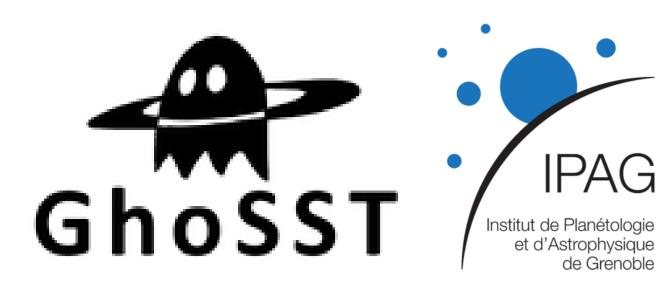
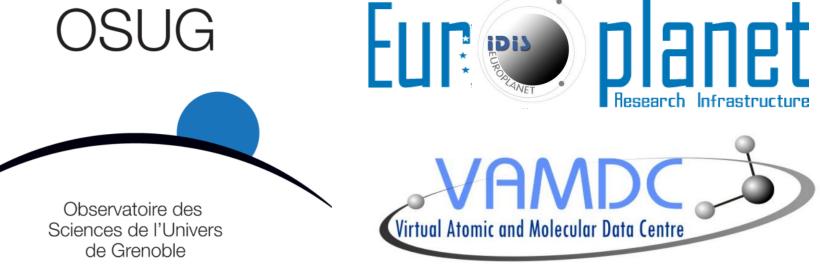
GhoSST: A database of experimental data on UV to FIR spectroscopy of solids of astrophysical interest



B. Schmitt, D. Albert, P. Bollard, L. Bonal, M. Gorbacheva, P. Beck, E. Quirico and the SSDM expert working group Institut de Planétologie et Astrophysique de Grenoble

(Bernard.Schmitt@obs.ujf-grenoble.fr)



OSUG





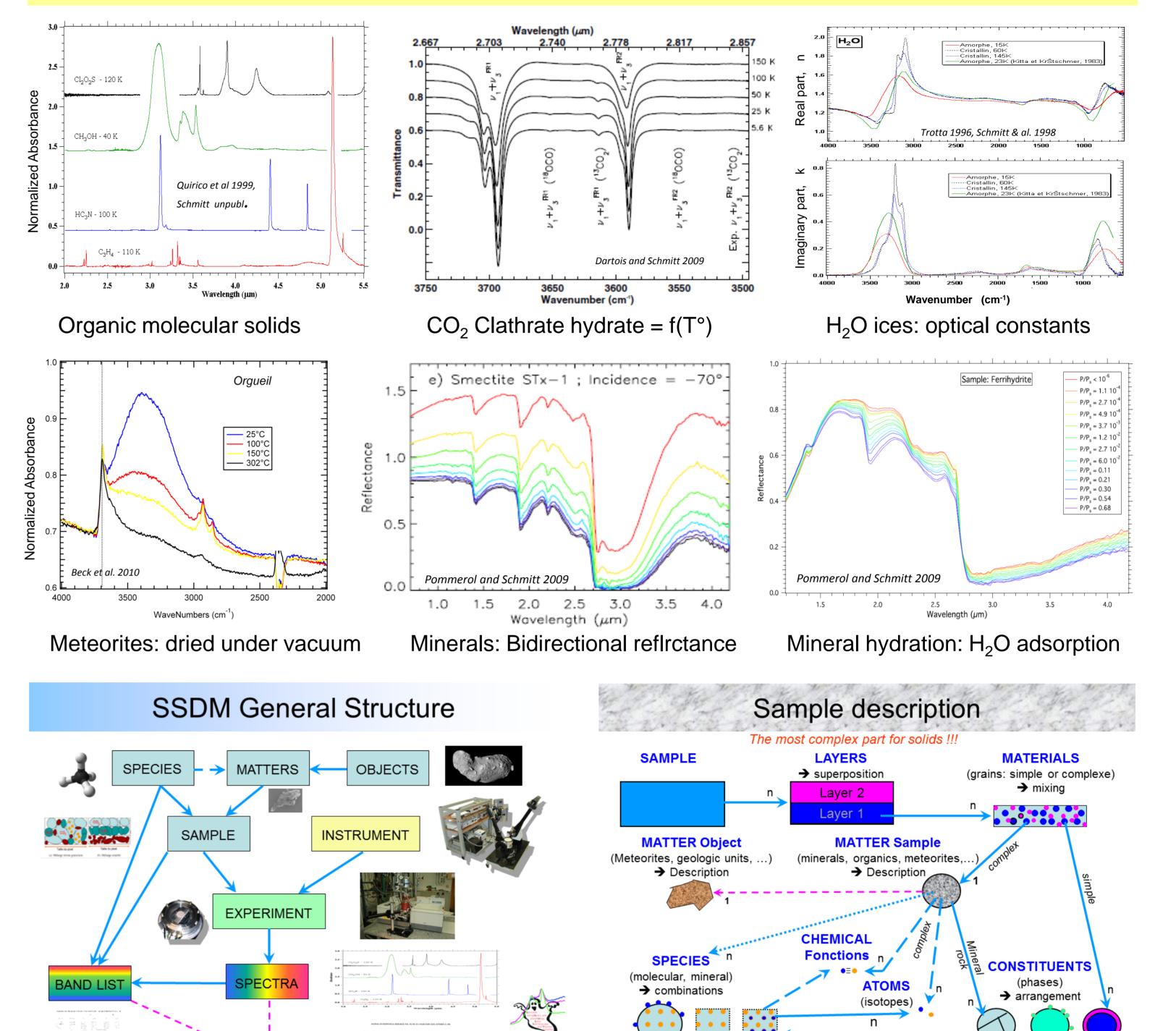
Introduction

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, Deep Impact/EPOXI, New Horizons, ...): icy, mineral or organic surfaces and grains, dust particles, aerosols, etc. On the other hand *infrared, Raman* and fluorescence micro-spectroscopies are used to study meteorites and cometary dusts in the laboratory and are also on board some space missions for in situ measurements. A major contribution to the analysis of these remote and in situ 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, ...).

Solid spectroscopy data at IPAG

At Institut de Planétologie et Astrophysique 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 6 years ago, we decided to develop a database to make all these data easily available to the community

Various spectra types: transmission, (bidir-)reflection, Raman, optical const., ...



Solid planetary materials

- Ices, hydrates, clathrates, ... + irradiation
- Organic solids: simple, macromolecular materials, polymers, ...
- Rocks, minerals, salts, hydrated materials, adsorption, ...
- Other compounds (sulphur compounds, ...) + irradiation
- Natural and extra-terrestrial samples (meteorites, IDP's, Stardust, ...)

Different physical and textural states

- Compact (rocks, ice, ...), powder (minerals, snow, ...)
- Thin films, individual grains, monocrystals, polished section, mixtures, ...
- Pressure: 10⁻⁹ mb to several bars - Temperature : 10 to 700K

SSDM: 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 an unique data model to best fit the purposes of the whole solid spectroscopy community. SSDM has four major modules to describe solid samples, experiments and instruments, spectroscopic data and band list data. The spectral range considered is from UV to sub-mm wavelengths. All types of optical spectroscopies are considered.

GhoSST Database

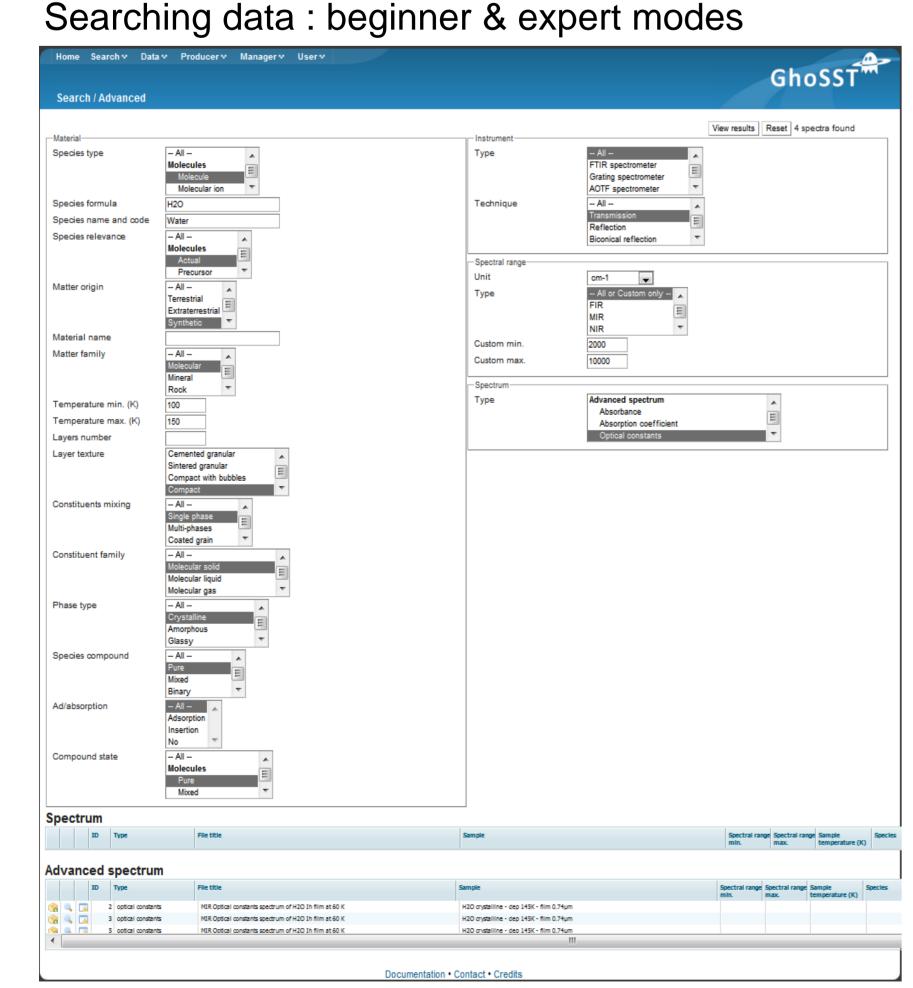
In the frame of both VAMDC and the EUROPLANET RI European programs we are developing a database for laboratory spectroscopy of solids: GhoSST ("Grenoble Astrophysics and Planetology Solid Spectroscopy and Thermodynamics")

http://ghosst.obs.ujf-grenoble.fr

The **GhoSST** relational database infrastructure is based on SSDM, in order to describe accurately the solid samples, the experiments, the spectra and their products. It will be also partly searchable from any Virtual Observatory (e.g. VAMDC, IDIS/europlanet ...).

User web interface of GhoSST: it provides 2 types of guided step-by-step search and an advanced search tools allowing to interrogate up to 25 different keywords about the sample, its constitutive materials, constituents and species, its properties, type of instrument/technique, spectral range, type of spectra. Tools allow *interactive spectra* visualization and provide detailed information, as well as data download options. A "band list" search interface is under development. It will allow users to find all bands of a chosen species in one well-defined constituent (e.g. pure ice, clathrate, mixture)

Web-based interface: Data search, visualization, export, history, ...



Browsing and visualization of search results...



'Grenoble Astrophysics and Planetology Solid Spectroscopy and Thermodynamics'' database service

PUBLICATIONS



"spectroscopy of solids" covering different types of natural and synthetic solid samples (molecular solids / ices, minerals and rocks, organics and carbonaceous materials, meteorites, ...) measured with various spectroscopic techniques from the VUV to the mm ranges (transmission, reflectance, Raman and Fluorescence emissions, microscopy, ...) and providing their electromagnetic spectra, as well as a "band list" database of the absorption bands of molecular solids • A database on the "physical properties molecular solids" based on bibliographical reviews and critical analyses of published data (measurements, theoretical calculations,

atabase of the GhoSST service intends to provide to the community various sets of laboratory data necessary for the analysis of the numerous spectrosco bservations of surfaces, atmospheric aerosols and grains of the solar system objects (planets, satellites, asteroids, comets, TNO, ...), and of interstellar and circum-stellar grains generated t he planetary space missions, space-born observatories and ground-based telescopes. It will be also of strong use by scientists performing laboratory experiments on solids samples or analyzing samples of extraterrestrial matter. Part of these data will be also useful for many terrestrial studies (glaciology and snow studies, aerosols, geology, etc.). This database is current under developmer

Data producers

Import of species, matters, objects, sample, experiment, instruments, spectra, band list, publications, ... + history

heterogeneous poly

crystal with adsorbed molecule

coated grains,

GhoSST Back-end / Import / Sample								
nport file	D:\BdD\Data\DATA-SET\H2O\Demo\sampl Parcourir_							
	Import data							
'Import type : S ' <u>Database inde</u> Sample : C Lay	2XCS : (references are shown in italic) O2+13C1602+HD0 / H20 amorphous - dep 10K - bi-film 7+2µm . Index : 58 yer n°1 : 1 materials. Material : H20 amorphous la. Index : 125 Composition : 1 constituent. Precursor : H20 gas. Index : 126 Composition : 1 constituent. yer n°2 : 1 materials. Material : CO2+13C1602+HD160 amorphous mix. Index : 127 Composition : 1 constituent. Precursor : CO2+13C1602+HD160 gas mix. Index : 128 Composition : 1 constituent.							

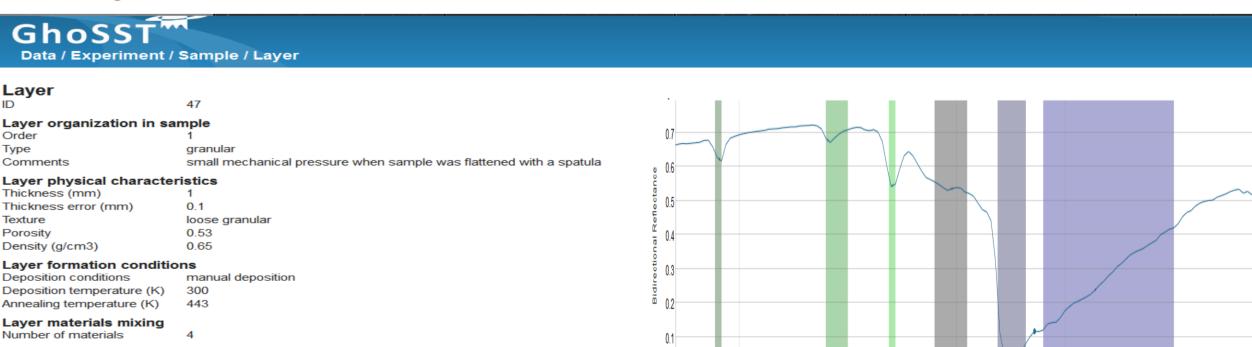
Looking at detailed information on sample, experiment, spectra, references

pure solid, molecular mixtur

polymer, clathrate, hydrate,

adsorption, absorption.

GhoSST



- 8	00 1000	1200	1400	1600	1800	2000	2200 Wavenum	2400 ber (cm-1)	2600	2800	3000	3200	3400	3600	3800
-Legends															
— k															
— n															
-Settings															
Display	Errors:	Infos: 📃													
Unit	cm-1	-													
Scale	Y1: Linear		Y2: Line	ear	-										
	Color: E62E		cis: Y1												
	Color: 1C9		cis: Y1												
		A	us. TI	Ψ.											
Zoom															
Full range	Zoom														
Valid range	Zoom														
-Help															
Vertical zoom	1	Click ·	+ Mouse	move (l	Jp or Do	wn)									
Horizontal zoo	om	Click ·	+ Mouse	move (L	.eft or Ri	ight)									
Zoom out		Click													
Zoom reset		Doubl	e Click												
Pan		[SHIF	T] + Clid	(+ Mou	se move	(Up, Do	wn, Left (or Right)							
Advanced	spectru	m													
D		6													
ile title		MIR Op	tical cons	stants sp	ectrum	of H2O I	h film at	60 K							
ile format		ascii-kn													
Driginal filenam	ne	kn-H2O	a-M.60K												
Analysis		Iterative	inversio	n of full	optical	model o	f the film	+substrat	te + Kra	mers-Kro	nig anal	ysis (but	MIR only	y) - F. Tr	otta thesi
Quality flag		4									-				
Created at		1995-12	2-24												
ast updated at		2011-12	2-06												
Comments		errors in	n and k	can occ	ur below	/ 1000 c	m-1 beca	use Far-l	R spect	um not t	aken int	o accour	it in KK a	analysis	

2011-12-06: new optical constant spectrum (mid-IR)

The GhoSST database starts its on-line public access on 25 September 2012. 🙂 🙂 😌

Development will continue by mostly adding the possibility to include spectra of cosmomaterials (meteorites, IDPs, ...) as well as a band-list data base connected to spectra. **Data feeding** is at its very beginning and will first focus on spectra with Comets, Asteroids, Mars and Pluto/TNO interests.

More details.

Acknowledgements: Europlanet RI and VAMDC programs, OSUG, PNP, PCMI, ASOV and CNES

0	OH- Smectite + H2O	H2O	OH- Smectite H2O	OH- Smectite H2O		
U	1.5	2	2.5	3	3.5	4
			Wavenumber	(cm-1)		

nited powder compaction

2008-02-01 Sample temperature error is mostly due to possible vertical temperature gradient in the sample. Temperature reading accuracy and stability is 0.1K - Fluid error depicts estimated therma Comments cell - H2O saturation pressure at 243K is 0.37mb

Sample physical characteristics

Sample name and references

Surface roughness	I
Thickness	

Sample layers organization

f layers	1
ition	The sample holder is filled to rim with the non-compacted sample powder and then flattened with a spatula to obtain a smooth surface with limit

Sample substrate

aluminum anodized blacl Substrate material

Sample processing

Processing type	fluid
Temperature (K)	243.1

- Annealing temperature (K) 443
- Pressure (bar

More details

Materials

Sample

Sample name

Number of I

Laver additi

Actions	ID	Name	Matter origin	Matter family	Mole fraction	Mass fraction
View	85	Smectite with adsorbed H2O	terrestrial	mineral		0.75
View	86	Quartz	terrestrial	mineral		0.08
View	87	Feldspar	terrestrial	mineral		0.16
View	88	Gypsum	terrestrial	mineral		0.01

Data delivery through mail or FTP...

H2O adsorbed on Smectite - 243K

Gho Export	ss	T				lome Search I	Data Us	er Logout
Spectra								
Actions	ID	Туре	File title	Spectral range min	Spectral range min	Sample temperature	Species	Date
View	10	transmission	N87_S09 CH4 ICE 30 K	1850	10500	-	-	2011-08-04
View 🔽	94	bidirectional reflectance	NIR-MIR bidirectional reflection spectrum (i=0°, e=30°) of Smectite SWy-2 with adsorbed H2O at -30°C an P(H2O)= 0.25 mbar	1.2				2011-10-01

μm 💌
Float •
10
3
Scientific (e) 💌
11
5
Spectrum data with short header
snow-NIR
zip (Zip)