MHD

Shocks

Turbulence

Chemistry

Thermal Balance

Grains physics

Radiative transfer

Platform of Theoretical Services for the Interstellar Medium

VO-Paris Datacentre

Franck Le Petit, P. Hennebelle, N. Moreau, J. Normand, B. Ooghe, F. Roy
LUTH / LERMA / Observatoire de Paris

Context

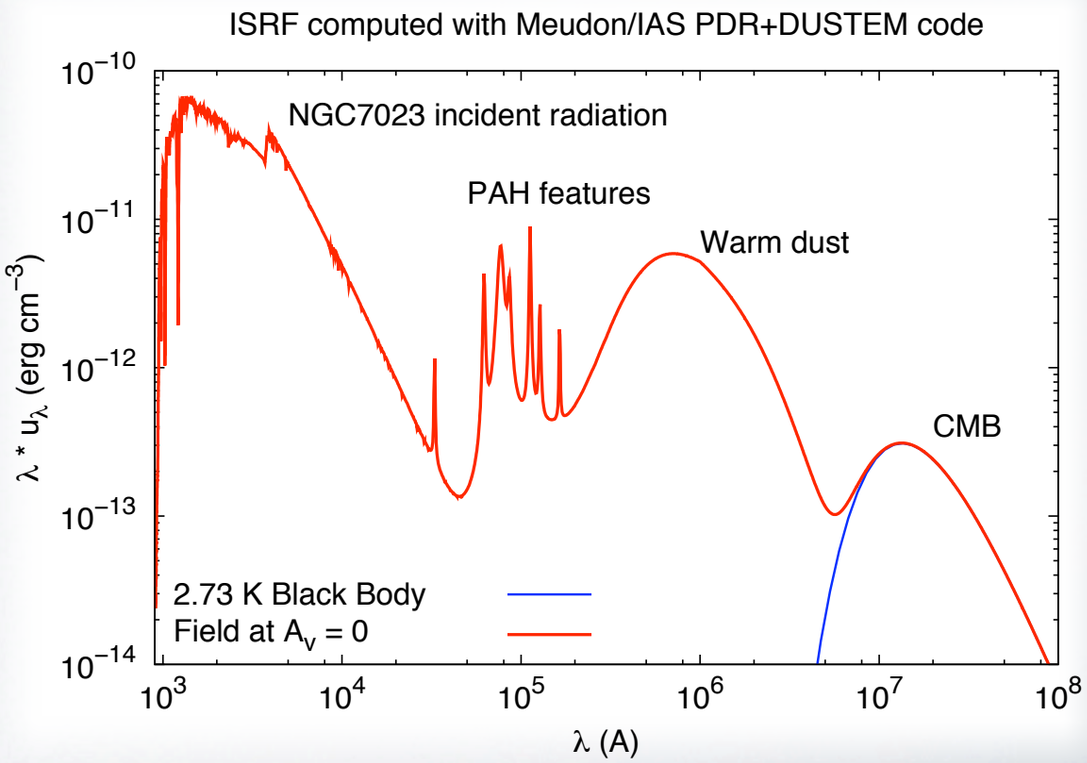
First Application : Meudon PDR code VO services

Computes the chemical and thermal structure of interstellar gas

- Radiative transfer (FUV - sub-mm)
- Chemistry
- Thermal processes
- Statistical equilibrium in levels

- Molecules abundance profiles
- Gas and grains temperature
- Levels excitation
- ...
- Line intensities
- Column densities
- Absorption & emission spectra

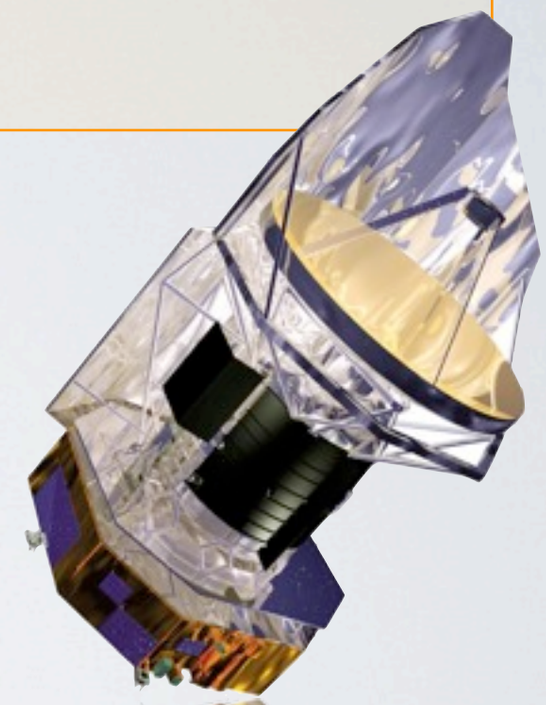
Public code : http://pdr.obspm.fr



Context

Objectives via the VO :

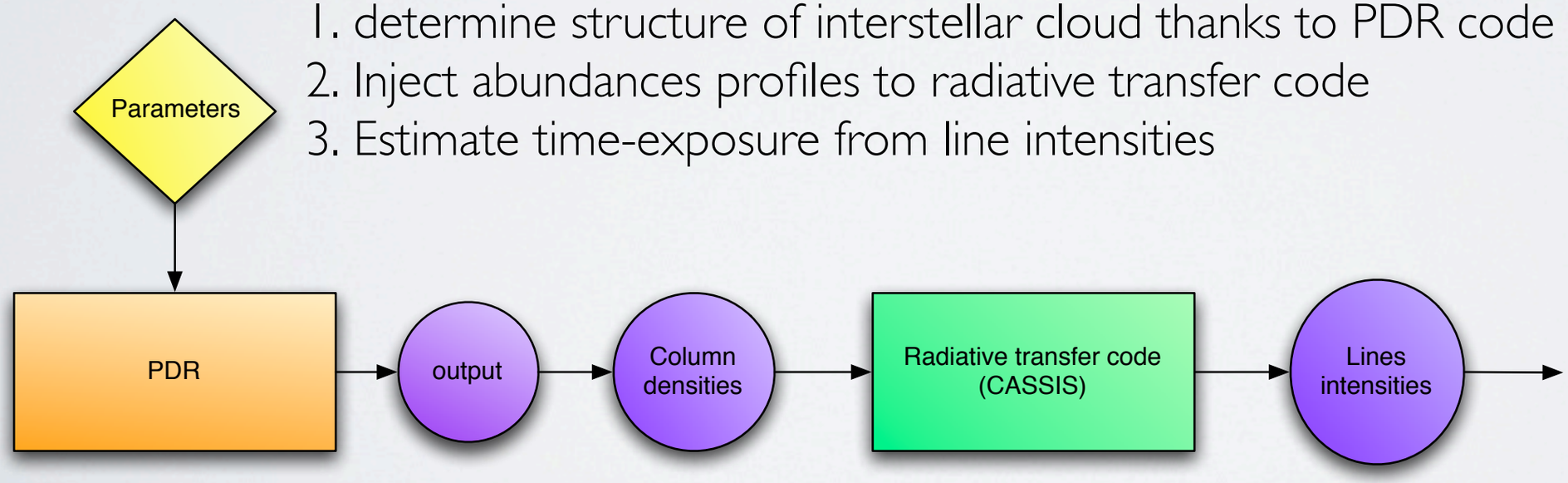
- Online access to online simulation code with computing ressources
- Development of a theoretical database (SimDB / SimDAP)
- Interoperability with other simulation codes / VO services



Example : Herschel preparation

Time-exposure estimation

1. determine structure of interstellar cloud thanks to PDR code
2. Inject abundances profiles to radiative transfer code
3. Estimate time-exposure from line intensities



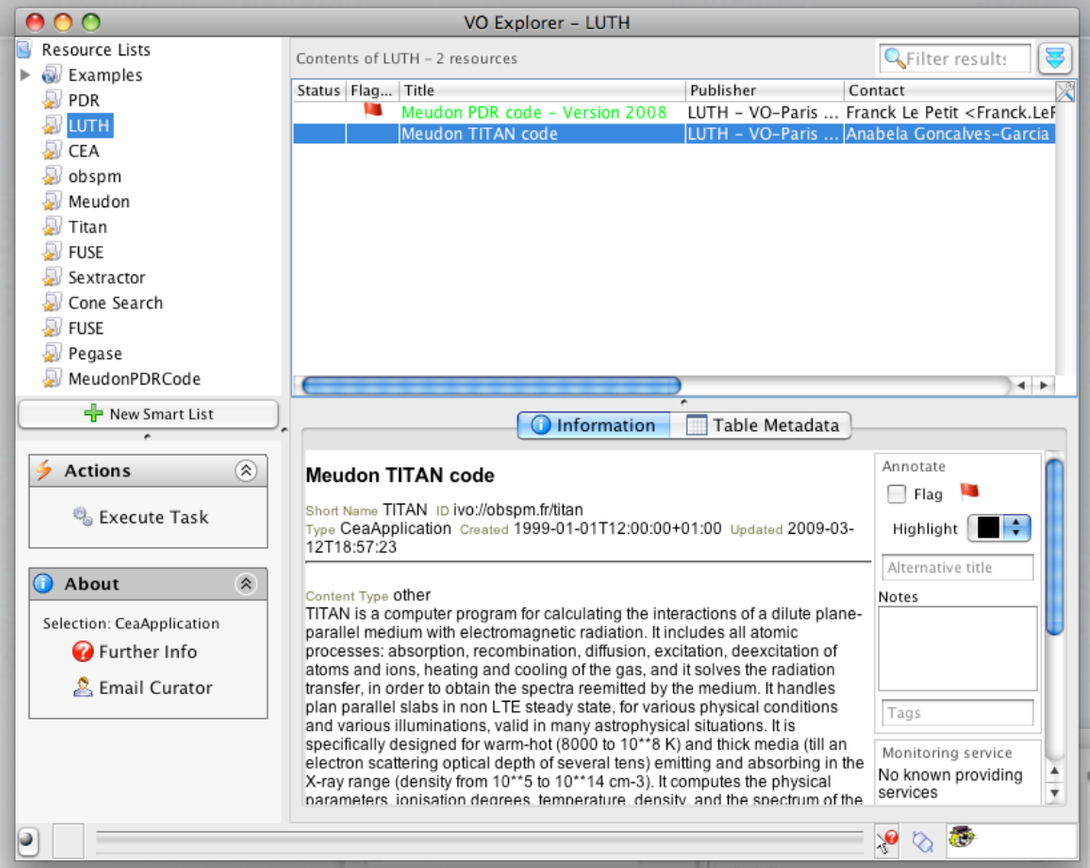
...Virtual telescope
...Time exposure
...AOR

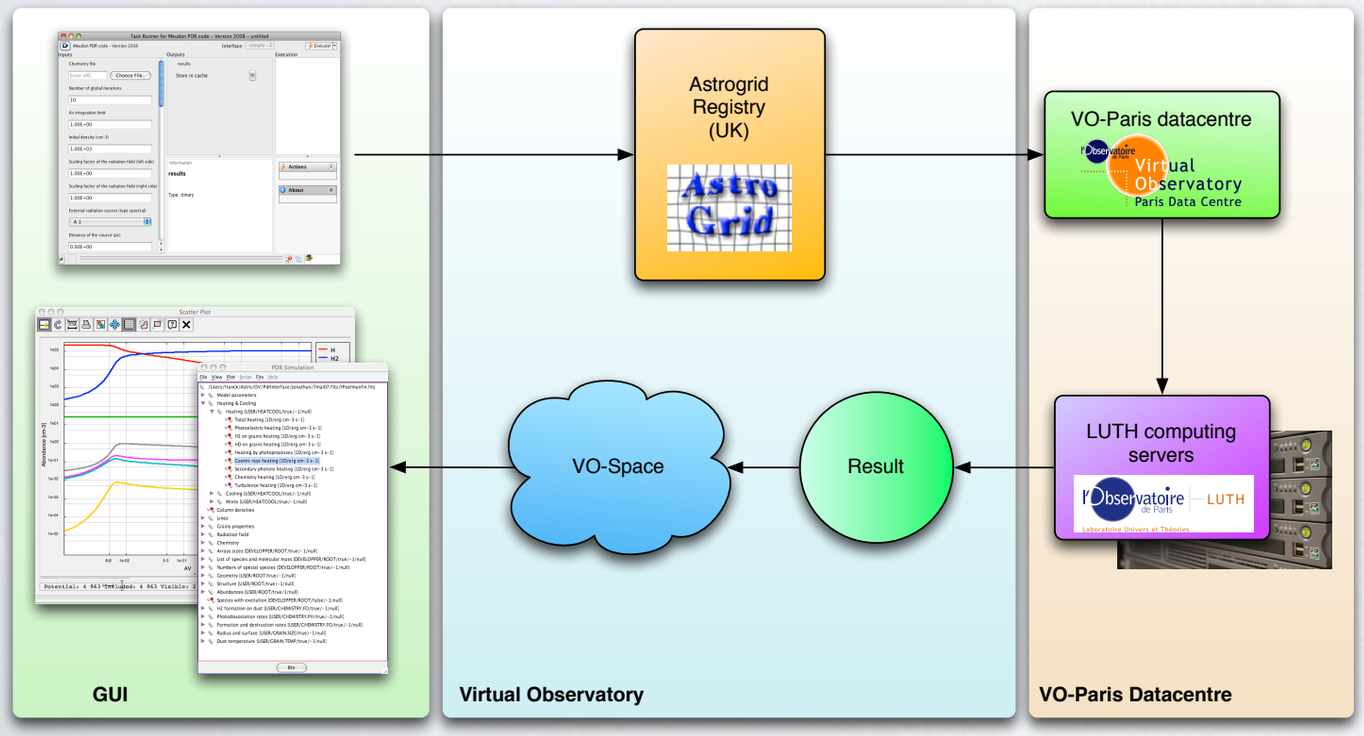
Online code

Use of Astrogrid Infrastructure

F. Roy

- Code is registered as a CEA service
- Can be found in the VO-Explorer
- Generic interface



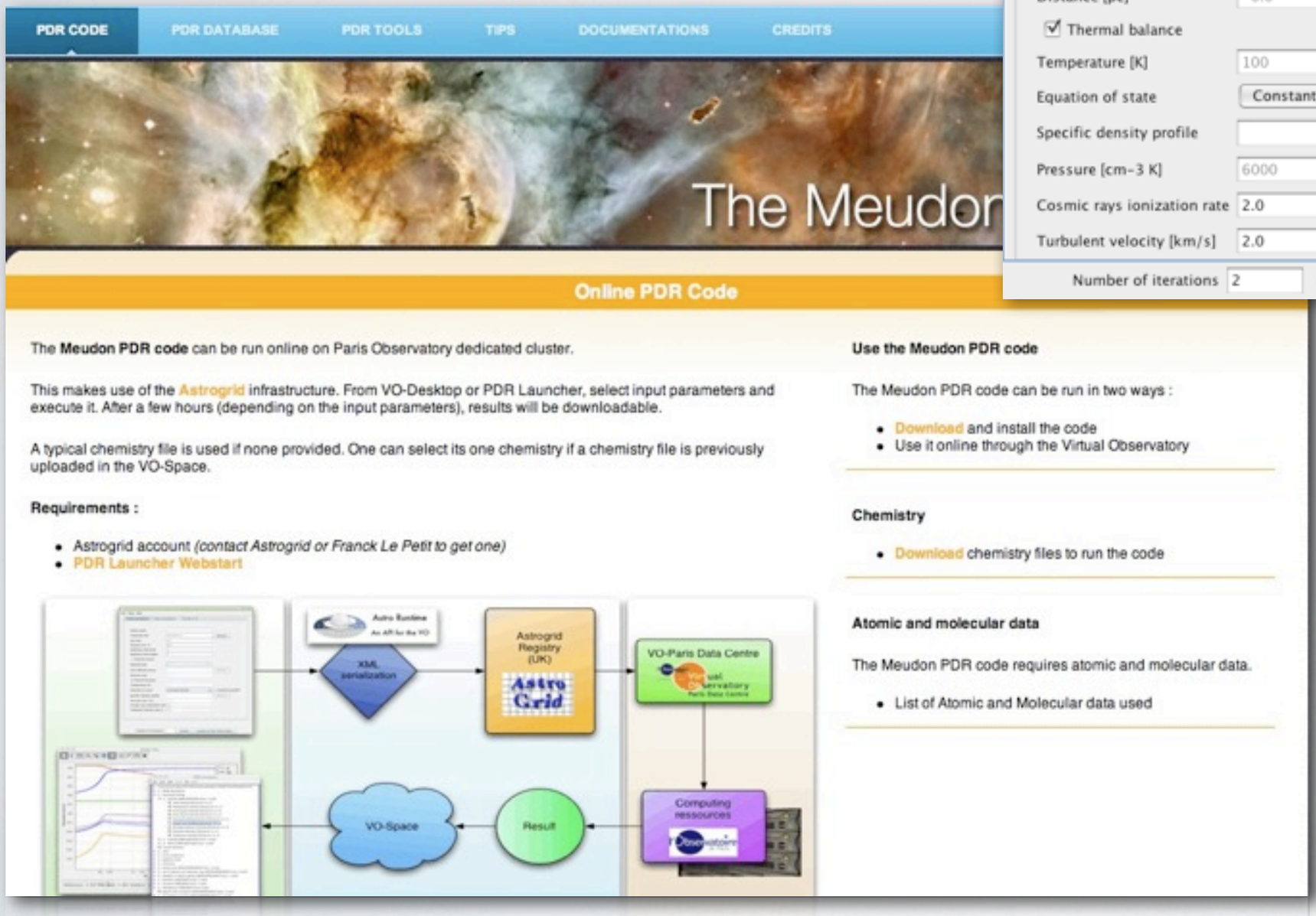


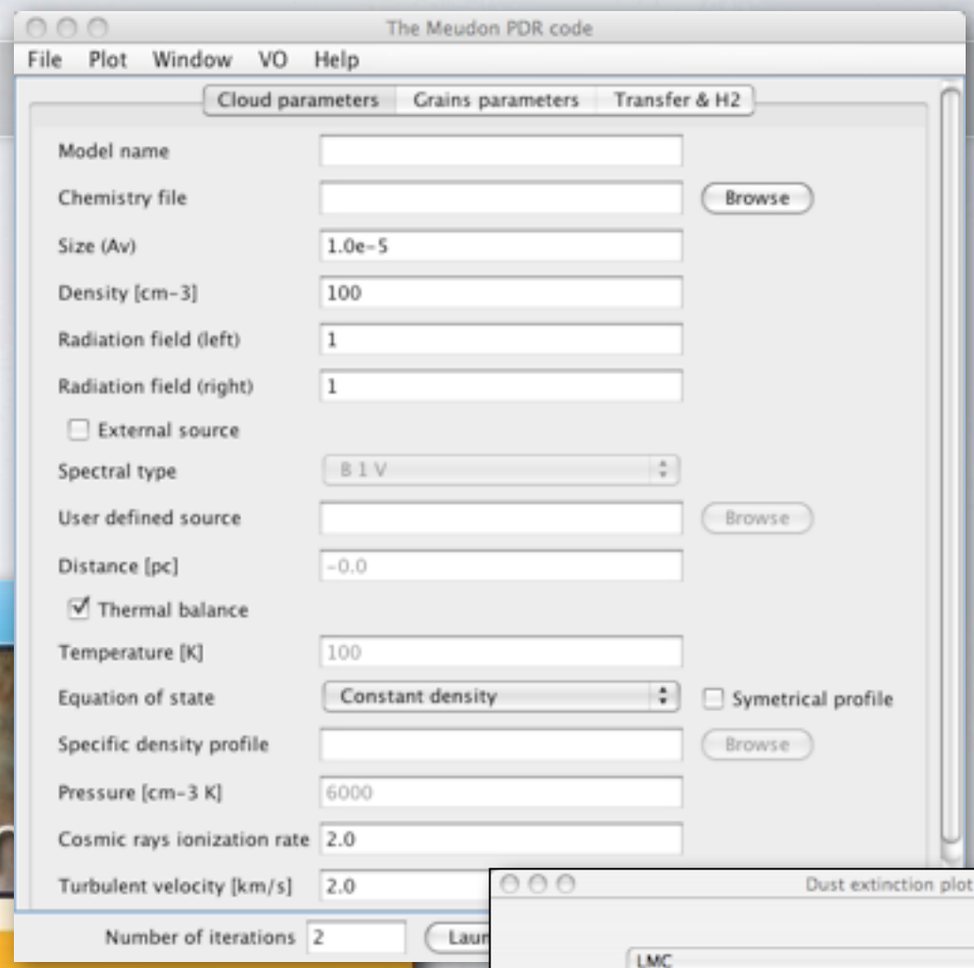
Online code

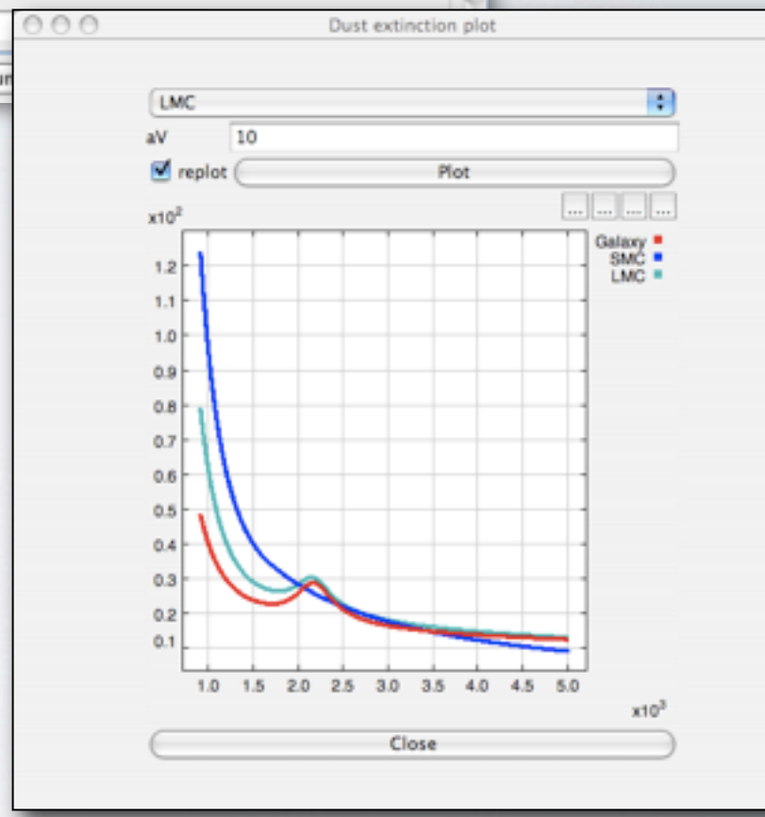
Specific code interface

F. Roy / N. Moreau

- relationships between parameters
- graphics
- Communicates with Astrogrid







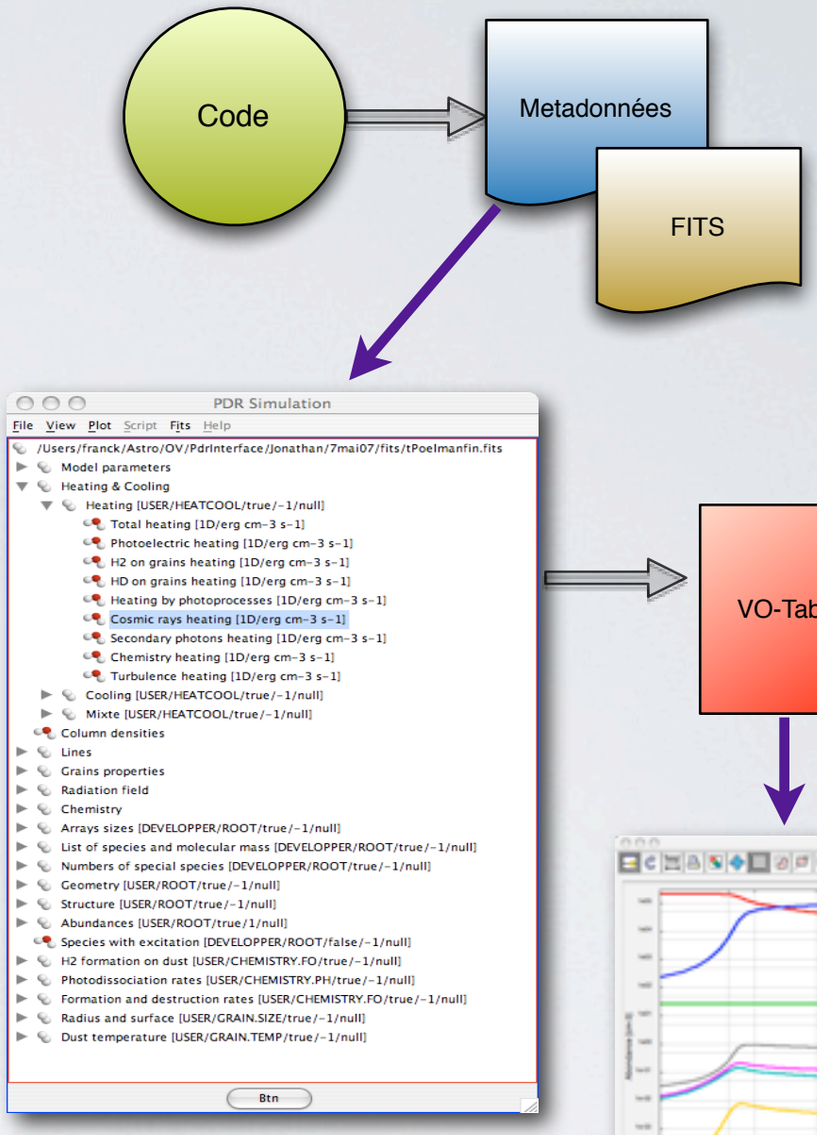
PDR Analyser

Output Files

Code produces
- FITS File : results
- VO-TABLE : meta-data
  (name, description, unities, UCD, ...)

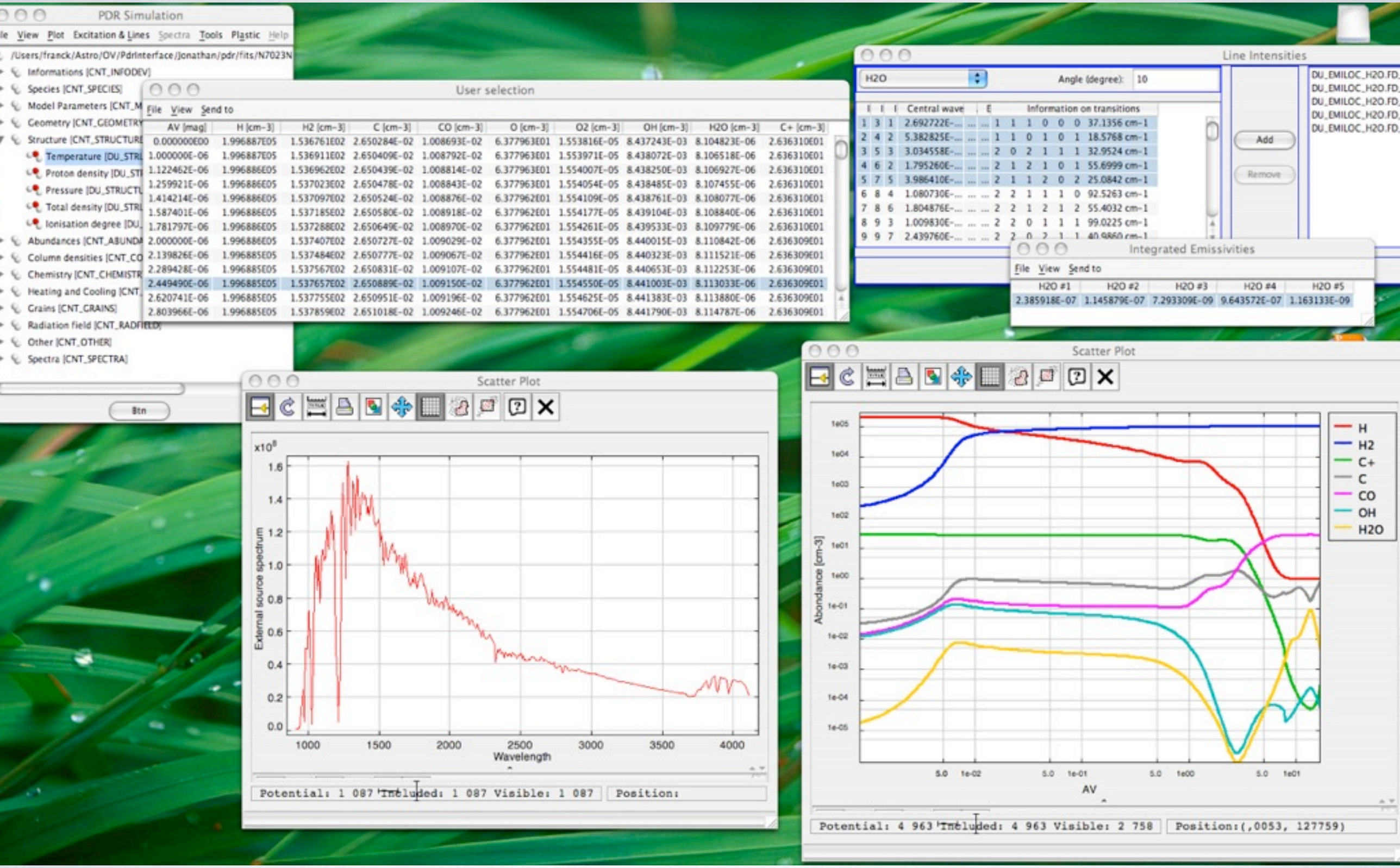
Provide all quantities computed by the code
- observables
- theoretical quantities

PDR Analyser
- browse the computed quantities
- extraction (ASCII, VO-Table)
- SAMP
- Download data from VO-Space
- scriptable

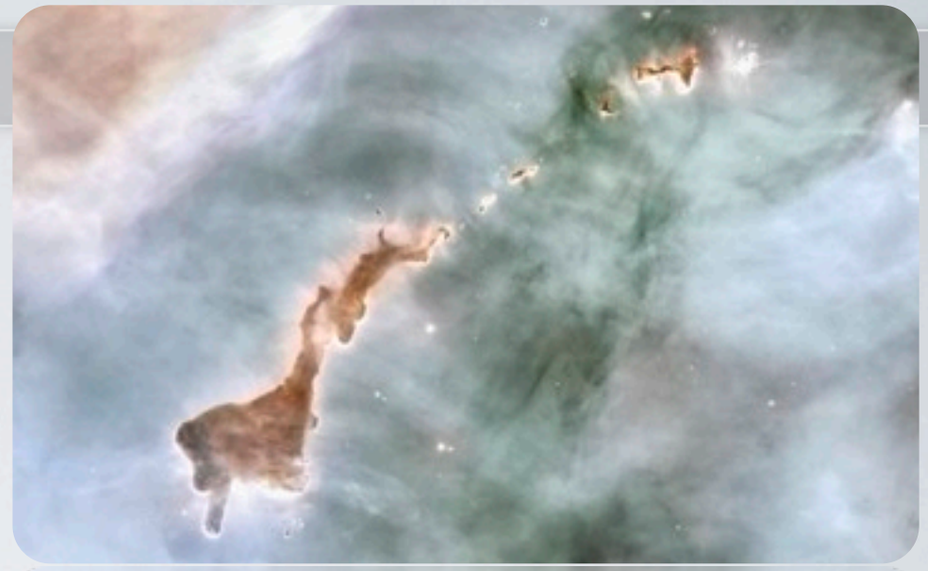


Laurent Bourgès
Jonathan Normand

PDR Analyser



PDR Database

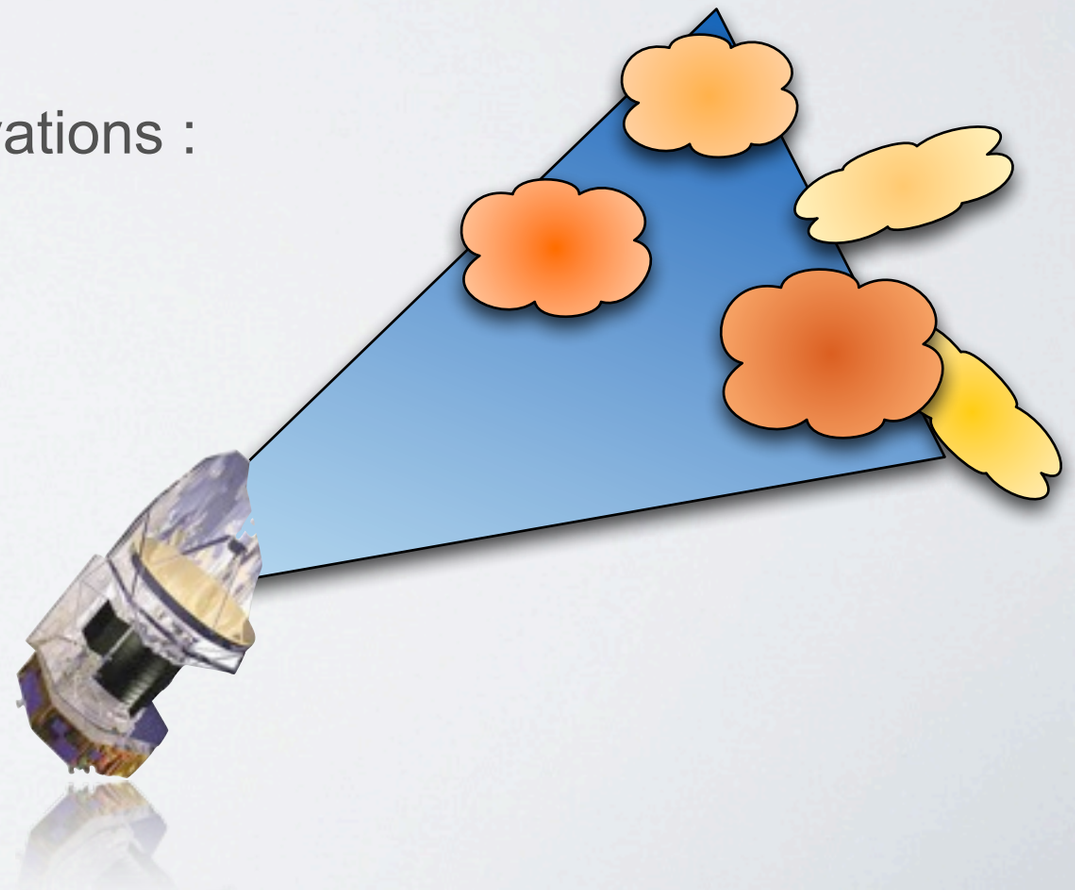


Objectives :
- Publish PDR simulations
- Facilitate solving of inverse problems

Example :
“In which kind of interstellar clouds can we detect H_2O ?”

“Which parameters produce a ratio of line intensity H_2 2-1 S(1) / 1-0 S(0) of 0.56 ?”

Motivated for fast interpretation of HERSCHEL observations :
- Diffuse Interstellar Clouds (PRISMA key prog.)
- Star-Forming regions (WADI key prog.)
- Search for O_2 (O_2 key. prog.)
- Extra-galactic medium



PDR Database

SimDB prototype : Laurent Bourgès (Euro-VO DCA - Aïda / LUTH)

PDR CODE | PDR DATABASE | PDR TOOLS | TIPS | DOCUMENTATIONS | CREDITS

Query the Pdr models :

previous page

To query the PDR models, select first a code version and then choose at least a search criteria :

refresh | cancel

Pdr1.2_chimie08 | select

Code version : Pdr1.2_chimie08
Description du code + fichiers input (chimie_08)

Query on Parameters | Query on Column densities

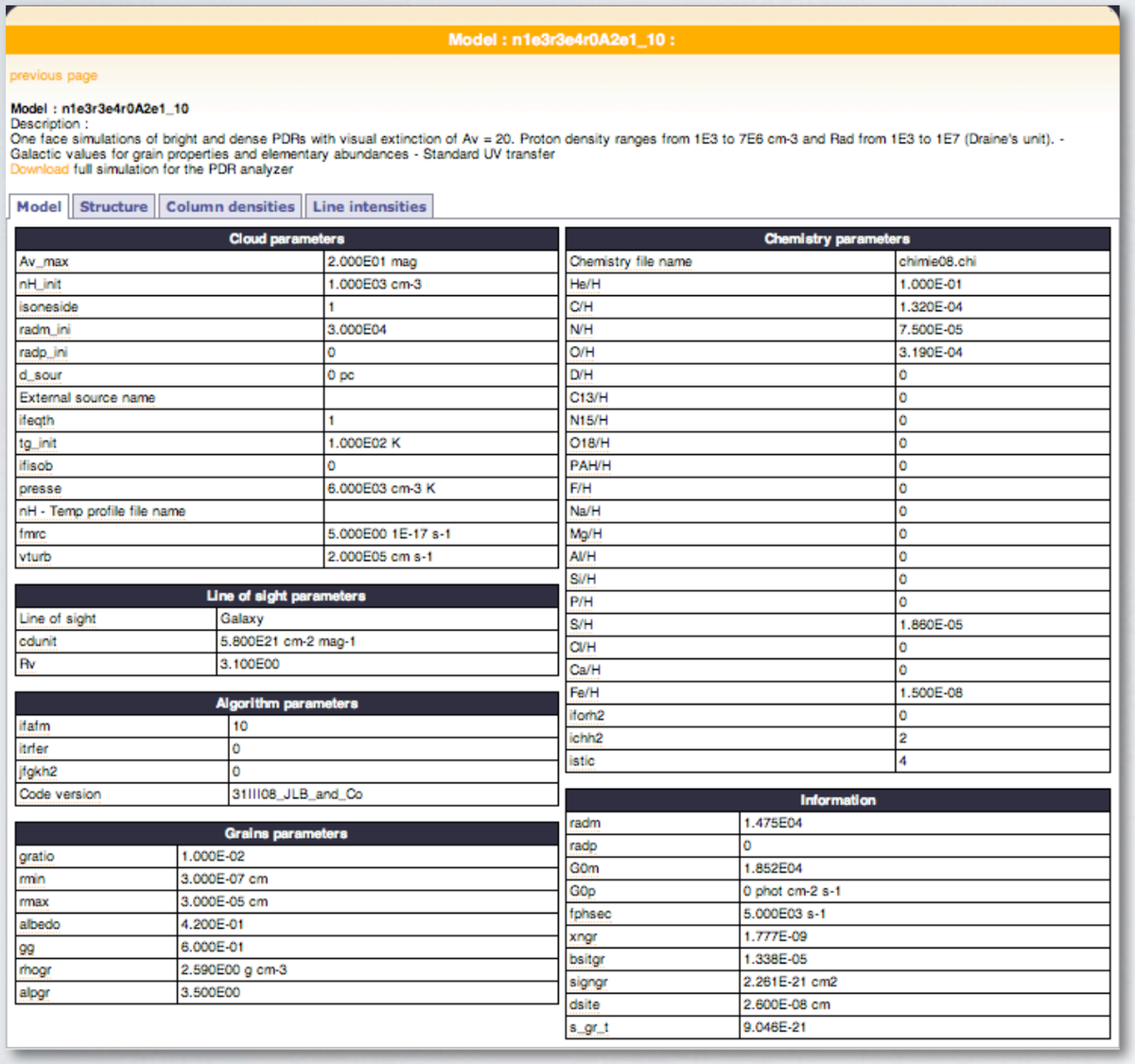
Select at least one criteria on parameters :

Parameter	Possible values	User value
nH_init	100.0, 500.0, 1000.0, 3.000E03, 7.000E03, 1.000E04, 3.000E04, 7.000E04, 1.000E05, 3.000E05, 7.000E05, 1.000E06, 3.000E06, 7.000E06	
radm_ini	1.0, 5.0, 10.0, 1000.0, 3.000E03, 7.000E03, 1.000E04, 3.000E04, 7.000E04, 1.000E05, 3.000E05, 7.000E05, 1.000E06, 3.000E06, 7.000E06, 1.000E07	
radp_ini	0.0, 1.0, 5.0	
Av_max	1.0, 20.0	

search

PDR Database

SimDB permits queries on :
- input parameters : density, flux of cosmic rays, ...
- characterisation of properties : column densities, line intensities



Model : n1e3r3e4r0A2e1_10 :

previous page

Model : n1e3r3e4r0A2e1_10
Description :
One face simulations of bright and dense PDRs with visual extinction of Av = 20. Proton density ranges from 1E3 to 7E6 cm-3 and Rad from 1E3 to 1E7 (Draine's unit). - Galactic values for grain properties and elementary abundances - Standard UV transfer
Download full simulation for the PDR analyzer

Model | Structure | Column densities | Line intensities

Cloud parameters	
Av_max	2.000E01 mag
nH_init	1.000E03 cm-3
isoneside	1
radm_ini	3.000E04
radp_ini	0
d_sour	0 pc
External source name	
ifeqth	1
tg_init	1.000E02 K
ifisob	0
presse	6.000E03 cm-3 K
nH - Temp profile file name	
fmrc	5.000E00 1E-17 s-1
vturb	2.000E05 cm s-1

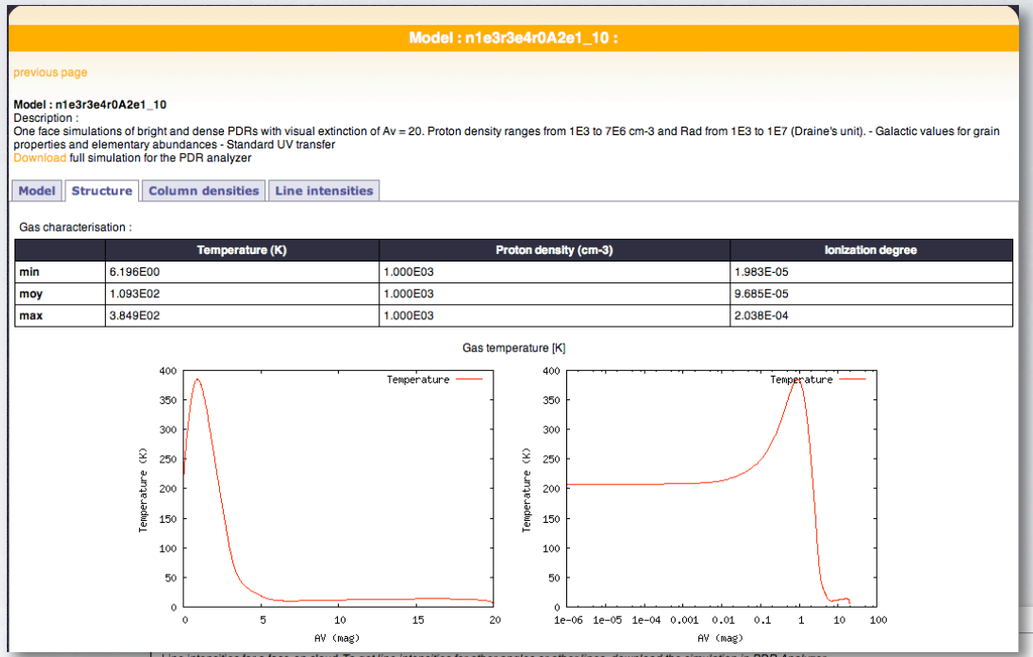
Line of sight parameters	
Line of sight	Galaxy
cdunit	5.800E21 cm-2 mag-1
Rv	3.100E00

Algorithm parameters	
ifafm	10
itrfer	0
jfgkh2	0
Code version	31III08_JLB_and_Co

Grains parameters	
gratio	1.000E-02
rmin	3.000E-07 cm
rmax	3.000E-05 cm
albedo	4.200E-01
gg	6.000E-01
rhogr	2.590E00 g cm-3
alpgr	3.500E00

Chemistry parameters	
Chemistry file name	chimie08.chi
He/H	1.000E-01
C/H	1.320E-04
N/H	7.500E-05
O/H	3.190E-04
D/H	0
C13/H	0
N15/H	0
O18/H	0
PAH/H	0
F/H	0
Na/H	0
Mg/H	0
Al/H	0
Si/H	0
P/H	0
S/H	1.860E-05
Cl/H	0
Ca/H	0
Fe/H	1.500E-08
iforh2	0
ichh2	2
istic	4

Information	
radm	1.475E04
radp	0
G0m	1.852E04
G0p	0 phot cm-2 s-1
fphsec	5.000E03 s-1
xngr	1.777E-09
bsitgr	1.338E-05
signgr	2.261E-21 cm2
dsite	2.600E-08 cm
s_gr_t	9.046E-21



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Download full simulation for the PDR analyzer

Model | Structure | Column densities | Line intensities

Gas characterisation :

	Temperature (K)	Proton density (cm-3)	Ionization degree
min	6.196E00	1.000E03	1.983E-05
moy	1.093E02	1.000E03	9.685E-05
max	3.849E02	1.000E03	2.038E-04

Gas temperature [K]

Line intensities for a face-on cloud *To get line intensities for other angles or other lines, download the simulation in PDR Analyzer*

[C I] Line intensities

Line	Intensity [erg cm-2 s-1]
3P_J=1, 3P_J=0, 609.75 micron	4.320E-06
3P_J=2, 3P_J=1, 370.37 micron	6.605E-06

[O I] Line intensities

Line	Intensity [erg cm-2 s-1]
3P_J=0, 3P_J=1, 145.53 micron	3.824E-05
3P_J=1, 3P_J=2, 63.19 micron	8.420E-04

[C II] Line intensities

Line	Intensity [erg cm-2 s-1]
2P_J=3/2, 2P_J=1/2, 157.68 micron	6.571E-04

H2 Line intensities

Line	Intensity [erg cm-2 s-1]
1 2 0 0 1- 0 S(0), 2.2232 micrometres	1.401E-09
1 3 0 1 1- 0 S(1), 2.1217 micrometres	1.346E-09
1 4 0 2 1- 0 S(2), 2.0337 micrometres	1.288E-09
1 5 0 3 1- 0 S(3), 1.9575 micrometres	6.064E-10
2 4 1 2 2- 1 S(2), 2.1541 micrometres	6.279E-10
2 5 1 3 2- 1 S(3), 2.0734 micrometres	2.768E-10

Next step : Add access protocol TAP / SimDAP

☐ PDR Services

☑ Online PDR code in the VO

☑ SimDB PDR service

☑ Documentations

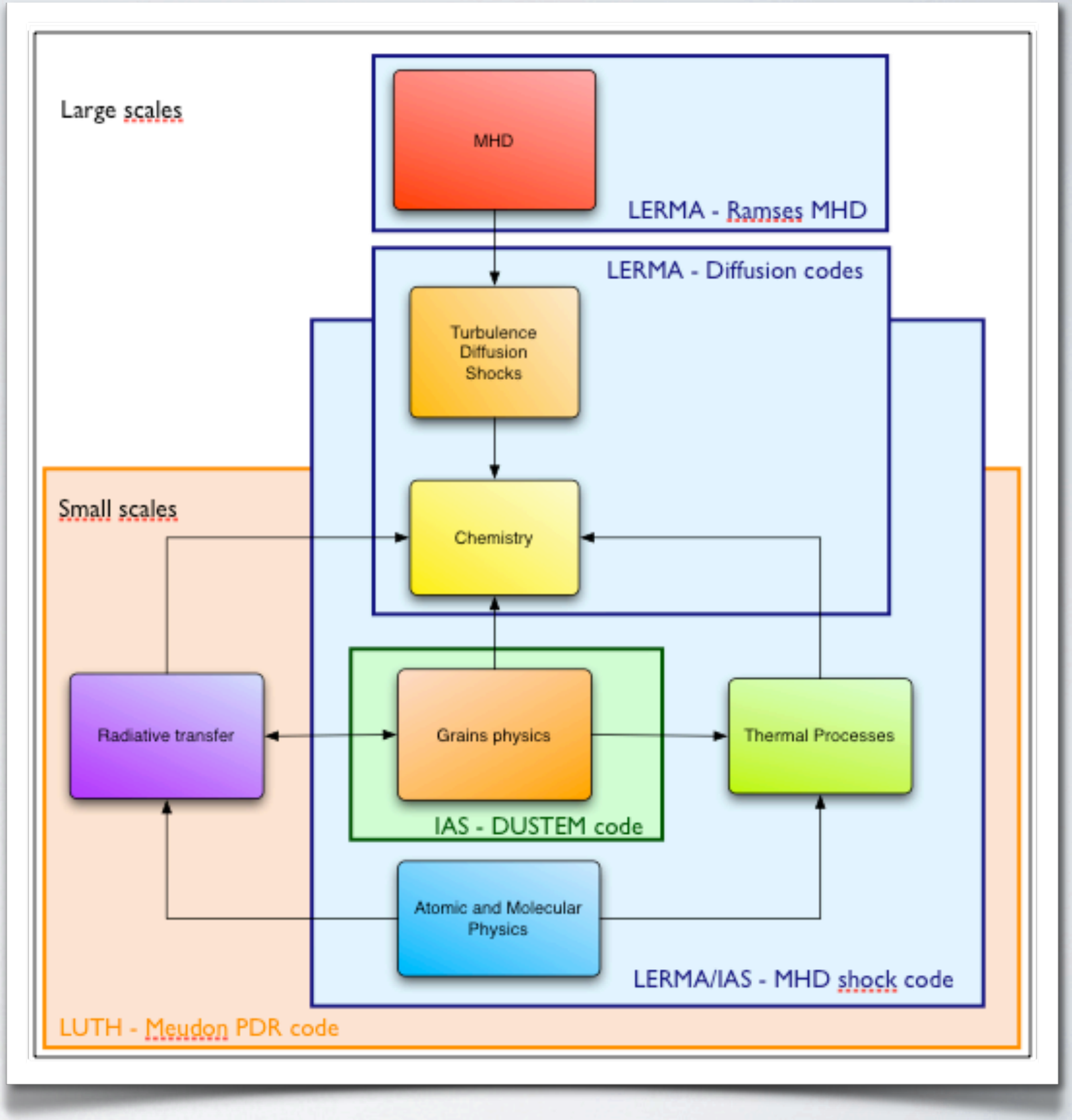
- Scientists using the services
- Developpers & scientists wishing to develop VO services

This work motivated scientists to build theoretical services
- among them those working on simulations of the ISM in Paris

VO Plateform for simulation of ISM

LERMA - LUTH - IAS

Franck Le Petit
Patrick Hennebelle
Fabrice Roy
Evelyne Roueff
Jacques Le Bourlot
Edith Falgarone
Nicolas Moreau
Benjamin Ooghe
Sylvie Cabrit
Pierre Lesaffre
François Lévrier
Laurent Pagani
François Boulanger
Laurent Verstraete
Guillaume Pineau des Forêts

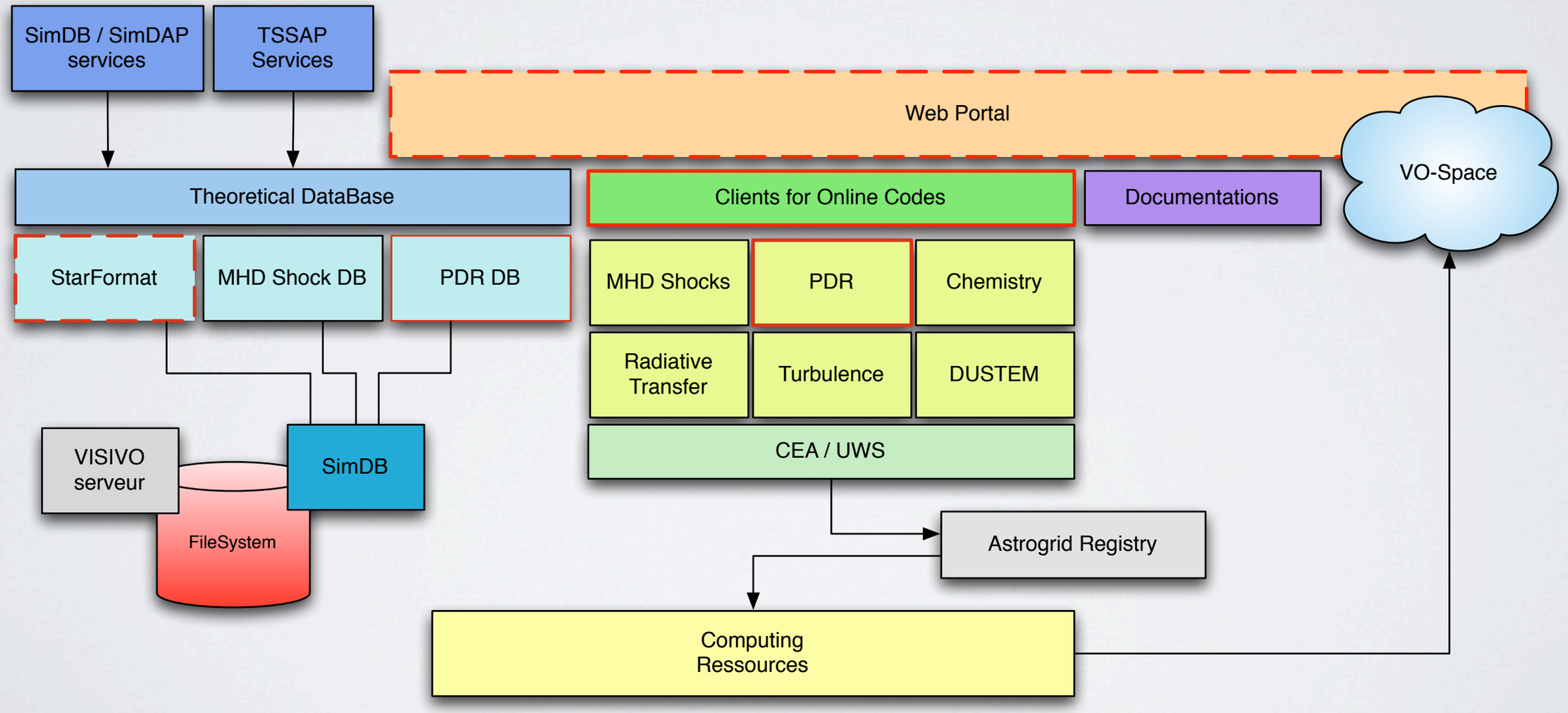


Interstellar Medium Platform

Bring together expertise in modeling / simulation of the ISM

Provide theoretical services about ISM

Codes - Databases - Tools & services



ASTRONET : Project **STARFORMAT**

First part of the project funded by ASTRONET
(P. Hennebelle et al.)

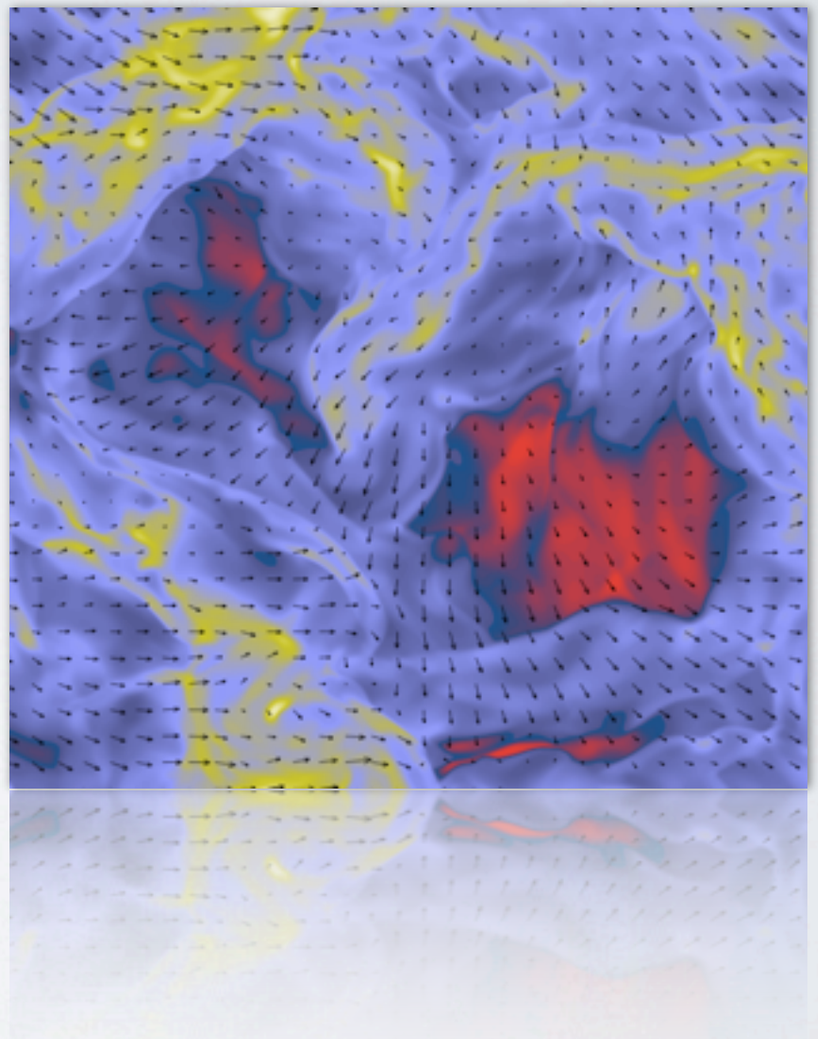
French & German teams

Development of services for MHD simulations
SimDB

Codes : Ramses / FLASH

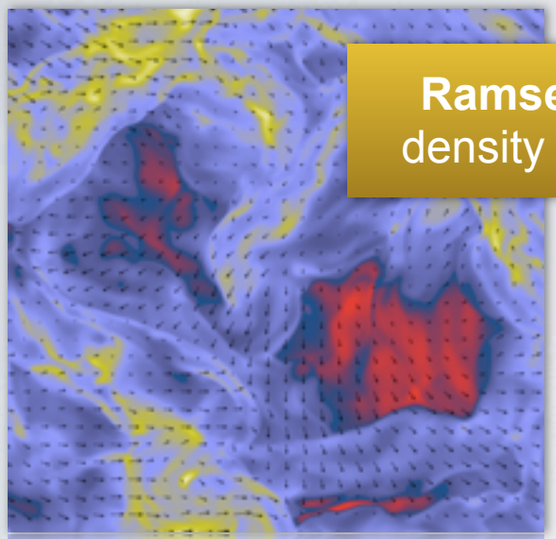
Catalogs of dense cores properties

services (SimDAP):
Extraction of cores
Extraction of density profiles on a line of sight



Interstellar Medium Platform

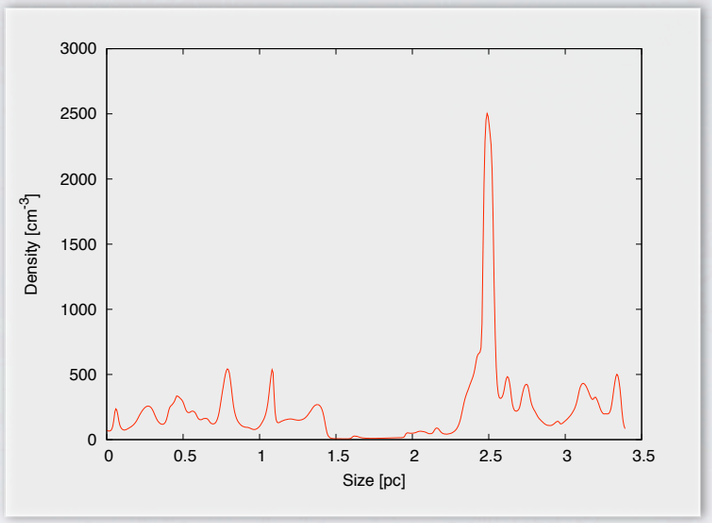
Interoperability between codes & services

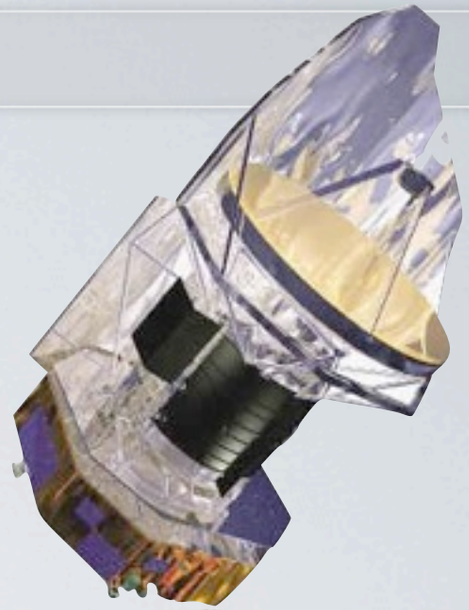


Ramses-MHD database
density & velocity structure

SimDAP

Density profile on a line of sight (3.5 pc)



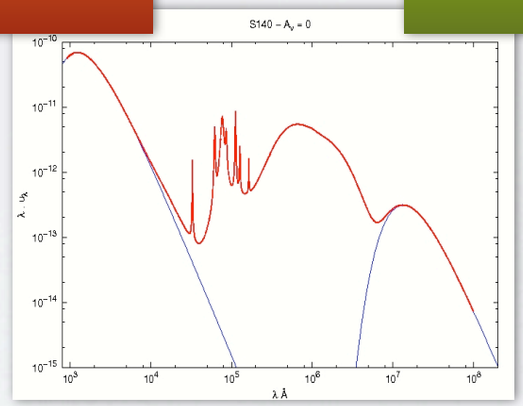


Meudon PDR code
Chemical & thermal structure

SimDAP

Radiative transfer code
Molecules excitations

Line intensity



DUSTEM
Grains emission / temperature

SLAP

SLAP

Atomic & Molecular Databases (VAMDC)

l'Observatoire de Paris

l'Observatoire de Paris — LUTH
Laboratoire Univers et Théories

l'Observatoire de Paris — LERMA
Laboratoire d'Étude du Rayonnement et de la Matière en Astrophysique

IAS

EURO VO DATA CENTRE ALLIANCE

l'Observatoire de Paris Virtual Observatory Paris Data Centre