

# ISMDB

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## InterStellar Medium DataBase

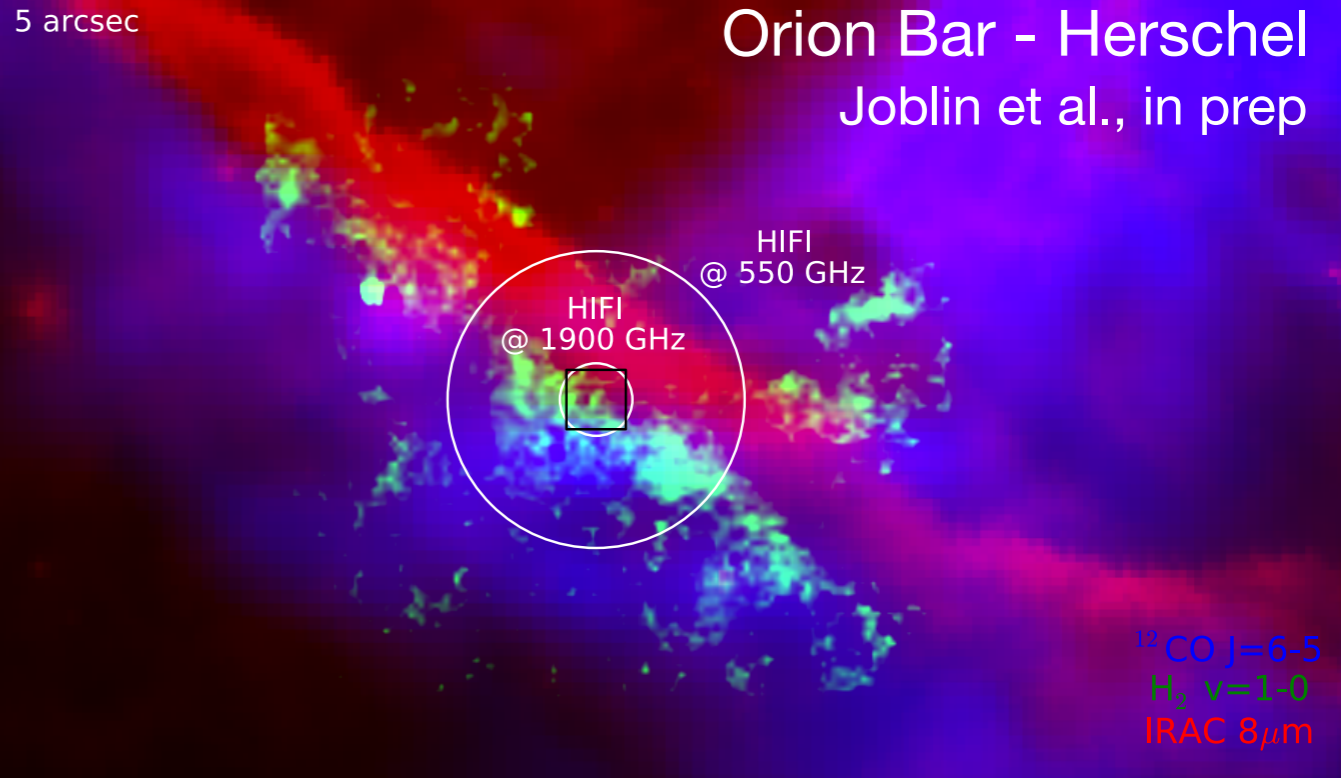
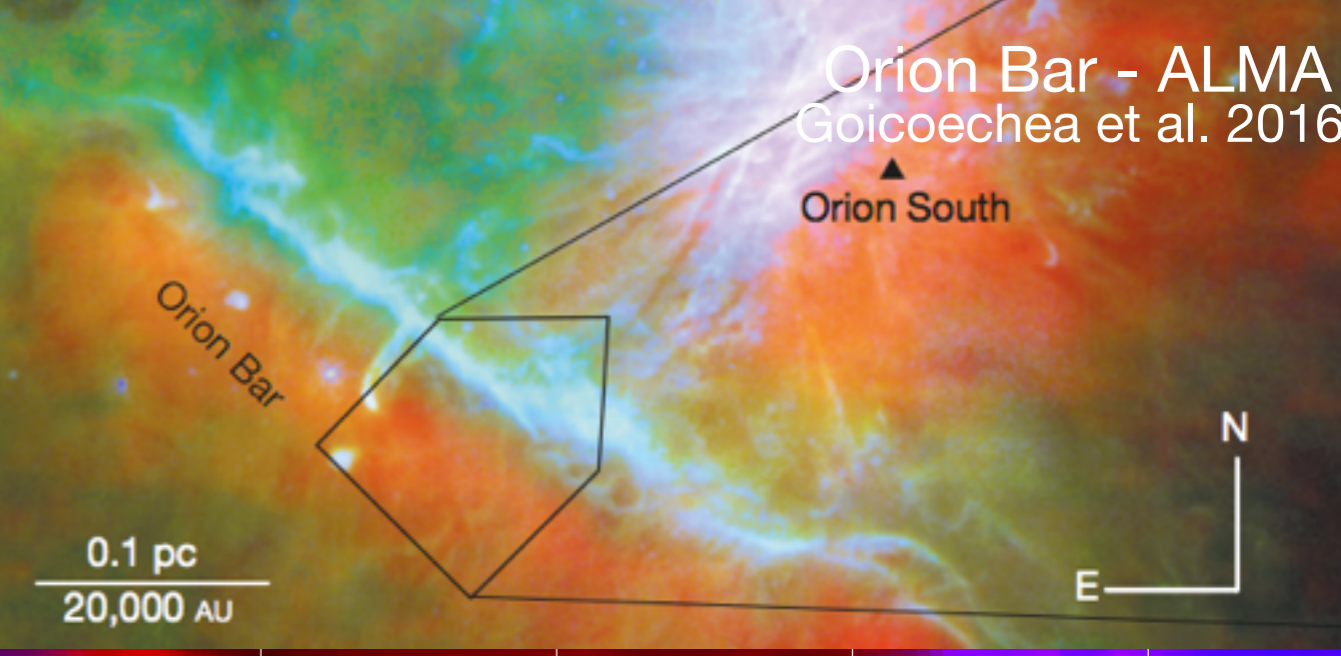
<http://ism.obspm.fr>

Franck Le Petit  
David Languignon  
Emeric Bron  
Benjamin Godard

# ISMDB

One of the services of the ANO5 "Plateforme MIS & Jets"

Goal: Provide services to prepare and interpret observations in Galactic & extragalactic interstellar medium



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One of the services of the ANO5 "Plateforme MIS & Jets"

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Services are based on reference state-of-the-art codes

PDR code

Paris-Durham Shock code

AMRVAC

TDR code

...

Several services are developed above the products of these codes

- Source codes & specific developments
- Online codes
- Tools to analyze results
  - Extractor & Chemistry Analyzer
- ISMDB

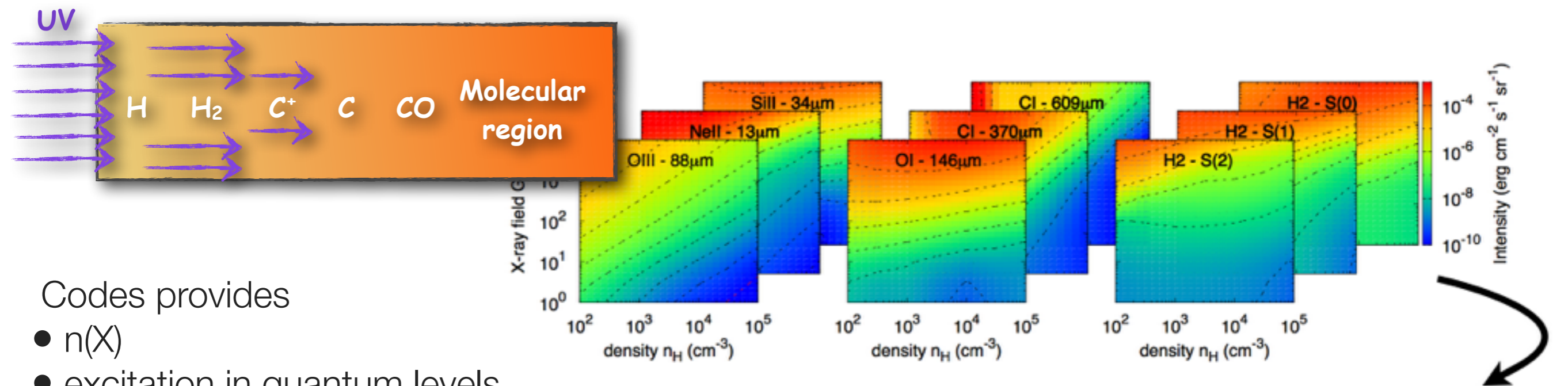
The screenshot shows the ISM Services website. At the top, there is a navigation bar with the following links: ISM Services (with a logo), CODES (access to codes), ISMDB (simulations database, circled in red), TECHNOLOGIES (standards), PARTNERS (credits), and REGISTRATION. Below the navigation bar is a large image of a colorful nebula. At the bottom, there is a grid of four service cards:

Service Name	Description
PDR Code	The Meudon PDR code
DustEM	Dust Emission
Shock	Paris-Durham Shock model
Starformat	MHD simulations data base

# ISMDB

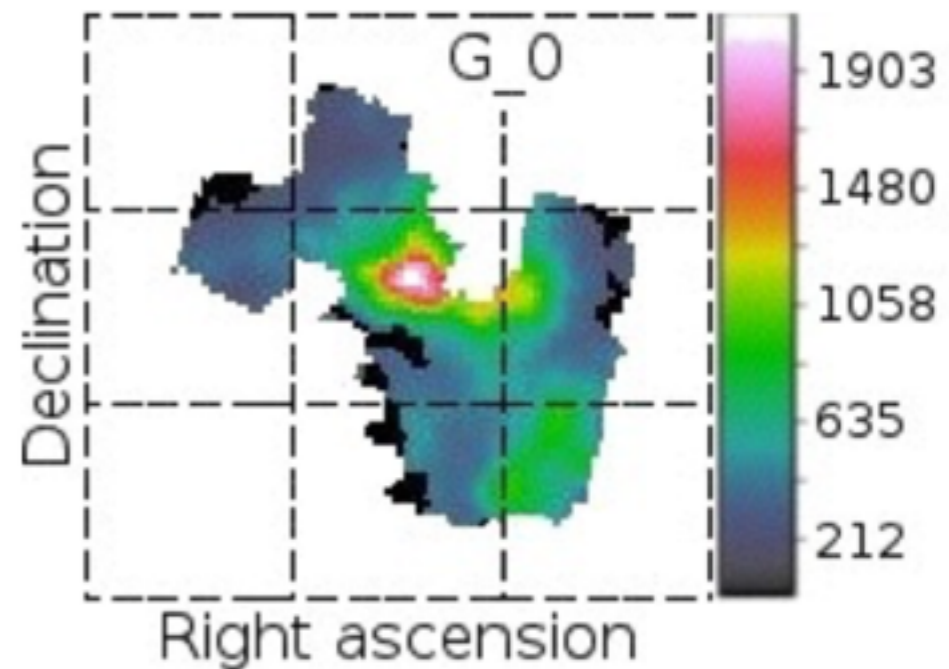
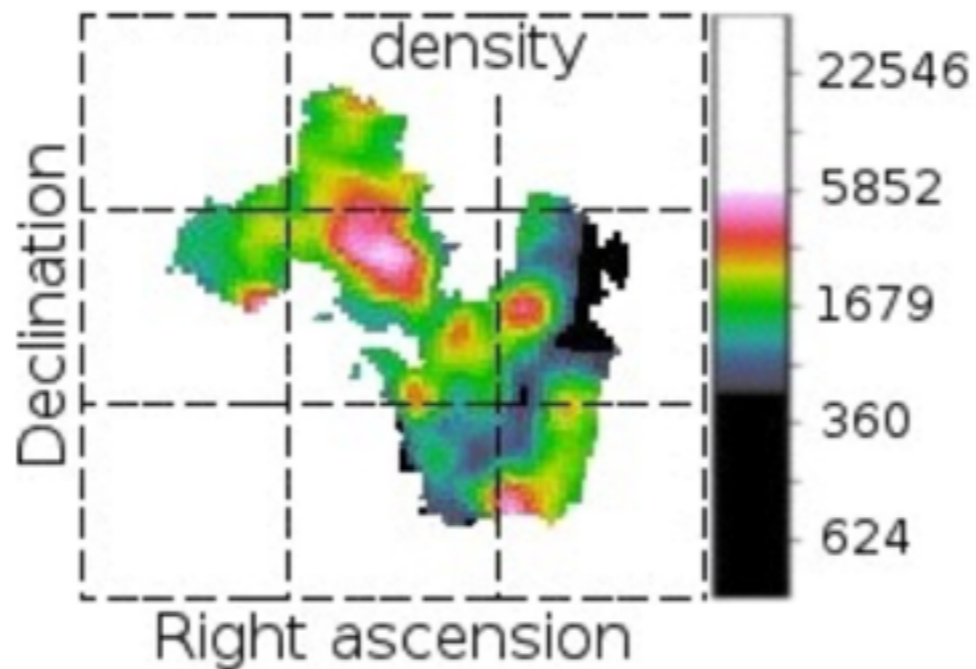
One of the services of the ANO5 "Plateforme MIS & Jets"

Goal: Provide services to prepare and interpret observations in Galactic & extragalactic interstellar medium



Codes provides

- $n(X)$
- excitation in quantum levels
- $T_{\text{gas}}, T_{\text{dust}}$
- ...
- $I(X)$
- $N(X)$
- spectre

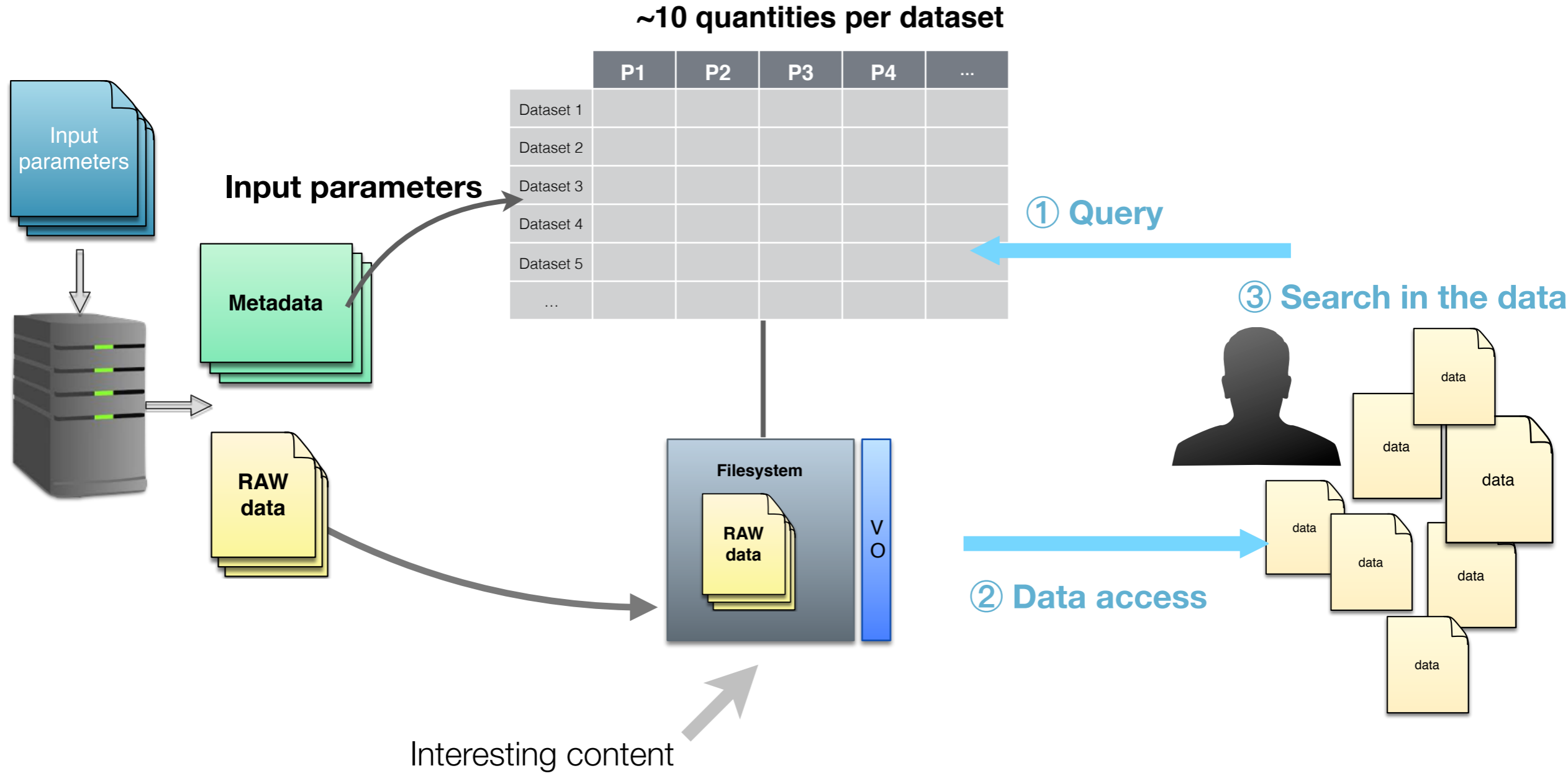


# ISMDB

## ISMDB: InterStellar Medium DataBase

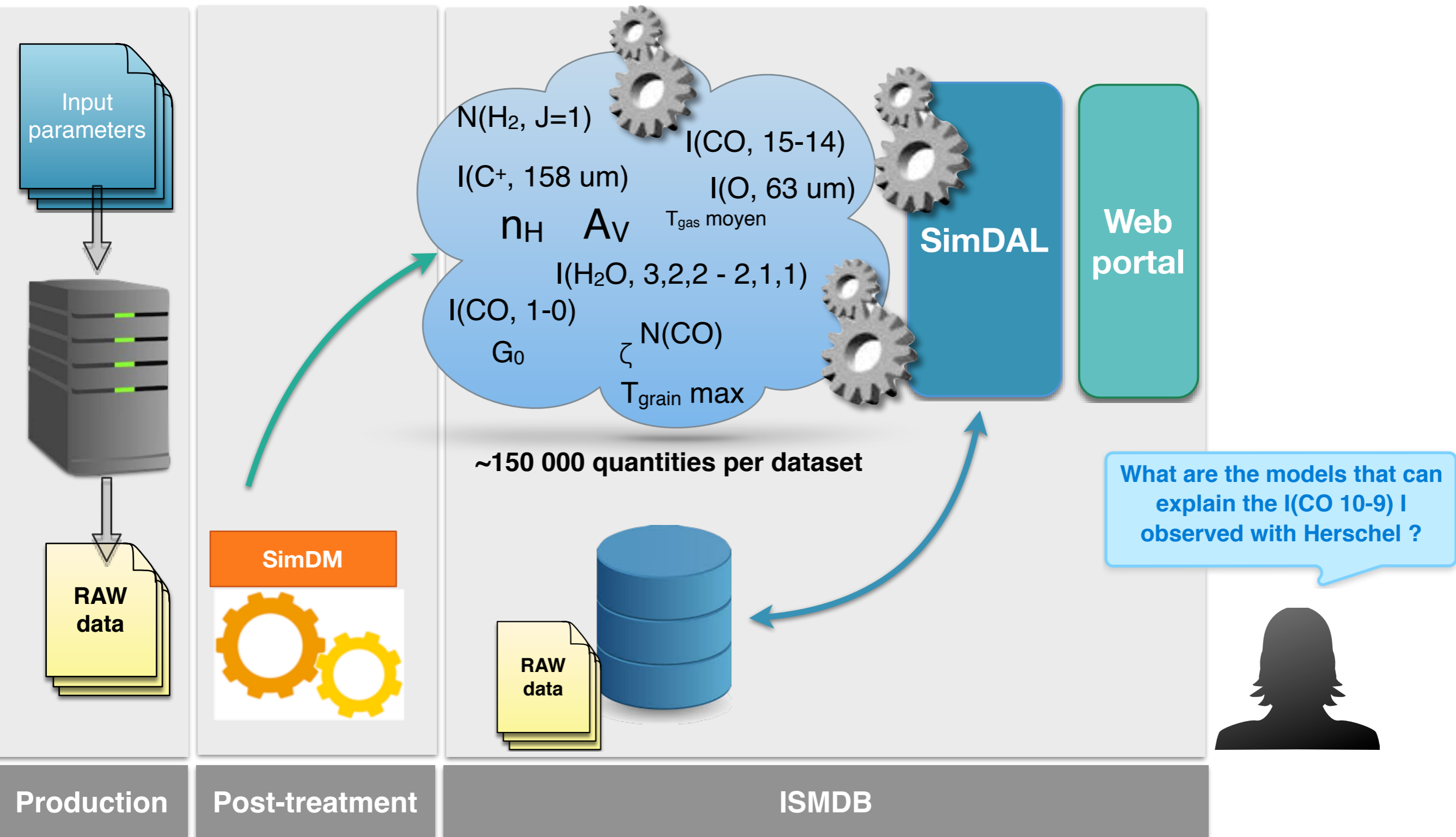
- not only a classical database to find pre-computed models
- but **also a tool that can interpret observations**

Standard databases:



# ISMDB

- not only a classical database to find pre-computed models
- but **also a tool that can *interpret* observations**



# ISMDB

Production of large grids of PDR models

- ~ 3000 PDR models in ISMDB for **standard galactic conditions**
- ~ 10 To of data

Cover: **PDR models for Herschel, IRAM/Noema, JWST, ALMA ... observations**

- Each model is characterized by + 150 000 queryable quantities
  - input parameters
  - computed **line intensities** (H<sub>2</sub>, CO, H<sub>2</sub>O, ...)
  - **column densities** (total and in quantum levels)
- Raw data contains
  - all computed quantities (spatial profiles, ...)
  - **spectra**
  - ...

Models are stored in two projects

- isobaric models
- isochoric models

## ISM DataBase – Inverse Search service Beta

[Help](#)
[Contact](#)

### Grid of isobaric PDR 1.5.2 models (2016-12-03)

code: PDR 1.5.2 rev 1714

#### Parameters

*avmax*: from 1.0 to 40.0 (mag)  
*radm\_ini*: from 1.0 to 1E5 (Mathis unit)  
*gas\_pressure\_input*: from 1E5 to 1E9 (K cm<sup>-3</sup>)



#### Description

This grid of isobaric PDR 1.5.2 models (revision 1714) covers photo-dominated regions conditions. Explored parameters are thermal pressure, UV field intensity and size of the clouds. The full grid contains 1372 2-side models where the back side of the cloud is submitted to the ISRF.

The chemistry takes into account 222 species, including C and O isotopes, linked by 6243 chemical reaction. No surface reactions are considered excepted for H<sub>2</sub>. H<sub>2</sub> formation model takes into account Eley-Rideal and Langmuir-Hinshelwood mechanisms as described in Le Bourlot et al. (2012).

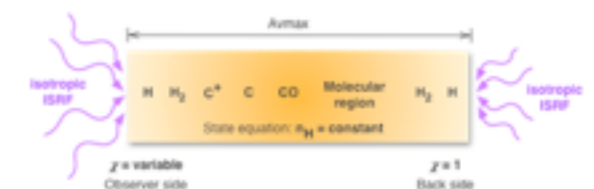
These models give access to all quantities computed by PDR 1.5.2 (line intensities, column densities, densities, temperature of gas and grains, ...).

### Grid of isochoric PDR 1.5.2 models (2017-02-17)

code: PDR 1.5.2 rev 1787

#### Parameters

*avmax*: from 1.0 to 30.0 (mag)  
*proton\_density\_input*: from 1E2 to 1E8 (cm<sup>-3</sup>)  
*radm\_ini*: from 1.0 to 1E5 (Mathis unit)



#### Description

This grid of isochoric PDR 1.5.2 models (revision 1787) covers photo-dominated regions conditions. Explored parameters are proton density, UV field intensity and size of the clouds. The full grid contains 2128 2-side models where the back side of the cloud is submitted to the ISRF.

The chemistry takes into account 222 species, including C and O isotopes, linked by 6243 chemical reaction. No surface reactions are considered excepted for H<sub>2</sub>. H<sub>2</sub> formation model takes into account Eley-Rideal and Langmuir-Hinshelwood mechanisms as described in Le Bourlot et al. (2012).

These models give access to all quantities computed by PDR 1.5.2 (line intensities, column densities, densities, temperature of gas and grains, ...).



ISMServices CODES ISMDB PARTNERS REGISTRATION

Help Contact

## ISM DataBase – Inverse Search service Beta

Grid of isobaric PDR 1.5.2 models  
2016.12.03

### 1 – search among two parameters

x  (cm-3\_K)  log scale

y  (Mathis\_unit)  log scale

### 2 – fix all the other parameters

(mag)

### 3 – observational constraints

```
"I(CO v=0J=1->v=0J=0 angle 00 deg)" > 1.8E-7  
"I(CO v=0J=1->v=0J=0 angle 00 deg)" < 2.4E-7  
"I(H2 v=0J=2->v=0J=0 angle 60 deg)" > 1E-8  
"I(H2 v=0J=2->v=0J=0 angle 60 deg)" < 5E-7
```

## ① Select the searched input parameters

Example of a search:

- gas pressure
- UV intensity

## ② Fix the other input parameters

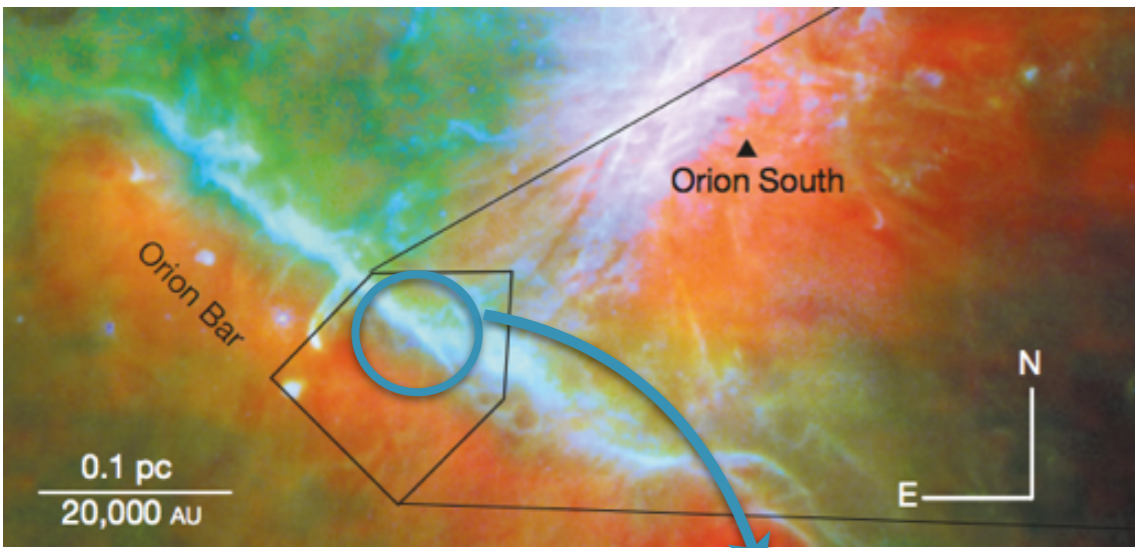
Example: size of the cloud

## ③ Enter the observations

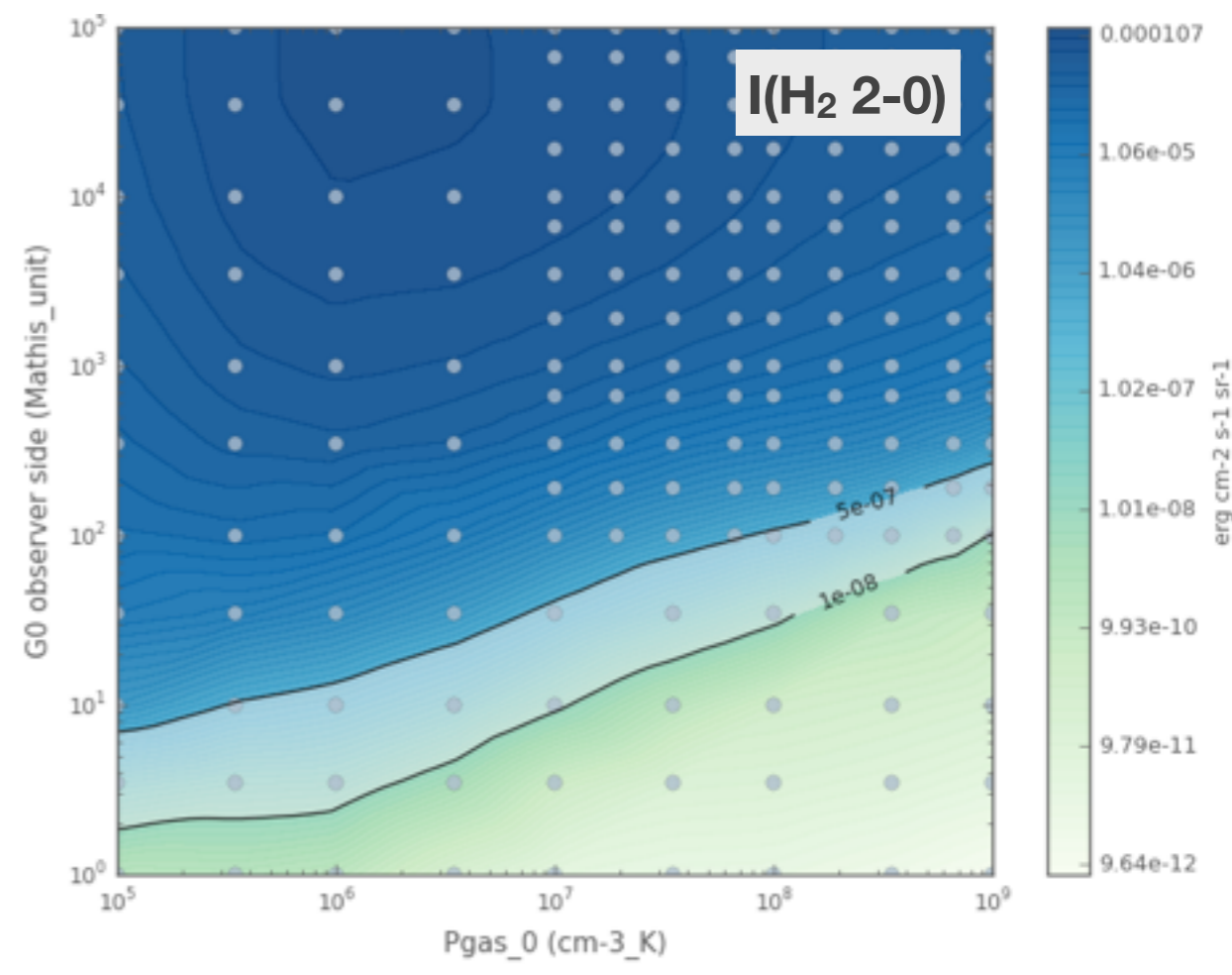
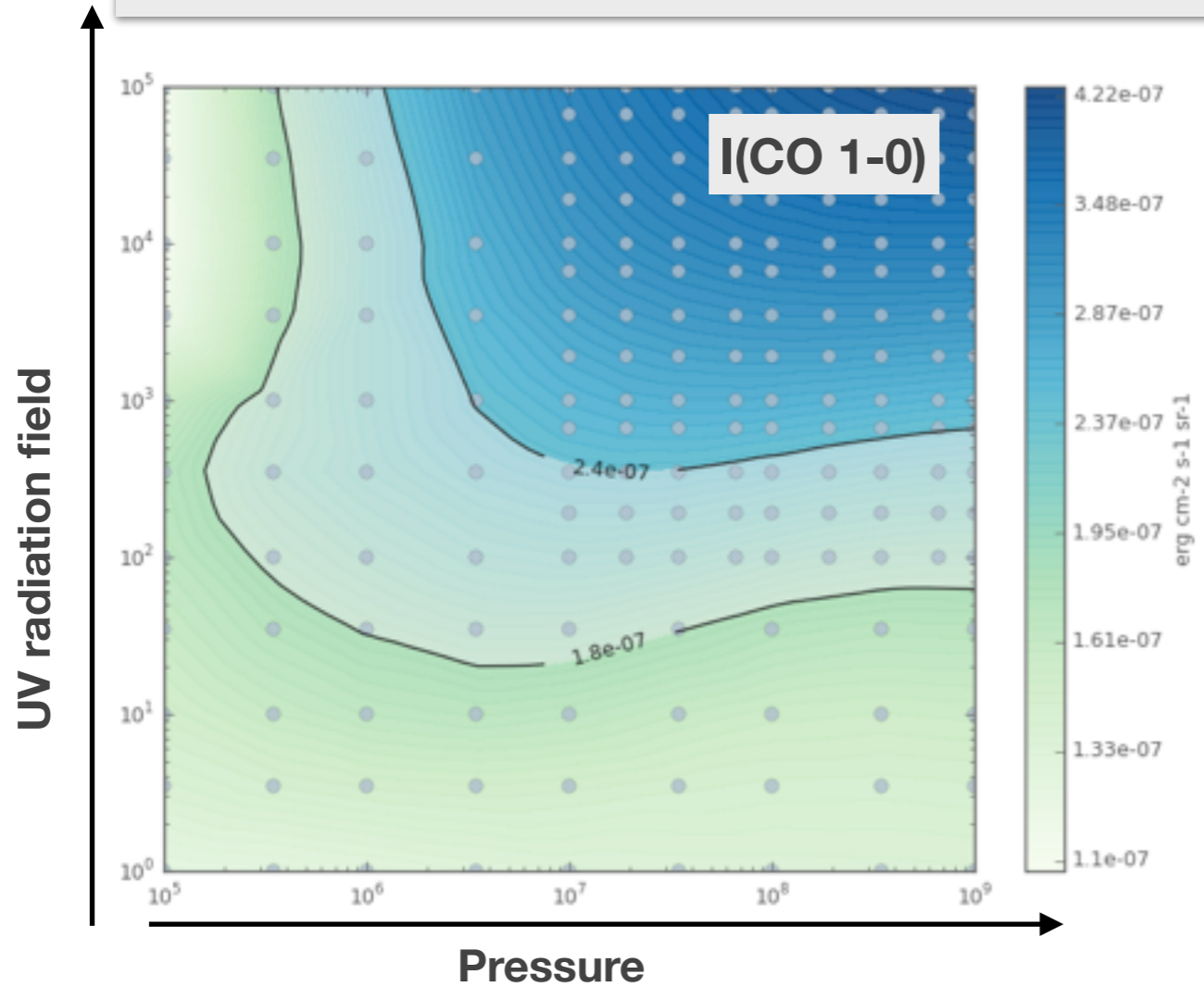
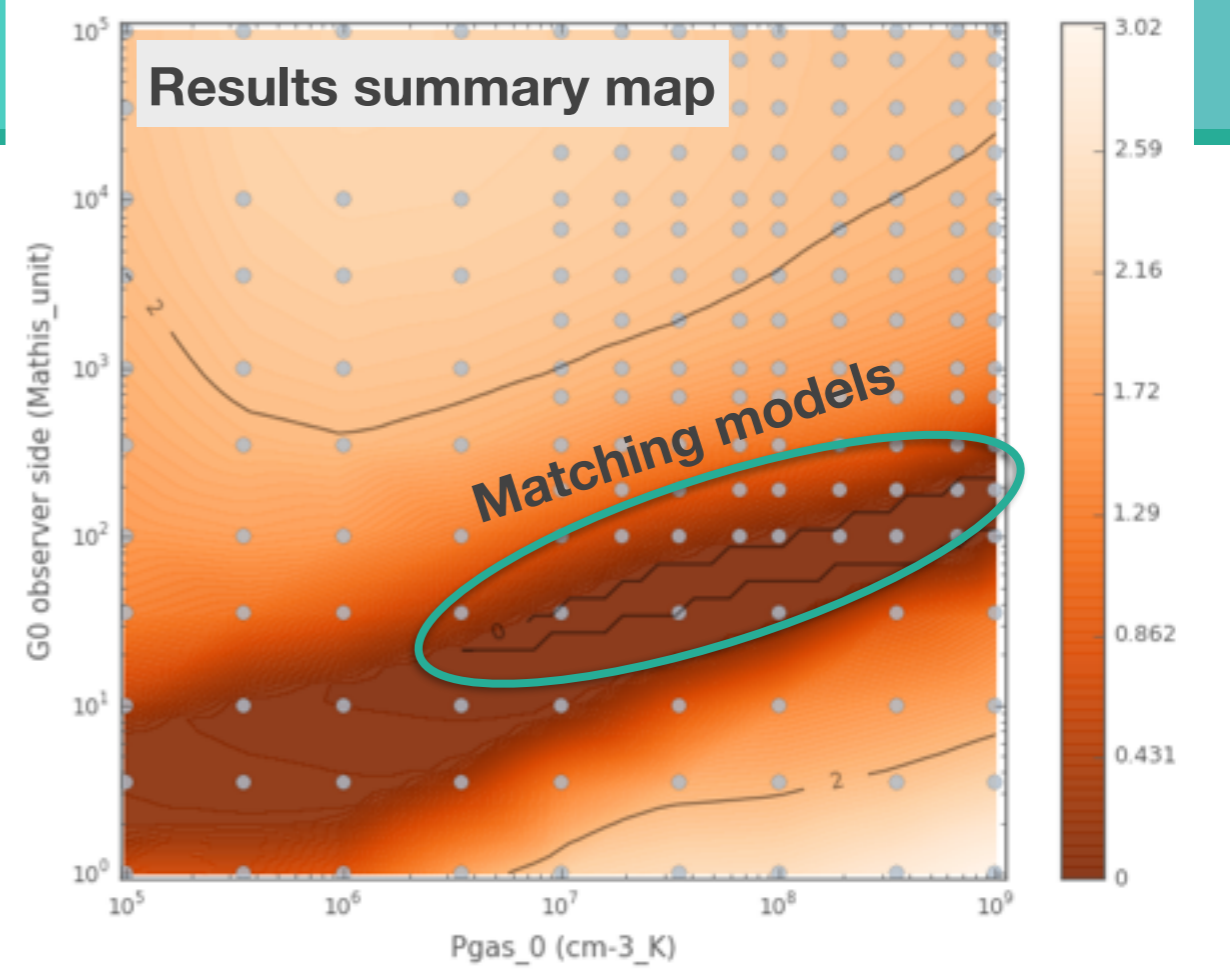
Example: observations CO and H<sub>2</sub> intensities

$$1.8 \cdot 10^{-7} < I(\text{CO } 1-0) < 2.4 \cdot 10^{-7} \text{ erg cm}^{-2} \text{ s}^{-1} \text{ sr}^{-1}$$
$$1.0 \cdot 10^{-8} < I(\text{H}_2 \text{ } 2-0) < 5.0 \cdot 10^{-7} \text{ erg cm}^{-2} \text{ s}^{-1} \text{ sr}^{-1}$$

# Interpretation of observations



$1.8 \cdot 10^{-7} < I(\text{CO } 1-0) < 2.4 \cdot 10^{-7} \text{ erg cm}^{-2} \text{ s}^{-1} \text{ sr}^{-1}$   
 $1.0 \cdot 10^{-8} < I(\text{H}_2 \text{ } 2-0) < 5.0 \cdot 10^{-7} \text{ erg cm}^{-2} \text{ s}^{-1} \text{ sr}^{-1}$



# Interpretation of observations

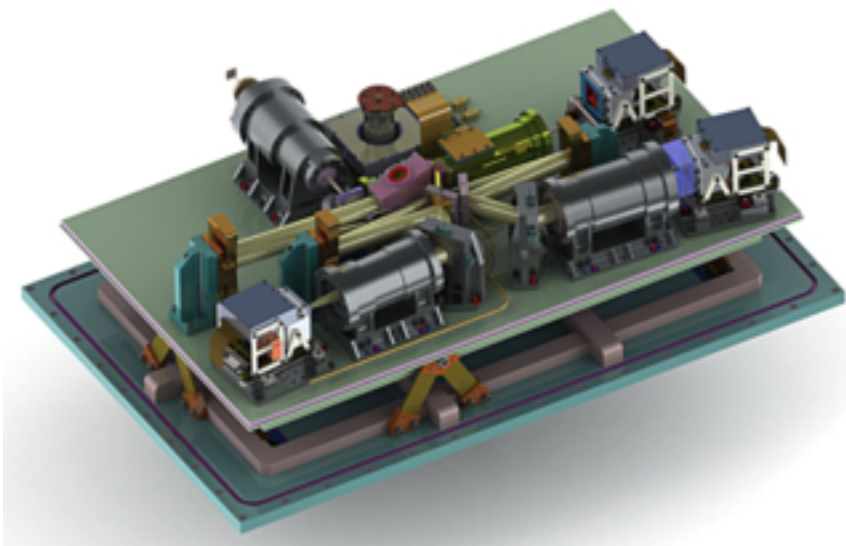
## IGRINS observations

Instrument - Univ. Texas, Austin

Mc Donald observatory

Bands: H et K (1.5 to 2.5 microns)

$R = 45\,000$

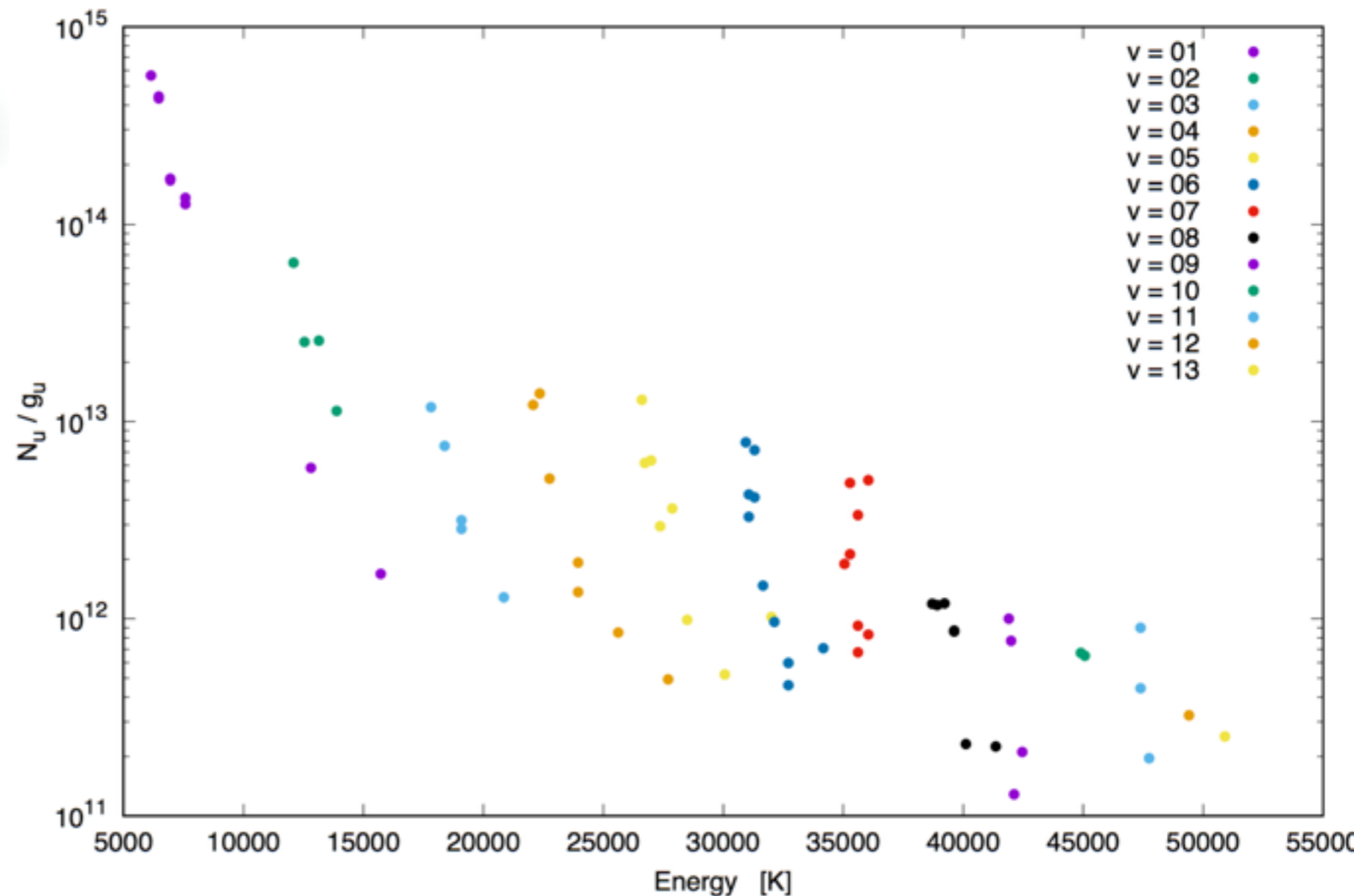


## Observations of NGC 7023

(Le et al. - 2016 / ArXiv)

- Detection of **70 H<sub>2</sub> lines in NGC 7023**
- Conclude to a clumpy medium

## H<sub>2</sub> excitation diagram at position A



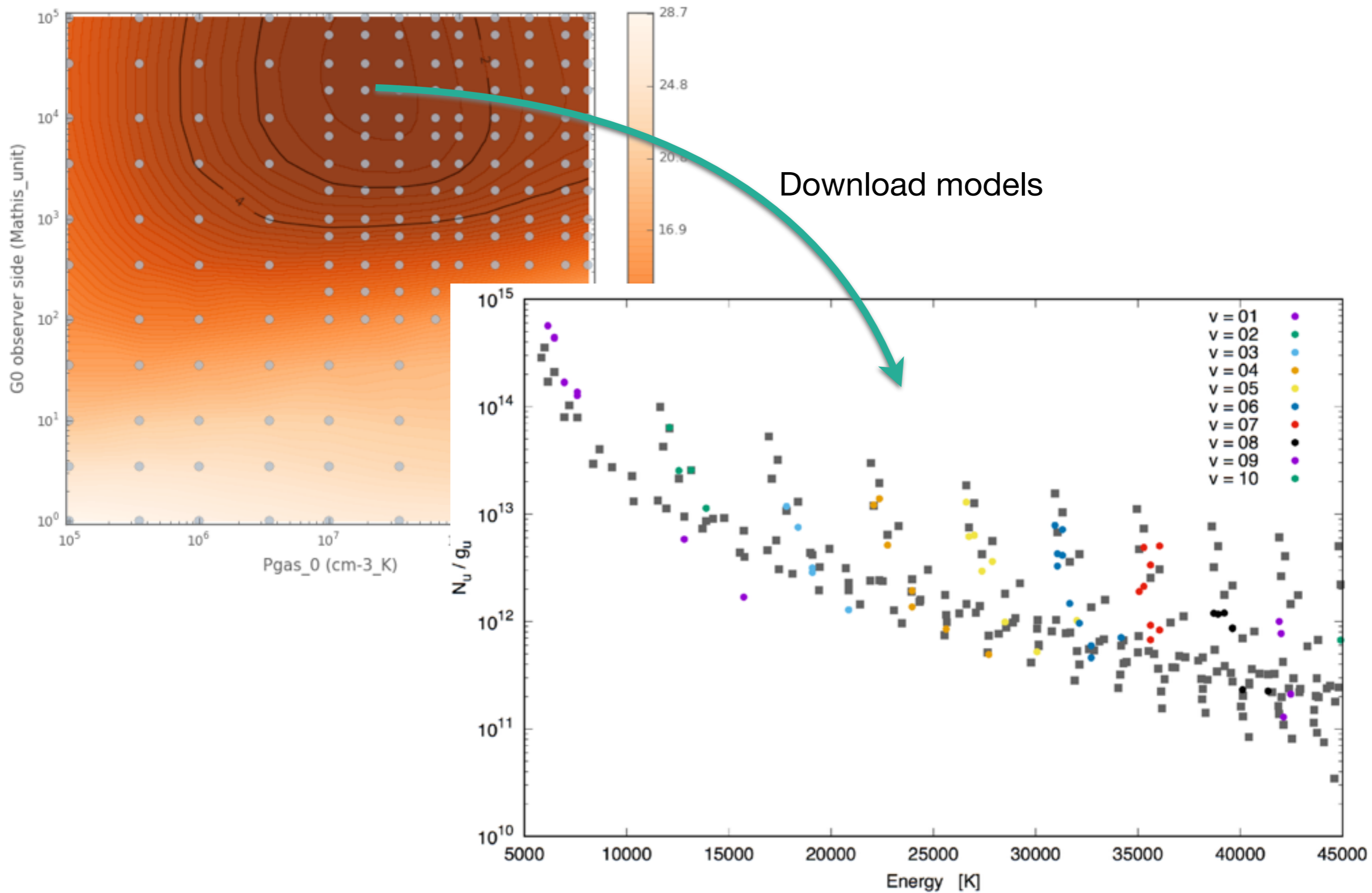
# Interpretation of observations

Build the query for the 70 H<sub>2</sub> lines (140 constraints)

```
"I(H2 v=4,J=9->v=2,J=9 angle 60 deg)" < 5.408e-06
"I(H2 v=4,J=9->v=2,J=9 angle 60 deg)" > 2.912e-06
"I(H2 v=4,J=1->v=2,J=3 angle 60 deg)" < 2.665e-05
"I(H2 v=4,J=1->v=2,J=3 angle 60 deg)" > 1.435e-05
"I(H2 v=5,J=4->v=3,J=4 angle 60 deg)" < 9.659e-06
"I(H2 v=5,J=4->v=3,J=4 angle 60 deg)" > 5.201e-06
"I(H2 v=3,J=3->v=1,J=5 angle 60 deg)" < 1.2532e-05
"I(H2 v=3,J=3->v=1,J=5 angle 60 deg)" > 6.748e-06
"I(H2 v=5,J=5->v=3,J=5 angle 60 deg)" < 9.607e-06
"I(H2 v=5,J=5->v=3,J=5 angle 60 deg)" > 5.173e-06
"I(H2 v=6,J=2->v=4,J=0 angle 60 deg)" < 7.67e-06
"I(H2 v=6,J=2->v=4,J=0 angle 60 deg)" > 4.13e-06
"I(H2 v=10,J=1->v=7,J=3 angle 60 deg)" < 4.121e-06
"I(H2 v=10,J=1->v=7,J=3 angle 60 deg)" > 2.219e-06
"I(H2 v=5,J=0->v=3,J=2 angle 60 deg)" < 1.118e-05
"I(H2 v=5,J=0->v=3,J=2 angle 60 deg)" > 6.02e-06
"I(H2 v=5,J=7->v=3,J=7 angle 60 deg)" < 6.955e-06
"I(H2 v=5,J=7->v=3,J=7 angle 60 deg)" > 3.745e-06
"I(H2 v=4,J=2->v=2,J=4 angle 60 deg)" < 1.1531e-05
"I(H2 v=4,J=2->v=2,J=4 angle 60 deg)" > 6.209e-06
"I(H2 v=7,J=4->v=5,J=2 angle 60 deg)" < 5.109e-06
"I(H2 v=7,J=4->v=5,J=2 angle 60 deg)" > 2.751e-06
"I(H2 v=6,J=1->v=4,J=1 angle 60 deg)" < 1.846e-05
"I(H2 v=6,J=1->v=4,J=1 angle 60 deg)" > 9.94e-06
"I(H2 v=6,J=2->v=4,J=2 angle 60 deg)" < 1.599e-05
"I(H2 v=6,J=2->v=4,J=2 angle 60 deg)" > 8.61e-06
"I(H2 v=5,J=9->v=3,J=9 angle 60 deg)" < 1.729e-05
"I(H2 v=5,J=9->v=3,J=9 angle 60 deg)" > 9.31e-06
"I(H2 v=5,J=1->v=3,J=3 angle 60 deg)" < 2.379e-05
"I(H2 v=5,J=1->v=3,J=3 angle 60 deg)" > 1.281e-05
"I(H2 v=13,J=1->v=9,J=1 angle 60 deg)" < 9.334e-07
"I(H2 v=13,J=1->v=9,J=1 angle 60 deg)" > 5.026e-07
"I(H2 v=6,J=3->v=4,J=3 angle 60 deg)" < 1.287e-05
"I(H2 v=6,J=3->v=4,J=3 angle 60 deg)" > 6.93e-06
```

```
I(H2 v=7,J=3->v=5,J=1 angle 60 deg)" < 1.1531e-05
"I(H2 v=7,J=3->v=5,J=1 angle 60 deg)" > 6.209e-06
"I(H2 v=4,J=3->v=2,J=5 angle 60 deg)" < 1.2961e-05
"I(H2 v=4,J=3->v=2,J=5 angle 60 deg)" > 6.979e-06
"I(H2 v=6,J=4->v=4,J=4 angle 60 deg)" < 3.523e-06
"I(H2 v=6,J=4->v=4,J=4 angle 60 deg)" > 1.897e-06
"I(H2 v=6,J=5->v=4,J=5 angle 60 deg)" < 7.878e-06
"I(H2 v=6,J=5->v=4,J=5 angle 60 deg)" > 4.242e-06
"I(H2 v=3,J=5->v=1,J=7 angle 60 deg)" < 2.457e-06
"I(H2 v=3,J=5->v=1,J=7 angle 60 deg)" > 1.323e-06
"I(H2 v=11,J=1->v=8,J=1 angle 60 deg)" < 2.899e-06
"I(H2 v=11,J=1->v=8,J=1 angle 60 deg)" > 1.561e-06
"I(H2 v=7,J=2->v=5,J=0 angle 60 deg)" < 4.628e-06
"I(H2 v=7,J=2->v=5,J=0 angle 60 deg)" > 2.492e-06
"I(H2 v=8,J=7->v=6,J=5 angle 60 deg)" < 5.824e-06
"I(H2 v=8,J=7->v=6,J=5 angle 60 deg)" > 3.136e-06
"I(H2 v=5,J=2->v=3,J=4 angle 60 deg)" < 9.425e-06
"I(H2 v=5,J=2->v=3,J=4 angle 60 deg)" > 5.075e-06
"I(H2 v=6,J=0->v=4,J=2 angle 60 deg)" < 9.776e-06
"I(H2 v=6,J=0->v=4,J=2 angle 60 deg)" > 5.264e-06
"I(H2 v=6,J=7->v=4,J=7 angle 60 deg)" < 1.2532e-05
"I(H2 v=6,J=7->v=4,J=7 angle 60 deg)" > 6.748e-06
"I(H2 v=11,J=3->v=8,J=3 angle 60 deg)" < 1.924e-06
"I(H2 v=11,J=3->v=8,J=3 angle 60 deg)" > 1.036e-06
"I(H2 v=1,J=11->v=0,J=9 angle 60 deg)" < 4.407e-06
"I(H2 v=1,J=11->v=0,J=9 angle 60 deg)" > 2.373e-06
"I(H2 v=8,J=5->v=6,J=3 angle 60 deg)" < 5.122e-06
"I(H2 v=8,J=5->v=6,J=3 angle 60 deg)" > 2.758e-06
"I(H2 v=7,J=1->v=5,J=1 angle 60 deg)" < 1.2922e-05
"I(H2 v=7,J=1->v=5,J=1 angle 60 deg)" > 6.958e-06
"I(H2 v=8,J=4->v=6,J=2 angle 60 deg)" < 5.109e-06
"I(H2 v=8,J=4->v=6,J=2 angle 60 deg)" > 2.751e-06
"I(H2 v=6,J=1->v=4,J=3 angle 60 deg)" < 2.405e-05
...
...
...
...
```

# Interpretation of observations



# VO Integration

Metadata definition & organization

Data Access

Raw data (extractor tool)

**Simulation Data Model (SimDM)**

**Simulation Data Access Layer (SimDAL)**

**VOTable**  
**SAMP connector**

Extractor Tool

SAMP

PDR Extractor

n(CO) Confirm Remove All

DM54NoPAH\_A1e1p6p7e7r1e4\_s\_20.hdf5

- Integrated quantities
- Local quantities
  - Auxiliary
    - Excitation
    - H2 chemistry
    - Ice layers
    - Molecular fraction
    - Photo reactions
    - Radiation
    - Thermal balance
  - Densities
    - Column densities
    - Densities
  - Dust
  - Gas state
  - Positions
    - AV
    - Distance
    - tauV
  - Parameters

Export as Text Export as VOTable Send Table

TOPCAT

Table List

1: PDR Extractor table 1

Current Table Properties

Label: PDR Extractor table 1

Location: PDR Extractor:PDR Extractor table 1

Name: PDR Extractor table 1

Rows: 760

Columns: 6

Sort Order: ↑

Row Subset: All

Activation Action: (no action)  Broadcast Row

SAMP

Messages: 0 Clients: 0

10	1,41421E-5	36682,	0,502178	4,84237	8,67592E-5	1,05931E-7
11	2,00000E-5	36683,	0,50224	4,84246	8,67717E-5	1,05952E-7
12	3,00000E-5	36653,	0,501271	4,83854	8,65837E-5	1,05723E-7
13	3,87298E-5	36681,	0,502296			
14	5,00000E-5	36682,	0,502387			
15	7,00000E-5	36651,	0,501473			
16	1,00000E-4	36678,	0,50262			
17	0,000141	36648,	0,501867			
18	0,0002	36673,	0,503188			
19	0,0003	36670,	0,503839			
20	0,000387	36665,	0,504349			
21	0,0005	36659,	0,505011			
22	0,0007	36648,	0,506189			
23	0,001	36632,	0,507966			
24	0,001414	36610,	0,510433			
25	0,002	36579,	0,51394			
26	0,003	36526,	0,519966			
27	0,003873	36482,	0,52531			
28	0,005	36426,	0,532248			
29	0,007	36328,	0,544744			
30	0,01	36190,	0,564053			
31	0,014142	36014,	0,591946			
32	0,02	35789,	0,634301			
33	0,025	35597,	0,672784			
34	0,03	35442,	0,715947			
35	0,034365	35318,	0,757359			
36	0,03873	35204,	0,802962			
37	0,04365	35090,	0,849811			

56 / 3641 M

n(H) / cm<sup>-3</sup>

AV / mag

# Technical challenges

Large amount of metadata → 2 main difficulties

## 1 - high dimension database

Standard solution: RDBMS / SQL

	Meta1	Meta2	Meta3	Meta4	...
Dataset 1					
Dataset 2					
Dataset 3					
Dataset 4					
Dataset 5					
...					

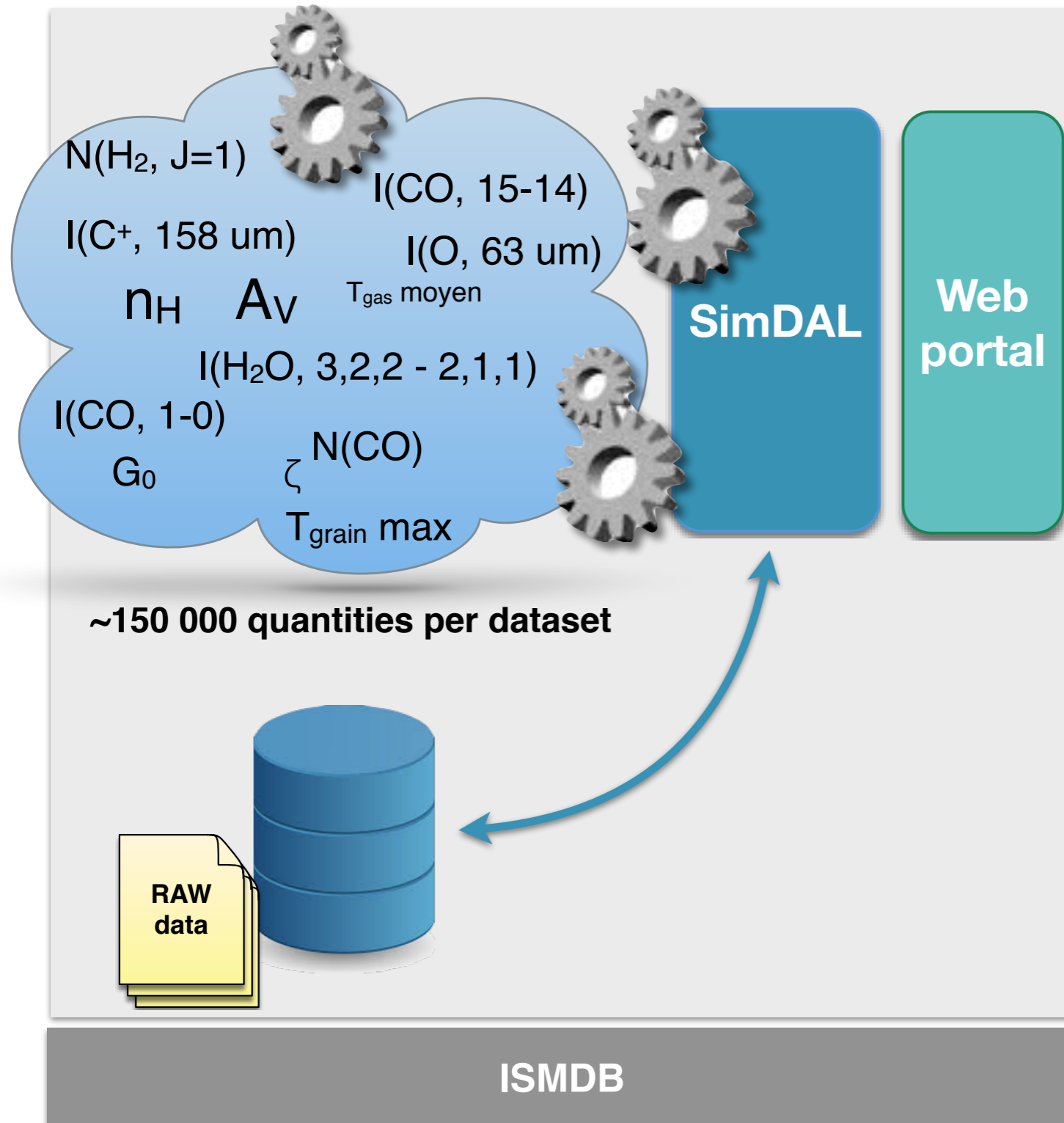
	Number of col.
MySQL	4096
Postgress	250 - 1600
Oracle	1000
Microsoft	30000

Standard solutions for databases (RDBMS/SQL) are not adapted to high dimensions / heterogeneous data

ISMDB must manipulate more than 100 000 dimensions

# Technical challenges

## 2 - interaction between a human and the system



What are the models that can explain the  $I(\text{CO } 10-9)$  I observed with Herschel ?



How the user can know the name of the available quantities ?



# Technical challenges

## VLA archive Interface

23 paramètres de recherche  
Interface complexe

**NRAO Science Data Archive : Advanced Search Tool**  
**Historical VLA, Jansky VLA, VLBA and GBT Data Products**

**Output Control Parameters :**

**Choose Query Return Type :**

- Download Archive Data Files
- VLA Observations Summary
- List of Observation Scans
- List of Projects

[Output Tbl Format](#)  [Sort Order Column 1](#)

[Max Output Tbl Rows](#)  [Sort Order Column 2](#)

**General Search Parameters :**

[Telescopes](#)  All  Jansky VLA  Historical VLA  VLBA  GBT

[Project Code](#)   [Project Session](#)

[Observer Name](#)  [Archive File ID](#)  [Dates From](#)  [To](#)

(partial strings allowed) (2010-06-21 14:20:30)

**Position Search :**

[Target Name](#)  [Search Type](#)  [Min. Exposure](#)  (secs)

[RA or Longitude](#)  [DEC or Latitude](#)  [Equinox](#)

(04h33m11.1s or 68.29d) (05d21'15.5" or 5.352d)

[Search Radius](#)   - OR -  Check for automatic VLA field-of-view, freq. dependent.??

(1d00'00" or 0.2d)

**Observing Configurations Search :**

[Telescope](#)  All  A  AB  BnA  B  BC  CnB

[Config](#)  C  CD  DnC  D  DA

[Sub\\_array](#)  All  1  2  3  4  5

[Polarization](#)  [Observing Bands](#)  All  4  P  L  S  C

[Data Type](#)   X  U  K  Ka  Q  W

[Frequency Range](#)  (In MHz : 1665.401 - 1720.500)

[Enter Locked Project Access key :](#)  Unique keywords may be used to unlock proprietary data from individual observing projects. Contact the [NRAO Data Analysts](#) for project access keys.

# Technical challenges

## VLA archive Interface

**NRAO Science Data Archive : Advanced Search Tool**  
Historical VLA, Jansky VLA, VLBA and GBT Data Products

Submit Query      Check Query      Clear Form

**Output Control Parameters :**

**Choose Query Return Type :**

- Download Archive Data Files
- VLA Observations Summary
- List of Observation Scans
- List of Projects

Output Tbl Format: HTML      Sort Order Column 1: Starttime      Asc

Max Output Tbl Rows: NO LIMIT      Sort Order Column 2: Starttime      Asc

**General Search Parameters :**

Telescopes  All  Jansky VLA  Historical VLA  VLBA  GBT

Project Code: GBT: AGBT12A\_055      Project Session:      Dates From:      JVA: 12A-256

Observer Name:      Archive File ID:      To:      (partial strings allowed)      (2010-06-21 14:20:30)

**Position Search :**

Target Name:      Search Type: SIMBAD or NED      Min. Exposure:      (secs)

RA or Longitude:      DEC or Latitude:      Equinox: J2000

Search Radius: 1.0'      - OR -       Check for automatic VLA field-of-view, freq. dependent.??

(1d00'00" or 0.2d)      (04h33m11.1s or 68.29d)      (05d21'15.5" or 5.352d)

**Observing Configurations Search :**

Telescope  All  A  AB  BnA  B  BC  CnB

Config:  C  CD  DnC  D  DA

Sub\_array  All  1  2  3  4  5

Polarization: ALL      Observing Bands:  All  4  P  L  S  C

Data Type: ALL      Frequency Range:      (In MHz : 1665.401 - 1720.500)

X  U  K  Ka  Q  W

Enter Locked Project Access key :      Unique keywords may be used to unlock proprietary data from individual observing projects. Contact the [NRAO Data Analysts](#) for project access keys.

Submit Query      Check Query      Clear Form

23 paramètres de recherche  
Interface complexe

**ISMDB**  
**150 000 parameters !**

# Semantics

ISM Services CODES ISMDB

## ISM DataBase – Inverse Search service Beta

Grid of isobaric PDR 1.5.2 models  
2016.12.03

### 1 – search among two parameters

x  (cm-3\_K)  log scale  
y  (Mathis\_unit)  log scale

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(mag)

### 3 – observational constraints

"I(CO v=0J=1->v=0J=0 angle 00 deg)" > 1.8E-7  
"I(CO v=0J=1->v=0J=0 angle 00 deg)" < 2.4E-7  
"I(H2 v=0J=2->v=0J=0 angle 60 deg)" > 1E-8  
"I(H2 v=0J=2->v=0J=0 angle 60 deg)" < 5E-7

### 3 – observational constraints



Semantics interpreter

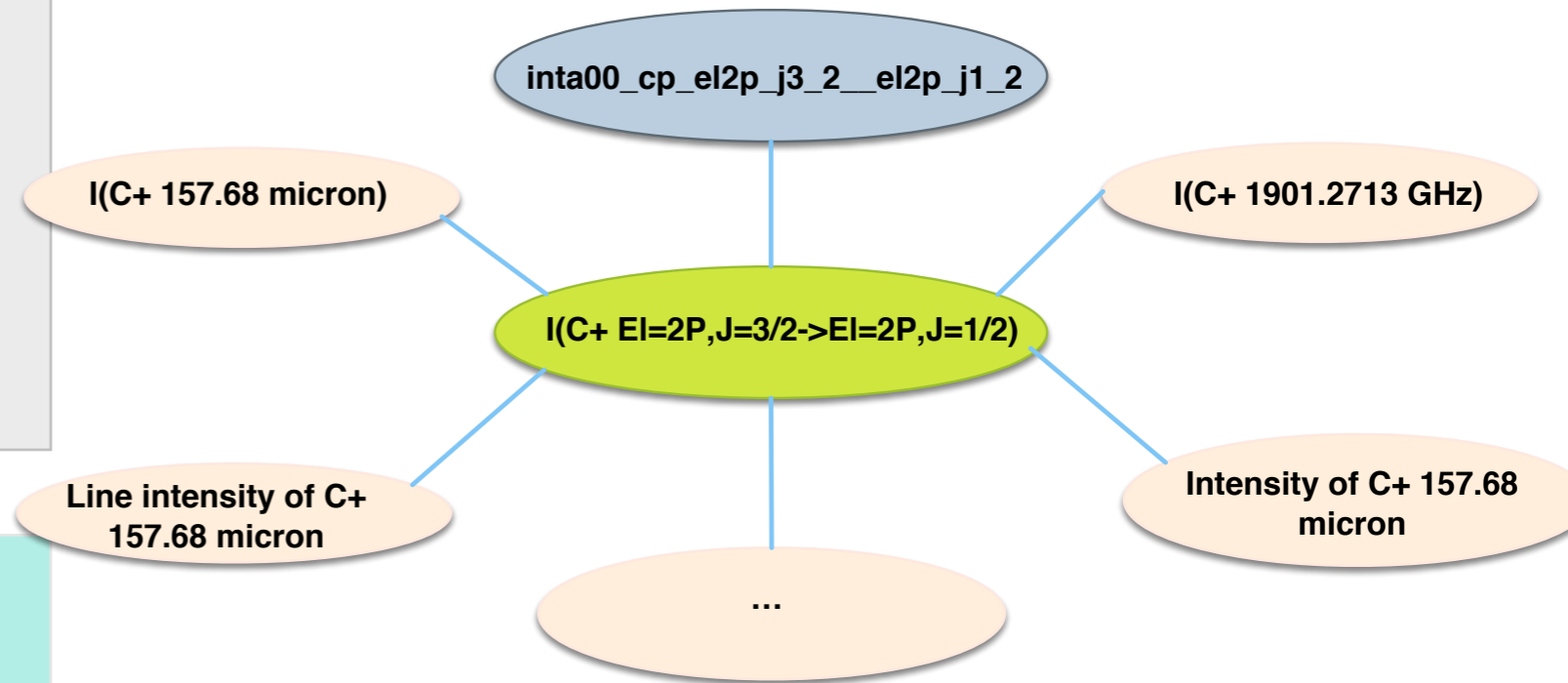
# Semantics

Each metadata is tagged by:

- ID
- name
- unit
- utype
- description
- **label (UCD / SKOS)**
- ...

Simulation  
DataModel

Example of the 157.7 micron C+ line intensity



## SKOS vocabulary

For each quantity several synonyms  
(name, units, ...)

~ 300 000 terms for the PDR code

**ID:** inta00\_cp\_el2p\_j3\_2\_el2p\_j1\_2  
**PREF:** I(C+ El=2P,J=3/2->El=2P,J=1/2)  
**ALT:** I(C+ El=2P,J=3/2->El=2P,J=1/2) face on  
**ALT:** I(C+ 157.68 micron) face on  
**ALT:** Intensity of C+ 157.68 micron face on  
**ALT:** Line intensity of C+ 157.68 micron face on  
**ALT:** I(C+ 1901.2713 GHz) face on  
**ALT:** Intensity of C+ 1901.2713 GHz face on  
**ALT:** Line intensity of C+ 1901.2713 GHz face on  
 ...

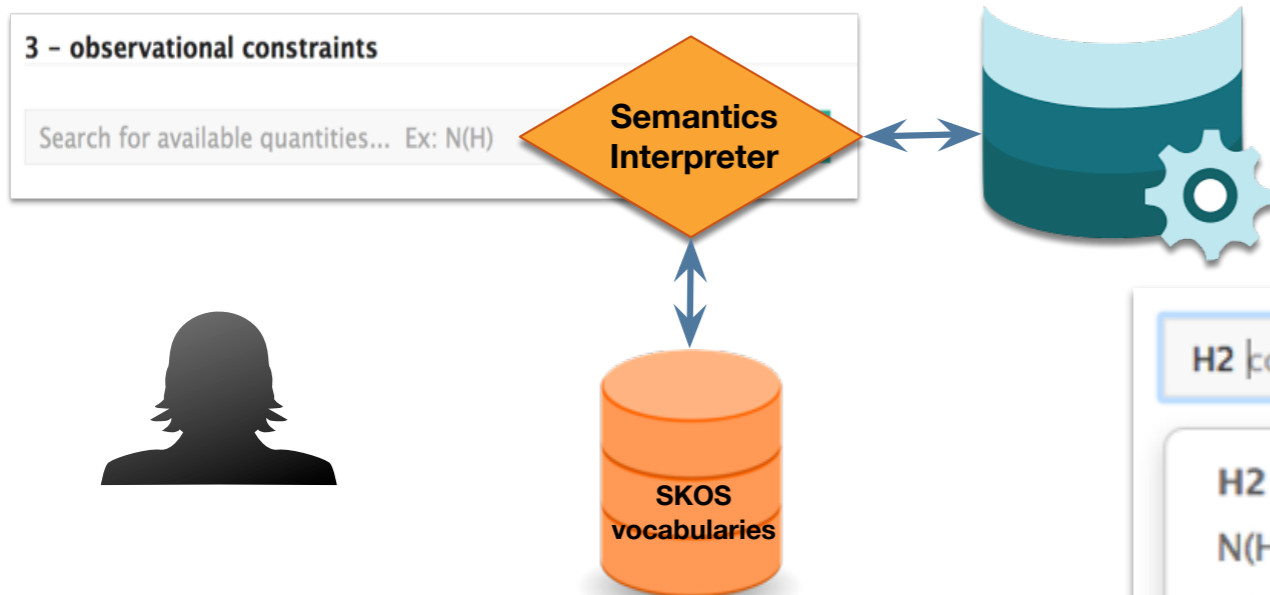
3 - observational constraints

Search for available quantities... Ex: N(H)

Semantics  
Interpreter



# Technical challenges



## Semantics Interpreter

### Semantics

SKOS: PREF + ALT  
→ synonyms

+

### Ranking system

(learn from users)

H2 column density Use

H2 column density  
N(H2)  
N(C2H2)  
N(c-C3H2)  
N(C\_13CH2)  
N(C\_13CH2+)  
C2H2 column density  
Column density of H2

I(H2 0-0 S(0)) angle 00 degrees Use

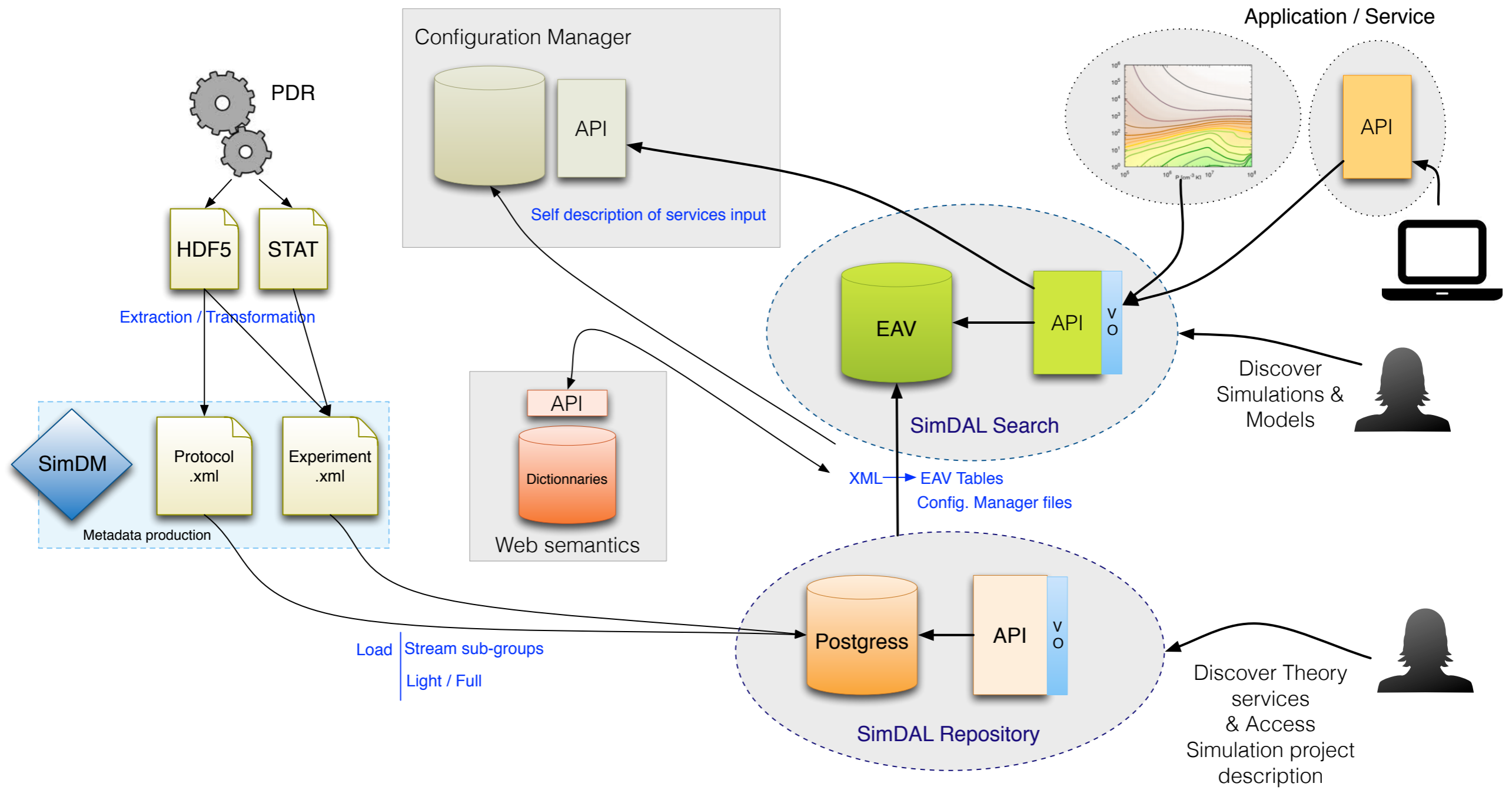
I(H2 0-0 S(0)) angle 00 degrees  
I(H2 10-10 S(0)) angle 00 degrees  
I(H2 9.6645 micrometres) angle 00 degrees  
I(H2 28.2196 micrometres) angle 00 degrees  
I(H2 156.4883 micrometres) angle 00 degrees  
I(H2 v=0,J=2->v=0,J=0) angle 00 degrees  
I(H2O 6.1140 cm-1) angle 00 degrees  
I(H2O J=1,ka=1,kc=1->J=0,ka=0,kc=0) angle 00 degrees

The screenshot shows a search interface with two search results. The first result is for 'H2 column density' and the second is for 'I(H2 0-0 S(0)) angle 00 degrees'. Each result has a 'Use' button and a list of related terms or synonyms. The interface also includes a search bar and a '3 - observational constraints' header.

# ISMDB infrastructure

## ISMDB infrastructure development

- **modular**
- based on **robust & mature technologies**
- **generic**: can integrate models from any similar code than the PDR code



The screenshot shows the ISM Services website. At the top, there are navigation links: ISM Services, CODES (access to codes), ISMDB (simulations database), TECHNOLOGIES (standards), PARTNERS (credits), and REGISTRATION. Below this is a large image of a nebula. Underneath the image are four buttons: PDR Code (The Meudon PDR code), DustEM (Dust Emission), Shock (Paris-Durham Shock model), and Starformat (MHD simulations data base). There are also 'Help' and 'Contact' buttons. The main section is titled 'ISM DataBase - Inverse Search service Beta' and 'Grid of isobaric PDR 1.5.2 models' with a date '2016.12.03'. It is divided into three steps: 1 - search among two parameters (with input fields for 'Pgas\_0' and 'G0 observer side'), 2 - fix all the other parameters (with an input field for 'AVmax'), and 3 - observational constraints (with a search bar and a 'Use' button). A yellow box contains instructions: 'Type quantities to plot in the input below, with optional constraints. (click Search to view the result of the example query below)'. Below this is a text area with example queries: '"I(CO v=0,J=1->v=0,J=0 angle 00 deg)" > 2.4e-9', '"I(CO v=0,J=1->v=0,J=0 angle 00 deg)" < 7.2e-8', and '"NH2)". A 'Search' button is at the bottom.

## Status

- Public at <http://ism.obspm.fr>
- Grids of PDR models

## Starts to be used:

- Individual teams
- Projects as SPICA, GUSTO (NASA/CNES)
- JWST ERS

## Plans - short term

- Semantics
- Grids of shocks models
- Operations on quantities

## Plans - medium term

- Other ways to query models
- Quickviews on models

## Plans - long term

- Search in N-dimension space
- Interpretation at each pixels of maps

# VO-Theory

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## Status on standards



Franck Le Petit  
David Languignon  
Nicolas Moreau  
Zakaria Meliani



# VO-Theory standards

## SimDM

- approved a few years ago
- no evolution

## SimDAL

Access to theoretical data  
(consider big / heterogeneous data)

- 2 reference implementations + client
  - all WG / IG have done their comments
  - few modifications (clarifications of the text)
- start of implementations on other services

Everything ready for the integration  
of theoretical data in the Virtual  
Observatory

Both documents on the IVOA documents page

IVOA Proposed Recommendation

### International Virtual Observatory Alliance

IVOA Documents



### Simulation Data Access Layer Version 1.0

IVOA Proposed Recommendation 30 January 2017

Interest/Working Group:

<http://www.ivoa.net/twiki/bin/view/IVOA/ivoaDAL>

Author(s):

David Languignon, Franck Le Petit, Carlos Rodrigo, Gerard Lemson, Marco Molinaro, Hervé Wozniak

Editor(s):

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### Abstract

The Simulation Data Access Layer protocol (SimDAL) defines a set of resources and associated actions to discover and retrieve simulations and numerical models in the Virtual Observatory. SimDAL and the Simulation Data Model are dedicated to cover the needs for the publication and retrieval of any kind of simulations: N-body or MHD simulations, numerical models of astrophysical objects and processes, theoretical synthetic spectra, etc... SimDAL is divided in three parts. First, SimDAL Repositories store the descriptions of theoretical projects and numerical codes. They can be used by clients to discover theoretical services associated with projects of interest. Second, SimDAL Search services are dedicated to the discovery of precise datasets. Finally, SimDAL Data Access services are dedicated to retrieve the original simulation output data, as plain raw data or formatted datasets cut-outs. To manage any kind of data, eventually large or at high-dimensionality, the SimDAL standard lets publisher choose any underlying implementation technology.

### Status of this document

This is an IVOA Proposed Recommendation made available for public review.

It is appropriate to reference this document only as a recommended standard that is under review and which may be changed before it is accepted as a full recommendation.

# VO-Theory standards

## Remise à plat du service d'accès aux vocabulaires pour SimDM / SimDAL

Nicolas Moreau  
Zakaria Meliani  
David Languignon  
Franck Le Petit

### Vocabularies:

- Algorithms
- Astronomical objects
- Data object types
- Physical processes
- Physical quantities

To be used to tag quantities in SimDM

Will be discussed at next InterOp

The screenshot shows the IVOA Theory Vocabularies website. At the top, there are navigation links for 'Home', 'Search concepts', and 'Credits', along with a 'Help' link. The main content area includes a description of the service, its purpose, and an example of a VO-Theory URI. A 'Search concepts' button is prominently displayed. Below this, the 'IVOA Theory Vocabularies' section is shown, with a dropdown menu set to 'Physical processes'. A 'Quick search' input field is present. The main content area displays a grid of concept tags, including 'AGN Feedback', 'Absorption', 'Acceleration Of Particles', 'Accretion', 'Advection', 'Alpha Process', 'Astrochemistry', 'Atomic Cooling', 'Atomic Processes', 'Barotropic Equation Of State', 'Birkeland Current Sheet', 'Bremsstrahlung', 'Chaos', 'Chemical Reaction', 'Chemistry', 'Collision', 'Collisional Broadening', 'Collisional Excitation', 'Collisional Plasma', 'Collisional Processes', 'Compton Effect', 'Compton Scattering', 'Conduction', 'Convection', 'Cooling Processes', 'Coronal Mass Ejection', 'Current Sheet', 'Cyclotron', 'Decaying Turbulence', 'Diffusion', 'Drag Force', 'Driven Turbulence', 'Dynamics', 'Electrodynamics', 'Electromagnetism', 'Energy Transfer', 'Equation of State', 'Fluorescence', 'Forcing Compressive Turbulence', 'Forcing Solenoidal Turbulence', 'Galactic Wind Feedback', 'Gas-Grains Collisions', 'General Relativity', 'Geomagnetic Storm', 'Gravitation', 'Gross Tail Current Sheet', 'Heating Processes', 'Hydrodynamics', 'Instability', 'Inverse Compton', 'Inverse Compton Scattering', and 'Isothermal Equation Of State'. On the right side, a 'Line Cooling' section is visible, showing a URL and a list of related concepts: 'Cooling Processes', 'Physical Process', 'Cooling Processes', 'Atomic Cooling', and 'Molecular Cooling'.