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sbpy: A Python module for small-body planetary astronomy

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Software

- Review
- Repository
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Summary

Planetary astronomy - the study of Solar System objects with telescopic observations from the ground or from space - utilizes a wide range of methods that are common in observational astronomy. However, some aspects, including the planning of observations, as well as the analysis and interpretation of the results, require tailored techniques and models that are unique and disparate from those used in most other fields of astronomy. Currently, there is no single open source software package available to support small-body planetary astronomers in their study of asteroids and comets in the same way in which `Astropy` (Astropy Collaboration et al., 2018, 2013) supports the general astronomy community.

`sbpy` is a community effort to build a Python package for small-body planetary astronomy in the form of an `Astropy` affiliated package. The goal is to collect and implement well-tested and well-documented code for the scientific study of asteroids and comets, including (but not limited to):

- observation planning tools tailored to moving objects;
- photometric models for resolved and unresolved observations;
- wrappers and tools for astrometry and orbit fitting;
- spectroscopy analysis tools and models for reflected solar light and emission from gas;
- cometary gas and dust coma simulation and analysis tools;
- asteroid thermal models for flux estimation and size/albedo estimation;
- image enhancement tools for comet comae and PSF subtraction tools;
- lightcurve and shape analysis tools;
- access tools for various databases containing orbital and physical data, as well as ephemerides services.

`sbpy` is available and being maintained as a github repository at github.com/NASA-Planetary-Science/sbpy; documentation is available on sbpy.readthedocs.io

All functionality provided as part of `sbpy` has been tested against published results in order to ensure its correctness. An internal reference tracking system enables users to query a list of appropriate references depending on the functionality that has been utilized. In order to improve the performance of computationally intensive functions, like thermal modeling of atmosphereless bodies, C-extensions are utilized.

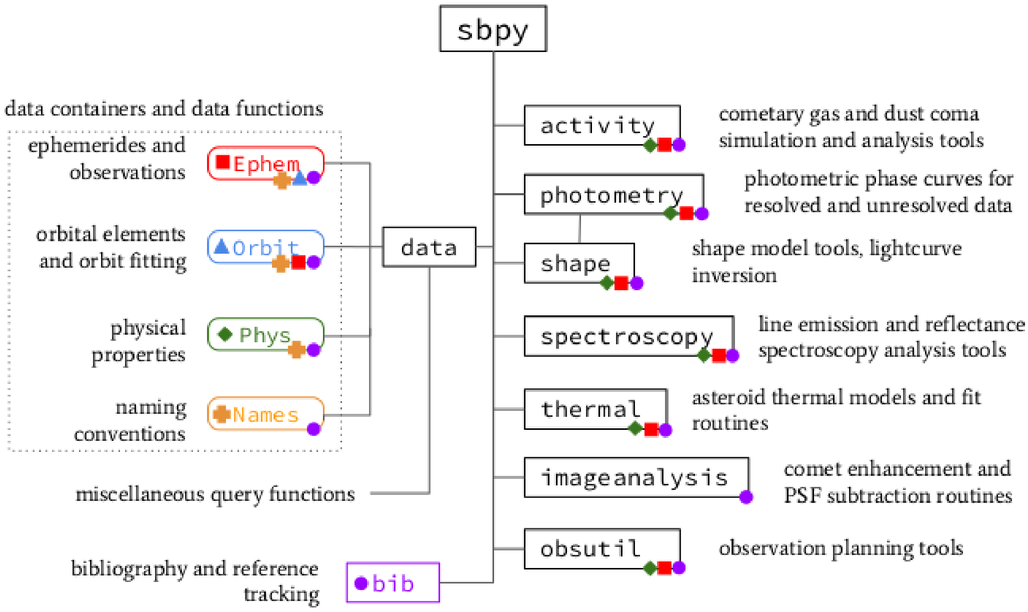

Figure 1: sbpy module structure.

Designed as an Astropy affiliated package, sbpy utilizes a wide range of functionality of Astropy, including its table, constants, units, and modeling submodules, and other affiliated packages like astroquery (Ginsburg et al., 2019). sbpy's API is deliberately emulating that of Astropy wherever possible in order to enable user-friendly and consistent access to its functionality.

sbpy is set up in a highly modular class-based fashion, roughly separated by the individual tasks listed above. Figure 1 provides an overview of these modules and their interrelations as indicated through colored symbols. The main modules, shown as black boxes, interact through data containers for ephemerides and observations (red box symbol), orbits (blue triangle), physical properties (green diamond), and target names (orange cross). All modules make use of the reference tracking system (purple circle).

sbpy is designed to support both professional researchers and interested citizen scientists in their activities.

Acknowledgments

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