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'Small Bodies: Near and Far' database for thermal infrared observations of Solar System small bodies

Róbert Szakáts (1), Csaba Kiss (1), Thomas Müller (2), Victor Alí-Lagoa (2), Gábor Marton (1), Anikó Takácsné-Farkas (1,3) and Evelin Bányai (1)
(1) Konkoly Observatory, Research Centre for Astronomy and Earth Sciences, Hungarian Academy of Sciences, Budapest, Hungary (szakats.robert@csfk.mta.hu) (2) Max-Planck-Institut für extraterrestrische Physik, Giesenbachstrasse, Garching, Germany (3) Eötvös University, Faculty of Science, Pázmány Péter sétány 1/A, H-1117 Budapest, Hungary

Abstract

The primary goal of the 'Small Bodies: Near and Far' infrared database is to help scientists working in the field of modeling the thermal emission of small bodies, and provide them with an easy-to-use tool. Our database collects thermal emission measurements of small Solar Systems targets that are otherwise available in scattered sources and gives a complete description of the data, with all information necessary to perform direct scientific calculations and without the need to access additional, external resources. This public database contains representative data of asteroid observations of large surveys (e.g. AKARI, IRAS and WISE) as well as collection of small body observations of infrared space telescopes (e.g. Herschel) and provides a web interface to access this data.

1. Introduction

Due to the typical subsolar temperature of near-Earth asteroids, trans-neptunian objects and Centaurs, their thermal emission peaks in the mid- to far-infrared, making them well-suited targets for infrared telescopes and observatories, e.g. Spitzer Space Telescope or Herschel Space Observatory. A recent summary of space-based thermal observations of asteroids can be found in [2]

In the previous decades the primary goal of these measurements was to derive diameters and albedos, but with the improvement of detector sensitivity and the availability of multi-epoch observations they do not only offer more precise diameter and albedo values, but also allows the derivation of other physical properties like thermal inertia and surface roughness, and consequently e.g. the porosity and composition of the regolith layer through thermal emission models ([1]).

The interpretation of the thermal emission measurements is rather complex, as the measured flux densities are strongly dependent on the epoch of the observations through e.g. the relative positions of the target, the Sun and the observer, the heliocentric distance, and the target's spin axis with respect to the Sun and the observer. The thermal inertia of the asteroid's surface is also a function of the local temperature, hence the heliocentric distance [1]. Researchers working on these type of interpretations need to collect and process all these auxiliary information to correctly interpret the thermal emission measurements, separately for all type of instruments.

In our 'Small Bodies: Near and Far' (SBNAF) ([6]) infrared database we collected disk-integrated, calibrated flux densities with all the necessary auxiliary data. These multi-epoch, multi-wavelength, multi-aspect data allow for a more complex thermophysical analysis for individual objects (e.g. using more sophisticated spin-shape solutions) or samples of objects. Data in our database will also help in establishing celestial calibrators for instruments working in the thermal infrared regime. ([5])

2. Thermal infrared observations of asteroids and transneptunian objects

The SBNAF database contains measurements of near-Earth, main-belt, and trans-Neptunian objects, with significant amounts of thermal measurements from different space missions (IRAS, MSX, ISO, AKARI, Spitzer, Herschel, WISE, NEOWISE). The current, 2nd release of the database contains data from AKARI, Herschel, MSX, IRAS and WISE; ISO and Spitzer observations will be added in the next releases. The public database contains 169 980 entries right now.

Besides the collected (calibrated) infrared flux den-

Mission	instrument	N_{obs}
AKARI	IRC-NIR	1
	IRC-MIR-S	6955
	IRC-MIR-L	13824
HSO	PACS-Blue/Red	1852
MSX	SPIRIT-III A/C/D/E	901
IRAS	12/25/60/100	25064
WISE	W3/W4	121383

Table 1: List of observatories/missions, instruments and the number of measurements with a specific instrument, in the present version of the Infrared Database.

sities and the corresponding flux density errors (measurement errors and absolute flux errors) we added auxiliary data for the observations from external sources. These data are partly stored as additional useful entries (e.g. orbital elements and coordinates from JPL/Horizons) or used to calculate quantities that are necessary for the correct interpretation of the measurements (e.g. colour correction). We calculate colour corrections on realistic SEDs based on existing knowledge on the object's albedo and the true observing geometry, following the recipe in [7]. We have already used our database for several modelling works (e.g. [3, 4])

3 Auxiliary data

Auxiliary fields include two main data types: (i) data downloaded from NASA's JPL-Horizons service, and (ii) data calculated/derived from the basic (photometry) fields and the Horizons fields. JPL-Horizons data include orbital elements, elements of target-observer geometry, XYZ Cartesian coordinates, apparent position, H and G values, etc. Derived quantities include the monochromatic flux density and the related colour correction factors, and the absolute flux density error. The full list and description of the database fields is to be found in the release notes[1] and the related publication [8]

4 Database and access

The public database is accessible through a web interface at https://ird.konkoly.hu/ (at Konkoly Observatory). To get data the user can use SQL queries to access the database, like this simple example:

```
targetname LIKE '%Ceres%'
```

that lists all thermal emission observations of (1) Ceres. After the query the filtered entries can be downloaded in CSV format. The user have to option to download the whole database in a single CSV file from the main page.

The users can find more examples on the webpage under the *Search* tab, and in the release notes. The description of all 56 database fields is available at the *Schema*[2] tab on the webpage.

Our future plans are to add more features to the webpage, upload more data and try to integrate our database to VESPA service.

Researchers working on small body thermal emission topics are encouraged to submit there own processed and calibrated thermal infrared observations to the SBNAF infrared database. These will be transformed to the database standards, supplemented with auxiliary data and made available to the planetary science community.

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