

Implementations of SimDM

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4 implementations :

- PDRDB
- Starformat
- DEUVO
- GAVO (G. Lemson)

GAVO example

G. Lemson et al. (Mpl - Garching)

Simulation Database - Browser - 1.0-20110520 - Browser

SimDB Browser - Home :

Browse Model

- All [Resources](#)
 - All [Projects](#)
 - All [Experiments](#)
 - All [Simulations](#)
 - All [PostProcessings](#)
 - All [Protocols](#)
 - All [Simulators](#)
 - All [PostProcessors](#)
 - All [Services](#)
 - All [SimDALServices](#)
 - All [CustomServices](#)
- All [Partys](#)

Documentation

Browse documentation of the data model.

SKOS Concepts

Browse SKOS vocabularies used in the model.

SQL Interface

Query the SimDM database using ADQL (well, SQL).

XML Validator

Validate an XML document against the data model's XML schemas.

XML Loader

Load an XML document into the database.
Requires a login.

[Log management \(requires a login!\)](#)

Cosmological simulations

<http://pdr.obspm.fr>

Models of interstellar clouds (micro-physics simulations)

- temperature,
- abundances of hundreds chemical species : H, H₂, C⁺, C, CO, H₂O, ...
- grains properties
- Lines intensities
- ...

Facilitate interpretations of HERSCHEL and ALMA observations

The screenshot displays the PDR Database website interface. The top navigation bar includes links for PDR CODE, PDR DATABASE, PDR TOOLS, TIPS, DOCUMENTATIONS, and CREDITS. The main content area is titled "Query the Pdr models" and shows a search query for "H2 formation on grains surfaces 2011 - PDR models (LH+ER)". Below the query, there is a section for "Available projects" and a "Project chosen" section. The interface also features a "Query on Parameters" section with a table of search criteria.

Parameter	Possible values	User value
ISRF scaling factor (Obs. side) - initial	1, 3, 7, 10, 30, 70, 100, 300, 700, 1000, 3000, 7000, 1.00x10 ⁴ , 3.00x10 ⁴ , 7.00x10 ⁴ , 1.00x10 ⁵ , 3.00x10 ⁵ , 7.00x10 ⁵ , 1.00x10 ⁶	
Gas pressure	1.00x10 ⁵ , 3.00x10 ⁵ , 7.00x10 ⁵ , 1.00x10 ⁶ , 3.00x10 ⁶ , 7.00x10 ⁶ , 1.00x10 ⁷ , 3.00x10 ⁷ , 7.00x10 ⁷ , 1.00x10 ⁸	

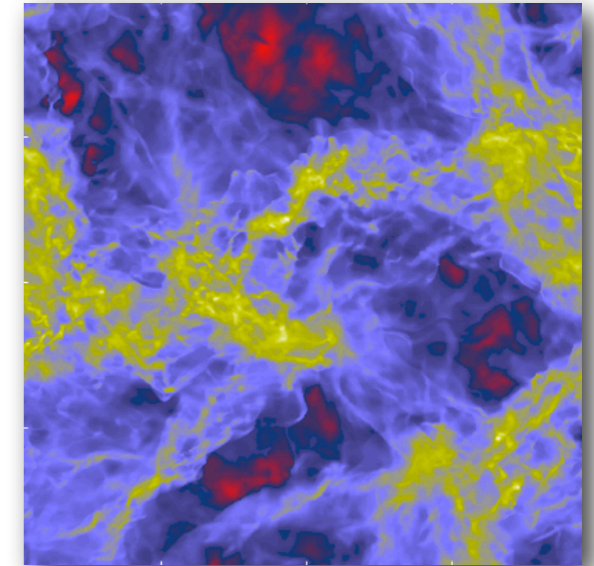
Two scientific plots are shown on the right side of the interface. The left plot is titled "C⁺ at 158 μm" and shows intensity maps for different gas pressures (P) and radiation field intensities (χ). The right plot is titled "H₂ - 0-0 S(0) 28.220 μm" and shows intensity maps for different gas pressures (P) and radiation field intensities (χ). Both plots use logarithmic scales for the x-axis (P) and y-axis (χ).

<http://starformat.obspm.fr>

MHD simulations for the interstellar medium

- density, velocity, magnetic fields, ...
- Dense cores, IMF
- Cooling flows
- MHD + chemistry

Preparation of ALMA observations



SIMULATIONS
DESCRIPTION

STARFORMAT

The StarFormat DataBase

The StarFormat database contains results of heavy numerical simulations computed in order to study the problem of star formation, essentially molecular cloud formation and evolution and collapse.

Understanding the dynamical evolution of the interstellar medium (ISM) and its relation to stellar birth is a key challenge in astronomy and astrophysics. The **STAR FORMATION** project aims at providing observers and theorists studying formation and evolution of molecular clouds, their morphological and kinematical characteristics, and the formation of stars in their interior with a set of theoretical tools and a database of models to aid in the analysis and interpretation of current and future observations.

The goal of this database is to give access to observers, or more generally to any scientist working on a related field, to the results of these numerical simulations, which can be useful to help prepare or analyze observations.

Available projects:

PROJECT	DESCRIPTION
Molecular cloud evolution with decaying turbulence	This project aims at describing the evolution of a turbulent molecular cloud in which the turbulence is decaying.
Barotropic dense core simulations	This project aims at describing the gravitational collapse of magnetized molecular dense cores.
Colliding flow simulations	This project aims at describing self-consistently the formation of molecular clouds starting from the very diffuse atomic interstellar medium.
Solenoidal vs. Compressive Turbulence Forcing	This project investigates the influence of different forcing (i.e., kinetic energy injection) on turbulent flows in the interstellar medium.

Snapshots available

t = 0.485 MYRS

EXTRACT AND DOWNLOAD SNAPSHOT DATA

STATISTICS ON ALL CELLS WITH
Density ≥

Mean Magnetic Intensity	2.494 microGauss
Mean Density	536.422 cm ⁻³
Total Mass	1.916x10 ³ solar mass

PROPERTY PLOTS

Column Density in XY ↓ ↑

Column Density in XZ ↓ ↑

t = 1.161 MYRS

EXTRACT AND DOWNLOAD SNAPSHOT DATA

STATISTICS ON ALL CELLS WITH
Density ≥

Mean Magnetic Intensity	3.812 microGauss
Mean Density	536.422 cm ⁻³
Total Mass	1.916x10 ³ solar mass

PROPERTY PLOTS

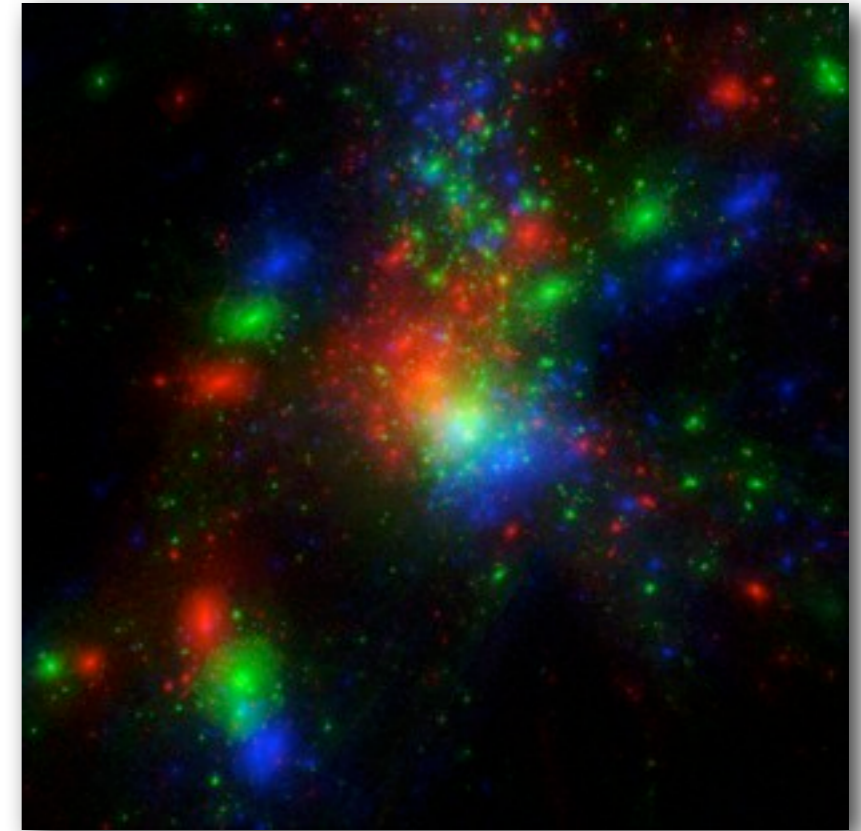
Column Density in XY ↓ ↑

Column Density in XZ ↓ ↑

in development

Publication of Grand Challenge cosmological simulations

- DEUSS : up to 9 billions particles
- 50 To of data produced
- Access to halos properties



DEUVO HOME
DEUVO QUERY
DOCUMENTATIONS
CREDITS

Dark Energy Universe Virtual Observatory (DEUVO)

This project aims at investigating the imprints of dark energy on cosmic structure formation through very high resolution cosmological simulations

<http://www.idris.fr/docs/docu/projets-Babel/DEUSS/CR-projet-DEUSS.html>

Query the models and snapshots (find a simulation)

Code	Cosmology	Physics	Box Length	Resolution
Ramses3 - DEUSS	Sugra Lambda Ratra-Peebles	Supernovae Star formation Cooling Hydrodynamics Gravity Metals	648 com Mpc/h 162 com Mpc/h 2592 com Mpc/h	1024

Matching simulations

boxlen648_n1024_sucdmw5, z=-0.000201
boxlen648_n1024_sucdmw5, z=0.173073
boxlen648_n1024_sucdmw5, z=0.245942
boxlen648_n1024_sucdmw5, z=0.425632
boxlen648_n1024_sucdmw5, z=0.66317
boxlen648_n1024_sucdmw5, z=0.999815
boxlen648_n1024_sucdmw5, z=1.490308
boxlen648_n1024_sucdmw5, z=2.329619
boxlen648_n1024_sucdmw5, z=3.965984

Simulation parameter settings

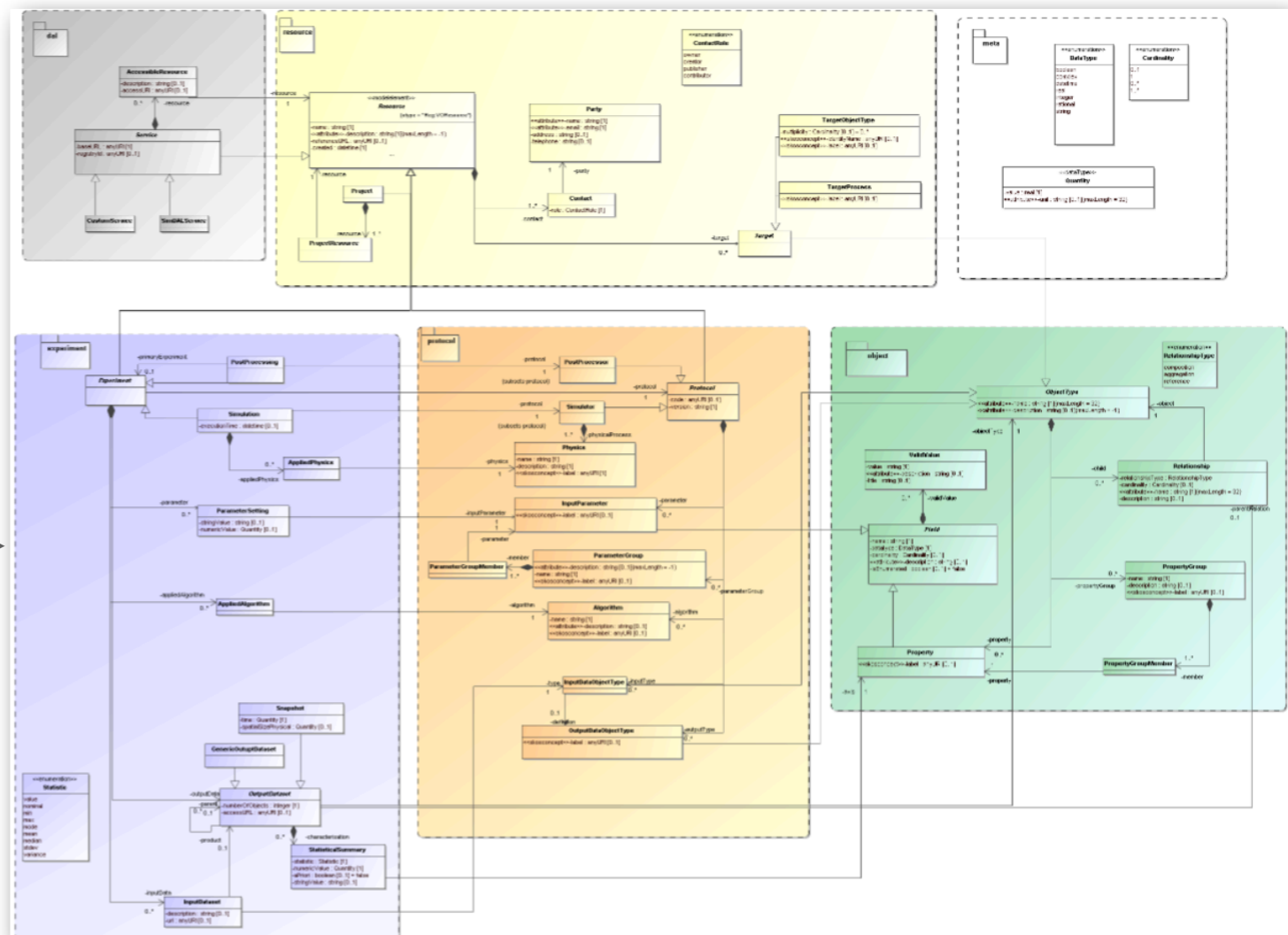
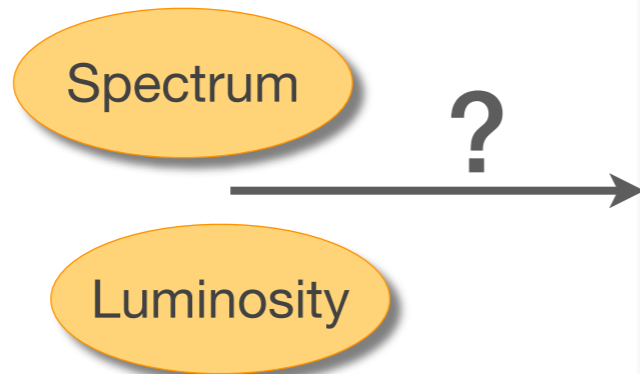
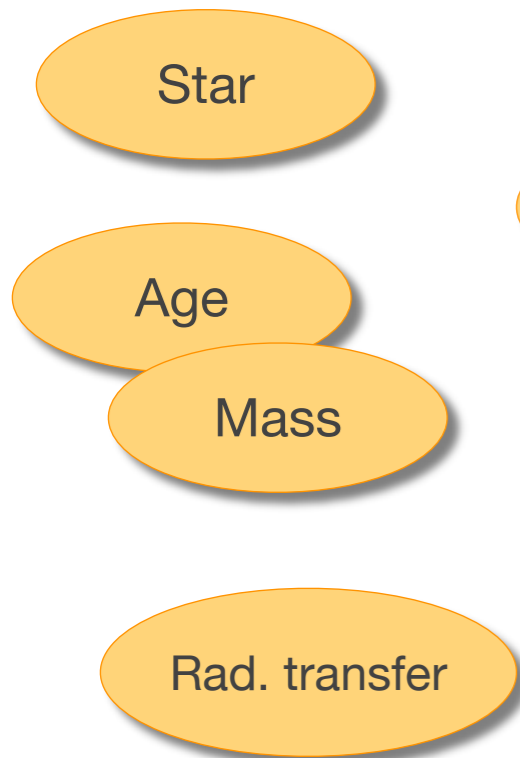
Dark energy type	3.00e+0
Dark energy parameter	1.00e+0
Dark energy density	7.50e-1
Matter density	2.50e-1
Baryon density	4.40e-2
Radiation density	0.00e+0
ns	9.63e-1
sigma8	-7.30e-1
h	7.20e+1
Boxlength	6.48e+2 com Mpc/h
npart_dm	1.07e+9
Lowest AMR level	1.00e+1
Highest AMR level	1.60e+1

Implementations

- 1 - Mapping of the DM
- 2 - Set up a relational data base
- 3 - Set up an ingestion pipeline
- 4 - Queries

1 - Mapping on the DM

SimDM is an abstract model :
mapping can be difficult



1 - Mapping on the DM (2)

Mapping requires training :

Having several examples in the implementation note can help scientists to do this.

Up to now : 2 detailed descriptions in the implementation note

Some pieces of advice :

- Some SimDM classes have SKOS concepts
 - try to map those ones first
- Do not try to fill the full SimDM
 - Publisher should ask himself how he wishes users discover simulation

Example : if the discovery of simulations is only done with input parameters, it is pointless to fill all the statistics.

All concepts

[3+1 Formalism](#)
[8-Wave Scheme](#)
[Accelerated Lambda Iteration](#)
[Adaptive Mesh Refinement](#)
[Advection Upstream Splitting Method Algorithm](#)
[Alternating Direction Implicit](#)
[BiConjugate Gradient](#)
[BiConjugate Gradient Stabilized](#)
[Block Based AMR](#)
[Bulirsch-Stoer](#)
[Cell Based AMR](#)
[Cell Centred](#)
[Central Difference Scheme](#)
[Chebyshev Iteration](#)
[Conjugate Gradient Method](#)
[Conjugate Gradient Squared Method](#)
[Constrained Transport](#)
[Coupled Escaped Probability](#)
[Crank-Nicolson](#)
[Discontinuous Galerkin](#)
[Discontinuous Galerkin methods](#)
[Escape Probability](#)
[Euler](#)
[Exact Radiative Transfer Method](#)
[Exact Riemann Solver](#)
[Extended Finite Element Method](#)
[Fast-Multipole Method](#)

List of vocabularies :
<http://votheory.obspm.fr>

2 - Set up a relational database based on SimDM

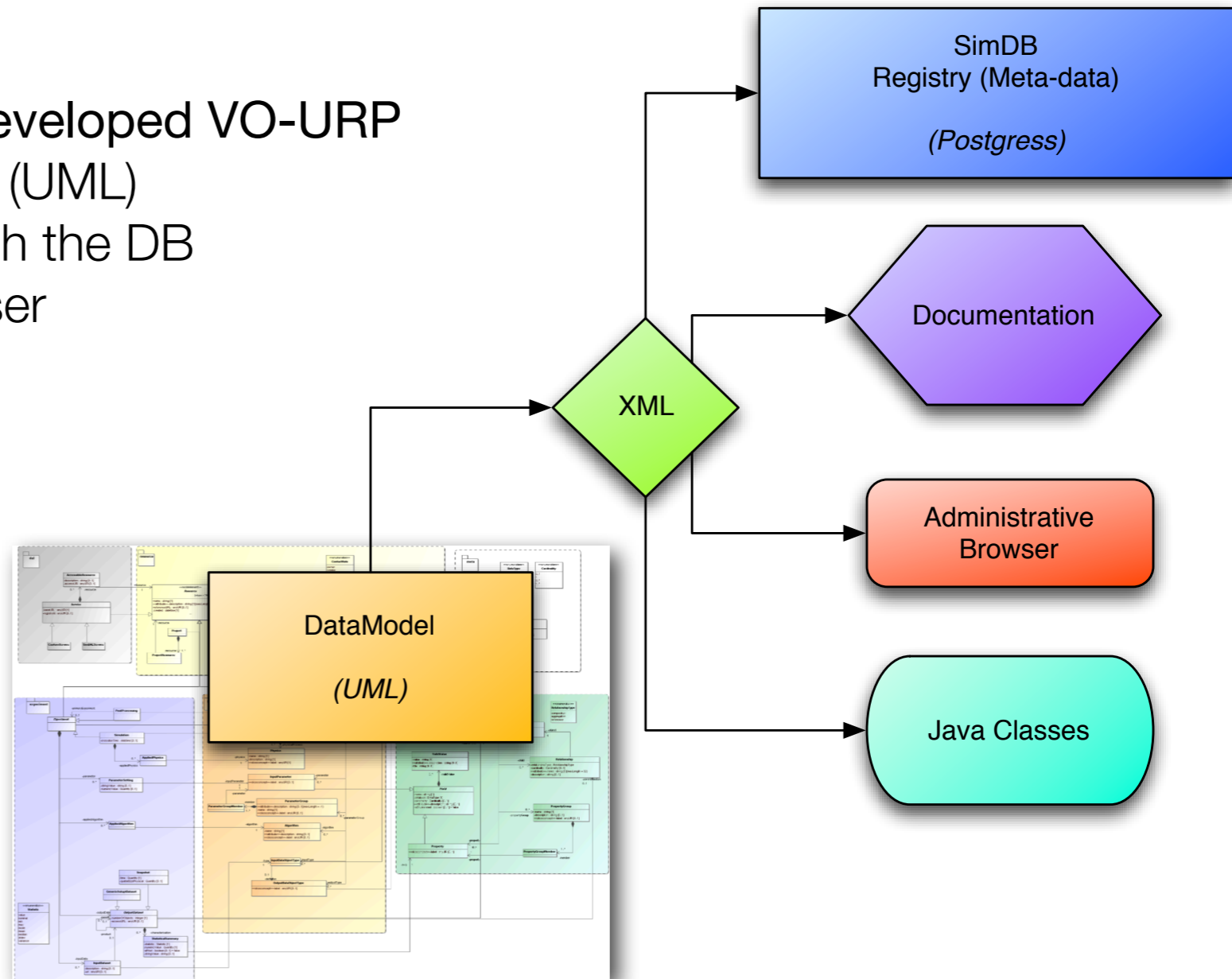
The creation of the relational data base based on SimDM can be complex

Gerard Lemson & Laurent Bourges developed VO-URP

- generate a database from SimDM (UML)
- provides APIs to communicate with the DB
- generates an administrative browser
- provides documentations

It requires time to learn how to use VO-URP but it is a benefit on the long term

Technology : Java JSP



Some tests are done in Strasbourg with Saada

3 - Ingestion pipeline

How to create metadata and store them in the data base ?

- Depending on the code, one can have hundreds or thousands metadata to produce.
- Moreover, if the code evolves frequently, the metadata to store evolves also (and we do not wish to re-build the database and queries each time ...)

Example : micro-physics simulations

- *code computes line intensities*
- *new lines can be added frequently*
- *new metadata (properties, statistics, ...)*

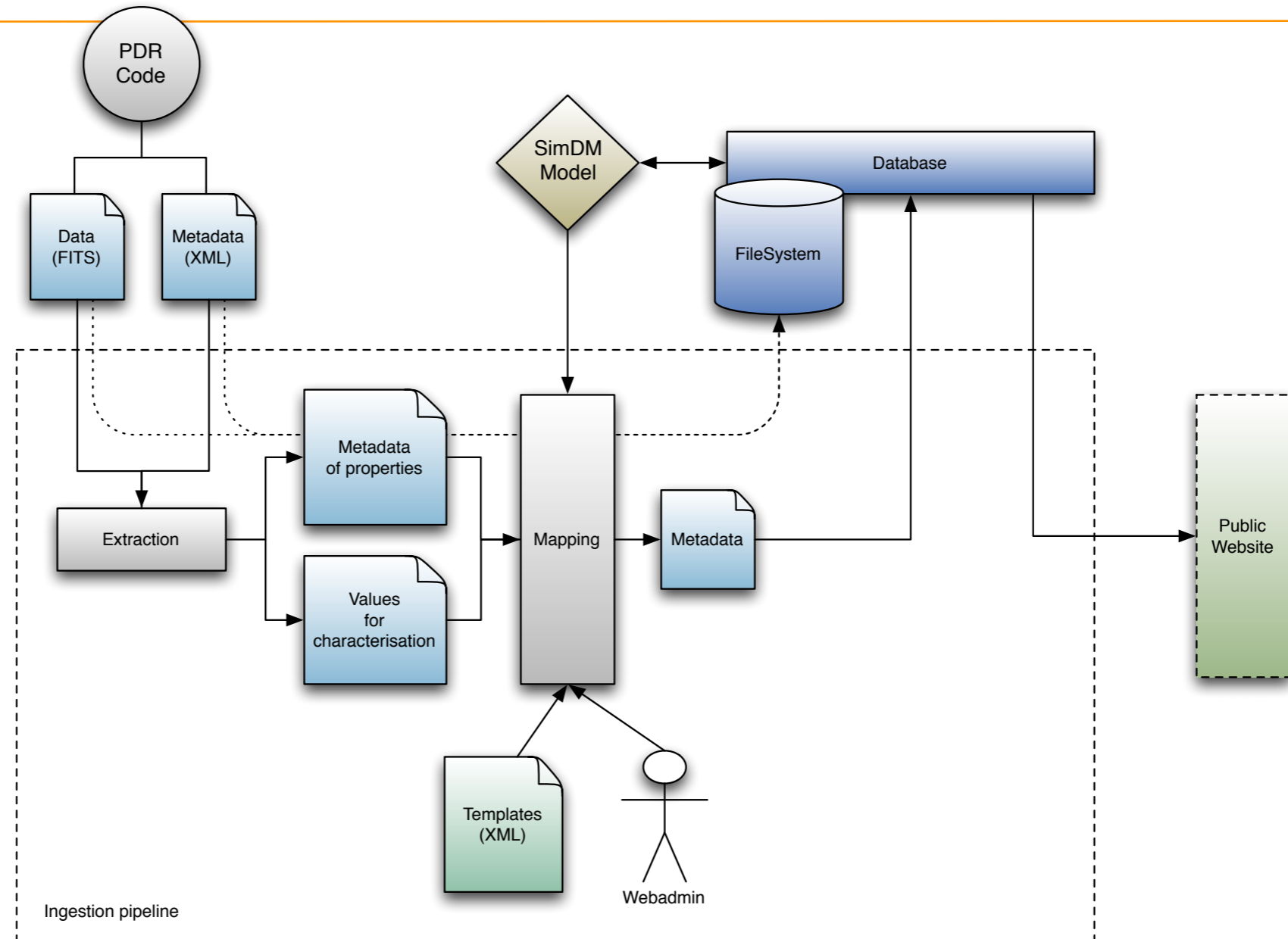
Generation of metadata :

- after a run of the code
- modifications of the code to generate automatically metadata

Ingestion pipeline

- When possible the ingestion pipeline should adapt itself to new metadata
- Automatic modification of the DB

3 - Ingestion pipeline

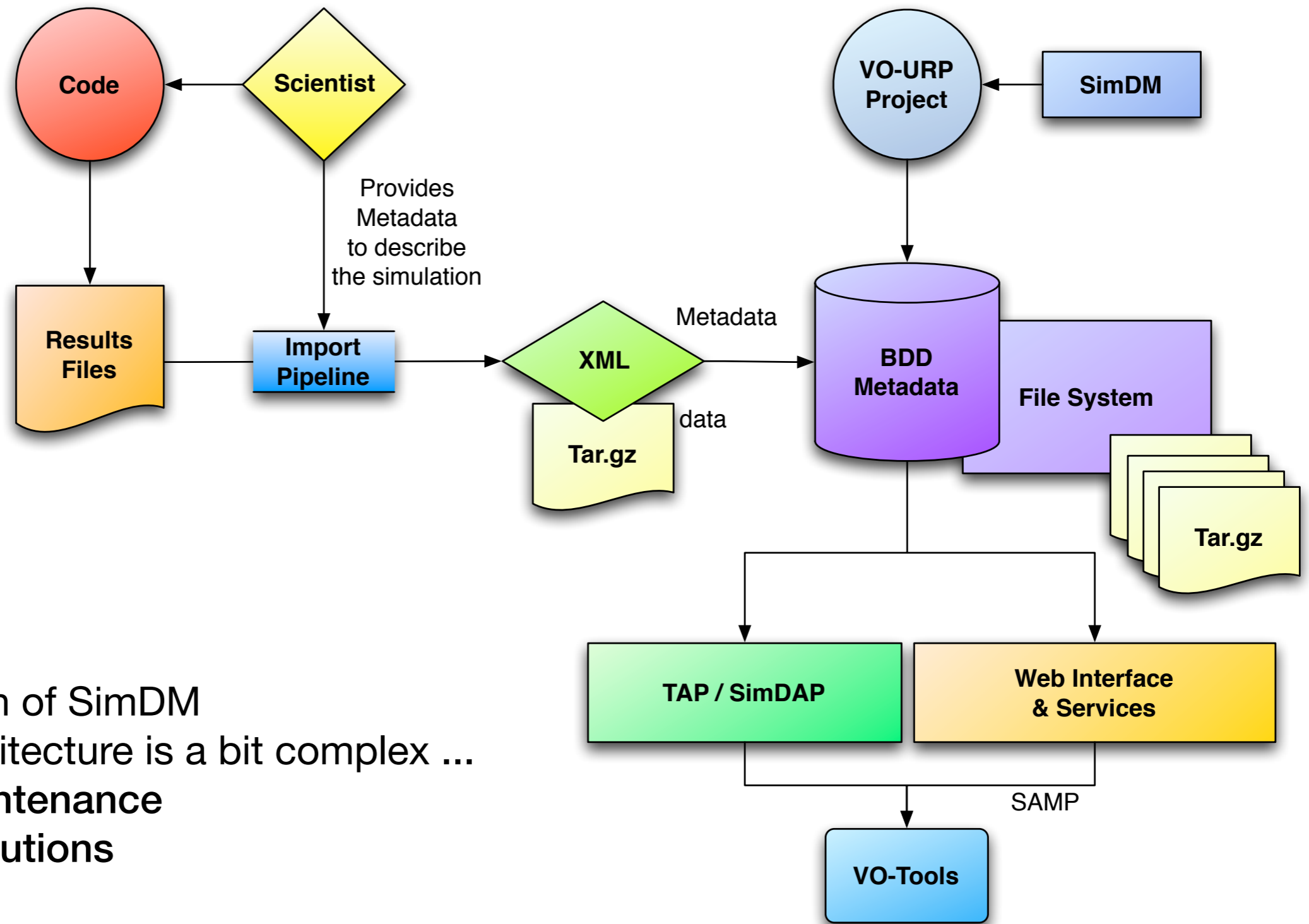


4 - Queries

- Queries can be difficult : hierarchical model - lots of joints
- Optimization of queries required on large data bases (*Ex : millions of halos*)

Typical queries should be simplified by the access protocol : SimDAL (SimTAP)
(see D. Languignon's talk)

Complex architecture



Implementation of SimDM

- the final architecture is a bit complex ...
- requires maintenance
- requires evolutions

=> Most evolutions have to be thought from the beginning.

Conclusions

SimDM : high level DM that can cover many different kind of simulations

It is difficult to set up a new service based on SimDM

- Mapping :
 - IVOA can help with a comprehensive implementation note
 - Share experiences

Before any implementation future evolutions / maintenance of the services have to be planned

Discussions in the VO-Theory I.G. :

- What global architecture for VO-Theory services in the VO ?
 - Which link with the registries ?
 - Are SimDBs required ?
- The access protocol (SimDAL) could simplify the implementation
- Answers should be given quickly :
 - more and more people want to share simulations
 - if we want it is done in a VO context, we have to provide good advices for implementation