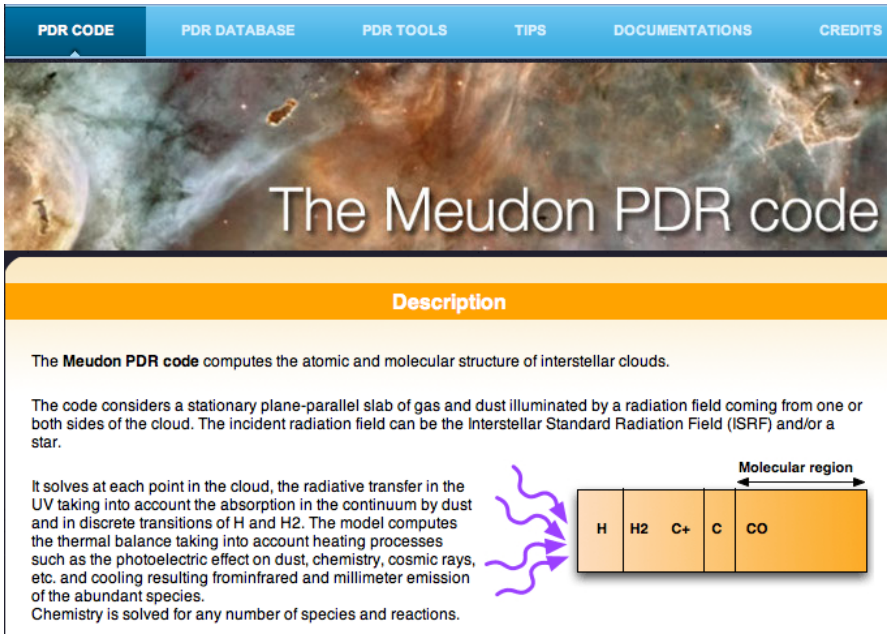
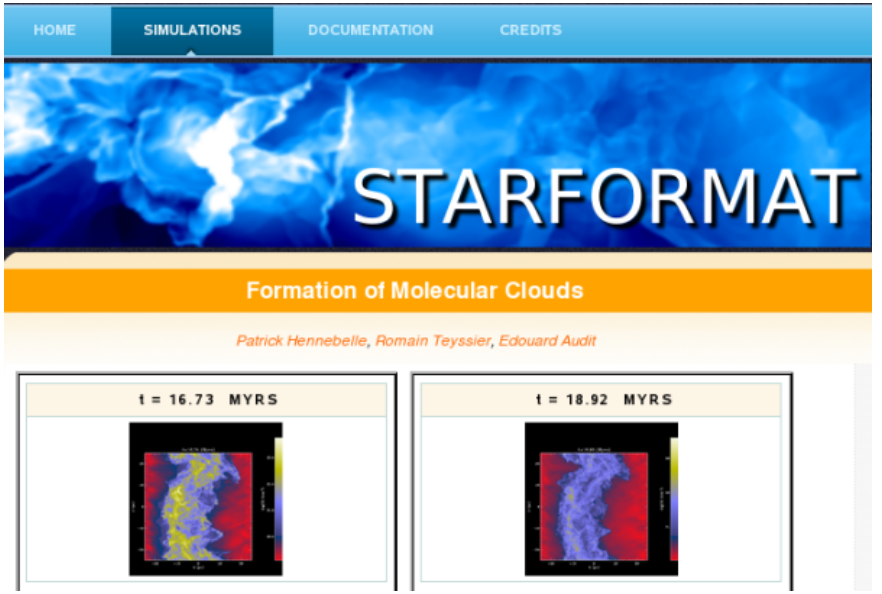
PDR & StarFormat

Recent developments on Paris Observatory's theoretical VO services

Benjamin Ooghe, Nicolas Moreau
Franck Le Petit, Patrick Hennebelle





Laboratoire d'Étude du Rayonnement et de la Matière en Astrophysique
Laboratoire Univers et Théories

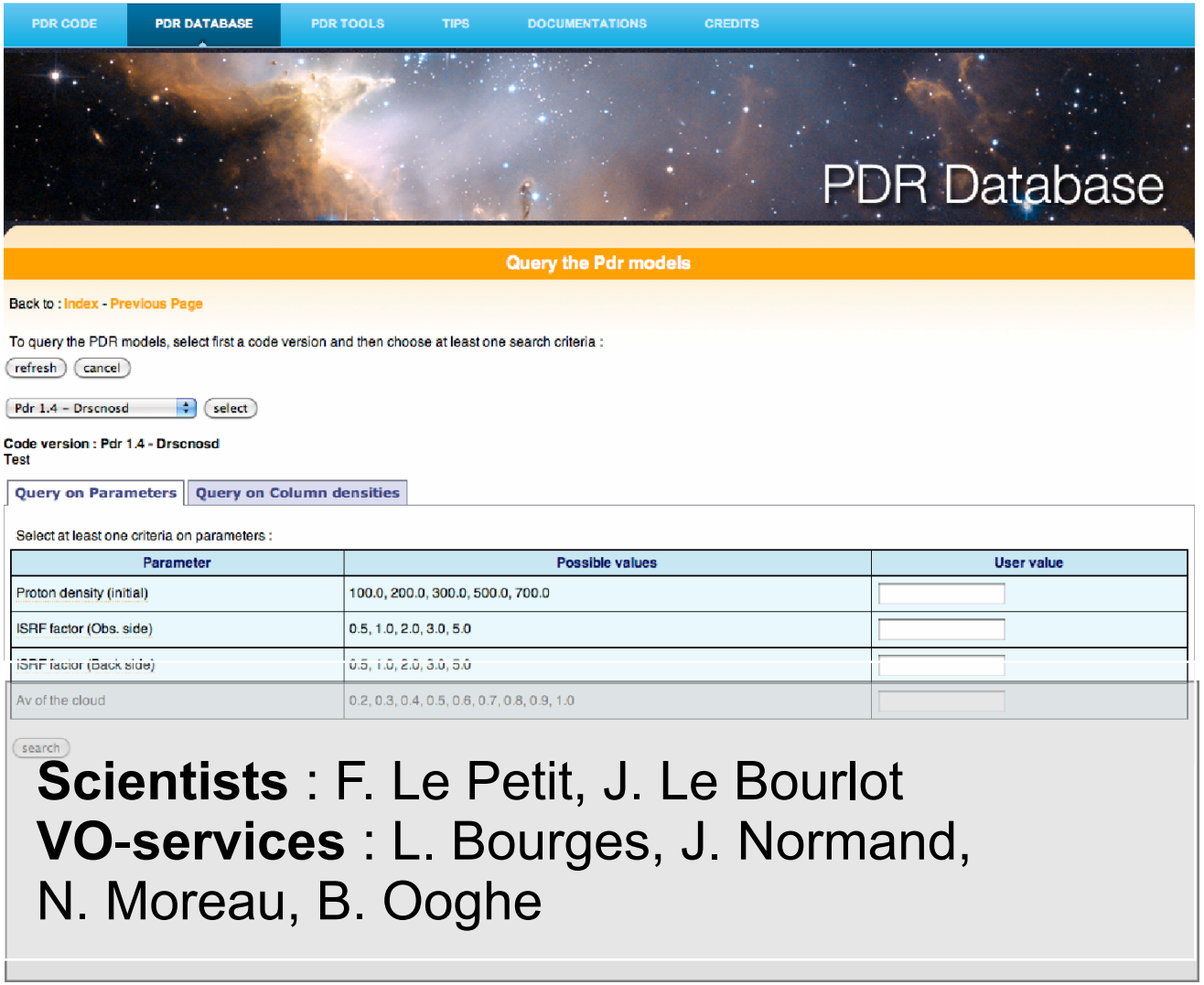
PDR WebSite & DataBase

- **Download Code with Doc**
- **Run Online Code**

CPU-demanding

=> Publish DataBase of grids of models:

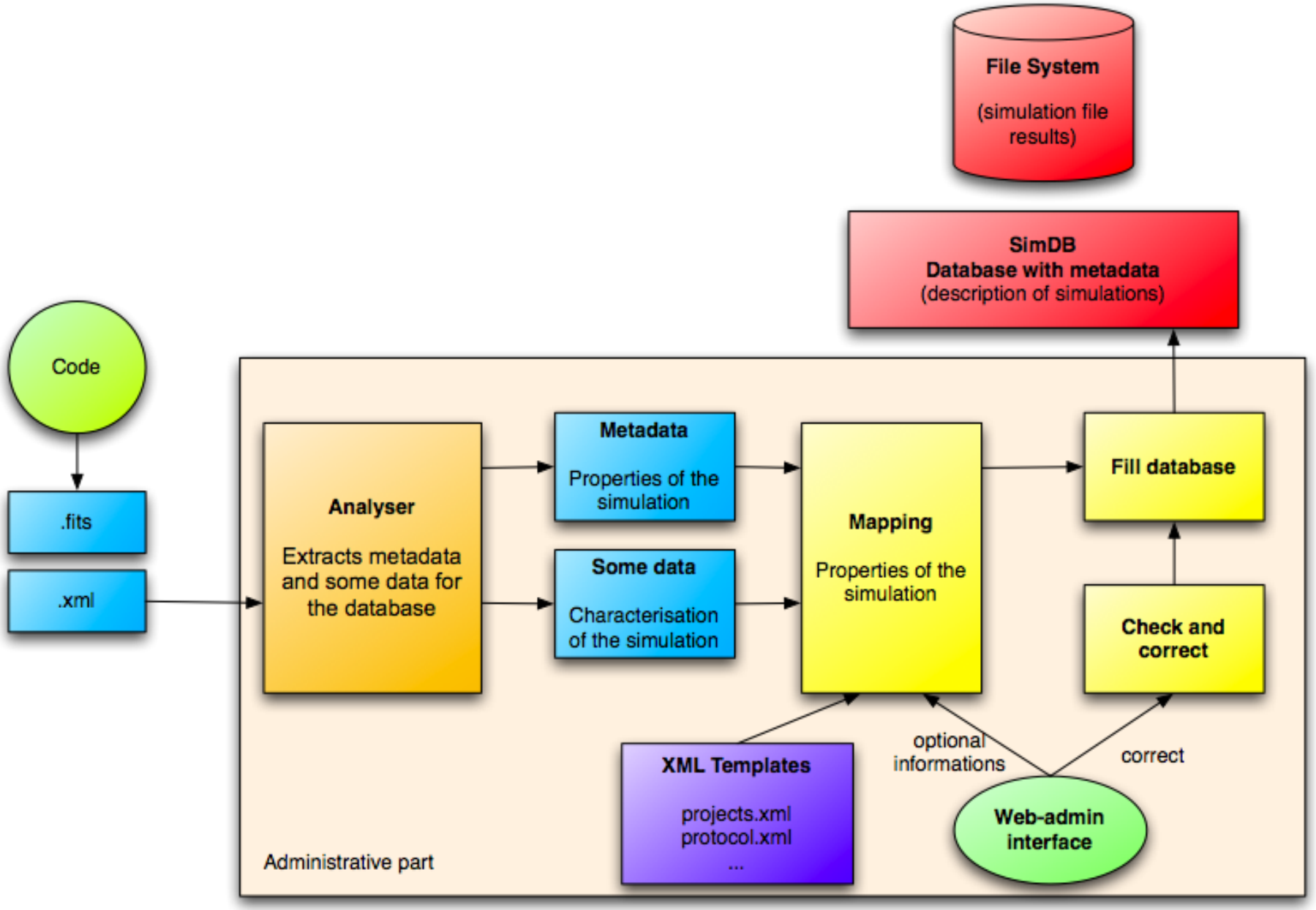
- **diffuse clouds**
- **dense clouds**
- **extragalactic medium**
- **...**



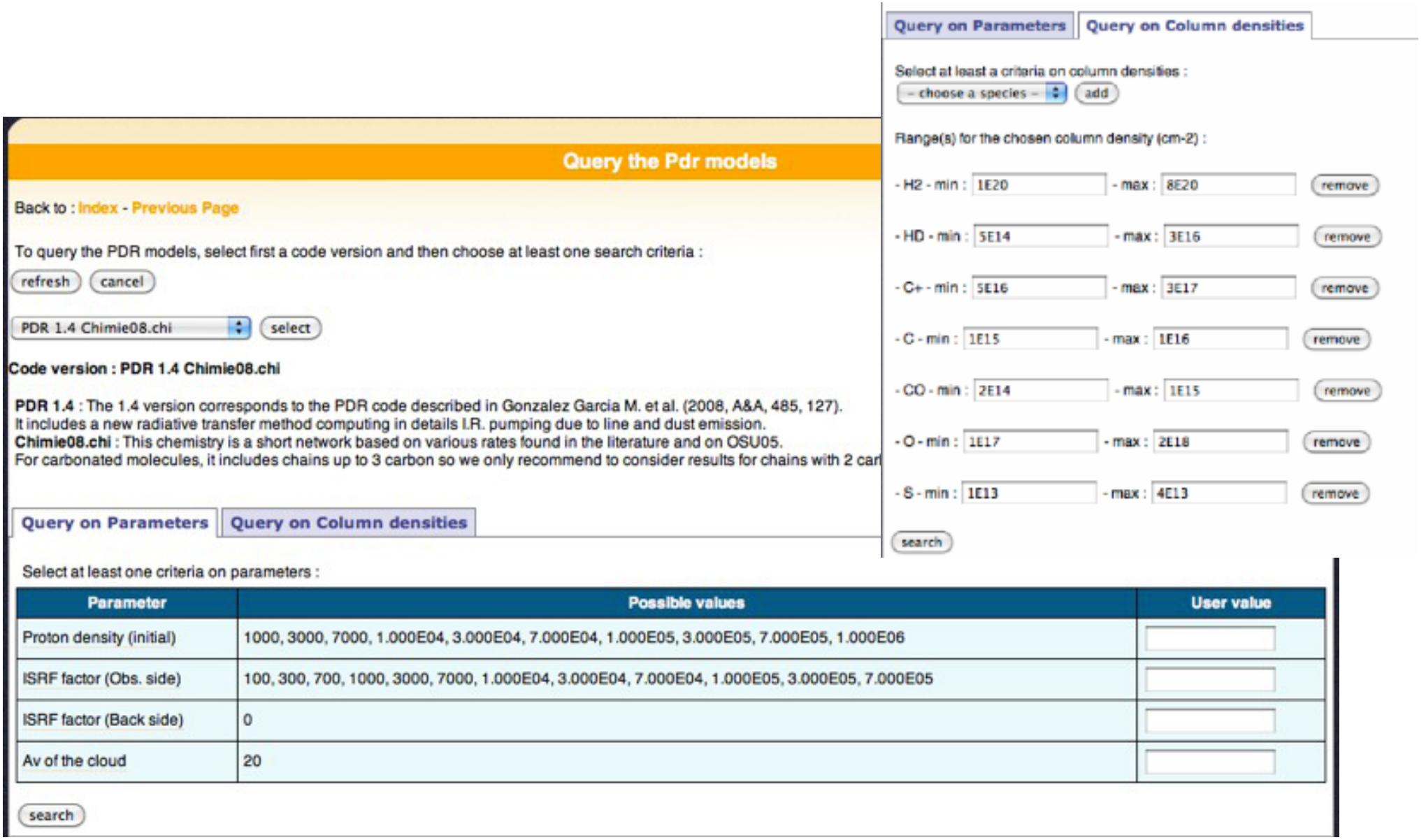
Scientists : F. Le Petit, J. Le Bourlot
VO-services : L. Bourges, J. Normand, N. Moreau, B. Ooghe

http://pdr.obspm.fr

Simple model ingestion process



Queries for Modelers & Observers



Browse models information

Name	n1e3r7e5A20_10	n1e3r7e4A20_10	n1e3r7e3A20_10
Actions	View Download	View Download	View Download
Cloud parameters			
Av of the cloud[mag]	20	20	20
Proton density (initial)[cm-3]	1000	1000	
Flag : 1 or 2 side(s) model	1	1	
ISRF factor (Obs. side)	7.00E05	7.00E04	
ISRF factor (Back side)	0	0	
Distance of the point UV source[pc]	0	0	
Flux of cosmic rays[1E-17 s-1]	5	5	
Micro-turbulent velocity[cm s-1]	2.00E05	2.00E05	
Chemistry parameters			
Chemistry file name	chimie08.chi	chimie08.	
He / H	1.00E-01	1.00E-01	
C / H	1.32E-04	1.32E-04	

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

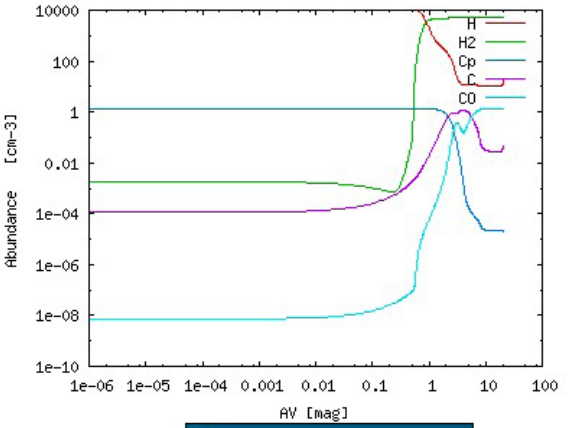
Chemistry parameters	
Chemistry file name	chimie08.chi
He/H	1.000E-01
C/H	1.320E-04
N/H	7.500E-05
O/H	3.190E-04
D/H	0
C13/H	0
N15/H	0
O18/H	0
PAH/H	0
F/H	0
Na/H	0
Mg/H	0
Al/H	0
	0
	0
	1.860E-05
	0
	0
	1.500E-08
	0
	2
	4

Information	
	1.475E04
	0
	1.852E04
	0 phot cm-2 s-1
	5.000E03 s-1

Model | Structure | Plot | Column densities | Line intensities | Spectra

Choose a property to plot
CO
Abundance Log
AV Log
Plot

Selected elements		
Element	Column density	Deletion
H	1.73e+21 cm-2	Delete
H2	1.78e+22 cm-2	Delete
C+	5.40e+17 cm-2	Delete
C	8.71e+17 cm-2	Delete
CO	3.49e+18 cm-2	Delete



Data		
VOTable	View	Send
Ascii	View	

VOTable

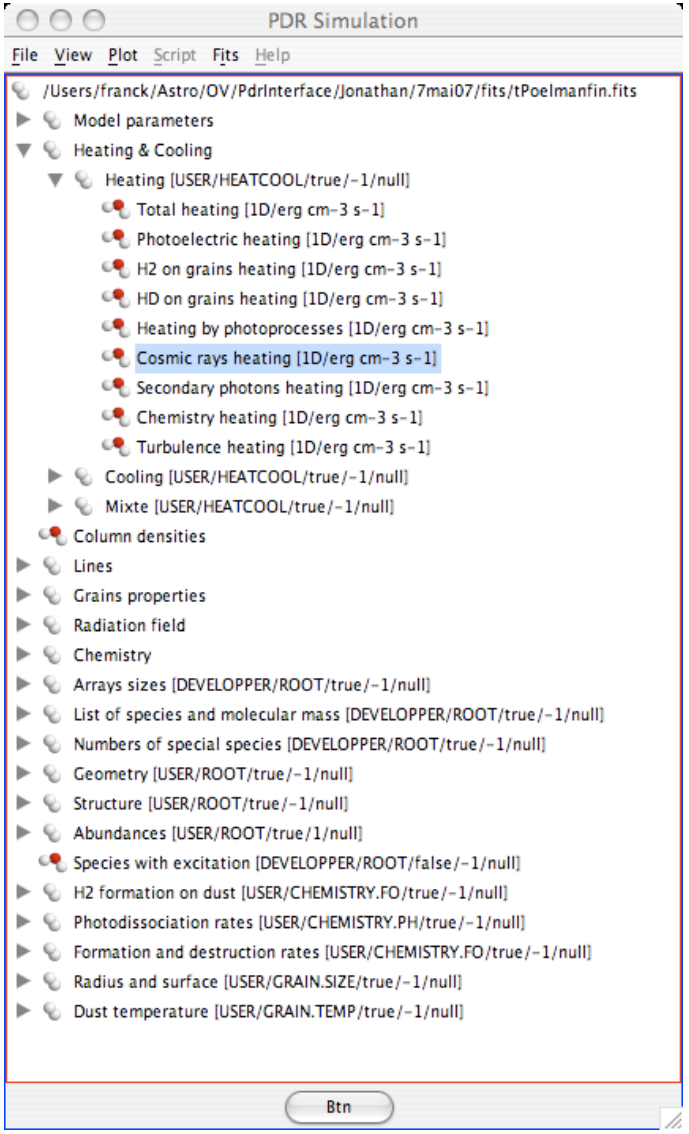
SAMP

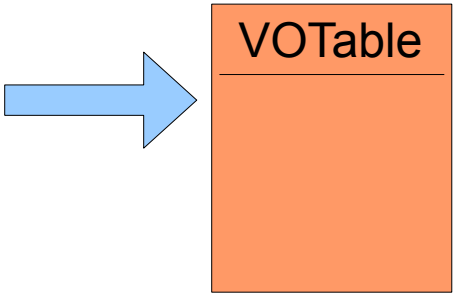
Download & manipulate full results

Download service
- Get full results of a model
- FITS file : data
- XML file : metadata

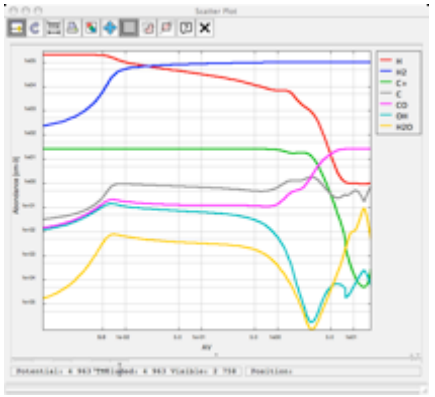
PDR Analyser
- Read & draw data
- Compute line intensities as a function of angle
- Chemistry analyser

Extraction ASCII/VOTable
→ TopCat/SAMP

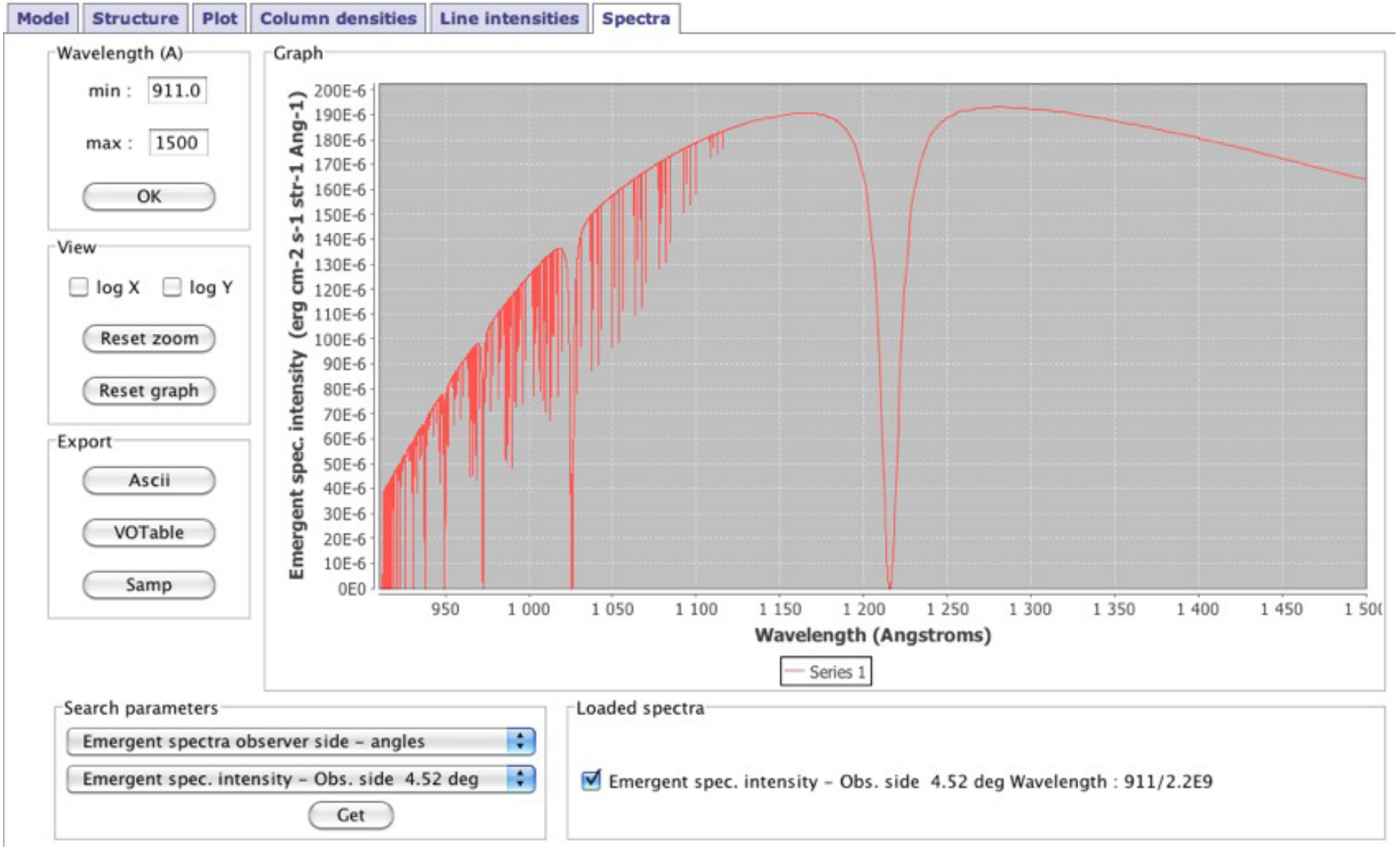




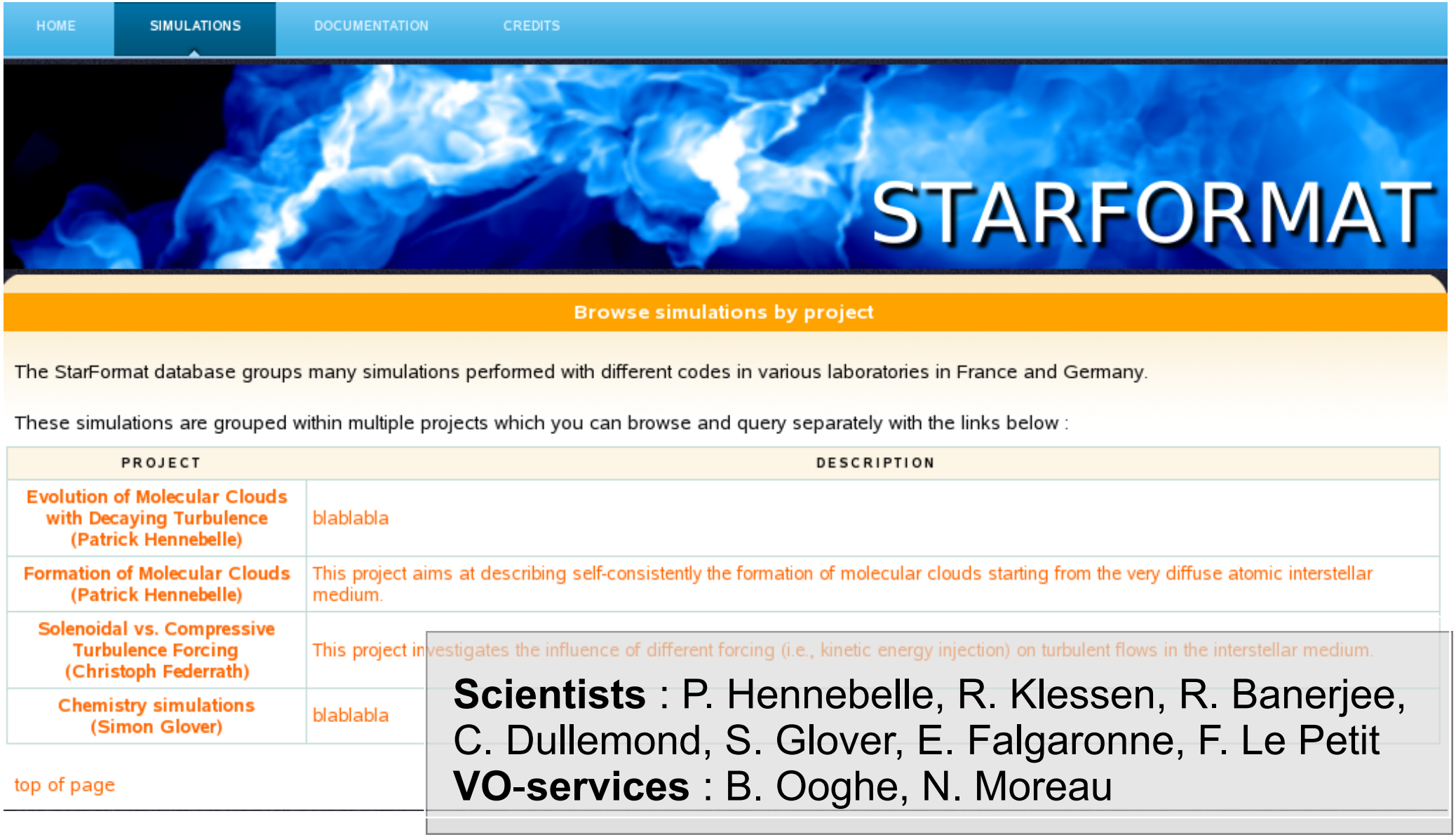
SAMP



Online Spectra Browsing



StarFormat

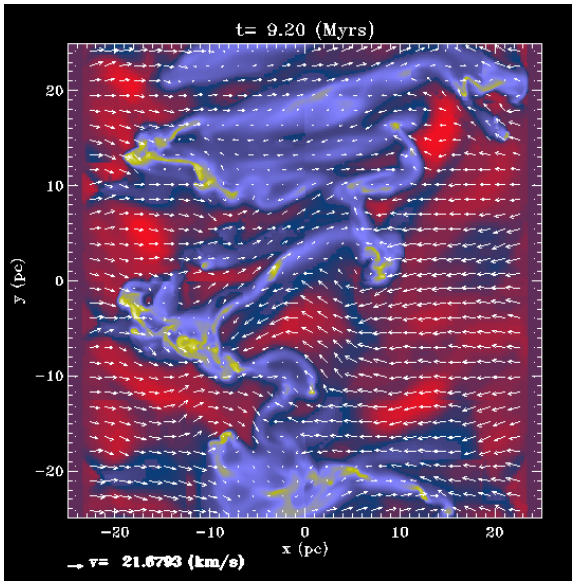


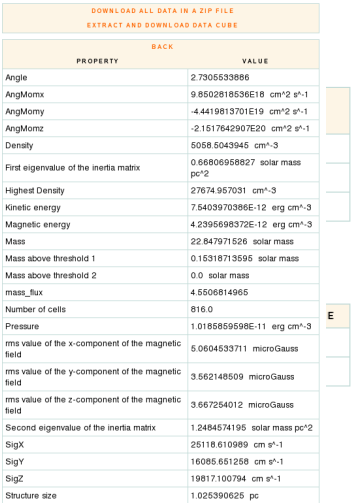
Scientists : P. Hennebelle, R. Klessen, R. Banerjee, C. Dullemond, S. Glover, E. Falgaronne, F. Le Petit
VO-services : B. Ooghe, N. Moreau

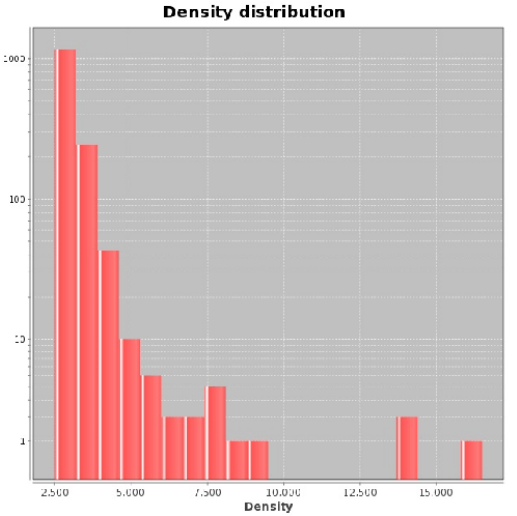
http://starformat.obspm.fr

RAMSES-MHD Simulations

- LERMA-ENS Project
- 2 Projects (Formation, Evolution)
  => 7 simulations
- 2 snapshots x 2 clump extractions
- Browse properties statistics and PDF on each snapshot
- 40 000 clumps
- Search clumps by characterization
- Extract raw results data

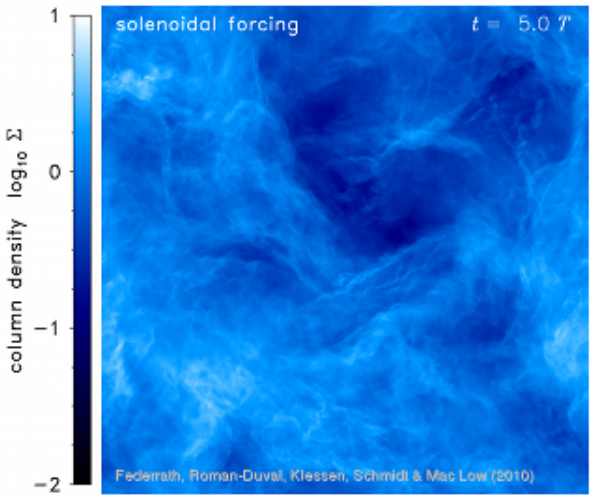


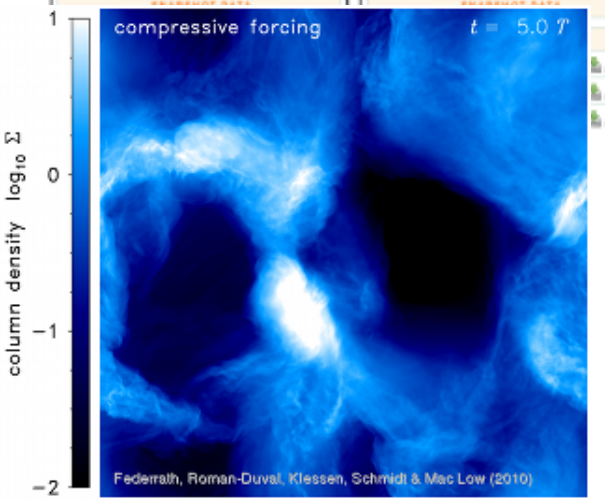




FLASH Turbulence Simulations

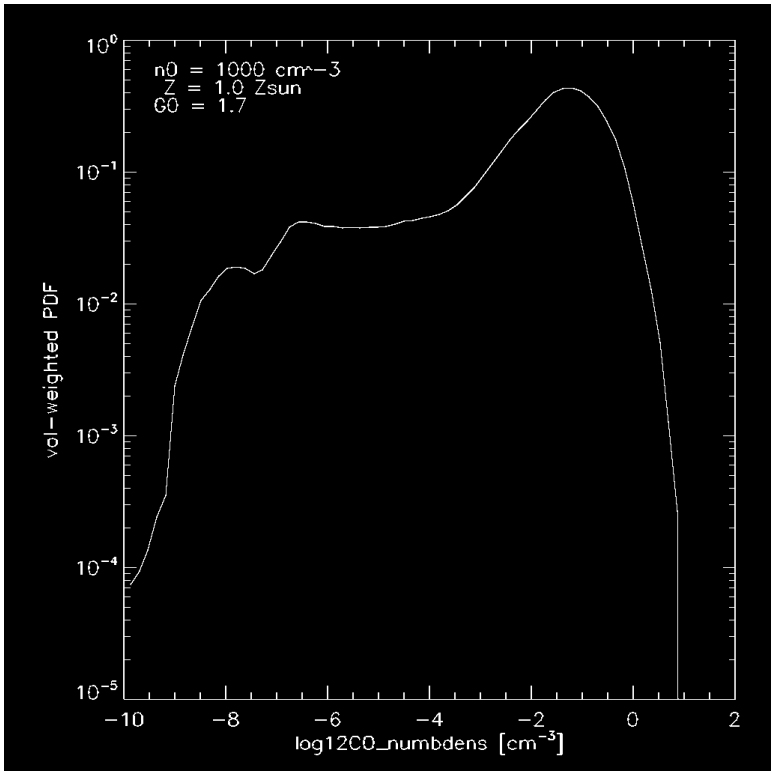
- ZAH Project
- 2 concurrent simulations
- 9 snapshots / simulation
- Extract raw results data





ZEUS Chemistry Simulations

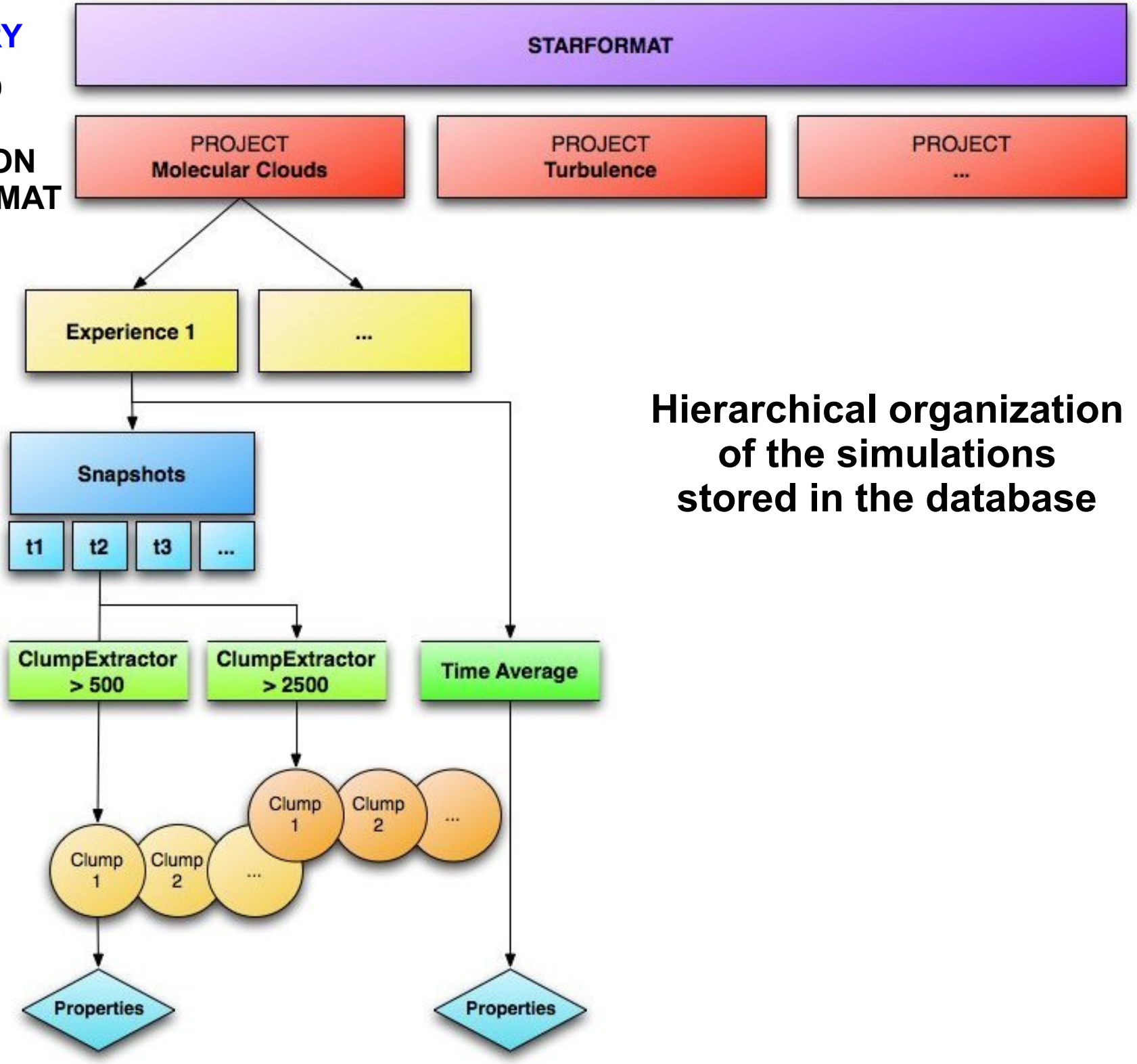
- ZAH Project
- First tryouts on 2 simulations out of a few dozens considered
- 5-6 snapshots / simulation
- Browse PDF on each snapshot



- Extract raw data?
- Chemistry applications?

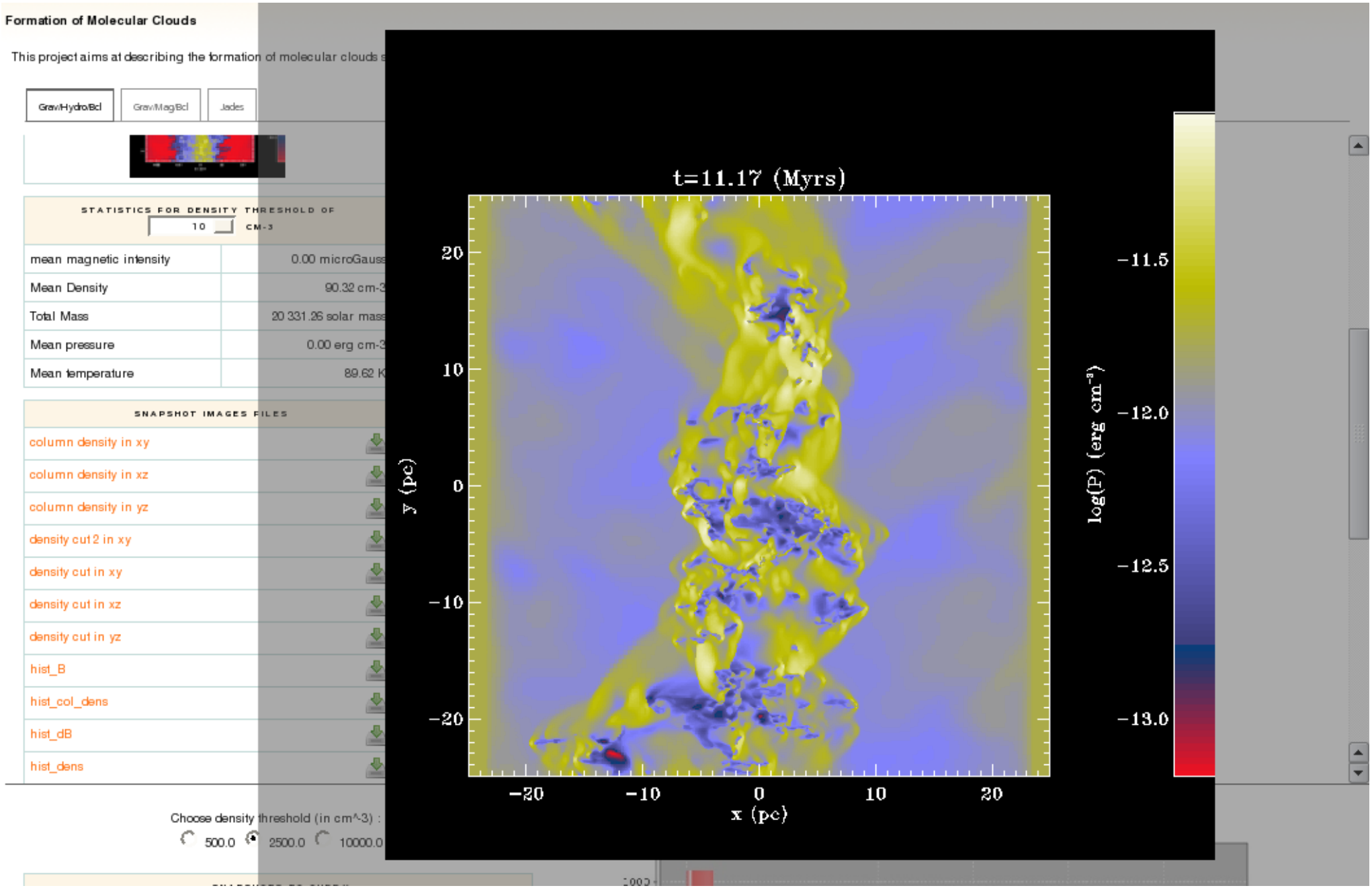
IVOA THEORY

SIMPLIFIED MODEL ORGANIZATION FOR STARFORMAT



Hierarchical organization of the simulations stored in the database

Snapshot info, statistics & images



Dense cores research by property

Choose density threshold (in cm^-3) :

○ 500.0 ◉ 2500.0 ○ 10000.0

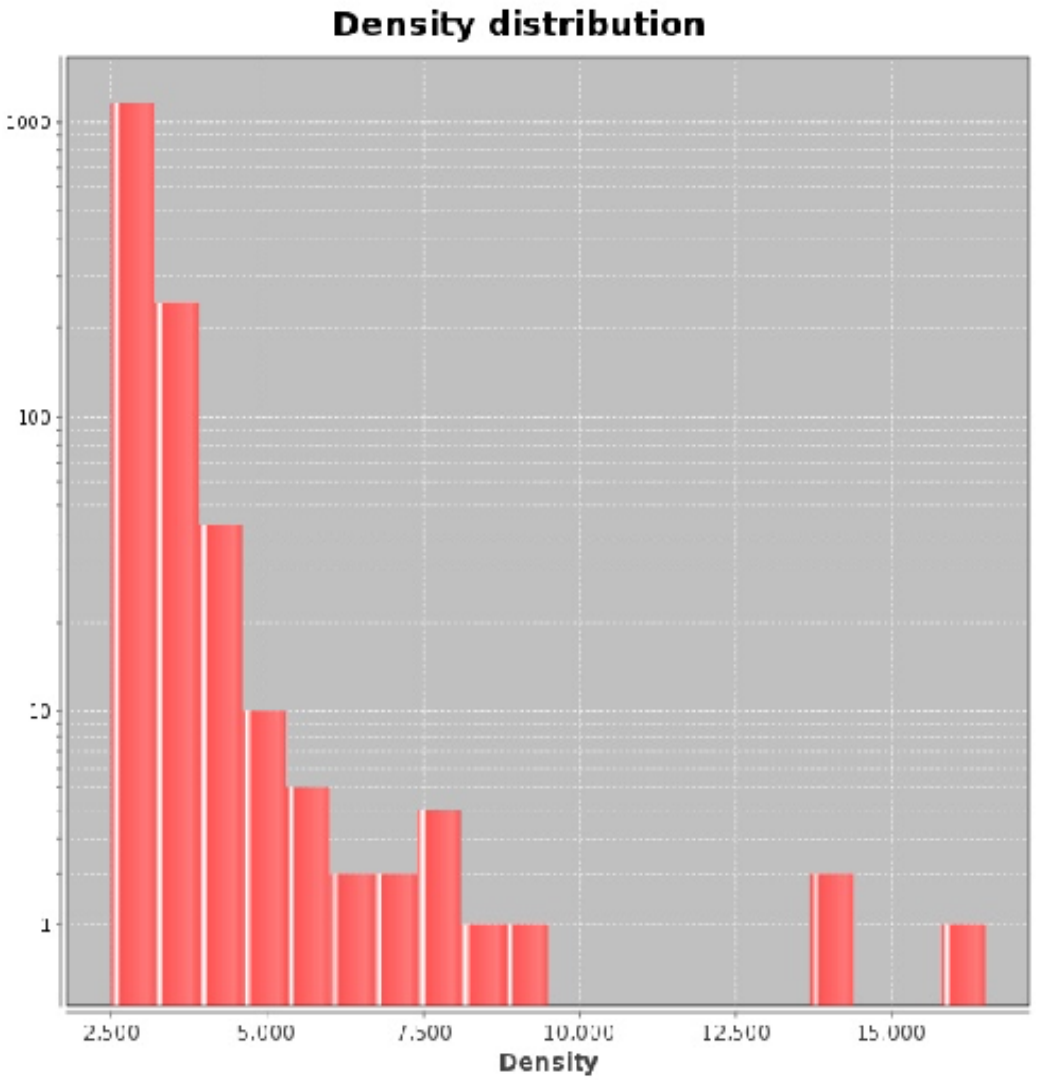
SNAPSHOTS TO QUERY	
EXPERIMENTS	SNAPSHOTS
Grav/Hydro/Bcl	8.38 Myrs ☐ 11.17 Myrs ☐
Grav/Mag/Bcl	8.55 Myrs ☑ 10.90 Myrs ☑
Jades	16.74 Myrs ☐ 18.93 Myrs ☐

Select

Search in 1476 clumps

PROPERTY	MINIMUM VALUE	MAXIMUM VALUE
Mass(solar mass)		
Density(cm^-3)	5000	8500

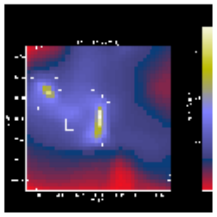
Search



Clump results & raw data extraction

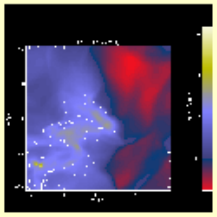
DECAY_HYDRO

t = 1.16 MYRS



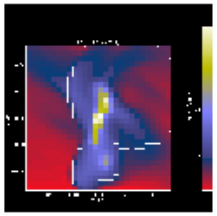
Mass : 5.08 solar mass

View details



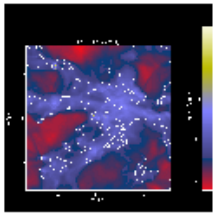
Mass : 6.5

View



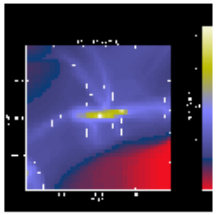
Mass : 9.9

View



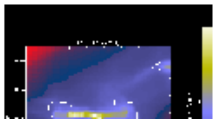
Mass : 20.0

View



Mass : 20.0

View



Mass : 25.97 solar mass

View details

BACK TO THIS CLUMP IN SEARCH RESULTS

EXTRACT AND DOWNLOAD CLUMP DATA

CLUMP PROPERTIES

Angle	0.66 rad
Density	64.48 cm^{-3}
	4.41 cm^{-3}
	croGauss
	croGauss
	croGauss
	croGauss
	olar mass
	28.14
	57000
	3.33 pc
	1.75 pc
	1.85 pc
	3.27 pc
	1.72 pc
	1.79 pc
	0.42 pc
	38 $cm.s^{-1}$
	05 $cm.s^{-1}$
	04 $cm.s^{-1}$
	04 $cm.s^{-1}$

http://starformat.obspm.fr - Extract StarFormat Data from Simulation - Mozilla Firefo:

File Edit View History Bookmarks Tools Help

Extract a subset of clump data from the simulation

What kind of values do you want to extract?

- a projection of column density
- a cube of density
- a cube of pressure
- a cube of velocity
- a cube of magnetic field

which component?

- X
- Y
- Z

Extraction box size: 0.84 pc (4.00 pc for the whole simulation)

Centered on: X 3.34 (pc) Y 1.75 (pc) Z 1.852 (pc)

Precision L_{max}: 10 corresponding to a resolution of 0.003 pc/cell

(maximum L_{max} allowed for this size of extraction: 10)

E-mail address (to receive a link to download the results): ooghe@lra.ens.fr

Extract Reset Cancel

If you need access to bigger sets of data, please e-mail the PI of the project.

Done

CLUMP IMAGES

Column Density in XY

Next ...

- Connect services together through GILDAS
- Advanced search queries & SIMDAL access
- Display extraction outputs online with VISIVO?
- Services for an InterStellar Medium Platform
  - Radiative transfer (RADMC)
  - Grains
  - Shocks
  - Turbulence
  - ...