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GhoSST: A database of experimental data on UV to FIR spectroscopy of solids of astrophysical interest

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Abstract

GhoSST is a database that will provide to the community a large number of spectra of solids (ices, minerals, organics, meteorites…) of astrophysical interests in the UV to far-IR range. It will also provide a band list data base of molecular solids and molecules ab/adsorbed on all types of solids. Its first public release is planned for summer 2012.

1. Introduction

Spectroscopy and spectro-imagery are increasingly used in space missions, in orbit or *in situ*, to study the solid phase of the small objects of the solar system (e.g. VIMS/Cassini, DISR/Huygens, VIRTIS/Rosetta, New Horizons, …): icy, mineral or organic surfaces and grains, dust particles, aerosols, etc. Infrared, Raman and fluorescence micro-spectroscopies are used to study meteorites and cometary dusts in the laboratory and onboard some space missions for *in situ* measurements. A major contribution to the analysis of these observations is the measurement in the laboratory of UV, Visible and IR spectra of a variety of materials (ices, minerals, organics, …) expected to be present at the surface of small bodies of the solar system or in their ejected grains (e.g. comets, asteroids, TNO, icy satellites, …). However, no spectroscopy database of solids covering a wide range of samples and spectroscopy techniques currently exists, in contrast to gas phase spectroscopy (cf. VAMDC Virtual Observatory).

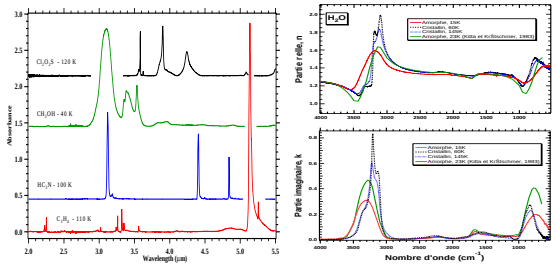

Figure 1: Spectra of organic molecular solids [1] (left), optical constants of H_2O ices [2] (right)

1.1 Solid spectroscopy at IPAG

At Institut de Planétologie et Astrophysique de Grenoble (formerly at Laboratoire de Planétologie de Grenoble) we performed numerous experiments during these last 23 years on various types of materials (ices, minerals, organic and carbonaceous materials, sulfur compounds, meteorites, IDPs, etc.) under variable conditions (e.g., temperature, phase, adsorption, irradiation) with various techniques (macro and micro-transmission spectroscopy, bidirectional reflection spectroscopy, Raman and fluorescence spectroscopy, ATR, etc.). Thus a few years ago, we decided to develop a database to make all of these data available to the community.

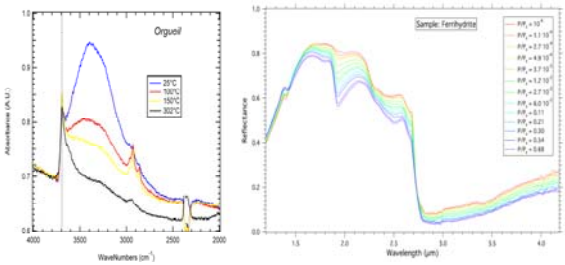

Figure 2: Spectra of meteorites dried under vacuum [3] (left); H_2O adsorption on mineral [4] (right).

2. Solid Spectroscopy Data Model

No solid spectroscopy data model covering a wide range of solids and spectroscopy techniques currently exists, contrary to gas spectroscopy. We thus defined a unique data model to best fit the purposes of the whole solid spectroscopy community.

The Solid Spectroscopy Data Model (SSDM) has five major modules to describe solid samples (sample, matters and species), experiments and instruments, spectroscopic data, band list data and their associated publications. The spectral range considered is from UV to sub-mm wavelengths. All types of optical spectroscopies are considered.

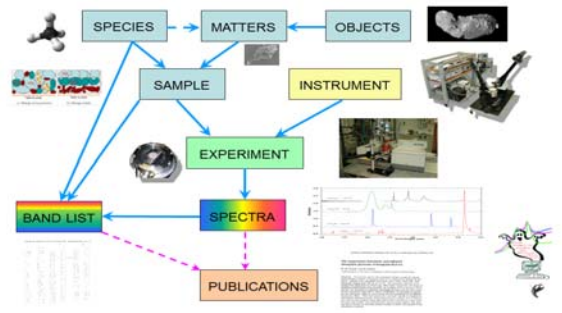

Figure 3: General structure of SSDM

3. GhoSST Database

In the frame of both the VAMDC and the EUROPLANET RI European programs we are developing a database for laboratory spectroscopy of solids: GhoSST ("Grenoble Astrophysics and Planetology Solid Spectroscopy and Thermodynamics" database service: http://ghosst.obs.ujf-grenoble.fr/). The GhoSST relational database infrastructure is based on a detailed and well-structured Solid Spectroscopy Data Model, SSDM, in order to describe accurately the solid samples, the experiments, the spectra and their products. It will be also easily searchable and interoperable from any Virtual Observatory (e.g. VAMDC, IDIS…).

2.1 Data provider interface

The data provider web interface of GhoSST provides tools for import (through xml import files) and management of the data, data updates follow up and data upload history.

Figure 4: Advanced search interface (left), spectra visualization interface and detailed spectrum information (right)

2.2 User interface

The user web interface of GhoSST provides 2 types of guided step-by-step search. (i) It either starts by species or by data types. There is also an advanced search tools allowing to query up to 25 different keywords about the sample, its constitutive materials, constituents and species and its properties. (ii) It also allows to search for the type of instrument/technique, the spectral range of interest and the type of spectra (e.g., calibrated spectra, absorption coefficient, optical constants). A tool also allows interactive spectra visualization and provides for their detailed information, as well as data download options. A "band list" search interface is under development. It will allow the user to find all bands of chosen species in one well-defined constituent (e.g. pure ice, clathrate, …). It will give detailed information on each band of the species and physical information on the constituent. We currently limit this fundamental band list database to molecular solids and molecules adsorbed on, or trapped in, other solids.

3. Summary and Conclusions

The prototype of the GhoSST database is under ß-test. It is now in its final stage of development and its public release is planned for summer 2012. Data feeding will first focus on those with the highest interest for the study of small bodies: comets, asteroids, meteorites, TNO, Pluto. The aim is to help for the interpretation of operating and soon coming space missions such as Rosetta and New Horizon.

Acknowledgements

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