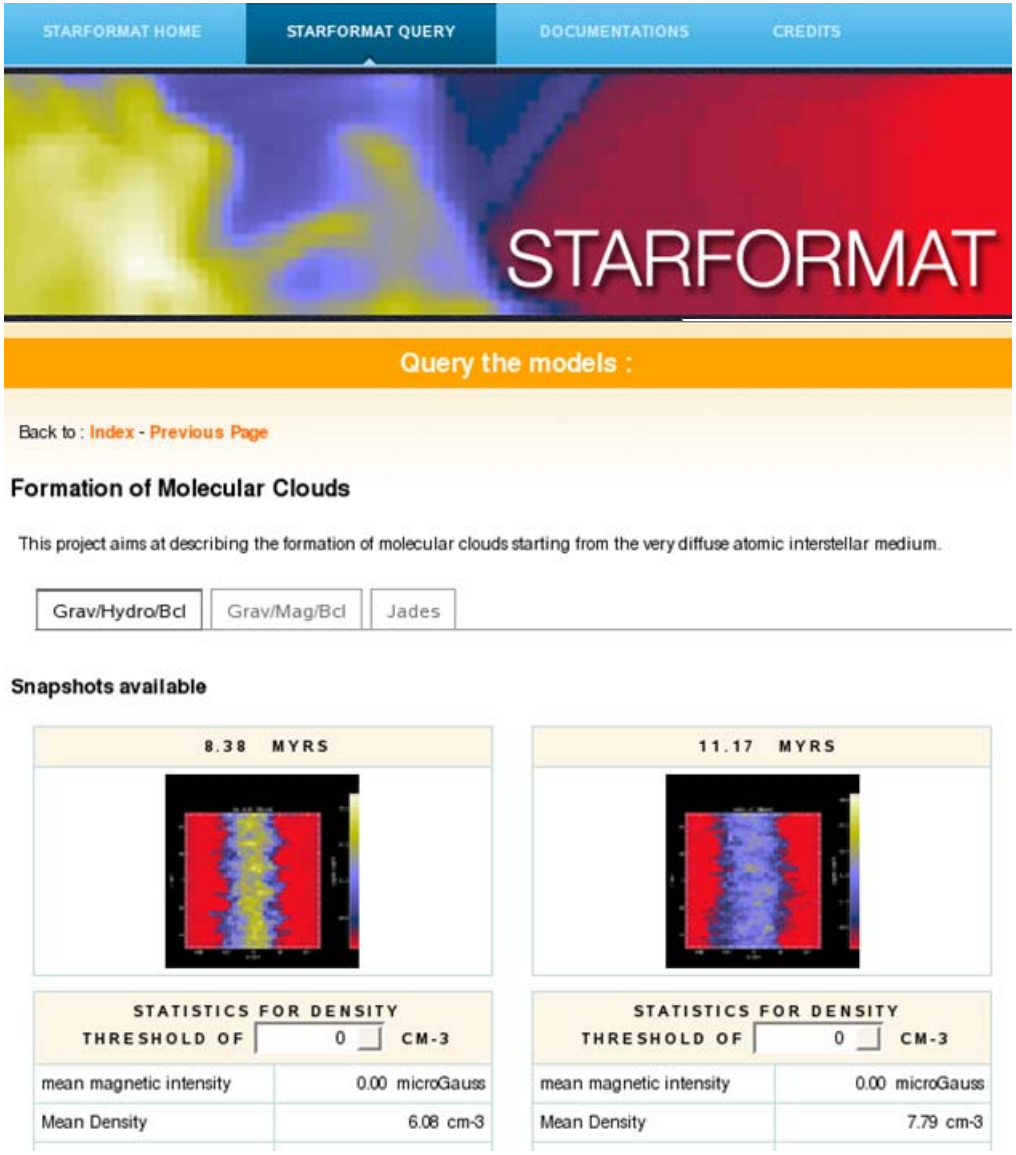
StarFormat
a simulation database
SimDB Implementation at VO-Paris Datacenter

Benjamin Ooghe, Nicolas Moreau, Franck Le Petit

http://starformat.obspm.fr



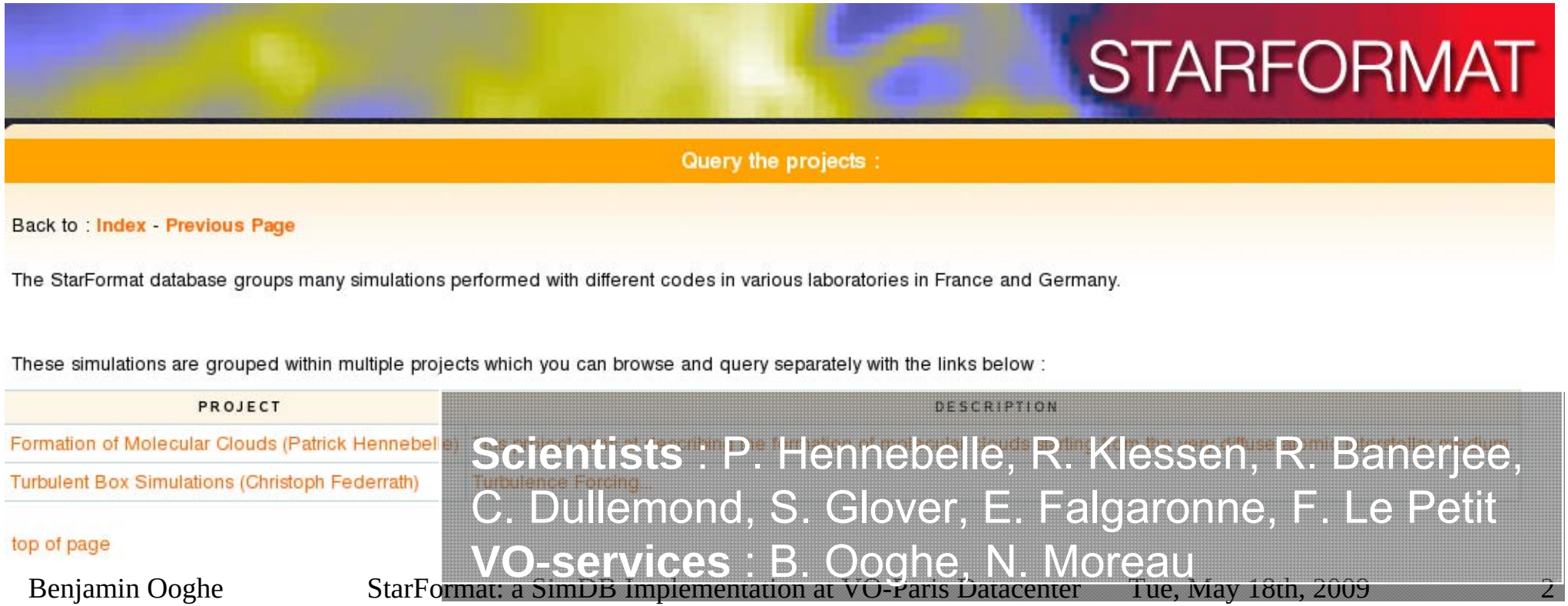
Laboratoire d'Étude du Rayonnement et de la Matière en Astrophysique

Laboratoire Univers et Théories

ARI ITA LSW

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



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

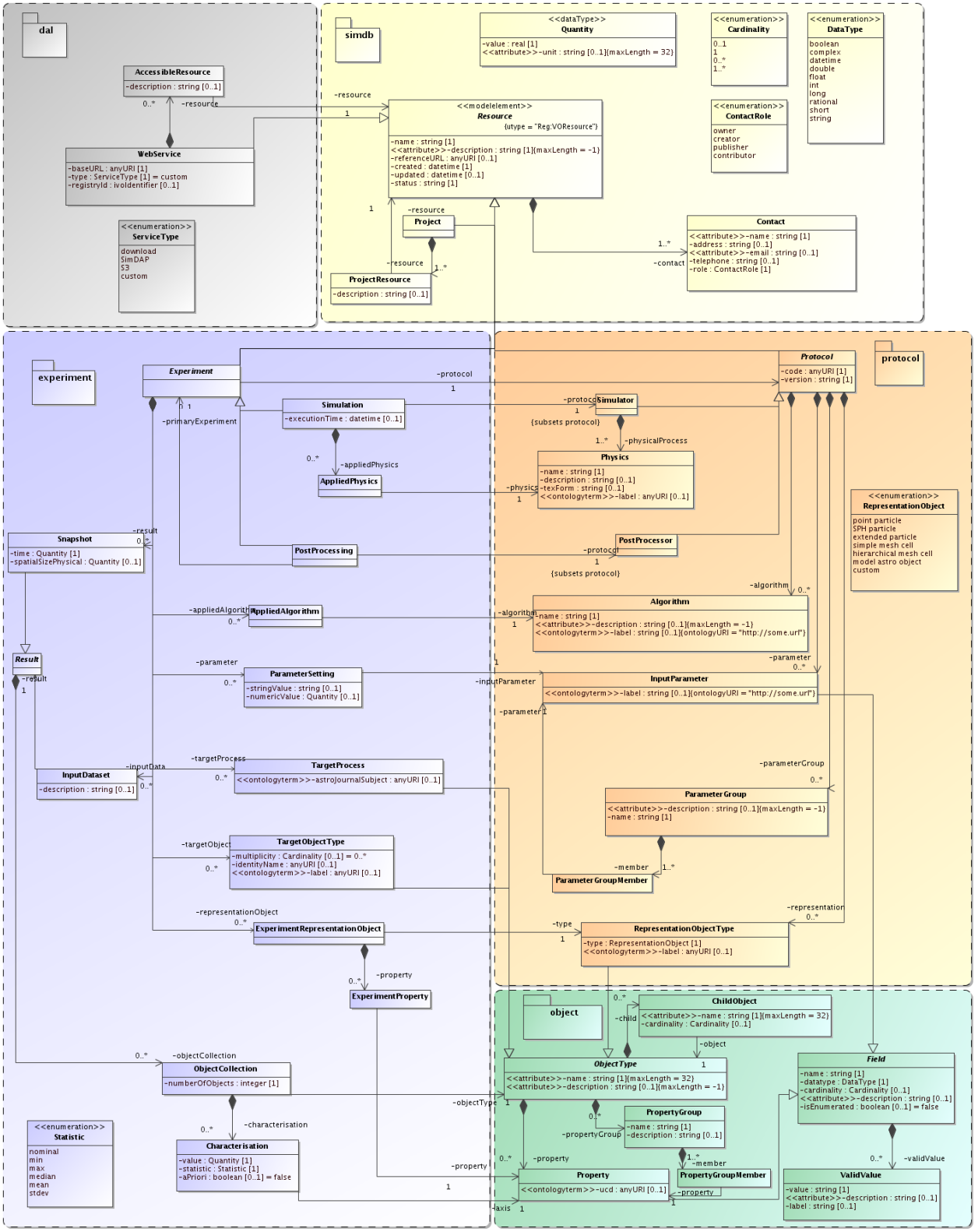
3) Visualize & extract subsets of raw simulation cubes
 Use of SimDAP
 Visualisation by VisiVO server

4) Maps of column densities (Ex: CO)

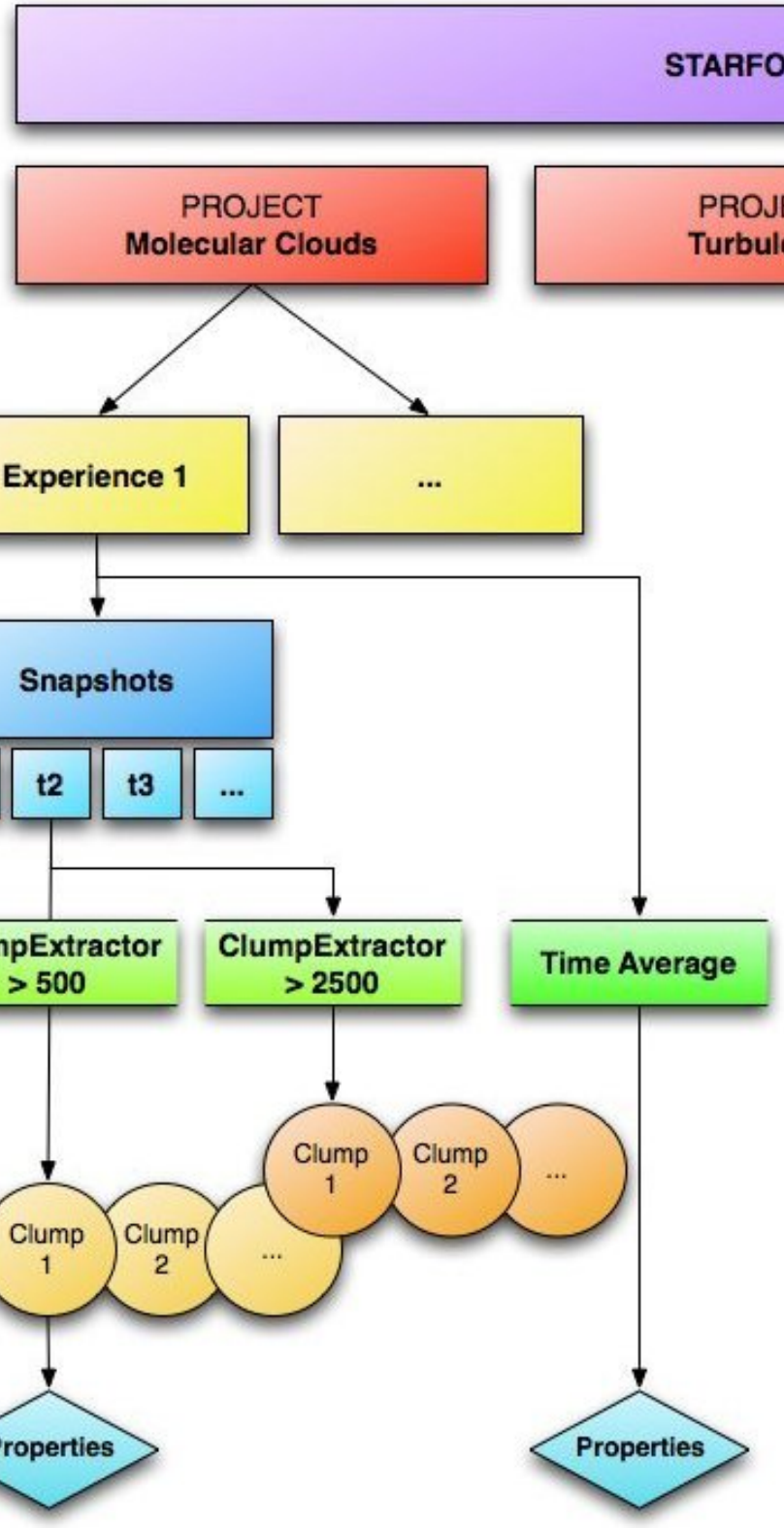
THEORY WORKING GROUP

SIMULATION DATA MODEL

by G. Lemson & L. Bourges

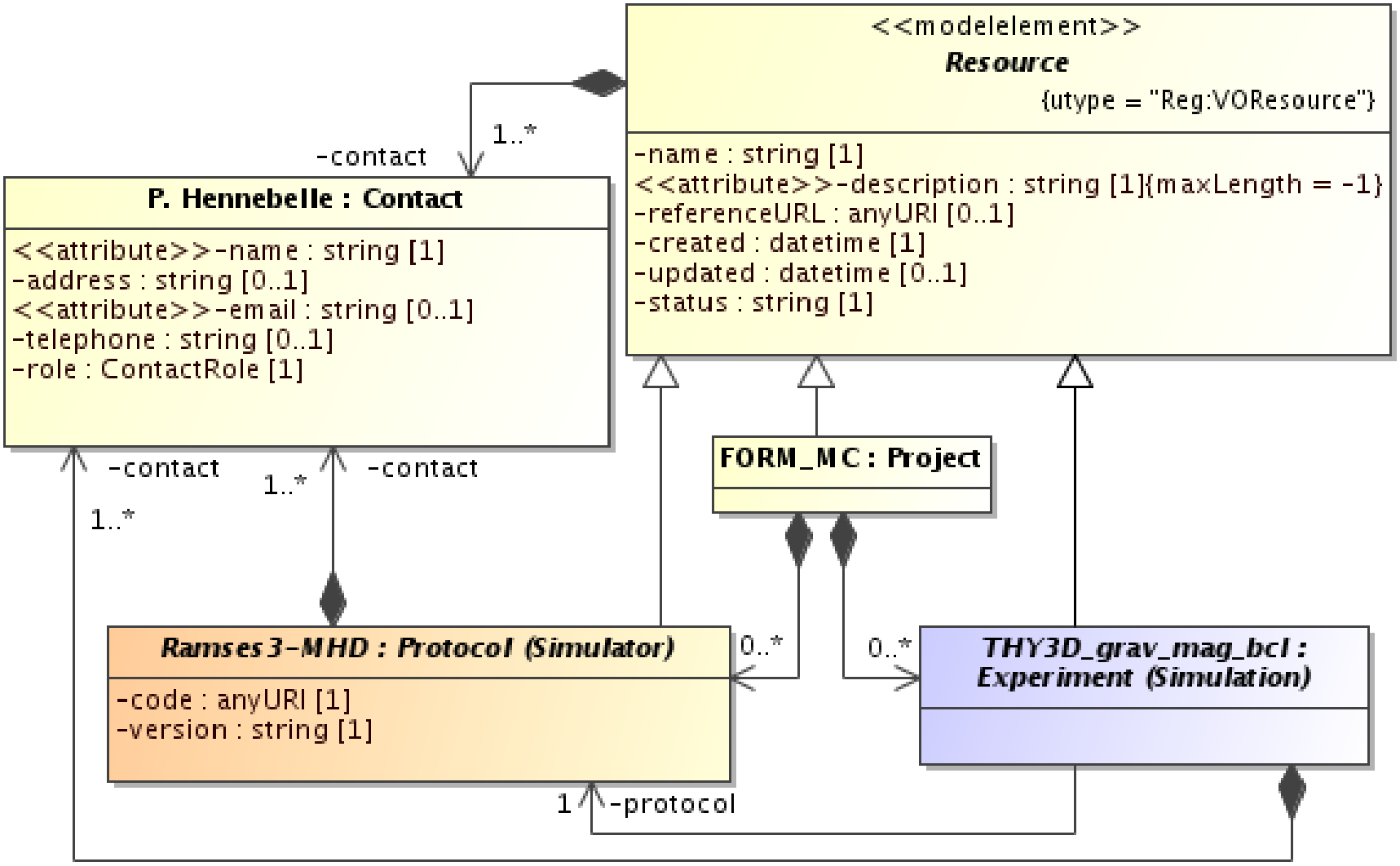


SIMPLIFIED MODEL ORGANIZATION FOR STARFORMAT

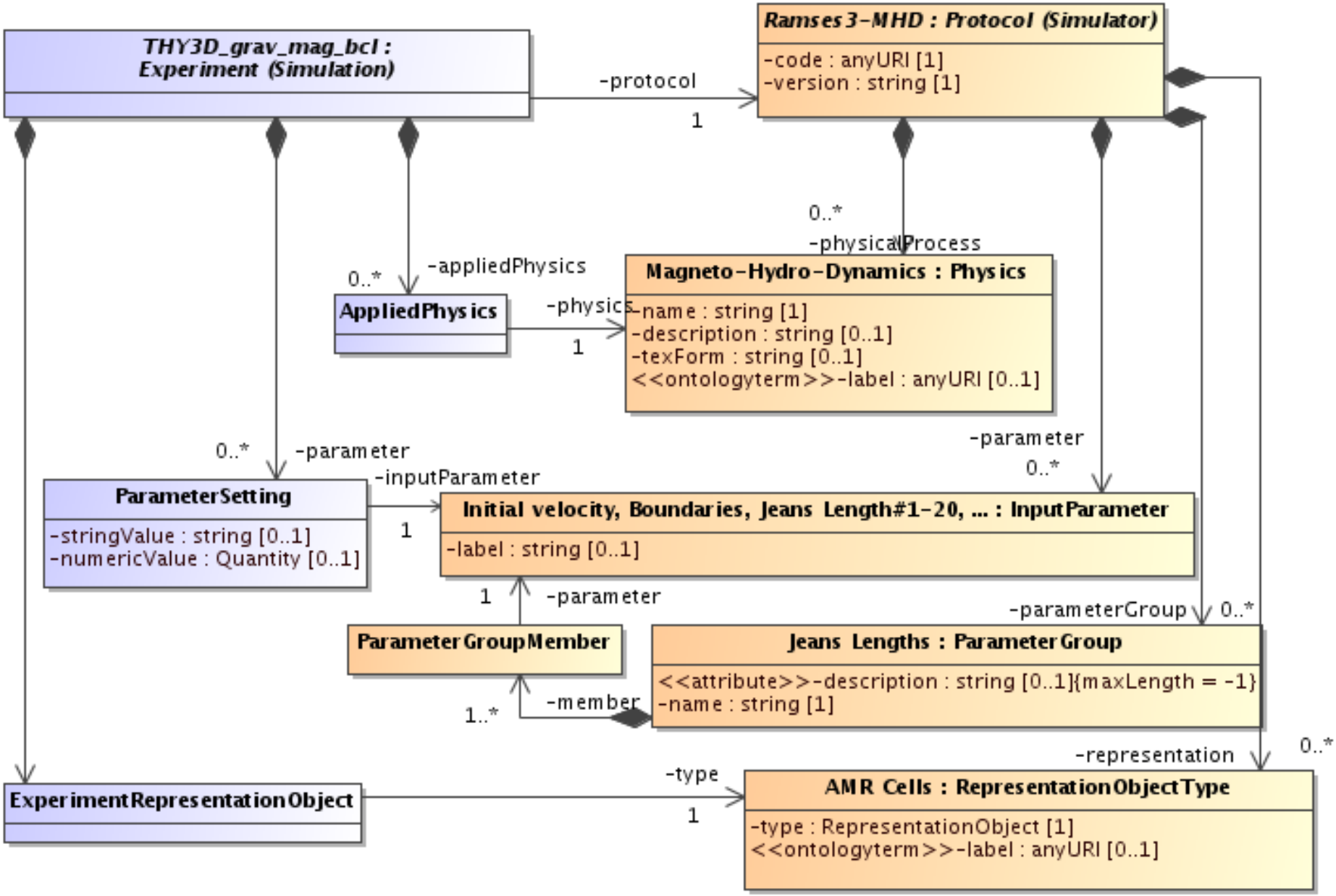


Hierarchical organization of the simulations stored in the database

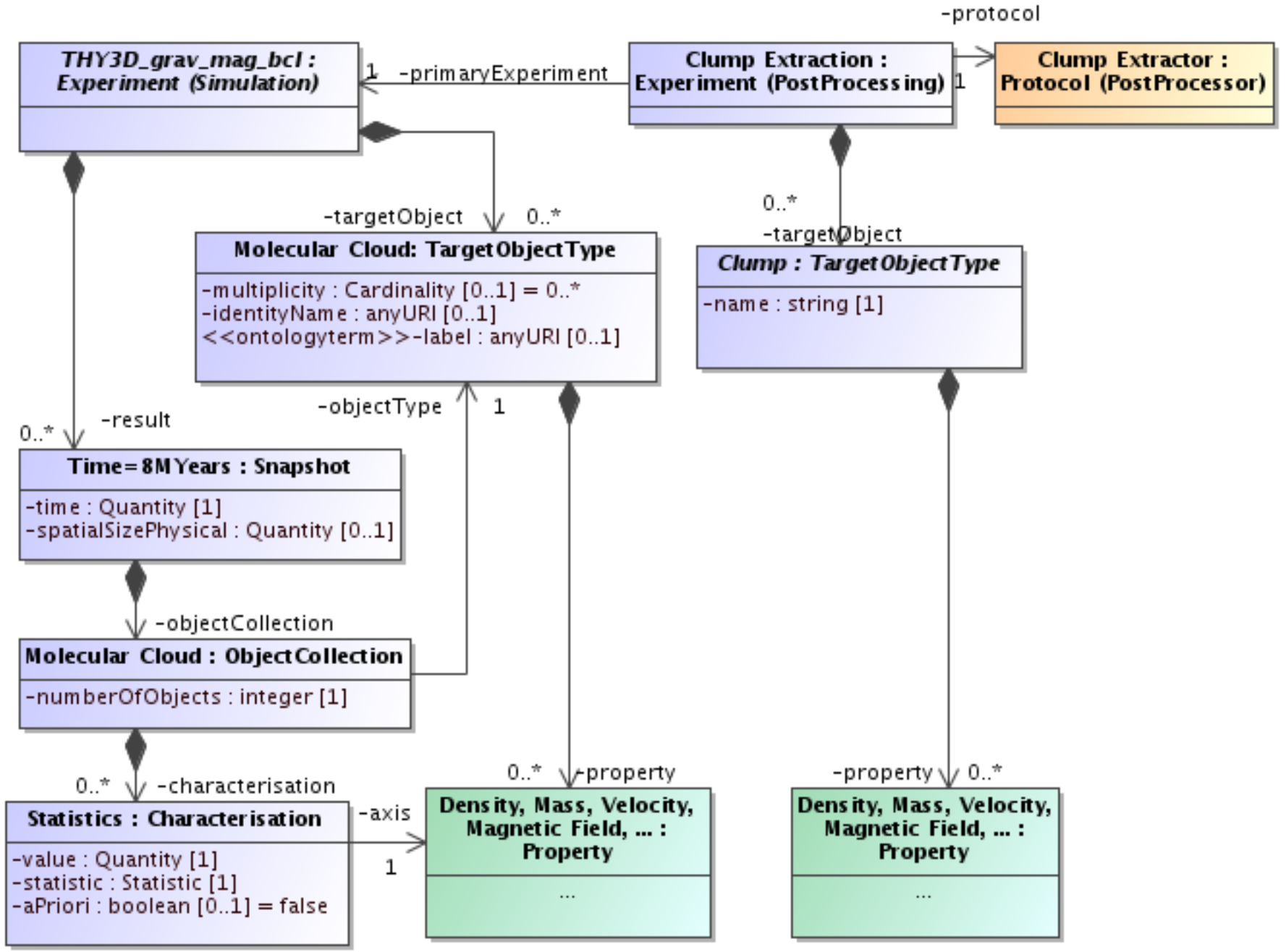
SimDB instantiation: Projects



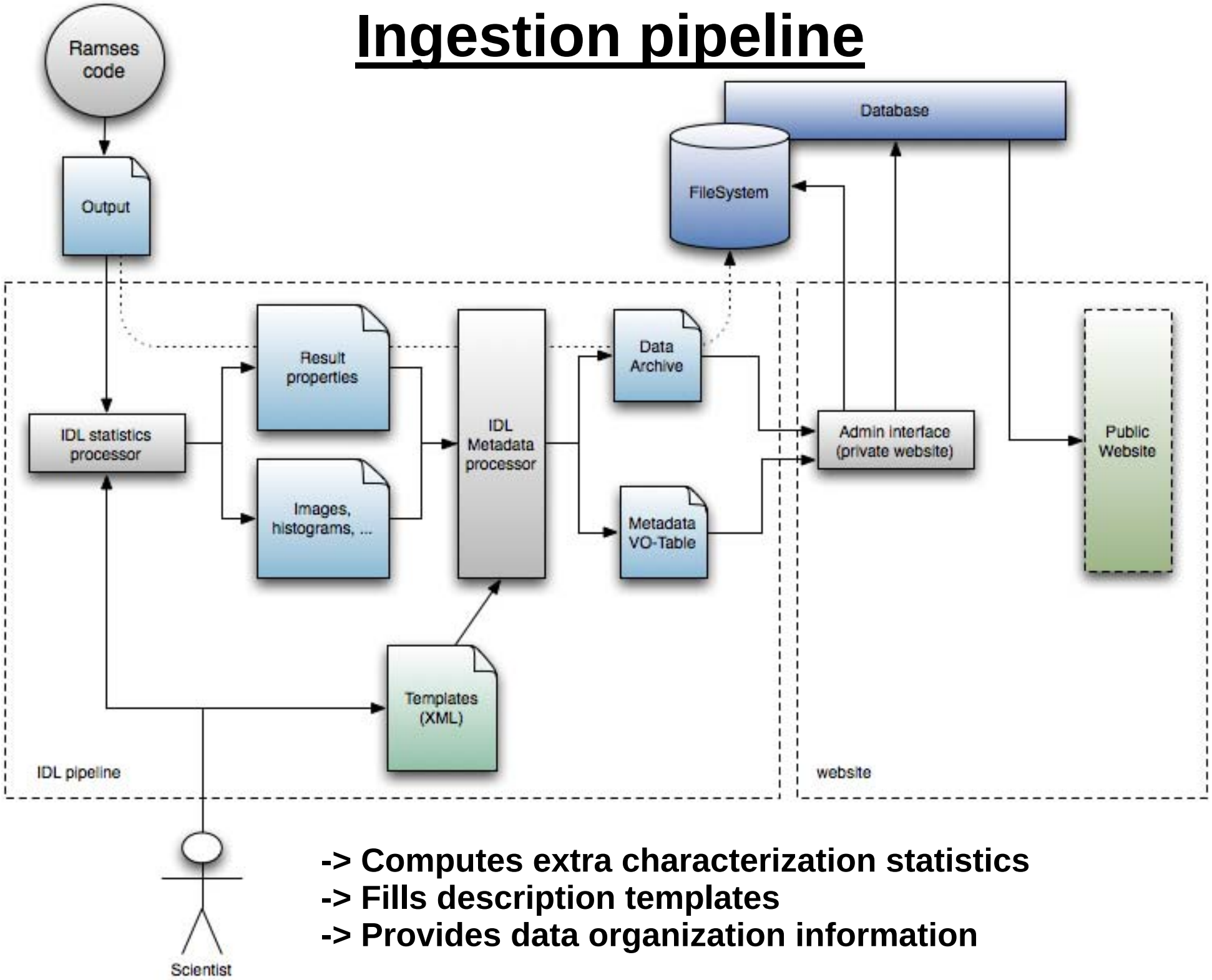
SimDB instantiation: Simulations & Codes



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.

Grav/Hydro/Bcl | Grav/Mag/Bcl | Jades

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.

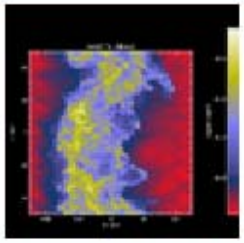
Heating
Photo electric heating on dust grains and PaH is implemented as described in Wolfire et al. 1995, ApJ, 453, 673 following the implementation described in Audit & Hennebelle, 2005, A&A, 433, 1.

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

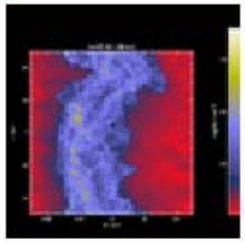
16.74 MYRS



STATISTICS FOR DENSITY THRESHOLD OF 0 CM-3

mean magnetic intensity	7.38 microGauss

18.93 MYRS



STATISTICS FOR DENSITY THRESHOLD OF 0 CM-3

mean magnetic intensity	7.41 microGauss

Snapshot details and images

Formation of Molecular Clouds

This project aims at describing the formation of molecular clouds s

Grav/Hydro/Bcl | Grav/Mag/Bcl | Jades

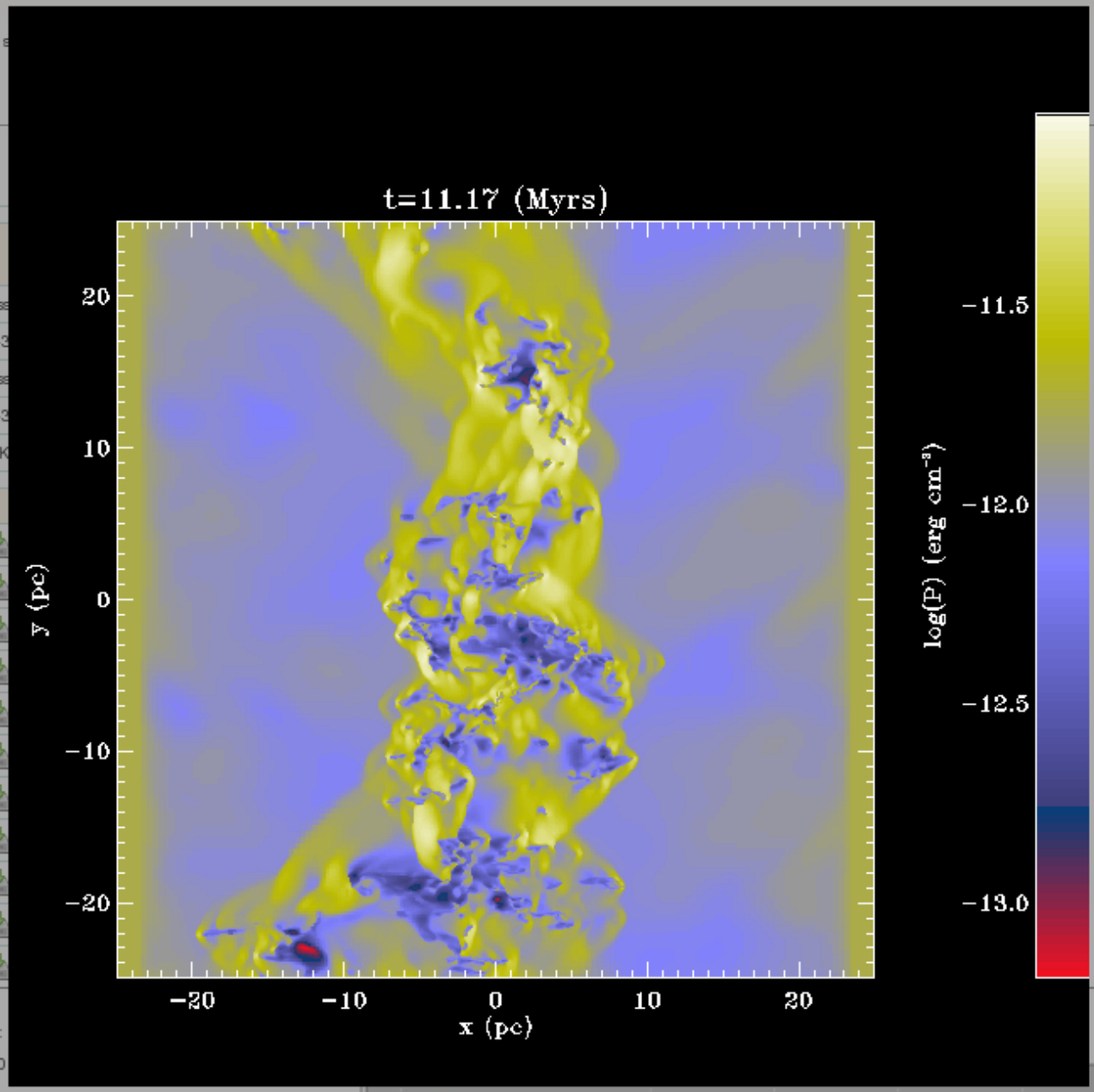
STATISTICS FOR DENSITY THRESHOLD OF 10 CM-3

mean magnetic intensity	0.00 microGauss
Mean Density	90.32 cm-3
Total Mass	20 331.26 solar mass
Mean pressure	0.00 erg cm-3
Mean temperature	89.62 K

SNAPSHOT IMAGES FILES

- column density in xy
- column density in xz
- column density in yz
- density cut 2 in xy
- density cut in xy
- density cut in xz
- density cut in yz
- hist_B
- hist_col_dens
- hist_dB
- hist_dens

Choose density threshold (in cm^-3) : 500.0 2500.0 10000.0



Clump query on properties

Choose density threshold (in cm^-3) :

○ 500.0 ◉ 2500.0 ○ 10000.0

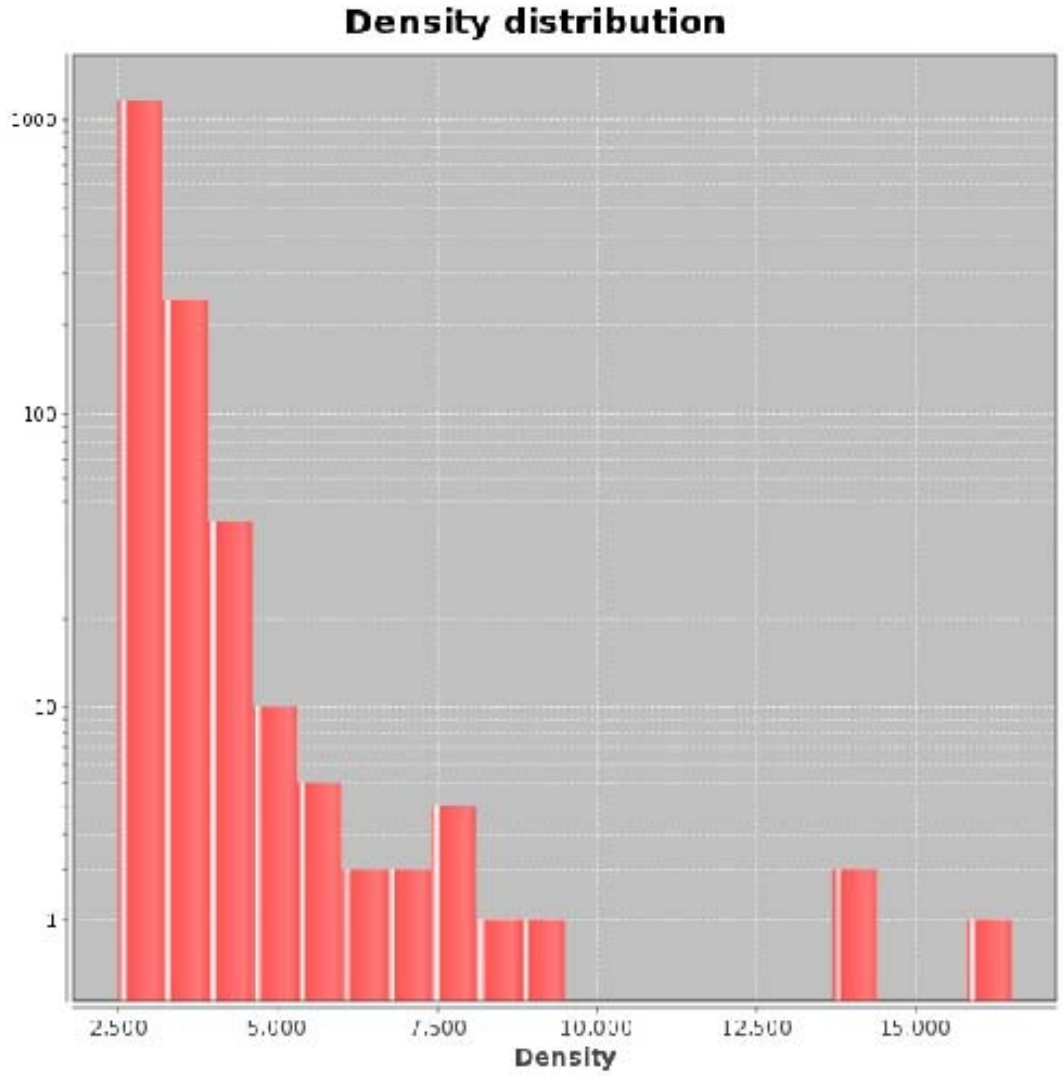
SNAPSHOTS TO QUERY	
EXPERIMENTS	SNAPSHOTS
Grav/Hydro/Bcl	8.38 Myrs ☐ 11.17 Myrs ☐
Grav/Mag/Bcl	8.55 Myrs ☑ 10.90 Myrs ☑
Jades	16.74 Myrs ☐ 18.93 Myrs ☐

Select

Search in 1476 clumps

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

Search



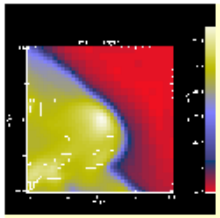
Query results: clump details

GRAV/MAG/BCL

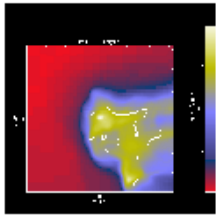
8.55 MYRS

Density : 5689.7998047 cm^-3
View details

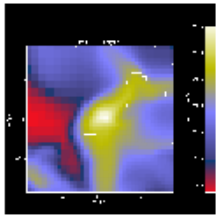
10.90 MYRS



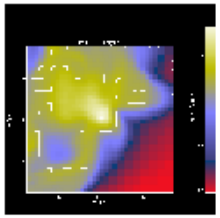
Density : 5058.5043945 cm^-3
View details



Density : 5686.9667969 cm^-3
View details



Density : 5767.3798828 cm^-3
View details



Density : 5943.5893555 cm^-3
View details

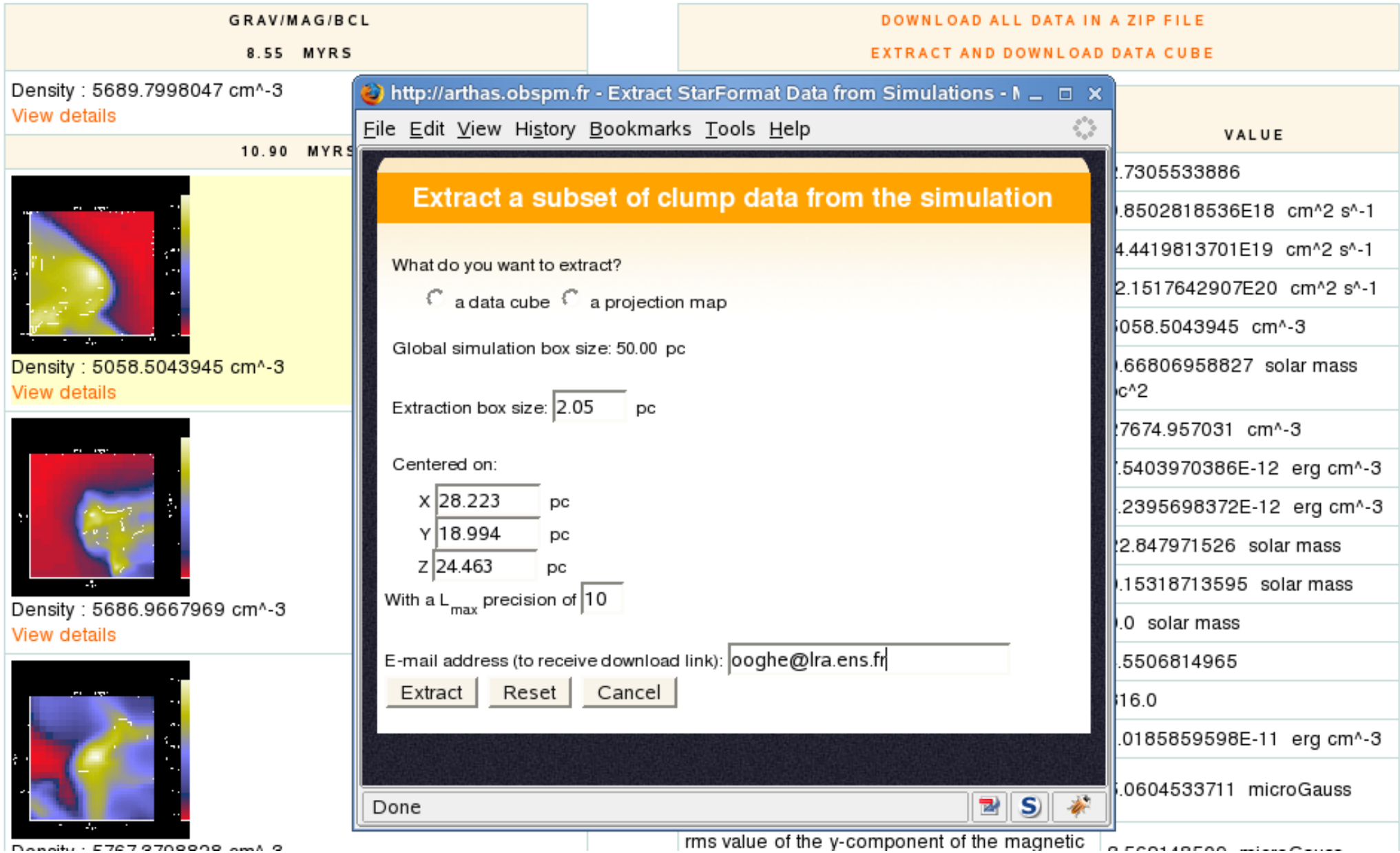
DOWNLOAD ALL DATA IN A ZIP FILE

EXTRACT AND DOWNLOAD DATA CUBE

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



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, ...