.

Solar System Photometry Handbook

Patrick Martinez



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