

Micro-physics simulations in the Virtual Observatory

Franck Le Petit

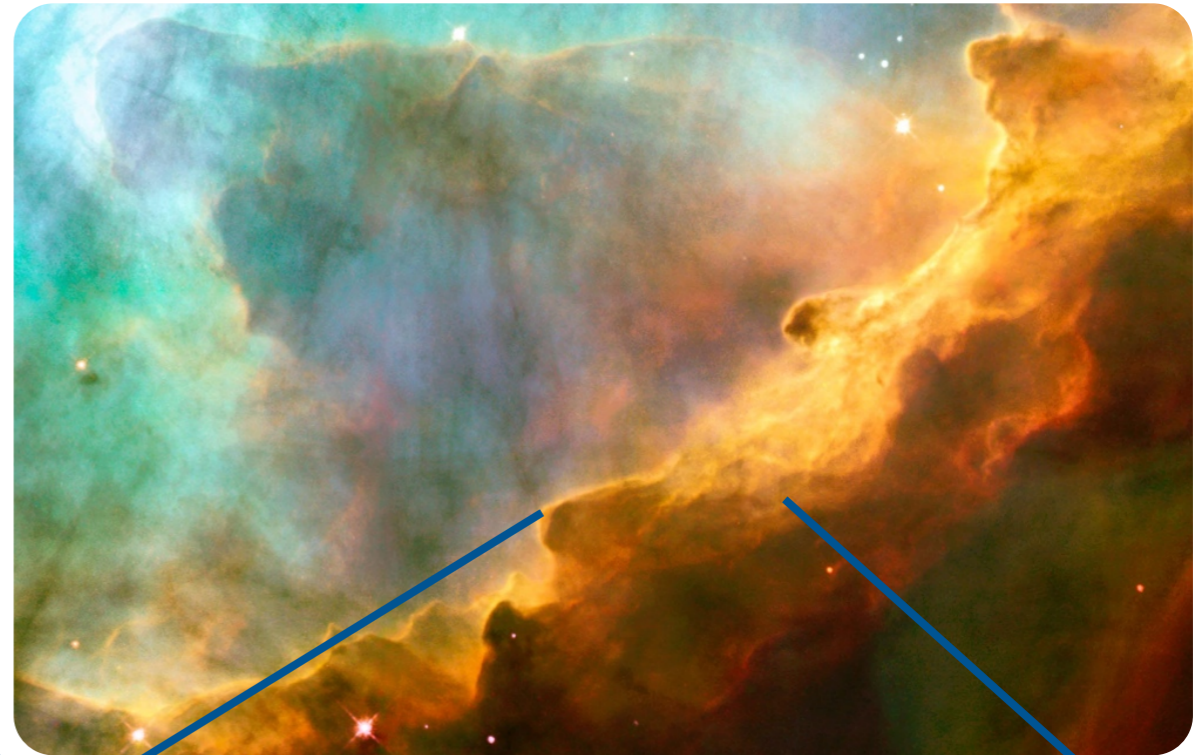


Microphysics codes (Ex: Photoionized regions, Photodissociation Regions, Chocs)

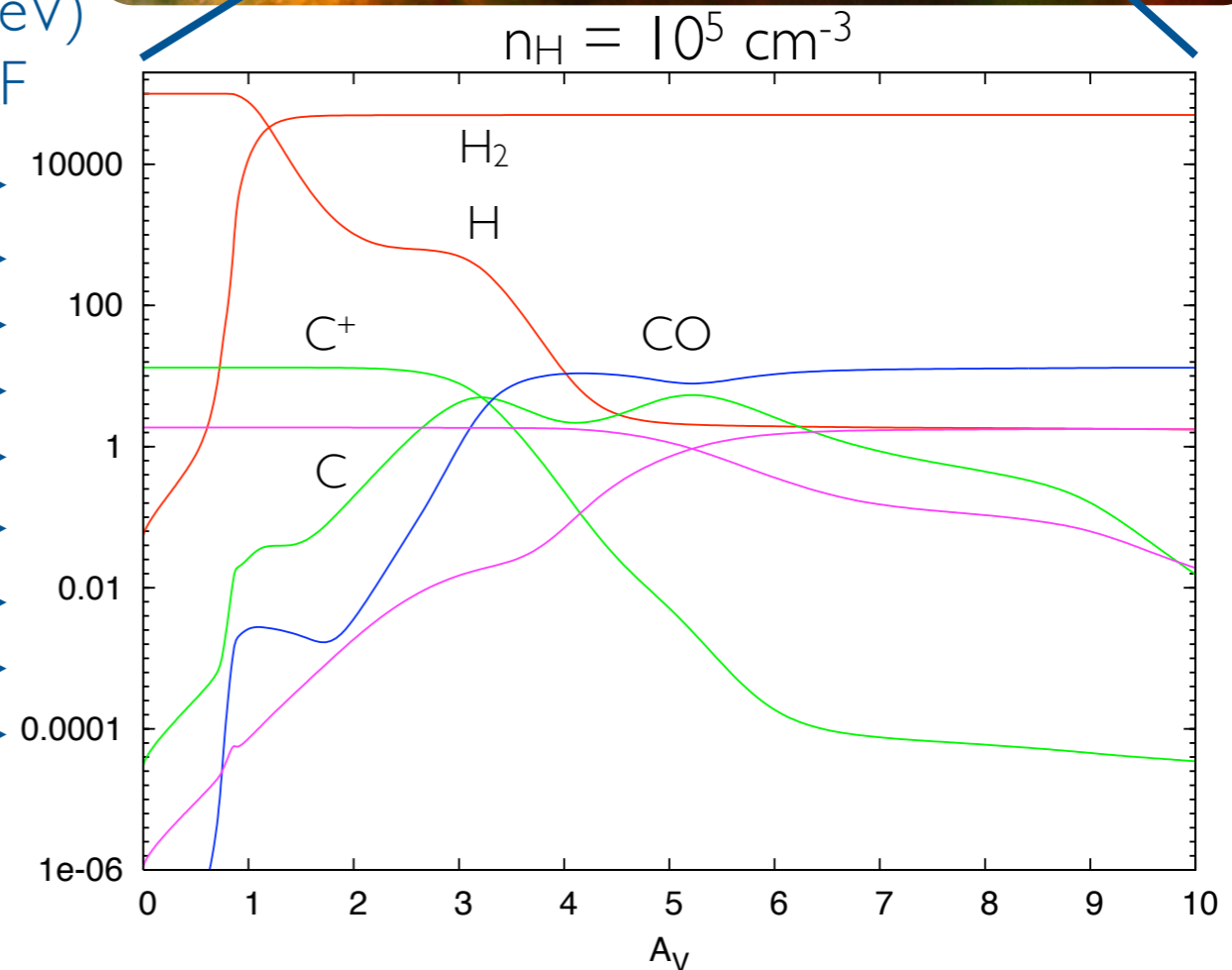
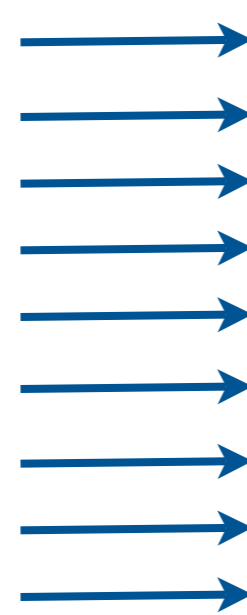
Case:
codes computing the microscopic structure of
astrophysical objects

- chemical abundances
- ionization degree of species
- level excitation
- line intensities
- spectra ...

- many other quantities

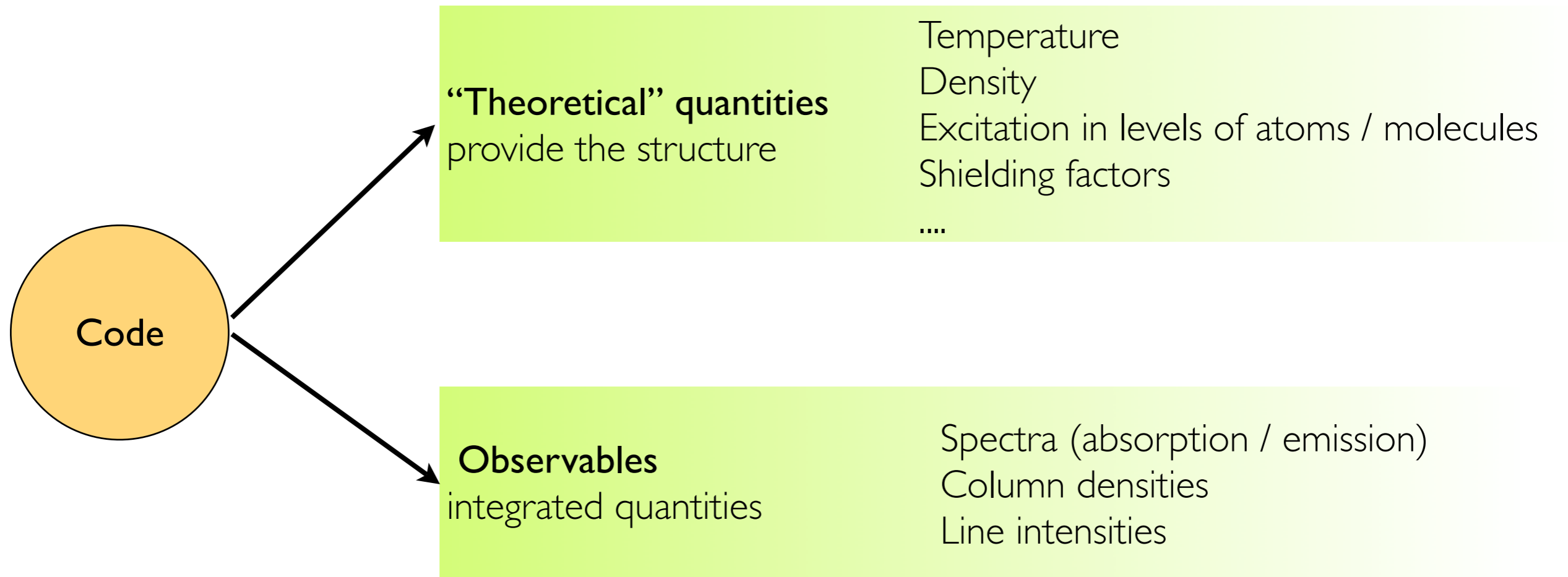


FUV
(13.6 eV - 6eV)
 $10^5 \times \text{ISRF}$



Microphysics codes (Ex: Photoionized regions, Photodissociation Regions)

Two categories of outputs



Why to publish such simulations in the Virtual Observatory

InterOperability with what ?

Observers point of view

- Interpret observations - **Inverse problem**

- Gets observables: spectra, line intensities, column densities, emission maps, ...
 - Want to get observables for a large set of input parameters (inverse problem)
- Deduce the best parameters to fit observations

- Want **to prepare faster observations**

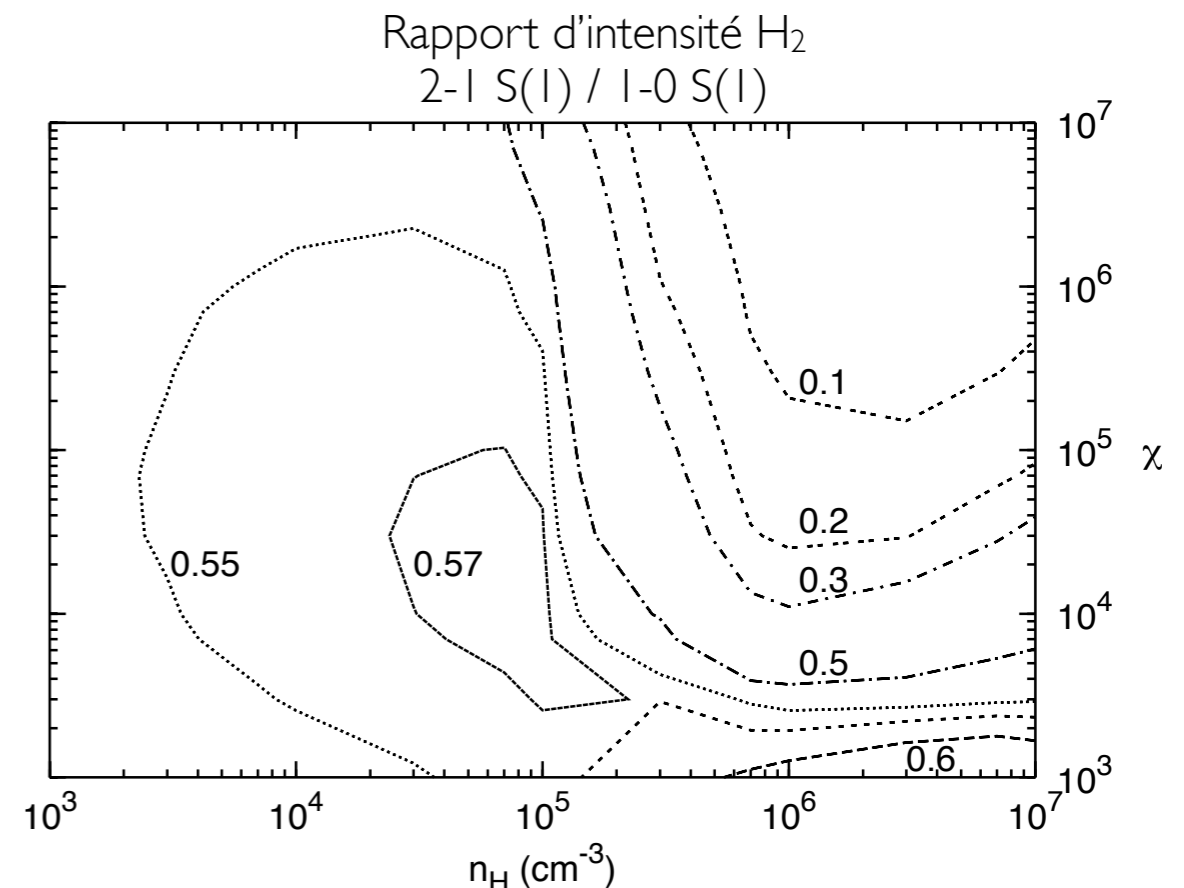
- Estimation of observables (Ex: line intensities)

Most of the time queries will be done on observables (outputs of the simulations)

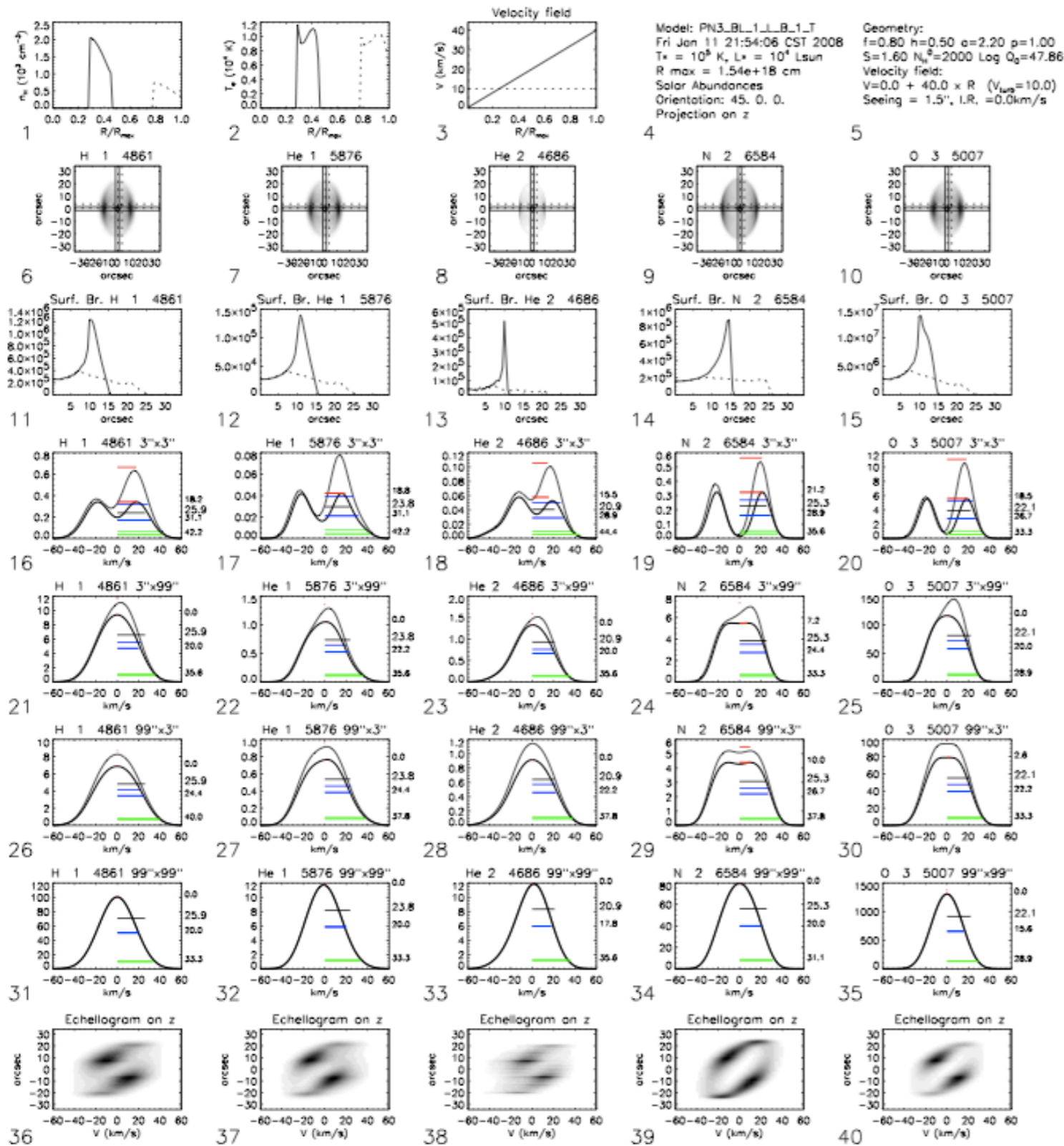
Example: Which category of nebula produce an O+ column density above a value

Need to publish data

- should be published in the V.O. for easy recovery
- Data as spectra may be interoperable with VO-plotting Tools



Microphysics codes (Ex: Photoionized regions, Photodominated regions)



Theory Workshop - Garching C. Morisset

- need to define precisely lines, species, quantum levels
- a problem related to Line DM

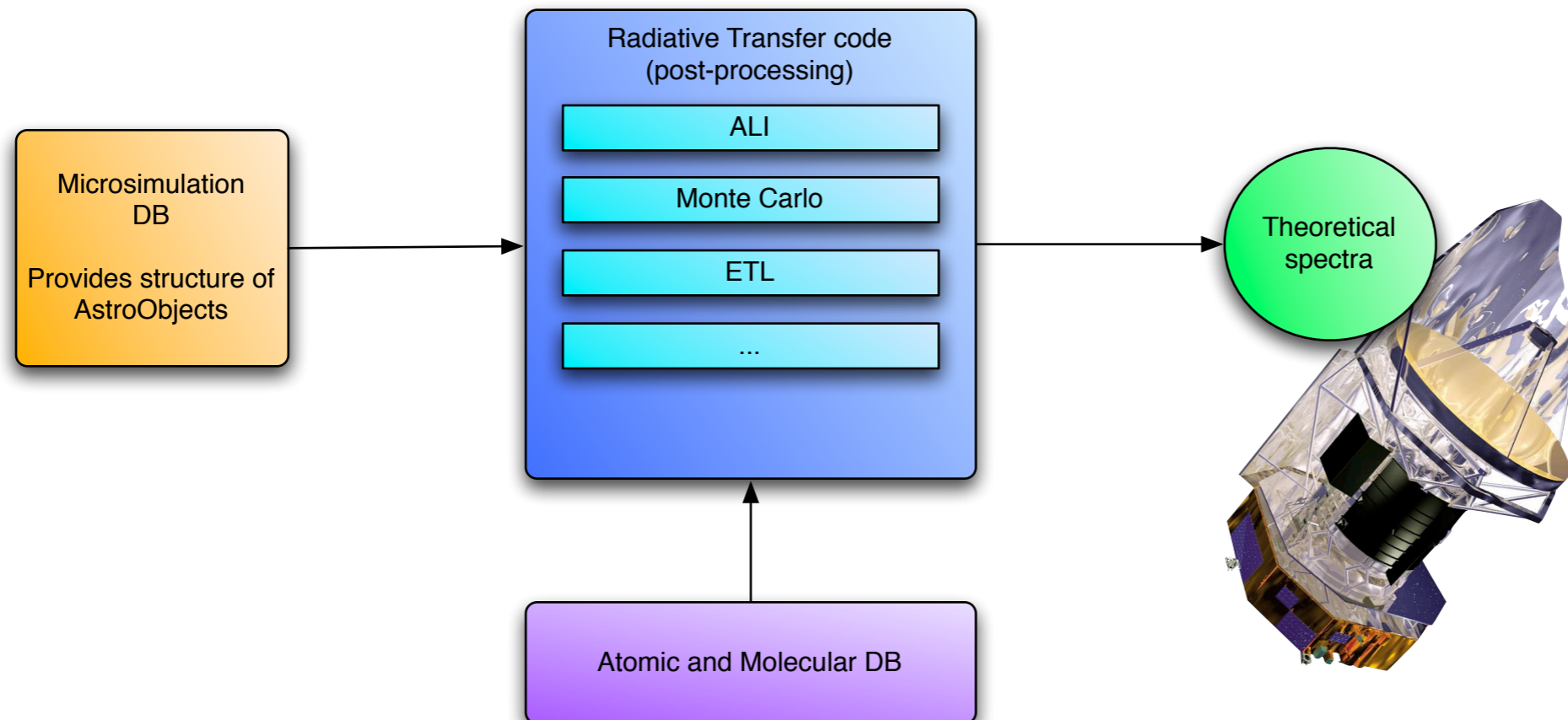
Why to publish such simulations in the Virtual Observatory

InterOperability with what ?

Theorists point of view

- postprocessing
- Towards interoperability between codes

- 1 - Find a model in a D.B.
- 2 - Extract profiles (Temperature, some abundances)
- 3 - Send them to a radiative transfer code
- 4 - Computes line intensities / spectra



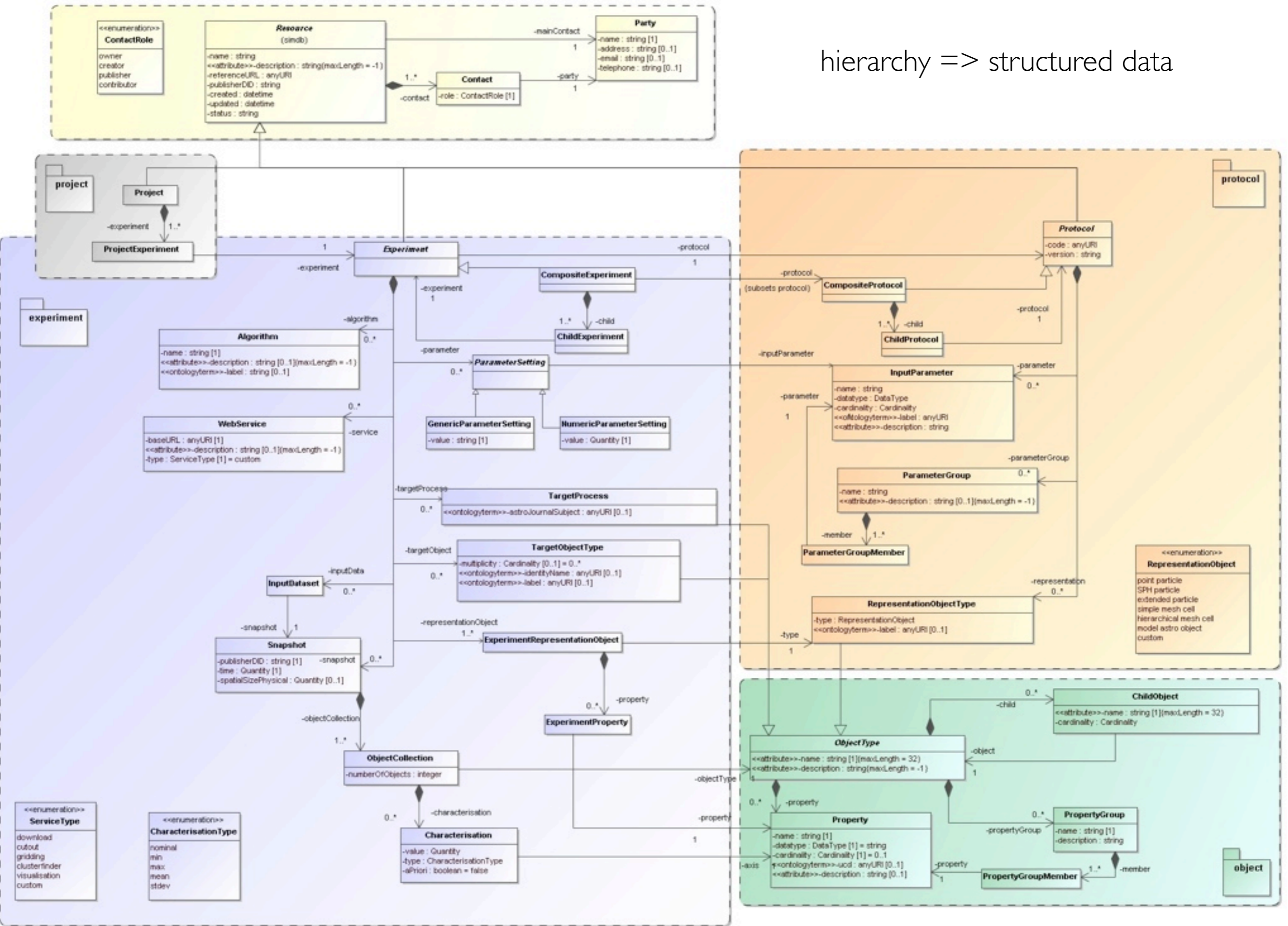
Characteristic of these simulations:

- 1D or more
- stationary or time dependant
- A large number of input parameters
 - Property of gas
 - Ex: density profile, metallicities, incident radiation field, ...
 - Property of grains
 - Parameters controlling algorithms
- A very large number of outputs
 - Structure of the astrophysical object
 - Profiles of density, temperature, pressure, ...
 - Profiles of abundances of chemical species with level populations
 - Line intensities
 - Column densities
 - Spectra

SimDB like

Can we use SimDB ?

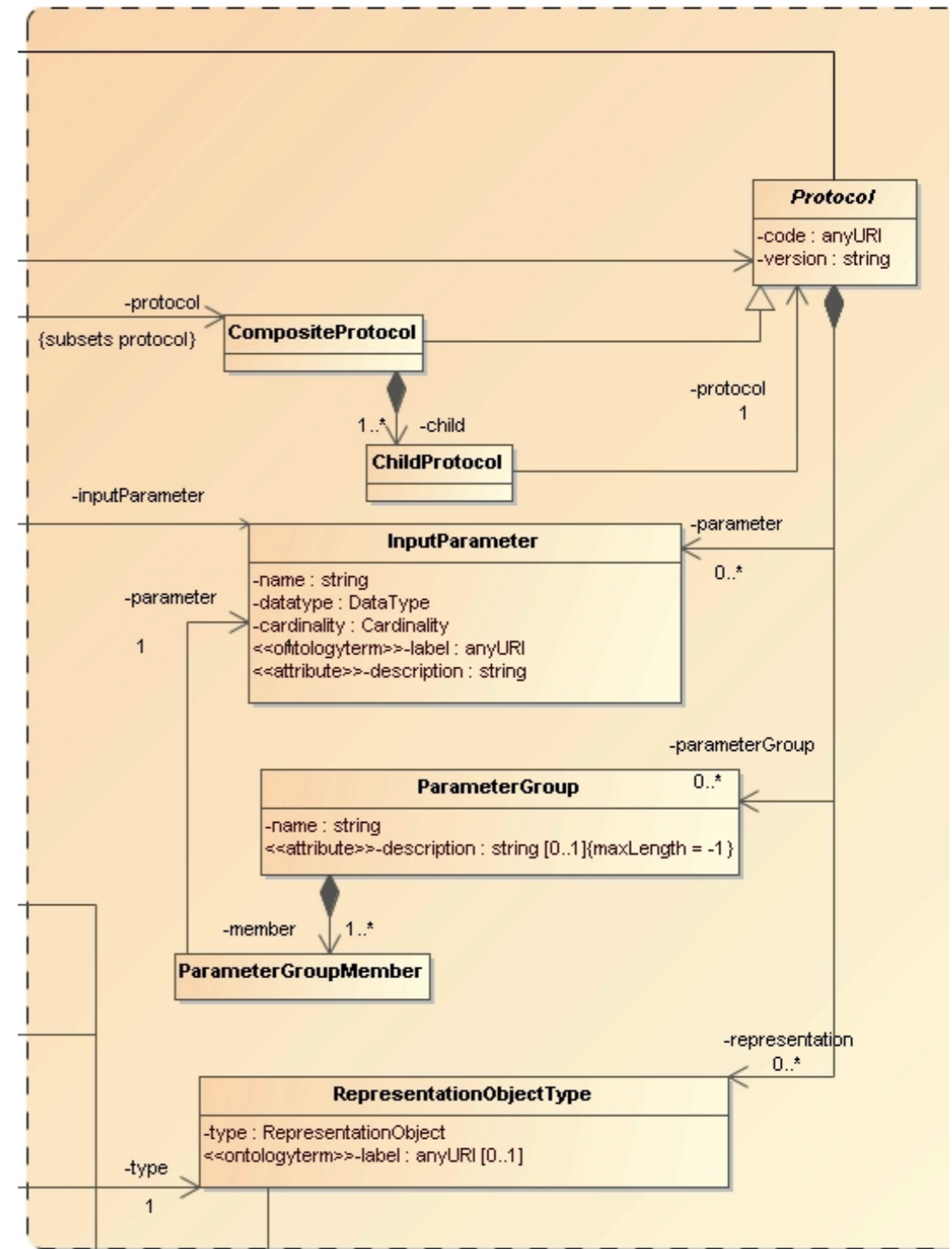
hierarchy => structured data



Parameters

A large number of parameters

- gas properties
 - density
 - incident radiation field
 - composition
 - ...
- grains properties
 - composition
 - size
 - ...
- algorithm properties



Parameters

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<name>FD_NHINIT : Initial proton density</name>

<description></description>

</parameters>

<parameters>

<name>FD_RADM_INI</name>

<label>Initial ISRF scaling factor (observer side) </label>

<description>Scaling factor to Draine radiation field</description>

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<name>FD_RADP_INI</name>

<label>Initial ISRF scaling factor (backside) </label>

<description>Scaling factor to Draine radiation field</description>

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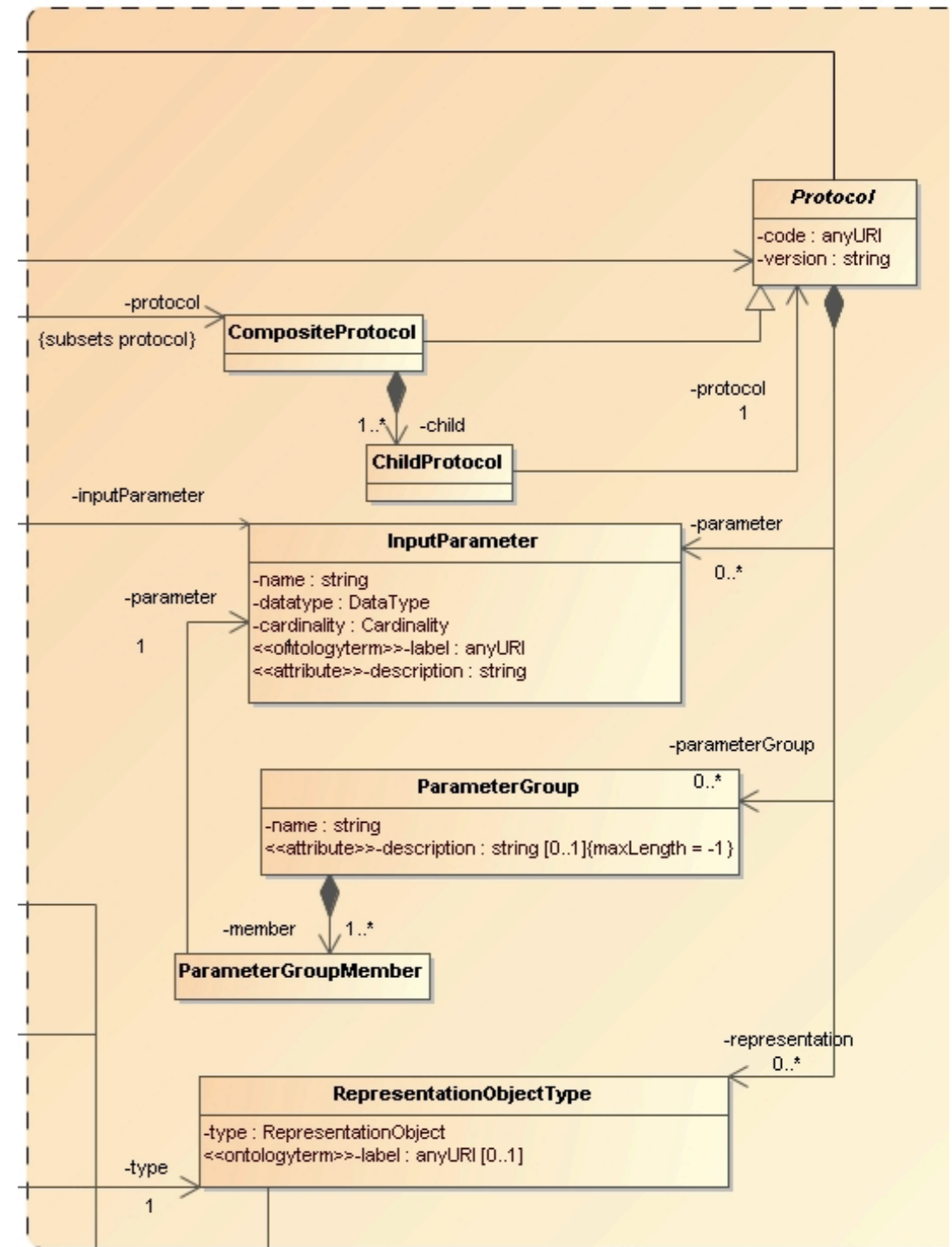
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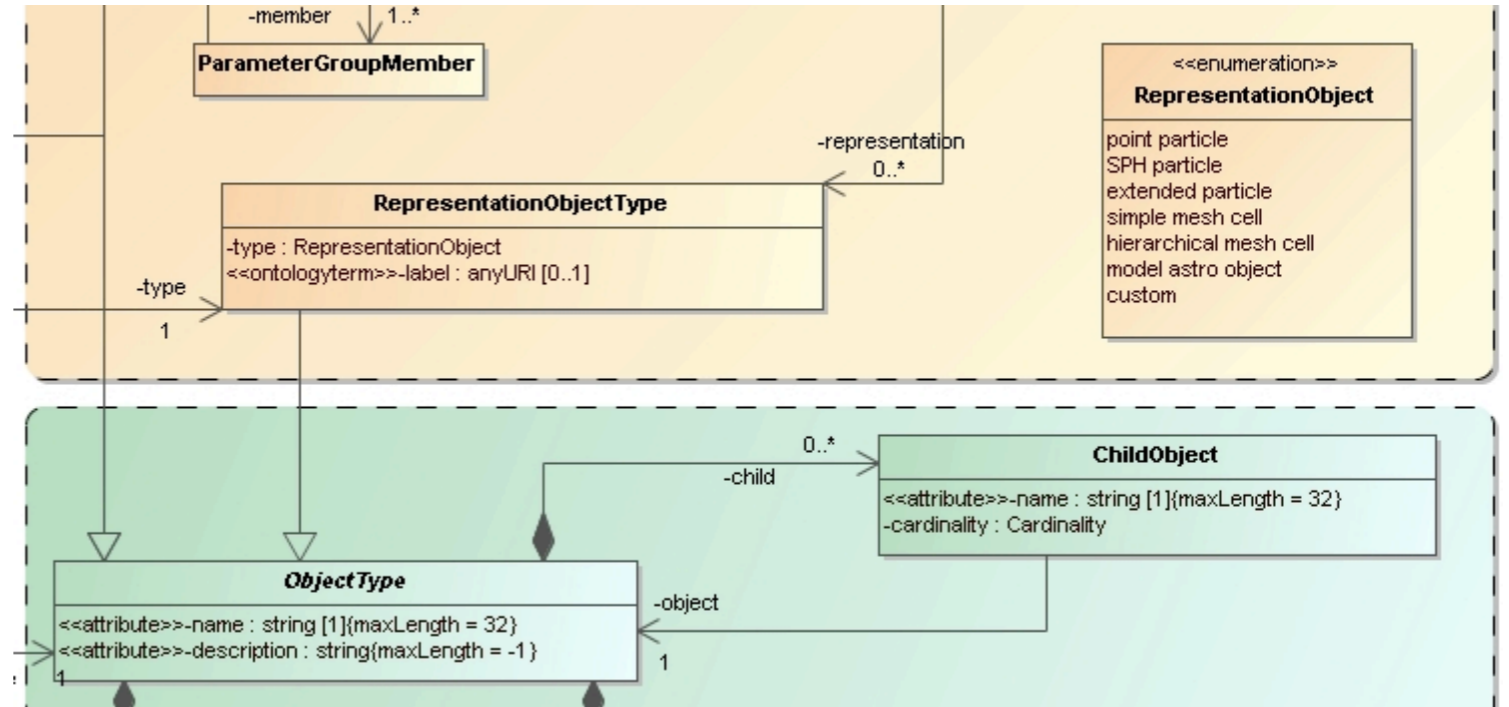
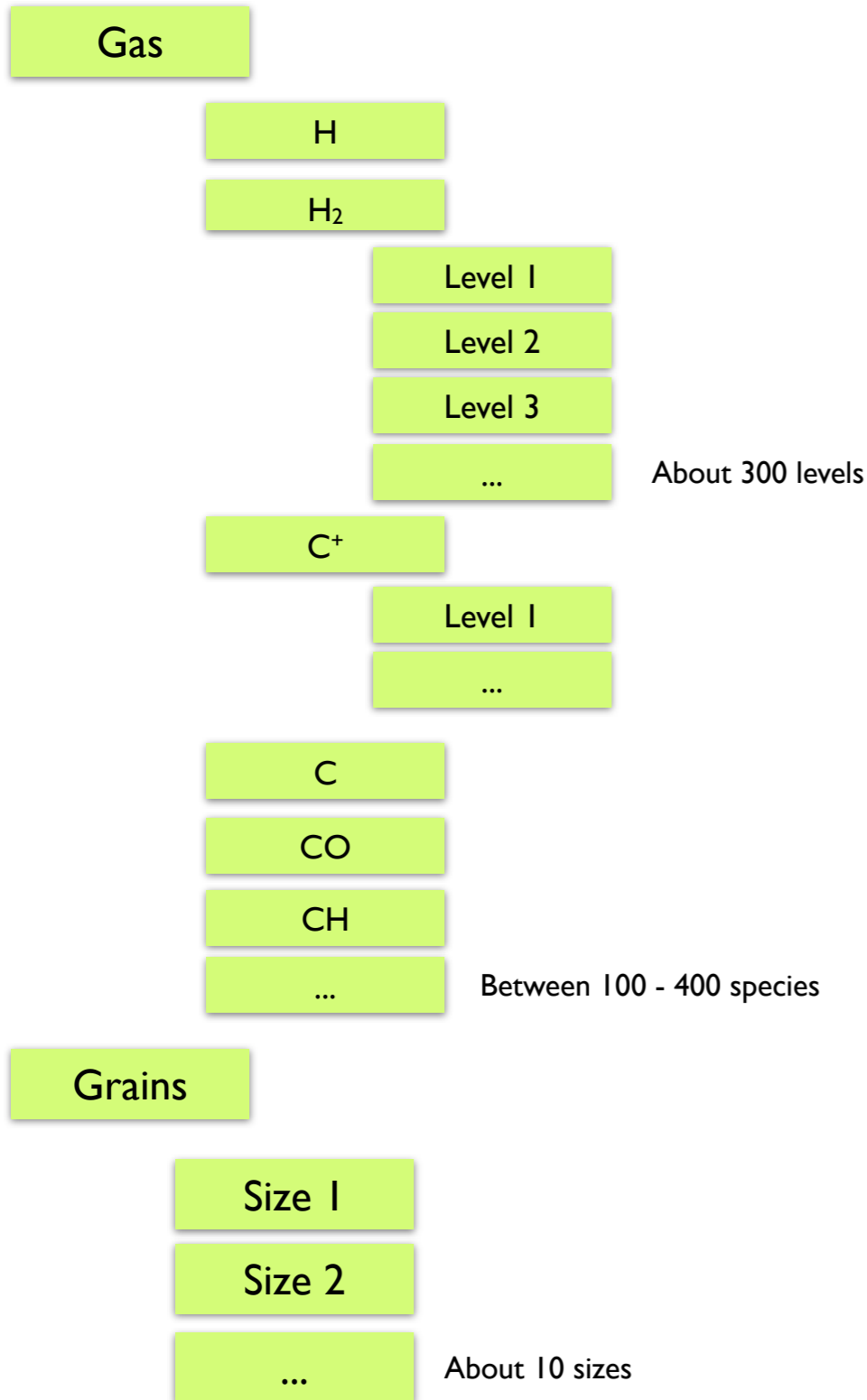
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ObjectTypes

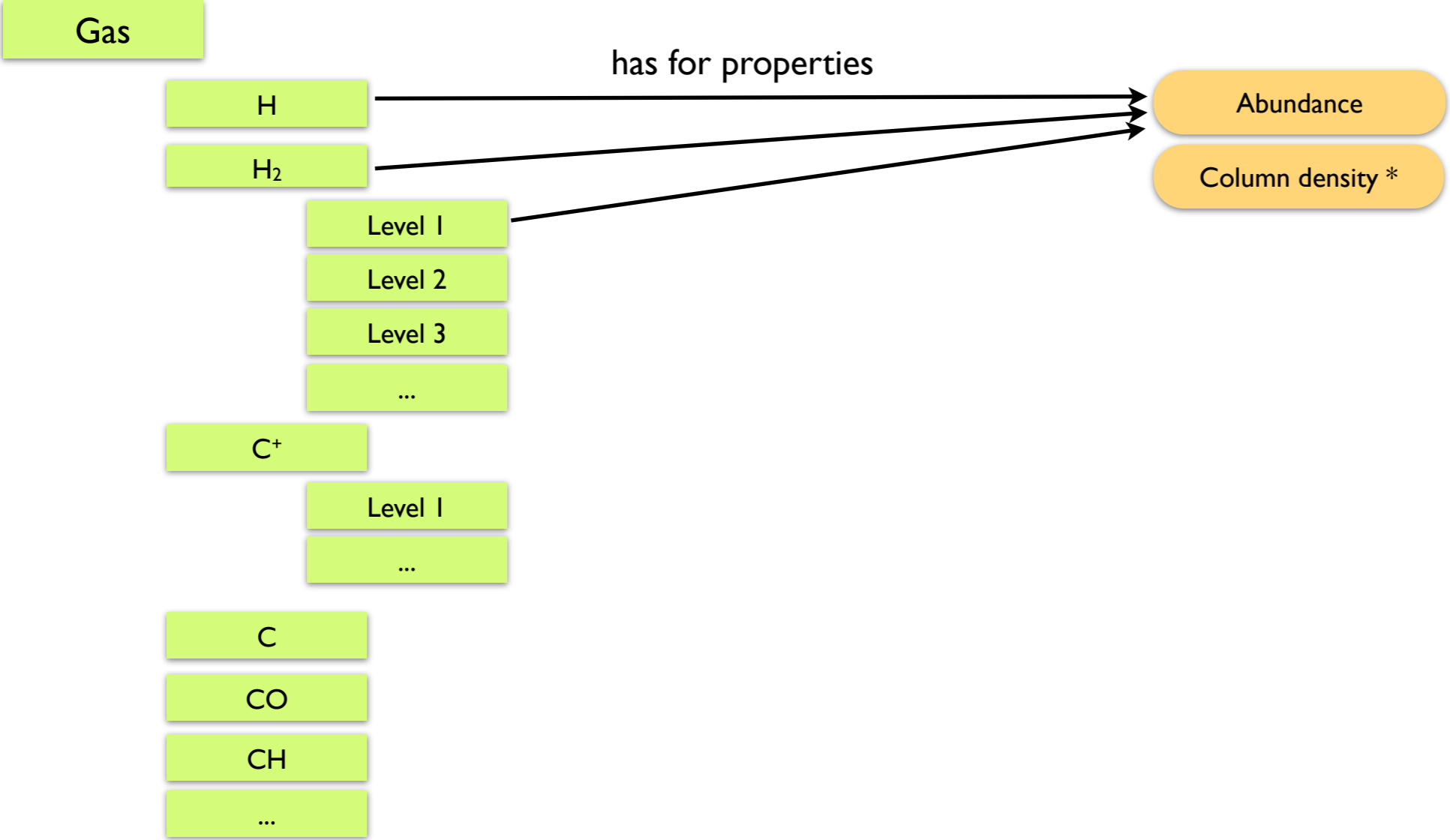
Simple Mesh Cells



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Properties



Conclusion on SimDB for such kinds of microphysics codes

SimDB seems to permit the description of protocols and some parts of the experiment.

In particular:

- the structure of an object.
- the hierarchy in Objects / Parameters / Properties
- detail description of protocol

But difficulties:

- Definition of a snapshot
- Integrated quantities related to a snapshot
Ex: Column densities, Line intensities
- Semantics: Atoms, Ions, Molecules, levels and lines
- These simulations produce also spectra

Conclusion on SimDB for such kinds of microphysics codes

some microphysics simulations are at the boarder of several domain

