



StarFormat

a simulation database

SimDB Implementation

at VO-Paris Datacenter

Benjamin Ooghe, Nicolas Moreau,
Franck Le Petit

<http://starformat.obspm.fr>

The screenshot shows the StarFormat website interface. At the top, there are navigation links: STARFORMAT HOME, STARFORMAT QUERY, DOCUMENTATIONS, and CREDITS. Below the links is a large, colorful density map of a molecular cloud simulation. To the right of the map, the word "STARFORMAT" is displayed in large white letters. Below the map, a yellow bar contains the text "Query the models :". Underneath the bar, there are links to "Back to : Index - Previous Page" and "Formation of Molecular Clouds". A descriptive text states: "This project aims at describing the formation of molecular clouds starting from the very diffuse atomic interstellar medium." Below this text are three buttons: "Grav/Hydro/Bcl", "Grav/Mag/Bcl", and "Jades". Further down, there is a section titled "Snapshots available" with two sub-sections: "8.38 MYRS" and "11.17 MYRS", each showing a density map. Below each map is a table titled "STATISTICS FOR DENSITY" with a threshold of 0 cm⁻³. The first table shows mean magnetic intensity of 0.00 microGauss and Mean Density of 6.08 cm⁻³. The second table shows mean magnetic intensity of 0.00 microGauss and Mean Density of 7.79 cm⁻³.



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



Laboratoire Univers et Théories

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StarFormat : MHD simulations of dense cores

Goal: Share MHD simulations of ISM

Interpretation of HERSCHEL and ALMA observations

Very different kinds of simulations from French & German teams:

Ramses-MHD, Flash, Gadget

Postprocessings : dense cores extraction, radiative transfer, ...

=> Many projects & simulations to store with different specs

The screenshot shows a web-based application for managing MHD simulation data. At the top, there's a decorative header featuring a colorful, abstract simulation visualization. To the right of this is the word "STARFORMAT" in large, white, sans-serif capital letters. Below the header is a yellow navigation bar containing the text "Query the projects :". Underneath this bar, a link "Back to : Index - Previous Page" is visible. The main content area contains descriptive text about the database and a table for viewing project details.

Back to : [Index](#) - [Previous Page](#)

The StarFormat database groups many simulations performed with different codes in various laboratories in France and Germany.

These simulations are grouped within multiple projects which you can browse and query separately with the links below :

PROJECT	DESCRIPTION
Formation of Molecular Clouds (Patrick Hennebelle)	<small>Formation of molecular clouds in turbulent environments</small> Scientists : P. Hennebelle, R. Klessen, R. Banerjee, C. Dullemond, S. Glover, E. Falgaronne, F. Le Petit
Turbulent Box Simulations (Christoph Federrath)	<small>Turbulence Feedback</small> VO-services : B. Ooghe, N. Moreau

[top of page](#)

Benjamin Ooghe

StarFormat: a SimDB Implementation at VO-Paris Datacenter

Tue, May 18th, 2009

2

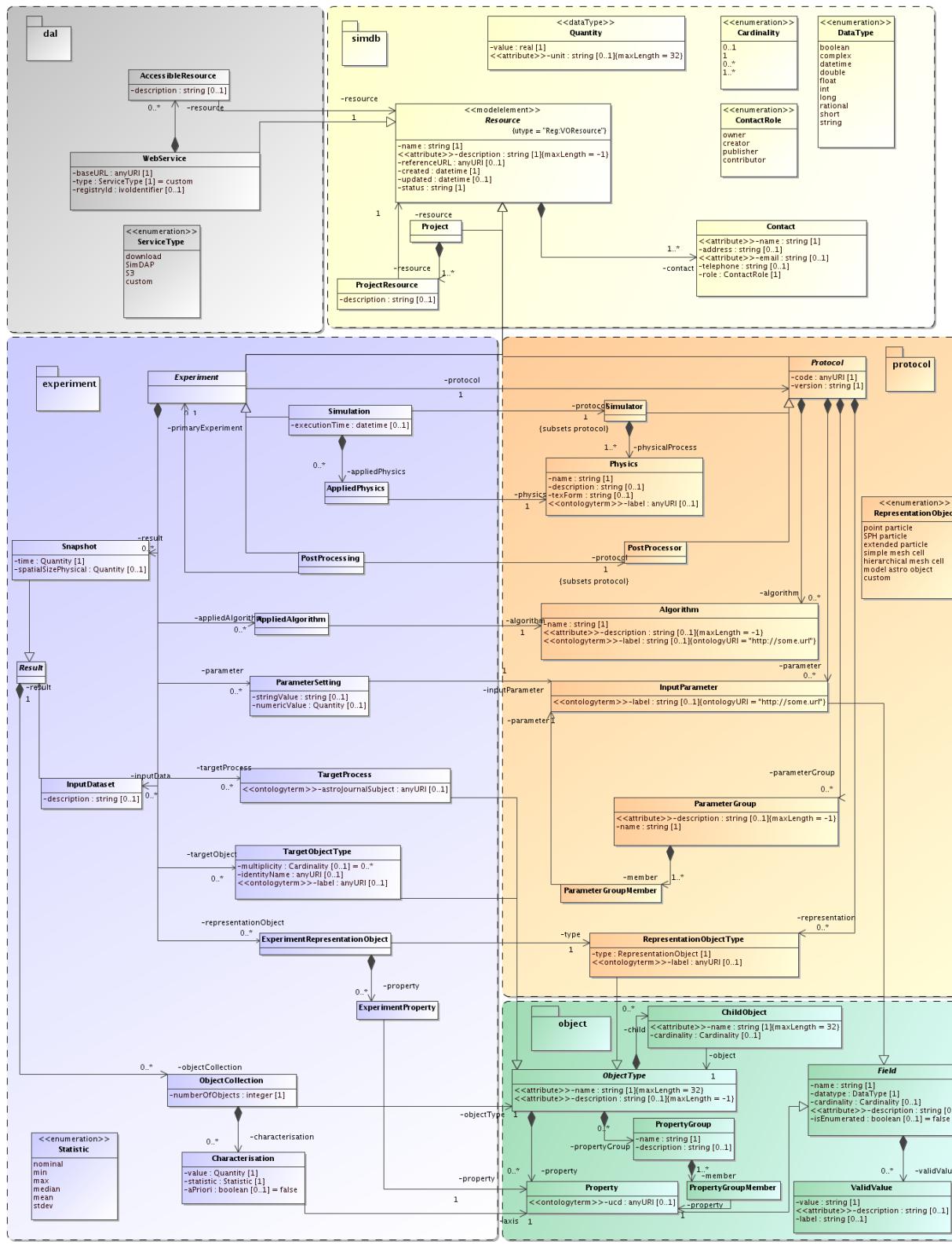
Objectives & Services

- 1) Release, Browse & Query results of Star Formation Simulations
- 2) Provide properties of lines of sight (density, velocity)
- 2) Identify extracted dense cores by properties:
mass, size, ...
density profiles
velocity profiles
- 3) Visualize & extract subsets of raw simulation cubes
Use of SimDAP
Visualisation by VisiVO server
- 4) *Maps of column densities (Ex: CO)*

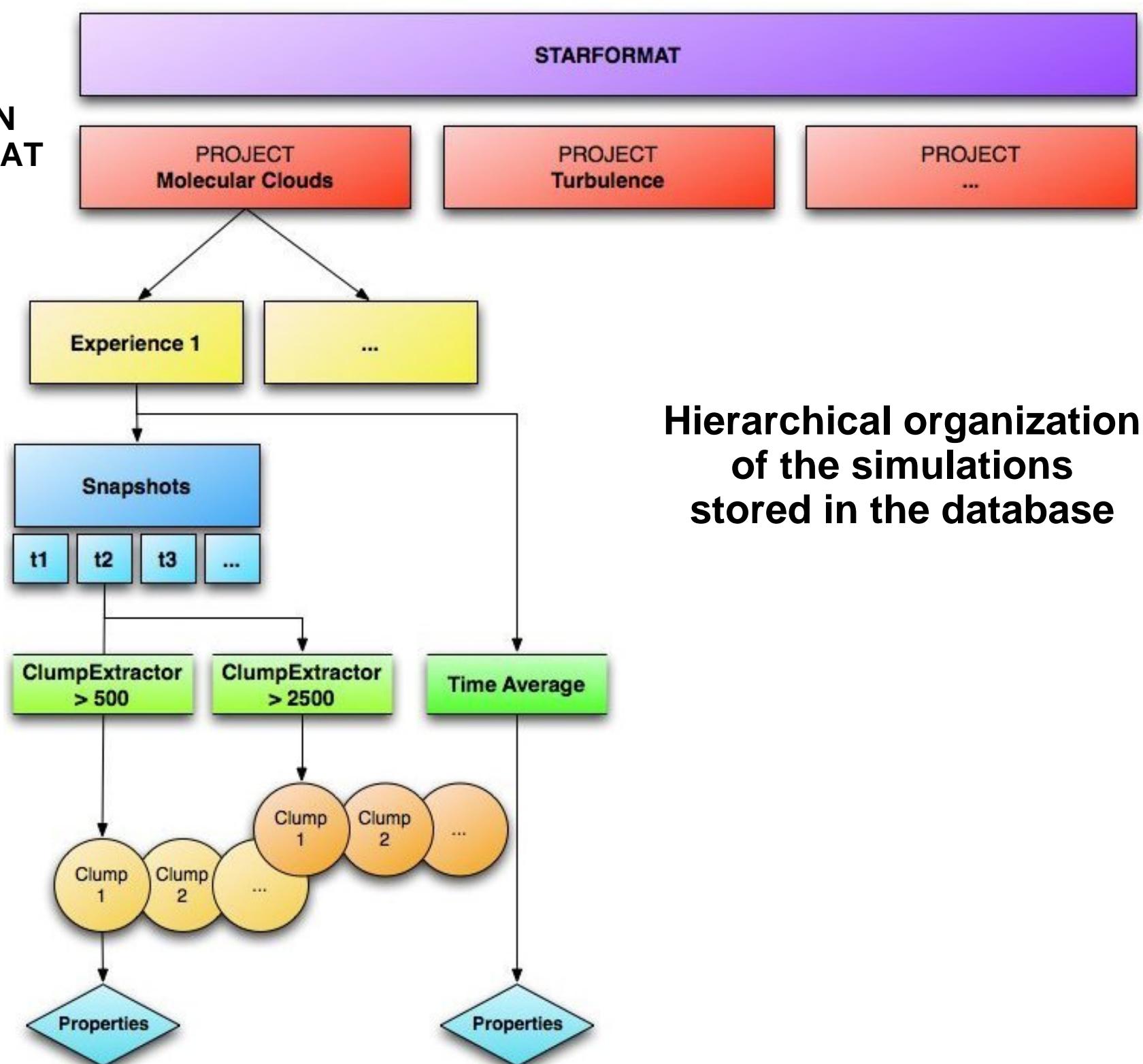
THEORY WORKING GROUP

SIMULATION DATA MODEL

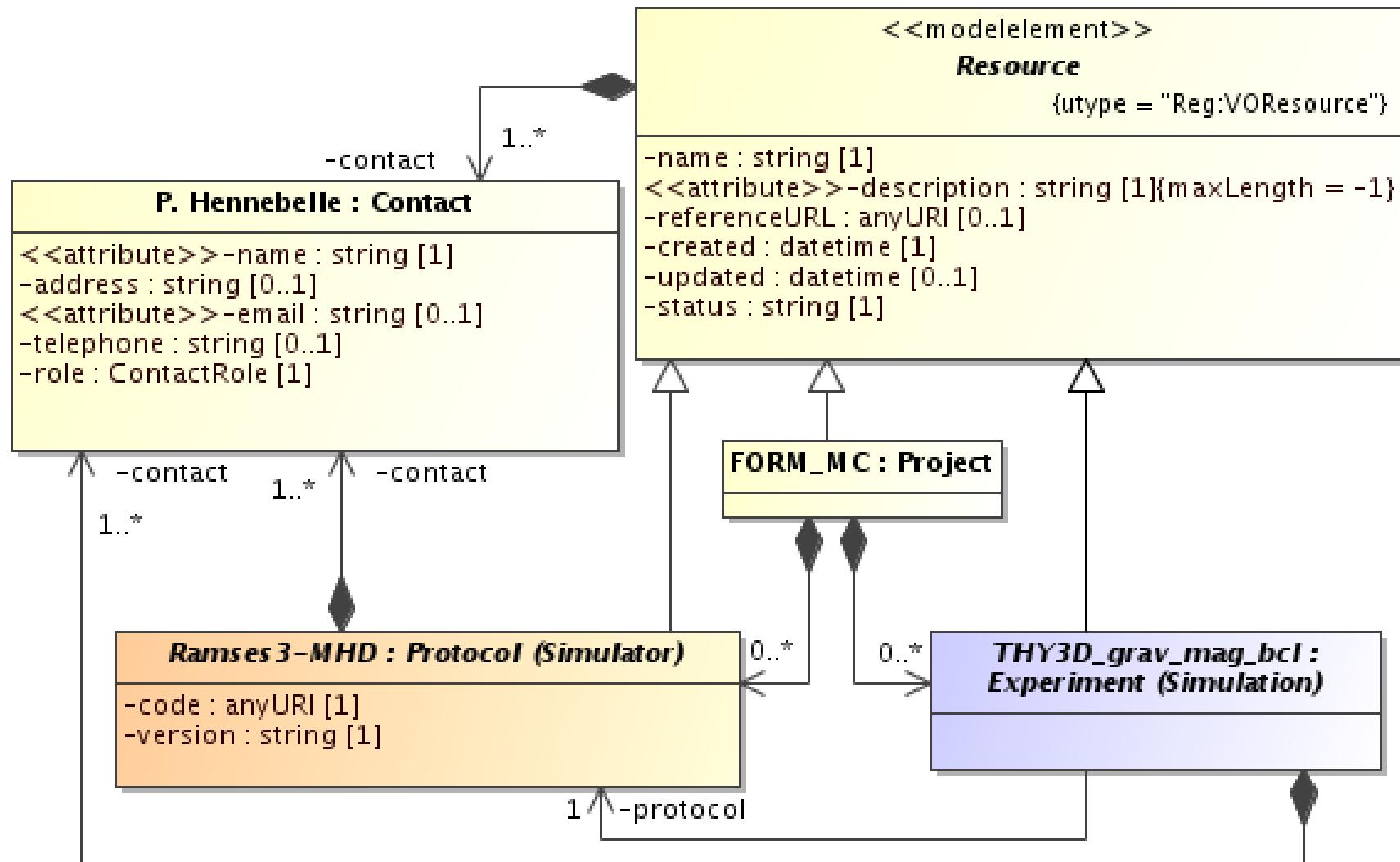
by G. Lemson
& L. Bourges



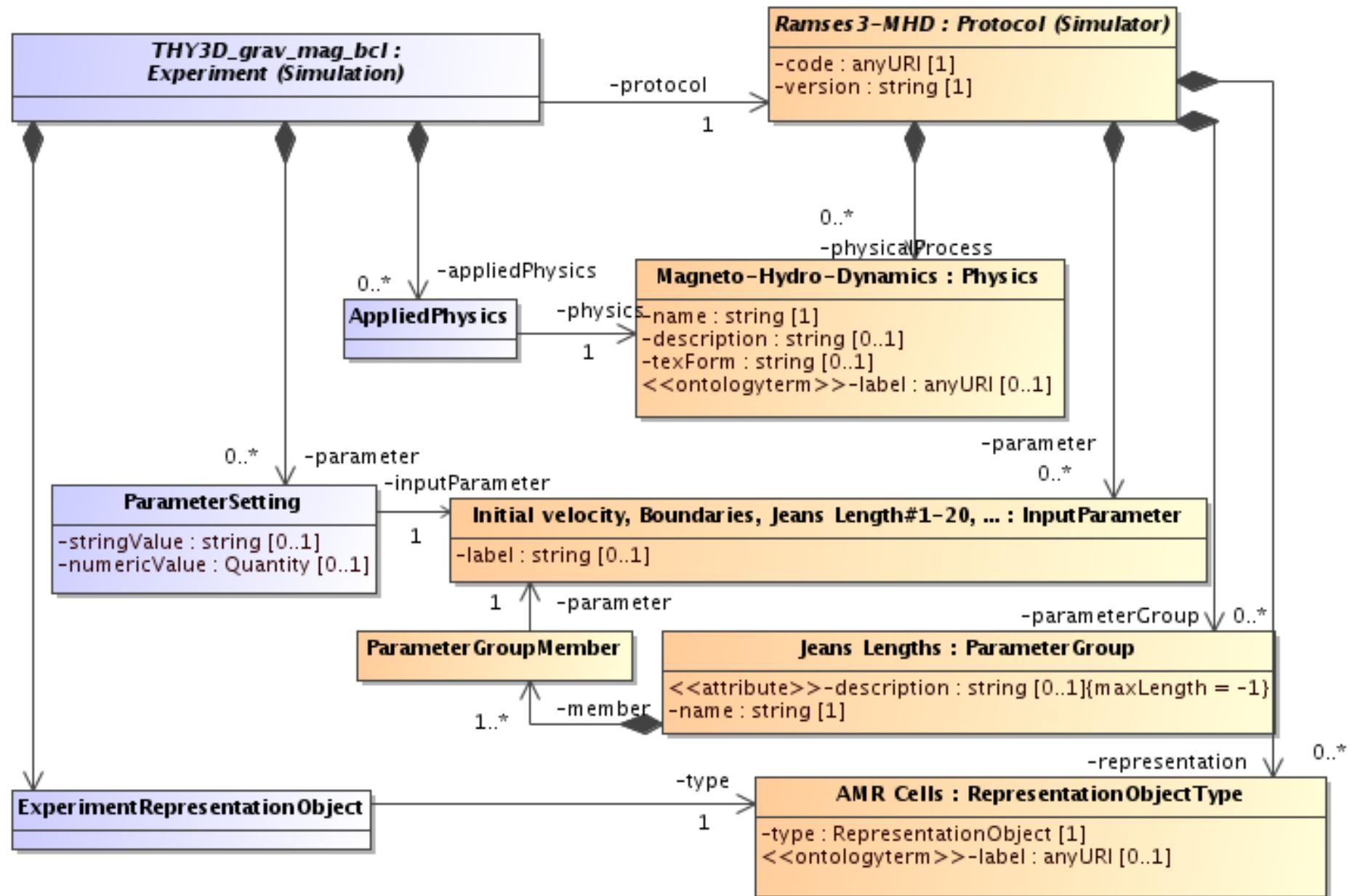
SIMPLIFIED MODEL ORGANIZATION FOR STARFORMAT



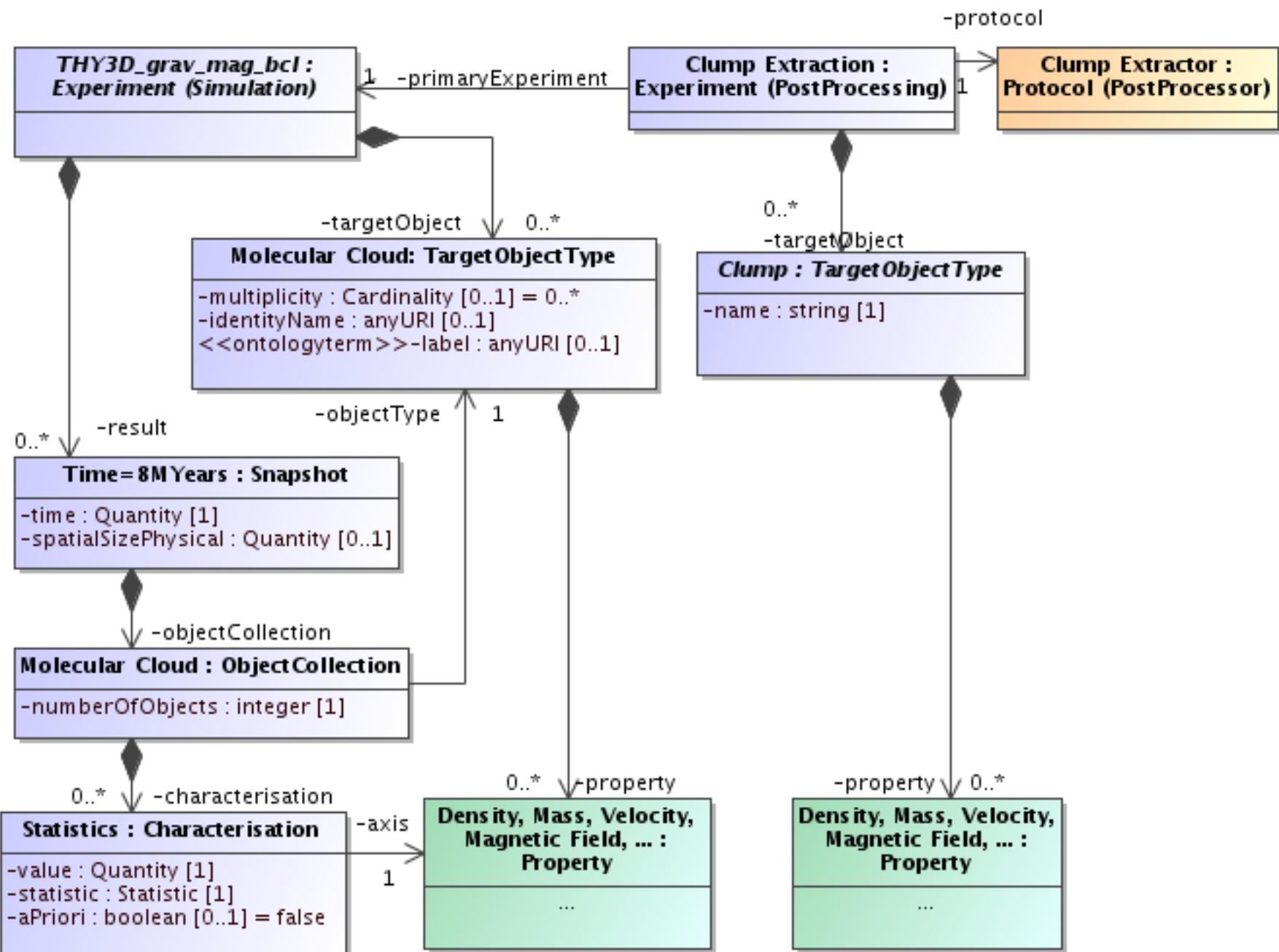
SimDB instantiation: Projects



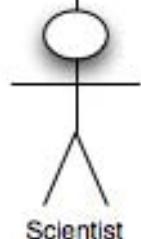
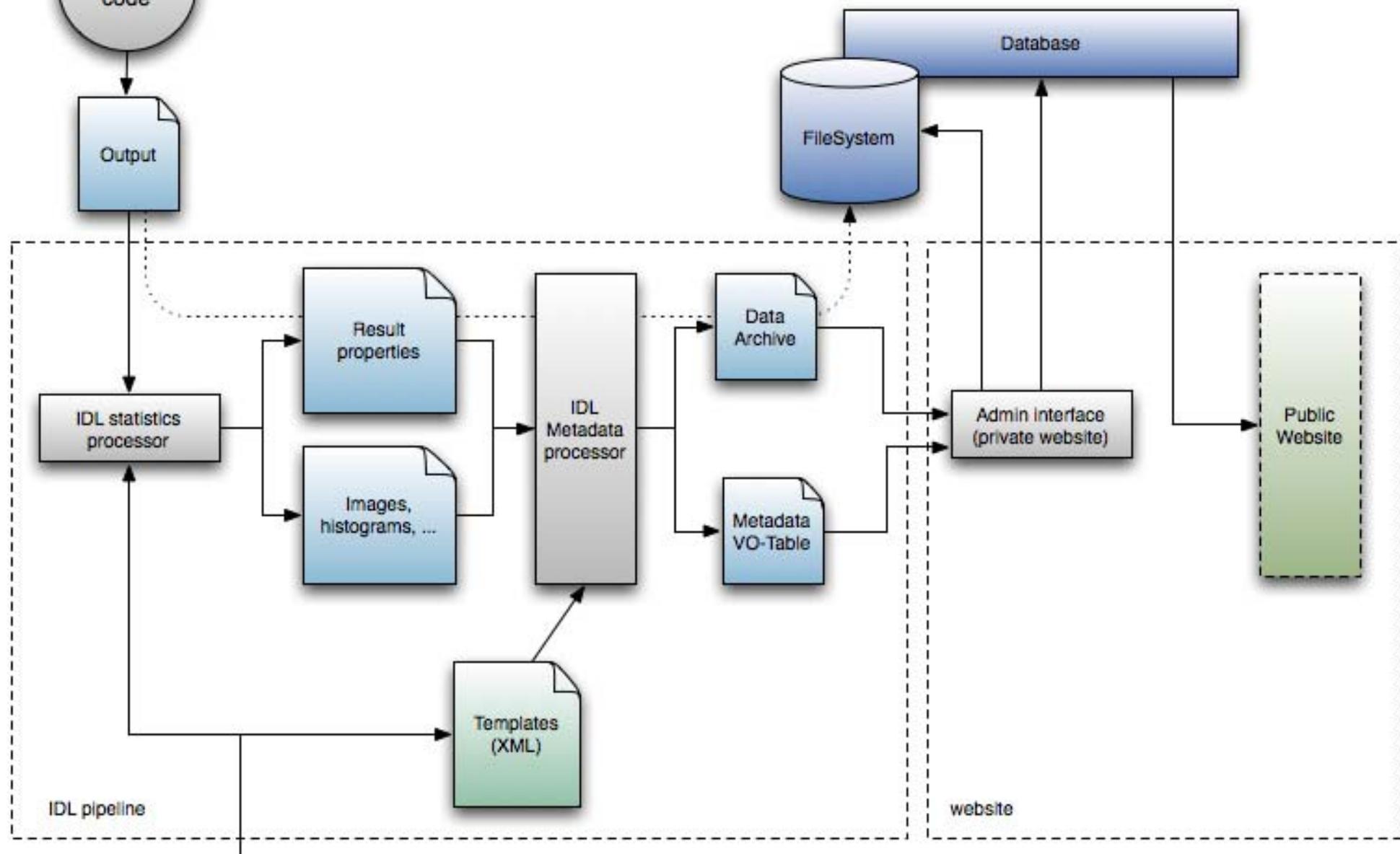
SimDB instantiation: Simulations & Codes



SimDB instantiation: Snapshots & PostProcessings



Ingestion pipeline



- > Computes extra characterization statistics
- > Fills description templates
- > Provides data organization information

A run's description

Online browsing and querying of simulations data require good metadata documentation

- Simulation's description (code used, simulated objects, contacts, ...)
- Physical processes involved (MHD, heating, gravitation, turbulence forcing, ...)
- Parameters (boundaries and initial conditions, grid definition, ...)
- Description of results for each time step (snapshots)
- Results or statistics on the results to help observers identify data
- Descriptive files like images, probability density functions, ...
- Eventually raw or postprocessed data

Import interface on the admin website

Import new Simulations :

Back to : [Index](#) - [Previous Page](#)

To import new simulations, put files (xml + tar.gz) in the following folder :

/SfsDB/input

[import](#) | [cancel](#) | [reset](#)

Simulations present in the INPUT folder : [refresh](#) [Files](#)

Simulation
FORM_MC_-THY3D_grav_hydro_bcl_-00022.xml
FORM_MC_-THY3D_grav_hydro_bcl_-00022_-clumps_2500.xml
FORM_MC_-THY3D_grav_hydro_bcl_-00022_-clumps_500.xml
FORM_MC_-THY3D_grav_hydro_bcl_-00032.xml
FORM_MC_-THY3D_grav_hydro_bcl_-00032_-clumps_2500.xml
FORM_MC_-THY3D_grav_hydro_bcl_-00032_-clumps_500.xml
FORM_MC_-THY3D_jades_-00198.xml
FORM_MC_-THY3D_jades_-00198_-clumps_10000.xml
FORM_MC_-THY3D_jades_-00198_-clumps_2500.xml
FORM_MC_-THY3D_jades_-00198_-clumps_500.xml
FORM_MC_-THY3D_jades_-00233.xml

Runs browsing: FORM_MC example

Formation of Molecular Clouds

This project aims at describing the formation of molecular clouds starting from the very diffuse atomic interstellar medium.

GravHydroBcl	GravMagBcl	Jades
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Description

In this experiment the magnetic field in the WNM is initially of the order of 5 microGauss, therefore comparable with the measurement performed in the ISM....

Applied physics

Magneto Hydro Dynamics

Magneto-hydrodynamics is treated in this simulation. This implies that the gas is subject to Lorentz forces while the evolution of the magnetic field is dictated by the induction equation.

Gravity

Self-gravity is treated. This implies that at each timestep, the Poisson equation is solved to obtain the gravitational potential and the gravitational forces.

atomic cooling

Atomic cooling is included as described in Wolfire et al. 1995, ApJ, 453, 673 following the implementation described in Audit & Hennebelle, 2005, A&A, 433, 1.

Heating

Photo electric heating on dust grains and PaH is implemented as described in Wolfire et al. 1995, ApJ, 453, 673 following the implementation described in Audit & Hennebelle, 2005, A&A, 433, 1.

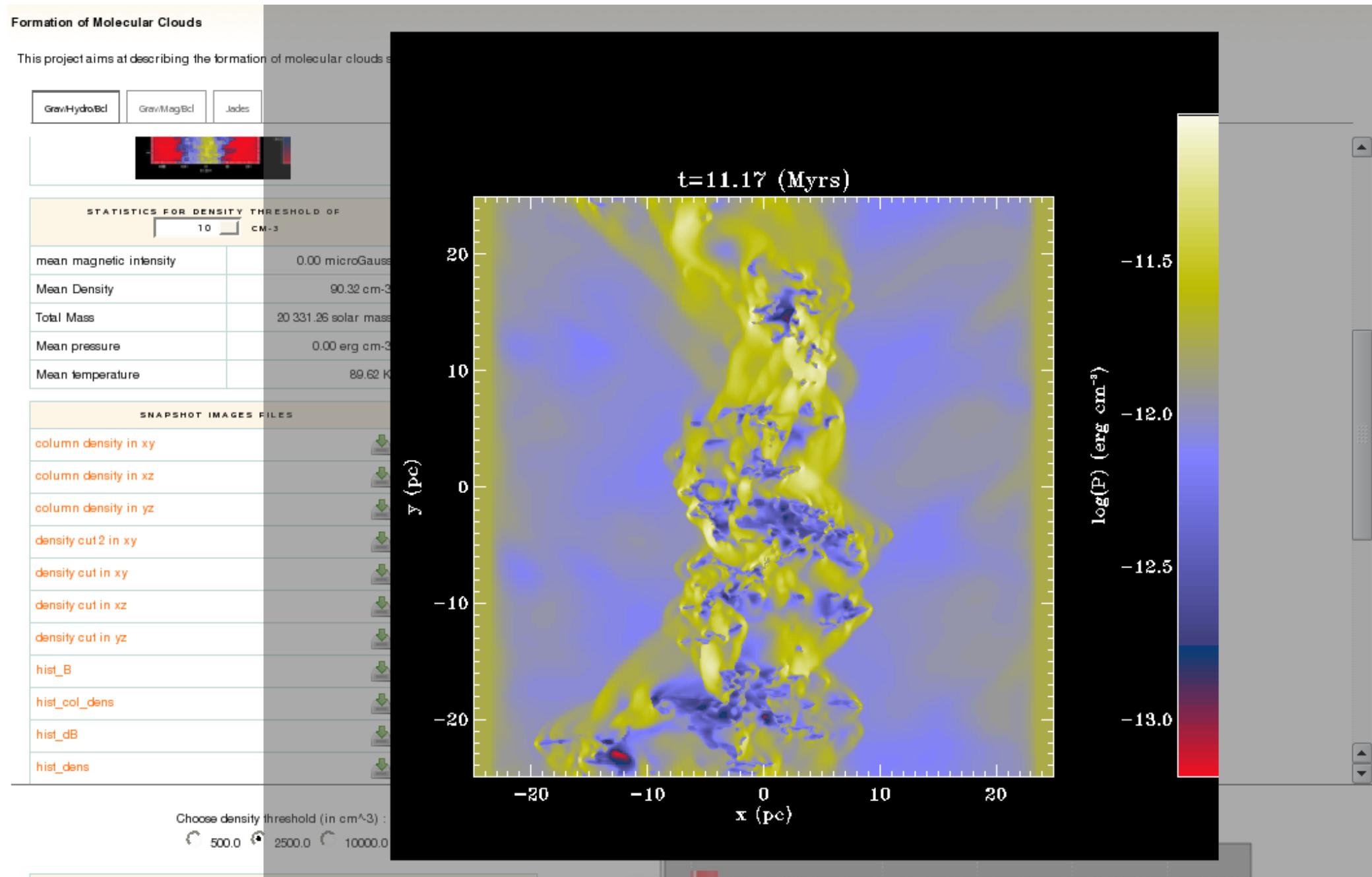
Parameters

NAME	VALUE
Lowest AMR level	7.00
Highest AMR level	10.00
Magnetic Field - X Boundary	0.80 5 microGauss
Modulation of the incoming flow	1.00
Initial density within the box	1.00 cm^-3
Initial temperature within the box	8,000.00 K
Velocity of the incoming flow	17.80 sound speed of the warm phase

Snapshots available



Snapshot details and images



Clump query on properties

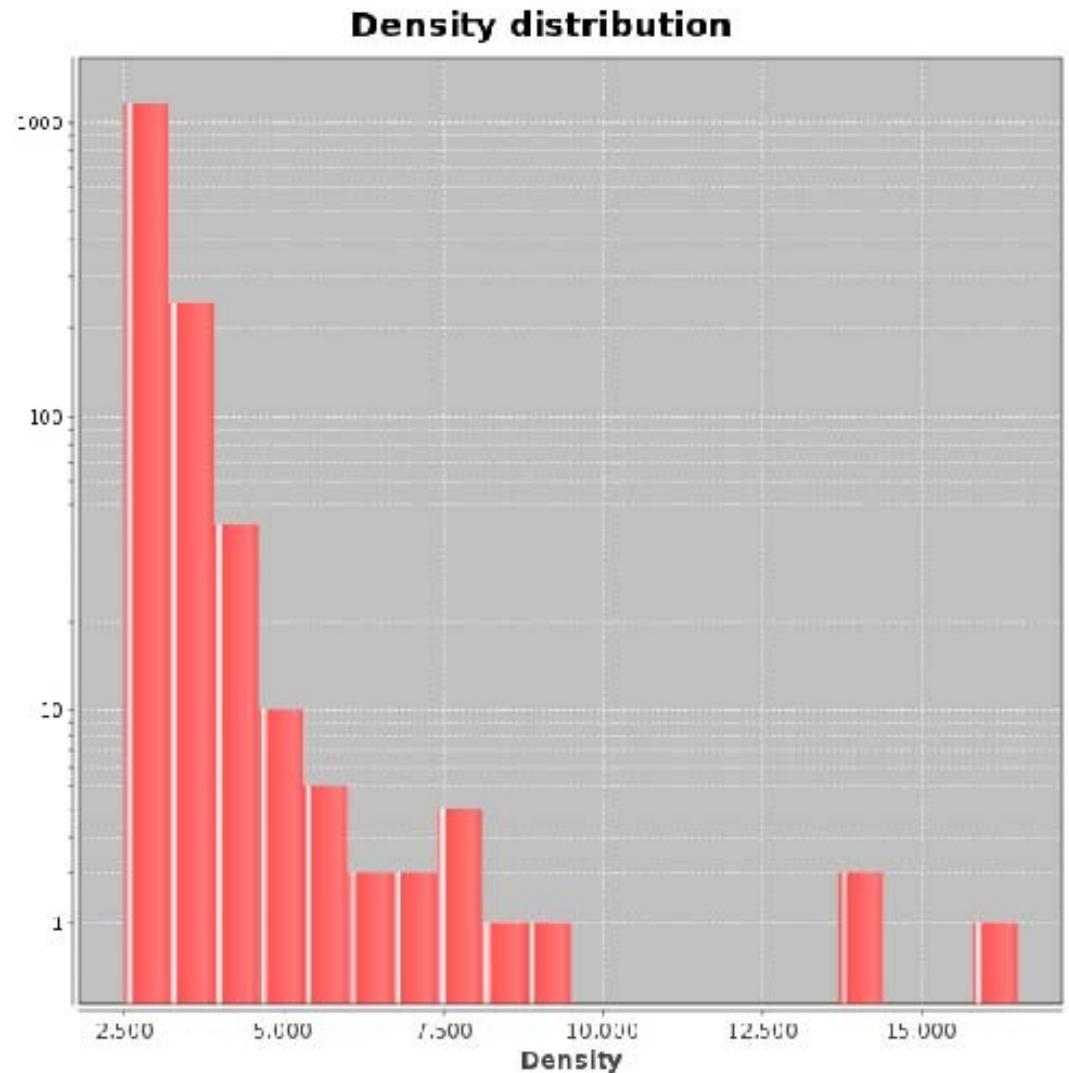
Choose density threshold (in cm⁻³) :

500.0 2500.0 10000.0

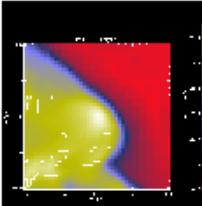
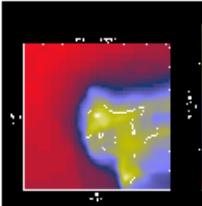
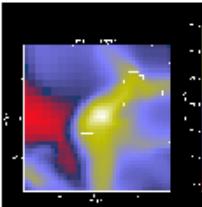
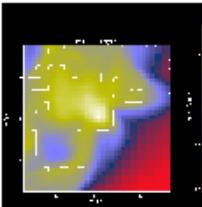
SNAPSHOTS TO QUERY	
EXPERIMENTS	SNAPSHOTS
Grav/Hydro/Bcl	8.38 Myrs <input type="checkbox"/> 11.17 Myrs <input type="checkbox"/>
Grav/Mag/Bcl	8.55 Myrs <input checked="" type="checkbox"/> 10.90 Myrs <input checked="" type="checkbox"/>
Jades	16.74 Myrs <input type="checkbox"/> 18.93 Myrs <input type="checkbox"/>

Search in 1476 clumps

PROPERTY	MINIMUM VALUE	MAXIMUM VALUE
Mass(solar mass)	<input type="text"/>	<input type="text"/>
Density(cm ⁻³)	<input type="text" value="5000"/>	<input type="text" value="8500"/>



Query results: clump details

GRAV/MAG/BCL	
8.55 MYRS	
Density : 5689.7998047 cm ⁻³	
View details	
10.90 MYRS	
	
Density : 5058.5043945 cm ⁻³	
View details	
	
Density : 5686.9667969 cm ⁻³	
View details	
	
Density : 5767.3798828 cm ⁻³	
View details	
	
Density : 5943.5893555 cm ⁻³	
View details	

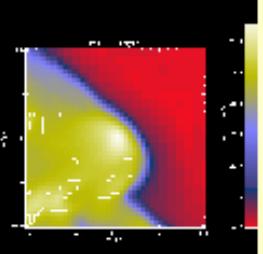
BACK	
PROPERTY	VALUE
Angle	2.7305533886
AngMomx	9.8502818536E18 cm ² s ⁻¹
AngMomy	-4.4419813701E19 cm ² s ⁻¹
AngMomz	-2.1517642907E20 cm ² s ⁻¹
Density	5058.5043945 cm ⁻³
First eigenvalue of the inertia matrix	0.66806958827 solar mass pc ²
Highest Density	27674.957031 cm ⁻³
Kinetic energy	7.5403970386E-12 erg cm ⁻³
Magnetic energy	4.2395698372E-12 erg cm ⁻³
Mass	22.847971526 solar mass
Mass above threshold 1	0.15318713595 solar mass
Mass above threshold 2	0.0 solar mass
mass_flux	4.5506814965
Number of cells	816.0
Pressure	1.0185859598E-11 erg cm ⁻³
rms value of the x-component of the magnetic field	5.0604533711 microGauss
rms value of the y-component of the magnetic field	3.562148509 microGauss
rms value of the z-component of the magnetic field	3.667254012 microGauss
Second eigenvalue of the inertia matrix	1.2484574195 solar mass pc ²
SigX	25118.610989 cm s ⁻¹
SigY	16085.651258 cm s ⁻¹
SigZ	19817.100794 cm s ⁻¹
Structure size	1.025390625 pc

Online Clump Extraction from raw data

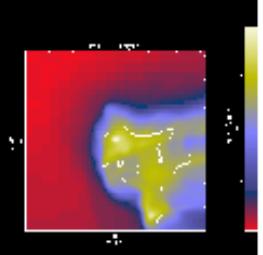
GRAV/MAG/BCL
8.55 MYRS

Density : 5689.7998047 cm⁻³
[View details](#)

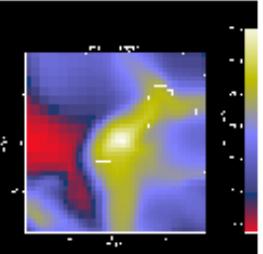
10.90 MYRS



Density : 5058.5043945 cm⁻³
[View details](#)



Density : 5686.9667969 cm⁻³
[View details](#)



DOWNLOAD ALL DATA IN A ZIP FILE
EXTRACT AND DOWNLOAD DATA CUBE

Extract a subset of clump data from the simulation

What do you want to extract?
 a data cube a projection map

Global simulation box size: 50.00 pc

Extraction box size: 2.05 pc

Centered on:
X 28.223 pc
Y 18.994 pc
Z 24.463 pc

With a L_{\max} precision of 10

E-mail address (to receive download link):

Extract Reset Cancel

Done

rms value of the y-component of the magnetic field

VALUE
7.7305533886
0.8502818536E18 cm ² s ⁻¹
4.4419813701E19 cm ² s ⁻¹
2.1517642907E20 cm ² s ⁻¹
5058.5043945 cm ⁻³
0.66806958827 solar mass
pc ²
7674.957031 cm ⁻³
1.5403970386E-12 erg cm ⁻³
0.2395698372E-12 erg cm ⁻³
2.847971526 solar mass
0.15318713595 solar mass
0.0 solar mass
0.5506814965
16.0
0.0185859598E-11 erg cm ⁻³
0.0604533711 microGauss

A few figures...

- 3 simulations
- 2 snapshots per simulation
- 2 or 3 clump extractions for different density thresholds per snapshot
- 33.600 characterized clumps stored
- 1.200.000 properties or statistics as queriable characterizations
- 215 Go (out of 1.5 To) of raw data

Next !

- Collect more simulations:
 - Adjust pipeline for other codes
- Connect services:
 - Define output fileformats and protocols (SimDAP)
 - Connect RADMC → GILDAS (+PDR)
 - Add semantic layer (vocabularies on TargetObjects, Representations, Algorithms, PhysicalProcesses, ...)