New developments on the MIS & Jets platform

Emeric Bron
Franck Le Petit
David Languignon
Nicolas Moreau

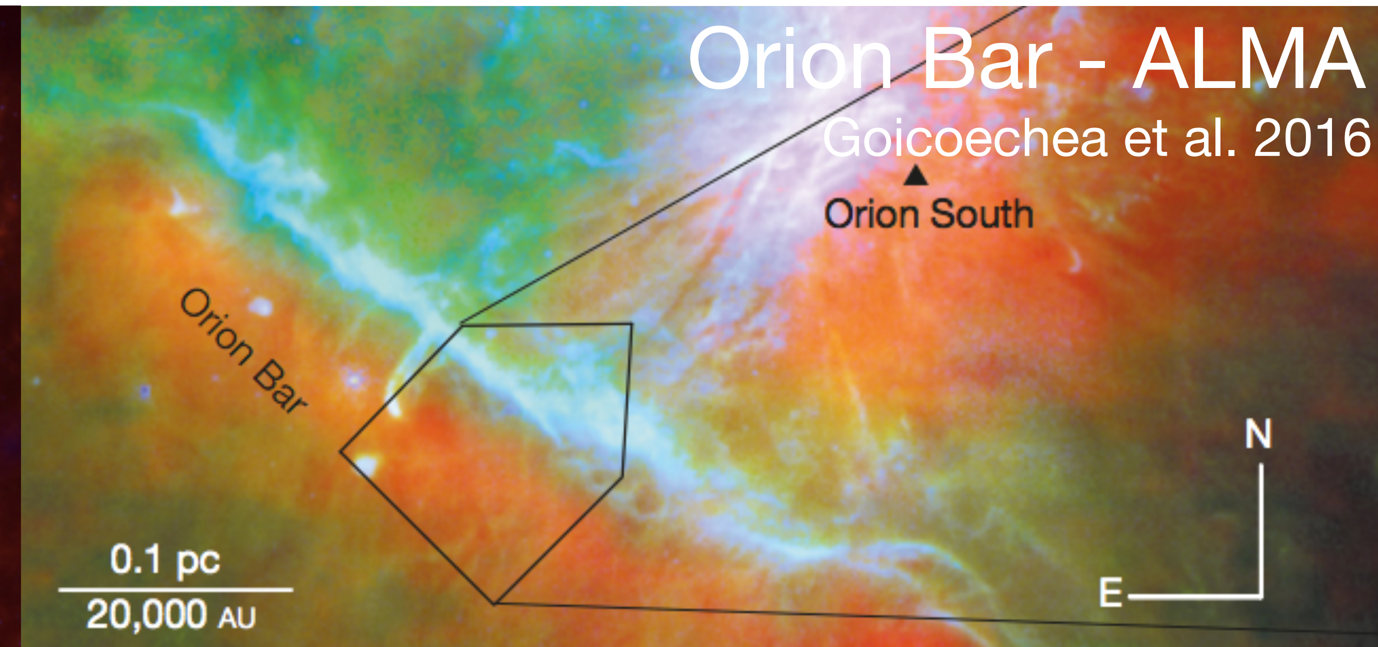
ASOV Meeting - 4 April 2019

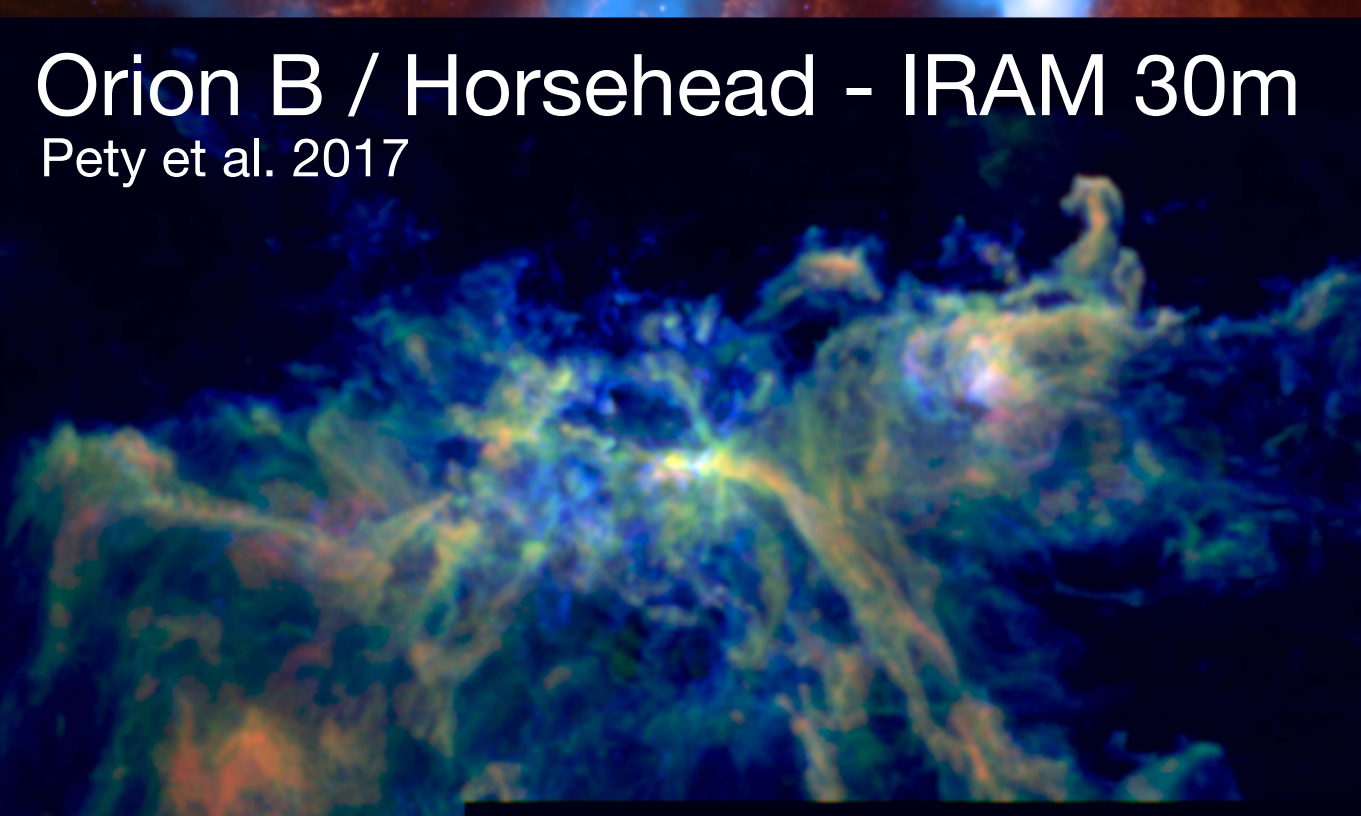
ISMDB

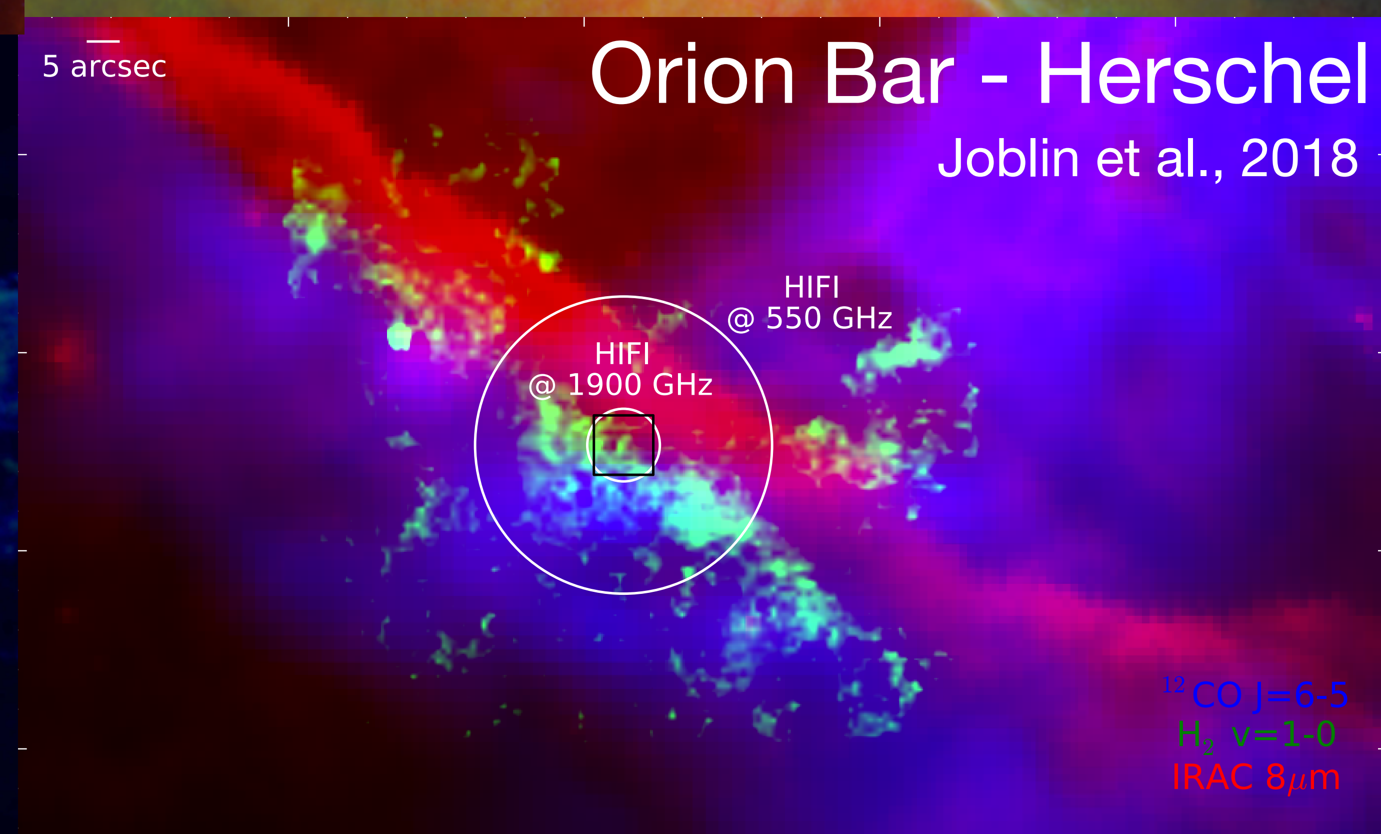
ISMServices

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

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







ISMDB

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

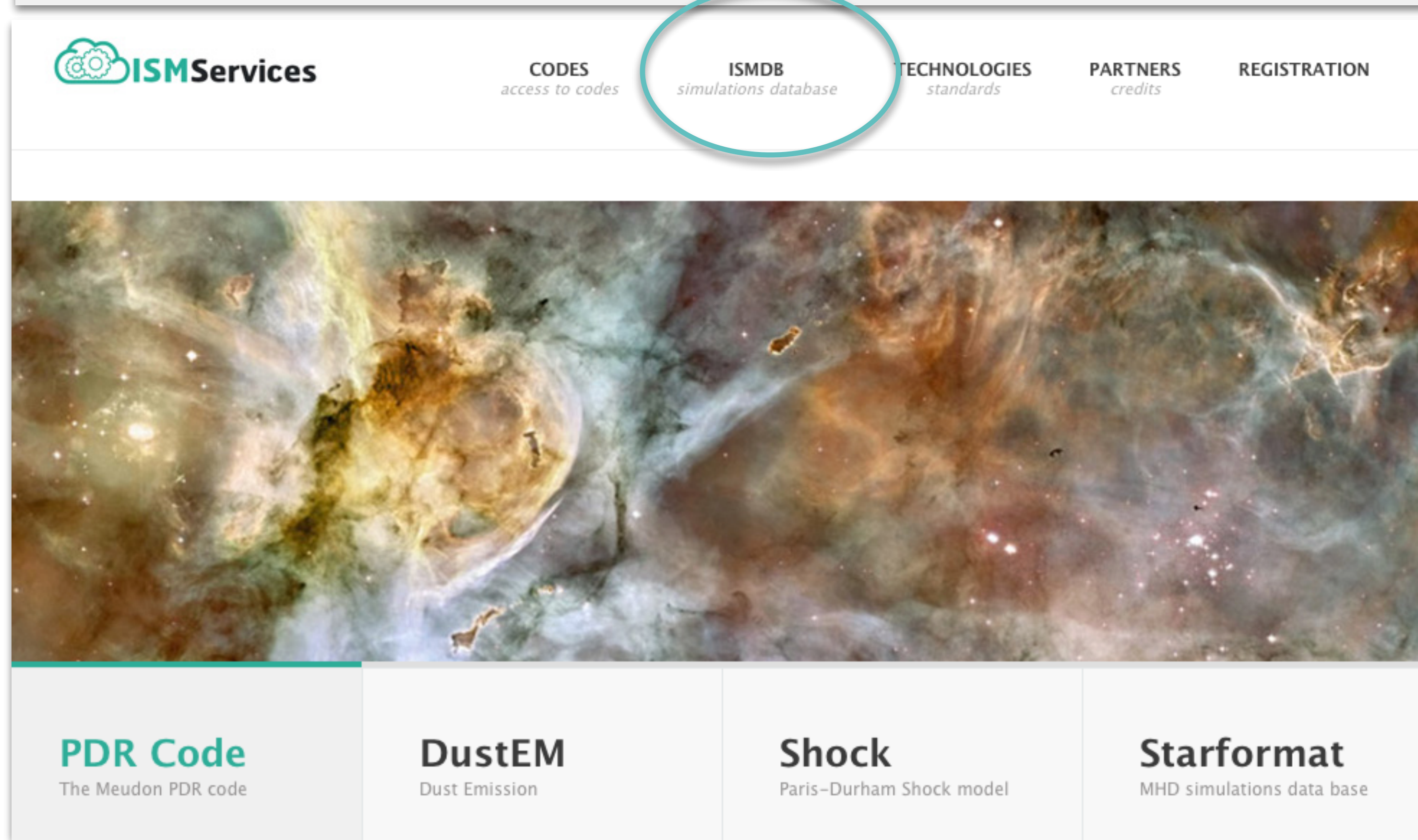
Goal: Provide services to prepare and interpret observations in Galactic & extragalactic interstellar medium

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



ISMDB

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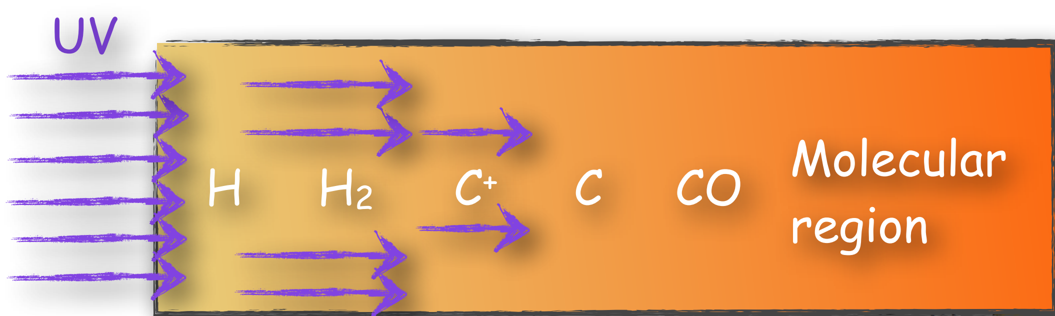
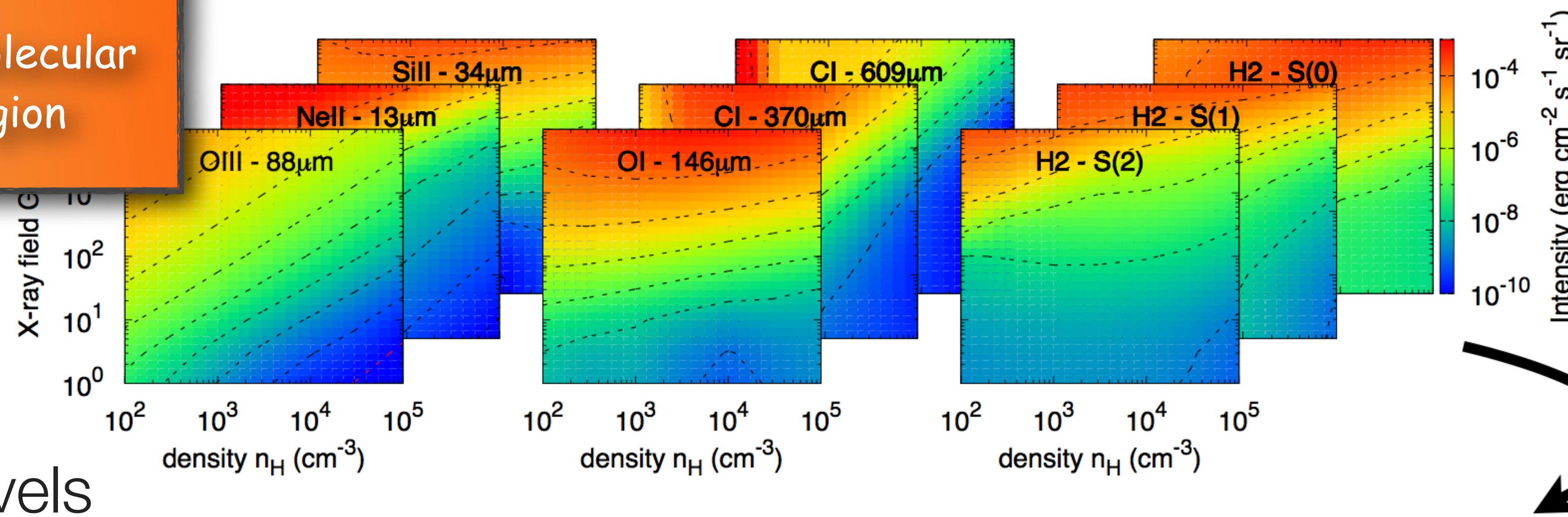
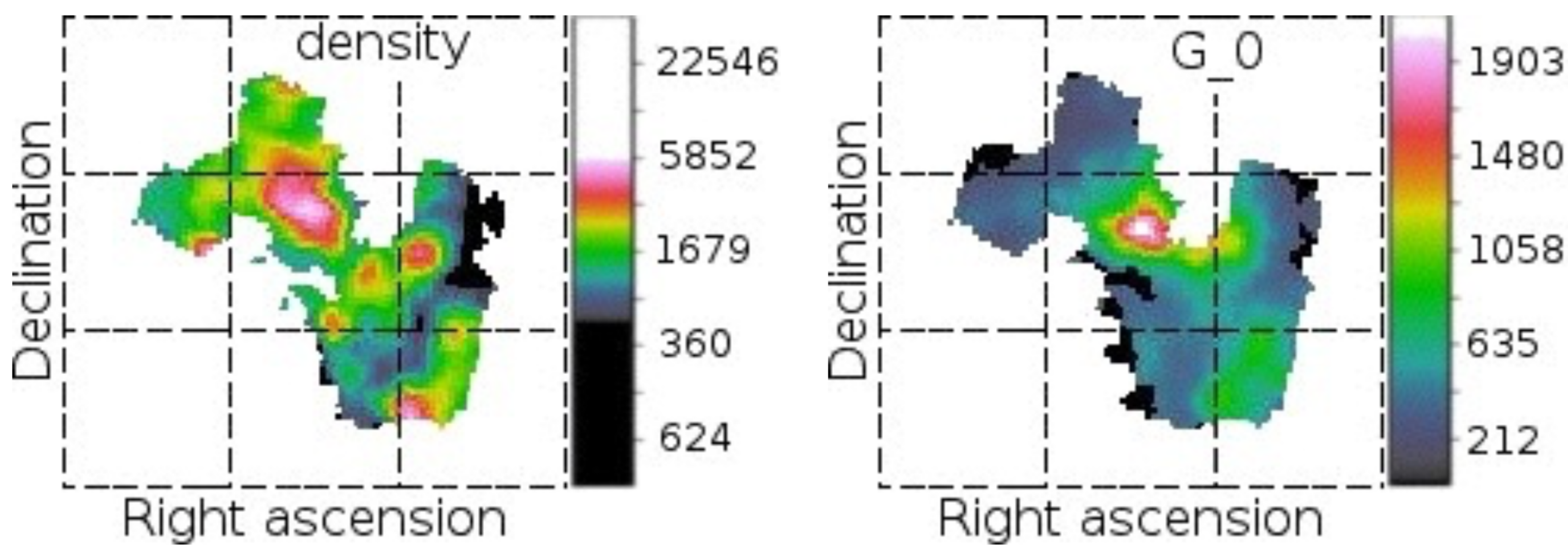




Codes provides

- n(X)
- excitation in quantum levels
- T_{gas}, T_{dust}
- ...

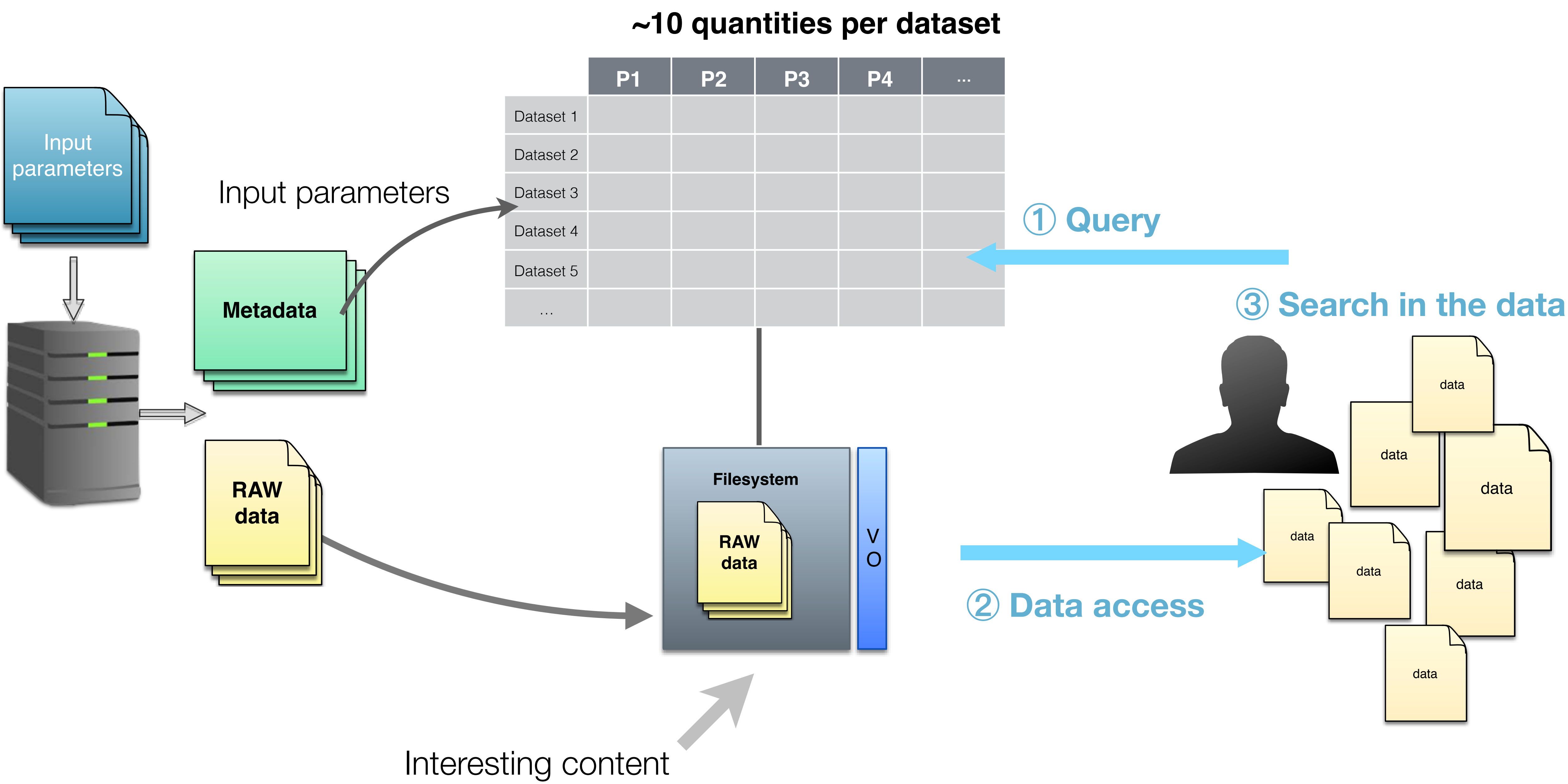
- I(X)
- N(X)
- spectre



ISMDB: InterStellar Medium DataBase

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

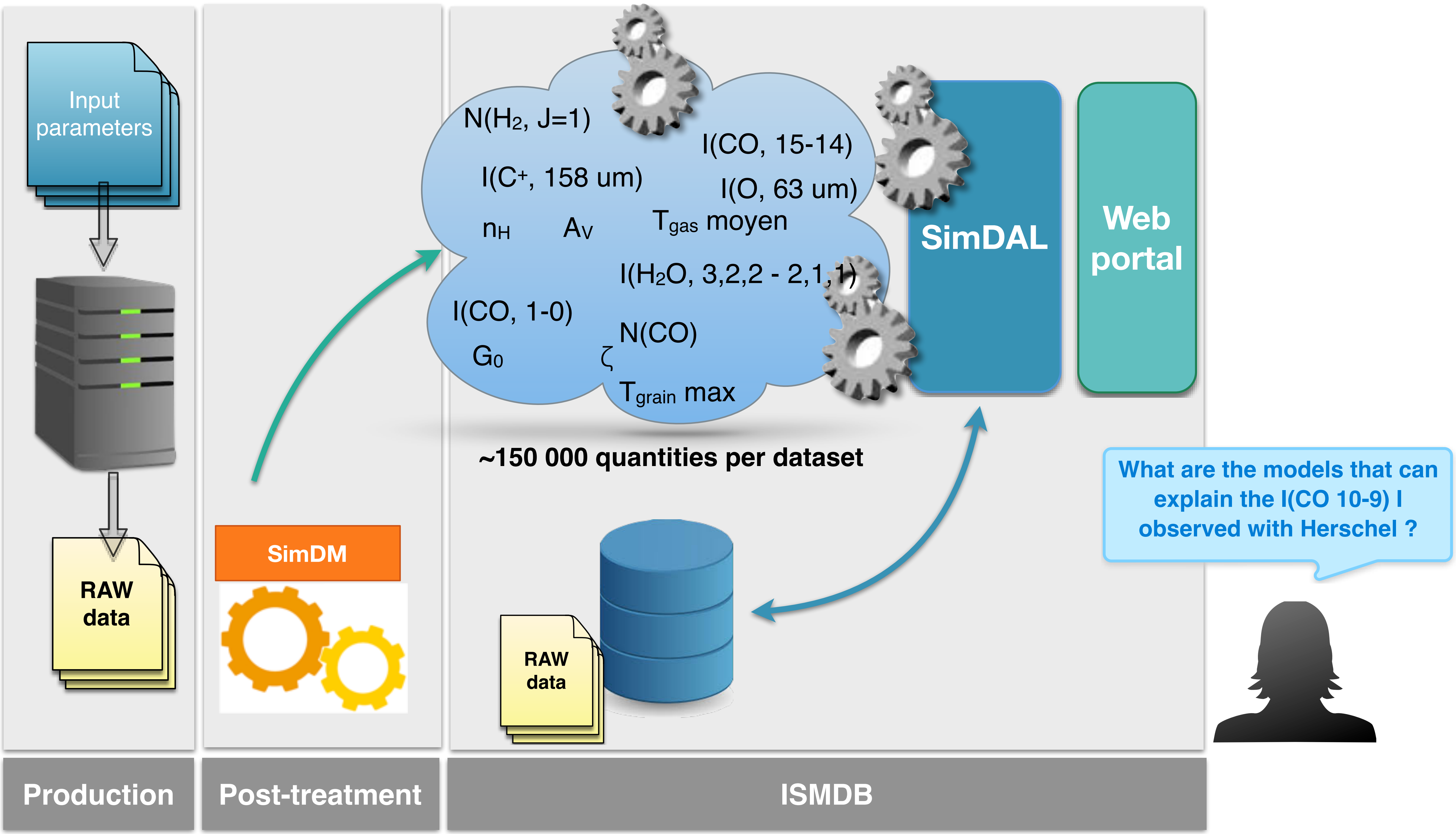
Standard databases:



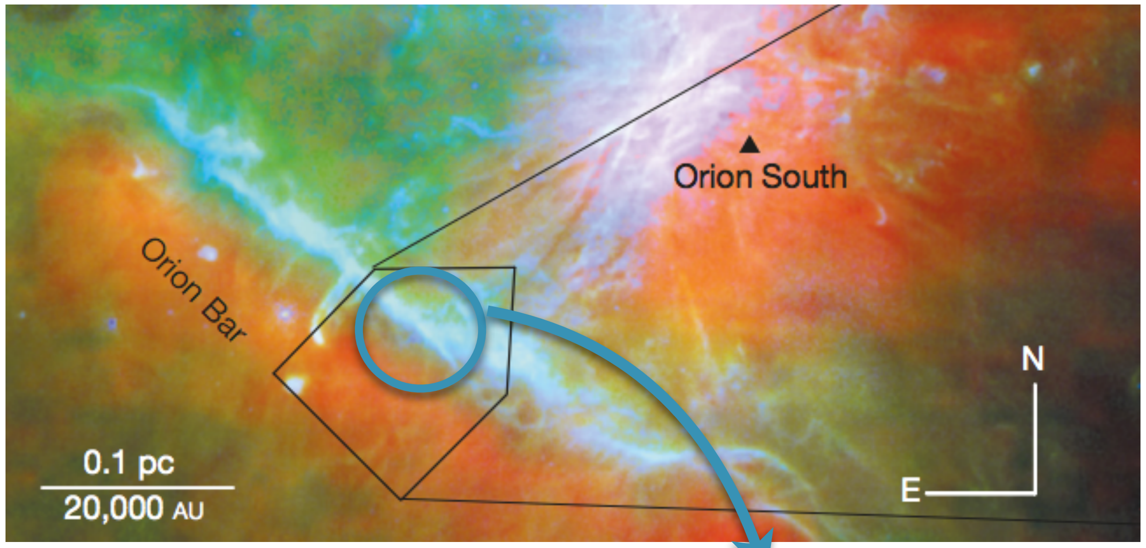
ISMDB

ISMServices

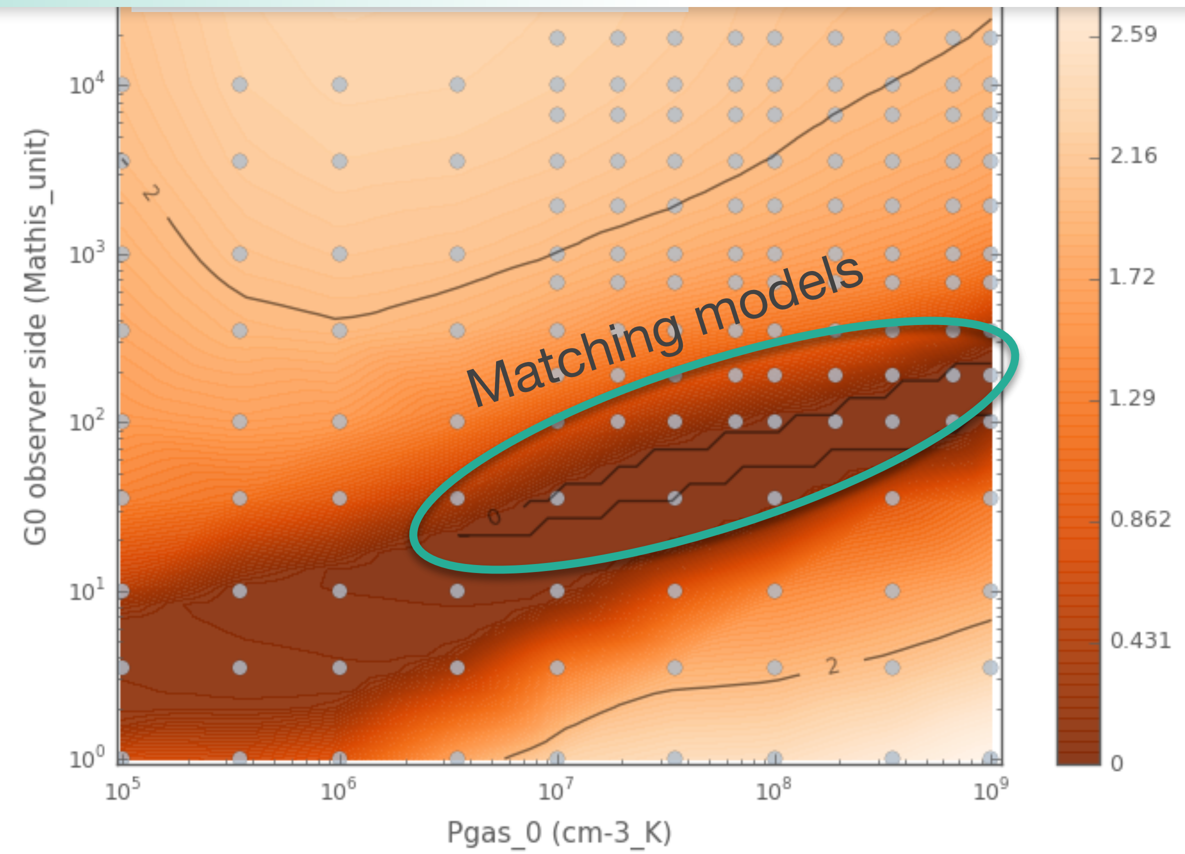
- not only a classical database to find pre-computed models
- but **also a tool that can *interpret* observations**

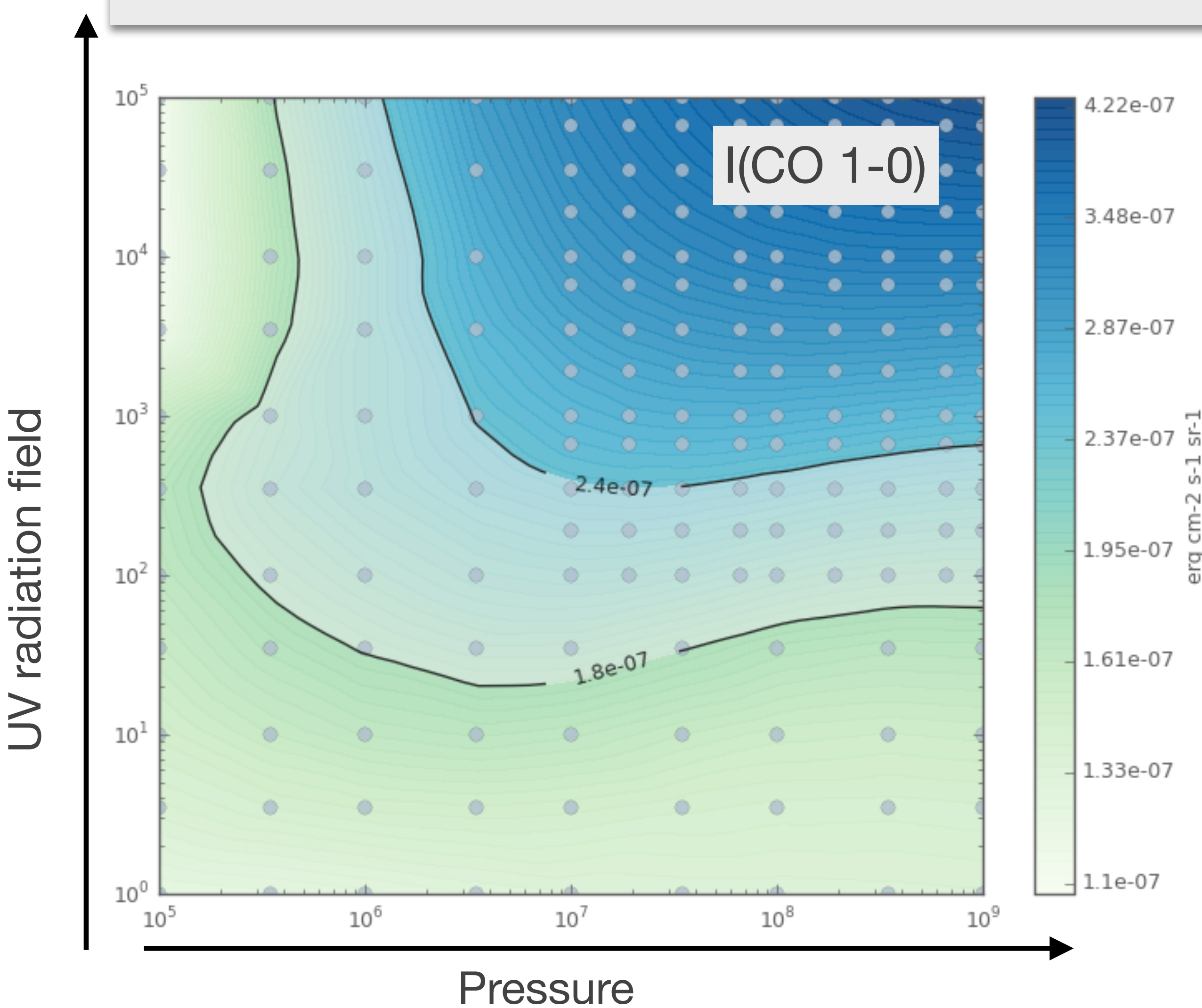


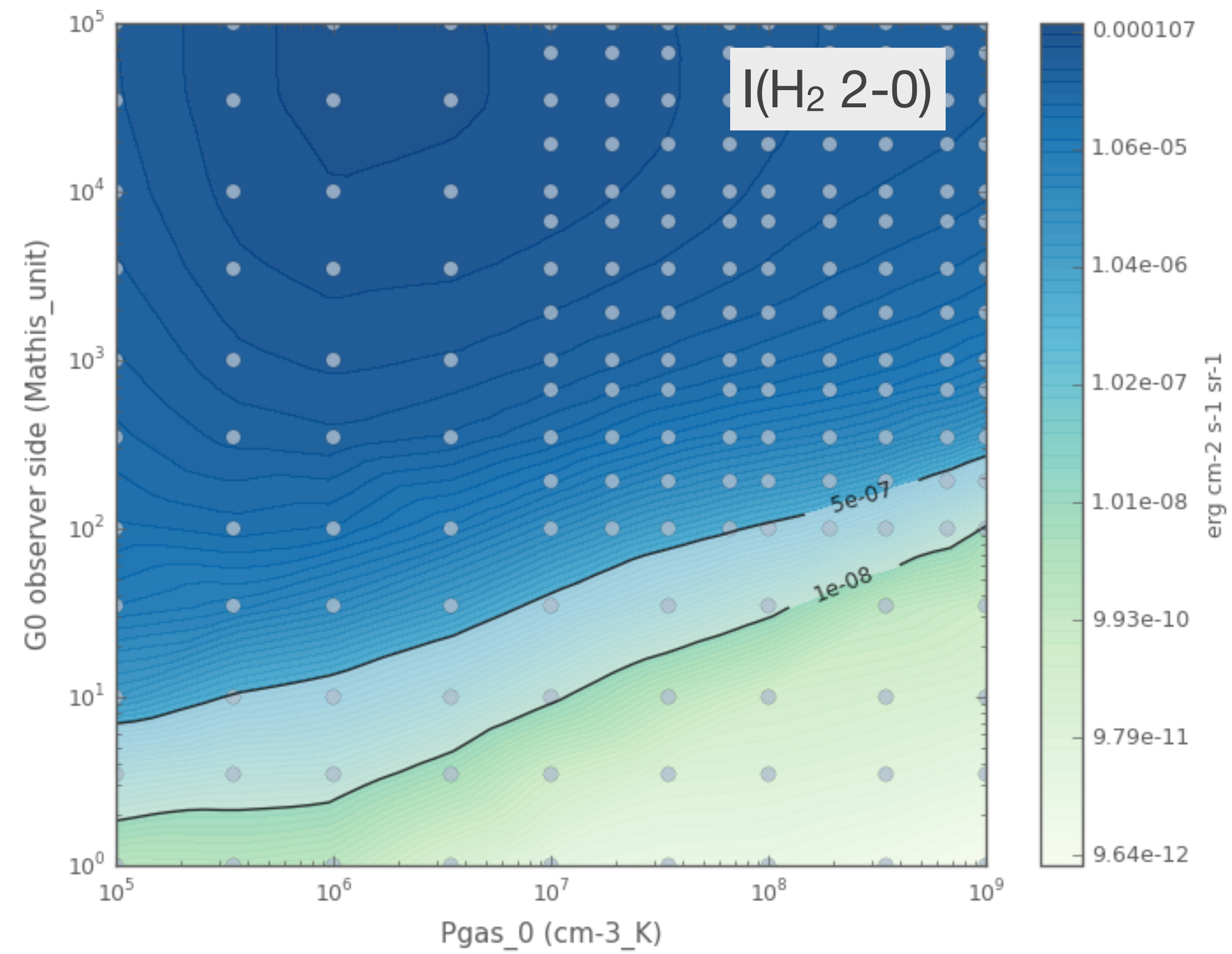
ISMDB



$1.8\ 10^{-7} < I(CO\ \ 1\text{-}0) < 2.4\ 10^{-7}$ erg cm-2 s-1 sr-1
$1.0\ 10^{-8} < I(H2\ \ 2\text{-}0) < 5.0\ 10^{-7}$ erg cm-2 s-1 sr-1



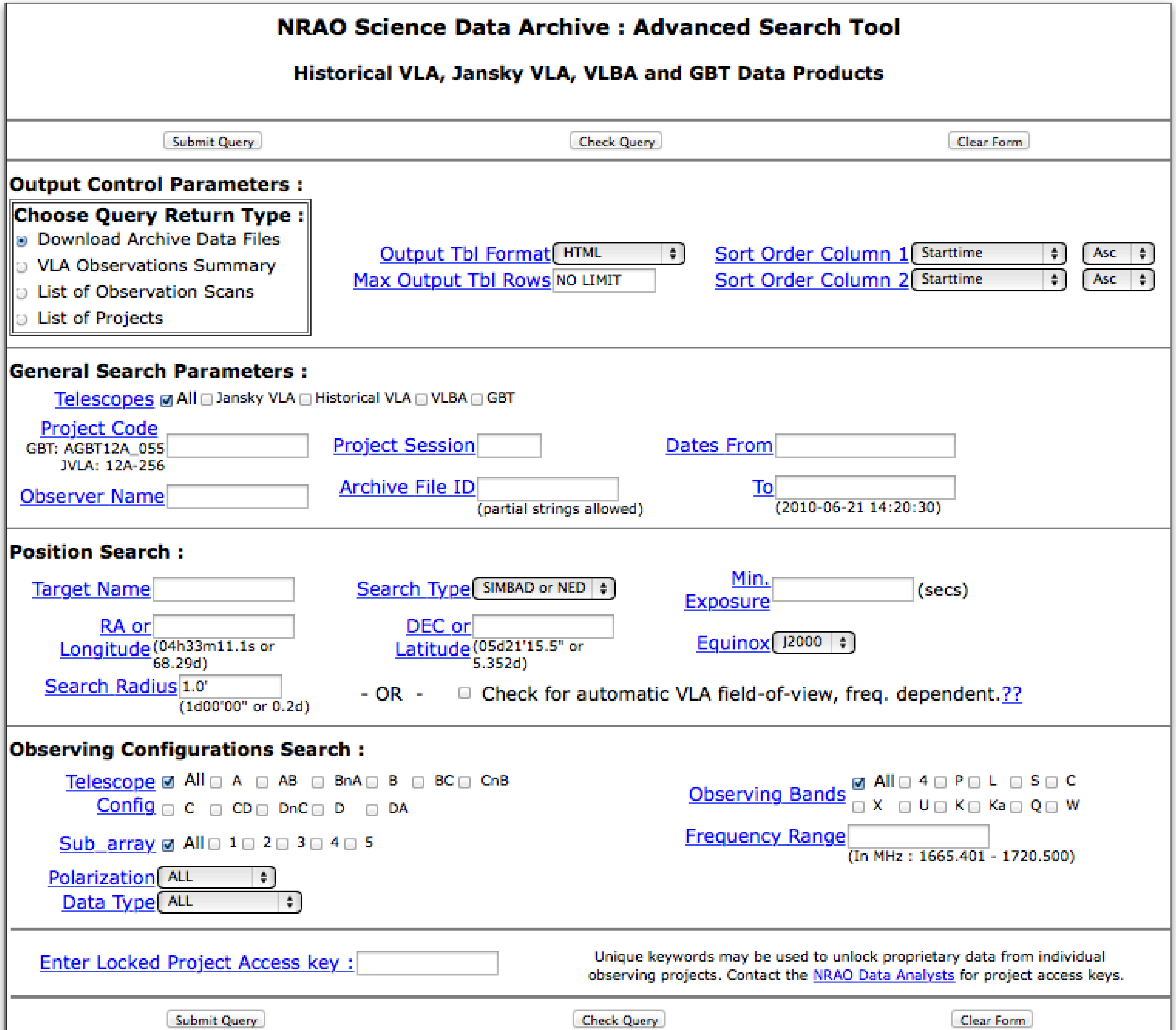




Technical challenges

ISMServices

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
Max Output Tbl Rows: NO LIMIT
Sort Order Column 1: Starttime Asc
Sort Order Column 2: Starttime Asc

General Search Parameters :

Telescopes: All, Jansky VLA, Historical VLA, VLBA, GBT

Project Code (GBT: AGBT12A_055, JVLA: 12A-256)
Project Session
Dates From
Observer Name
Archive File ID (partial strings allowed)
To (2010-06-21 14:20:30)

Position Search :

Target Name
Search Type: SIMBAD or NED
Min. Exposure (secs)
RA or Longitude (04h33m11.1s or 68.29d)
DEC or Latitude (05d21'15.5" or 5.352d)
Equinox: J2000
Search Radius: 1.0' (1d00'00" or 0.2d)
- OR - Check for automatic VLA field-of-view, freq. dependent. ??

Observing Configurations Search :

Telescope Config: All, A, AB, BnA, B, BC, CnB, C, CD, DnC, D, DA
Sub_array: All, 1, 2, 3, 4, 5
Polarization: ALL
Data Type: ALL
Observing Bands: All, 4, P, L, S, C, 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.

Submit Query | Check Query | Clear Form

Brian Glendenning, NRAO, InterOp Heidelberg 2013

23 paramètres de recherche
Interface complexe

ISMDB
150 000 parameters !

Technical challenges

ISMServices

ISMServices 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	Pgas_0	(cm-3_K)	log scale
y	G0 observer side	(Mathis_unit)	log scale

2 – fix all the other parameters

AVmax	(mag)	10

3 – observational constraints

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

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

Search

3 – observational constraints

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

Semantics interpreter

New and upcoming developments

Standard activities continue:

- upgrade of codes:
  - new physics
  - new atomic, molecular & chemistry data
  - more detailed documentations
- continue formation of students (schools & master classes)
- participation in IVOA on semantics + transfer of competences on SimDAL

Major new developments:

① Integration of the various services (e.g. extractor tools in web interface)

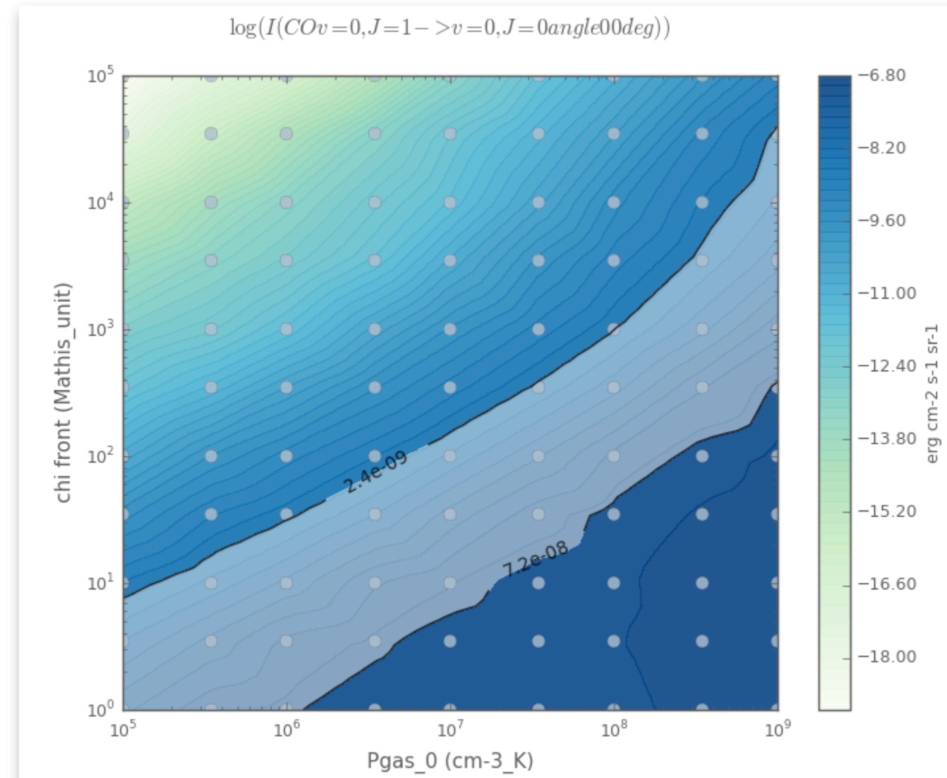
② Extend content of ISMDB (additional codes)

③ ISMDB evolutions : map interpretation

④ Links with other services

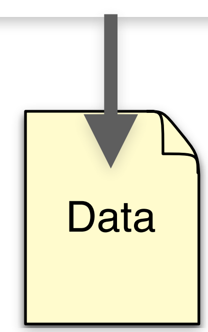
① Integration of the various services

- Integration of Analysis Tools on ISMDB web-page
  - data extractor
  - chemistry analyzer
    - ➔ **Plot & extract any quantity online**
    - ➔ **Analyse results online**



- New presentation of models:
  Each model presented as card with:
  - **main results** (intensities, column densities)
  - **pre-defined plots** of important quantities

- Download data file for all generated plots
  - allows users to manipulate data as they wish



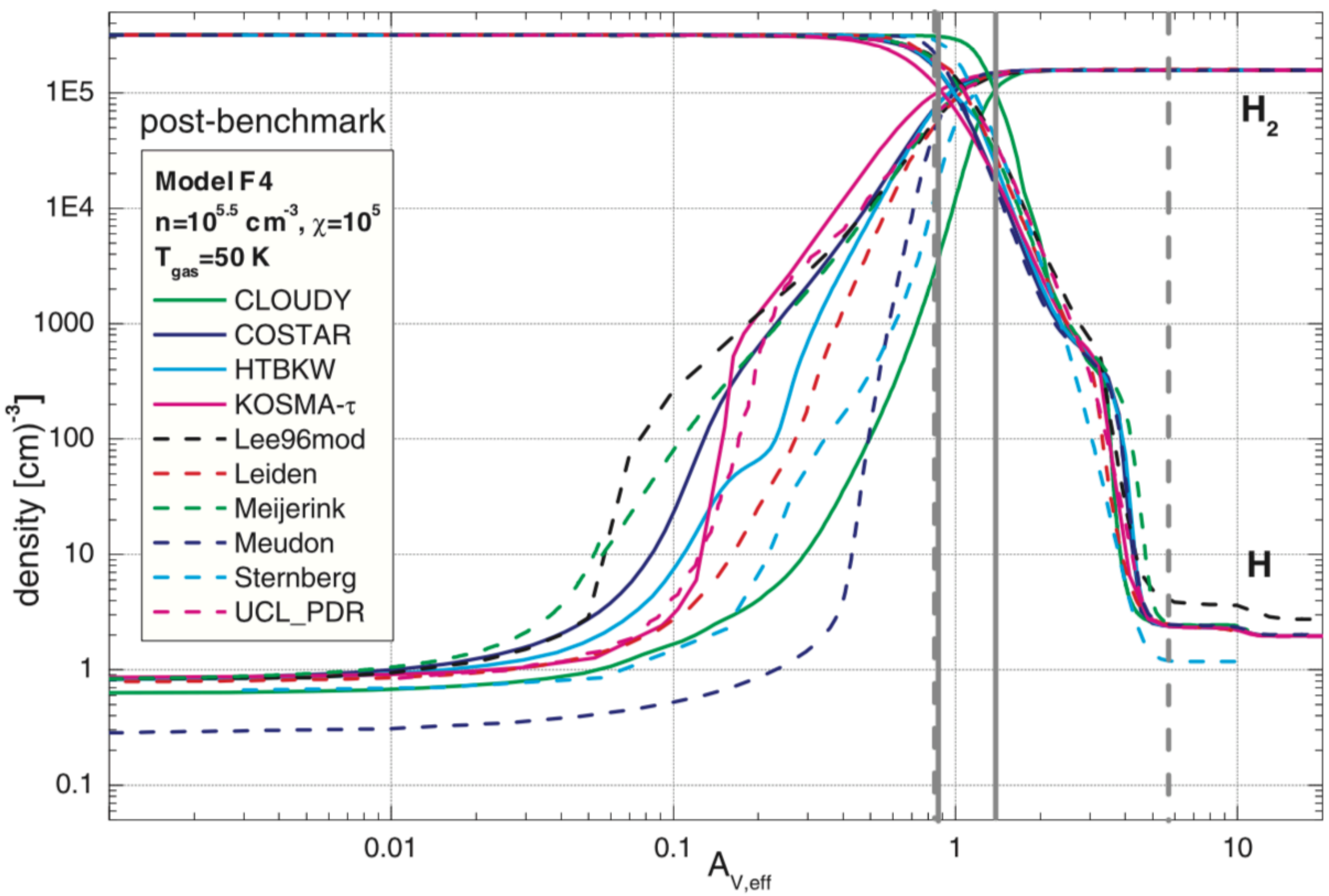
P	G0	I(CO 1-0)
…	…	…
…	…	…
…	…	…

- Search by input parameters

② Extend scientific content of ISMDB

Several kinds of models are required to interpret observations in Galactic and extragalactic ISM:

- PDR
- shocks
- dust emission
- H II regions models
- radiative transfer
- astrochemistry models
- …



Complex physics in these codes

- useful to have **several sources to compare results**

Röllig et al. (2006)

We have defined a **simple data format to ingest models in ISMDB**

➔ simple for data providers to integrate their models in ISMDB

ISMServices

Presently in ISMDB:

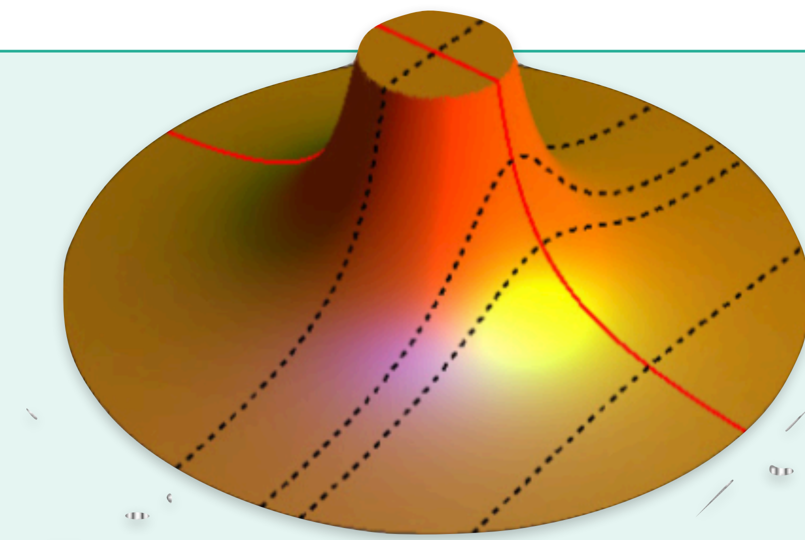
Two Meudon PDR code grids

- constant n_H and constant P
- Galactic PDR conditions (Z = 1)
- ~ 2000 models

Extensions motivated by JWST & IRAM observations

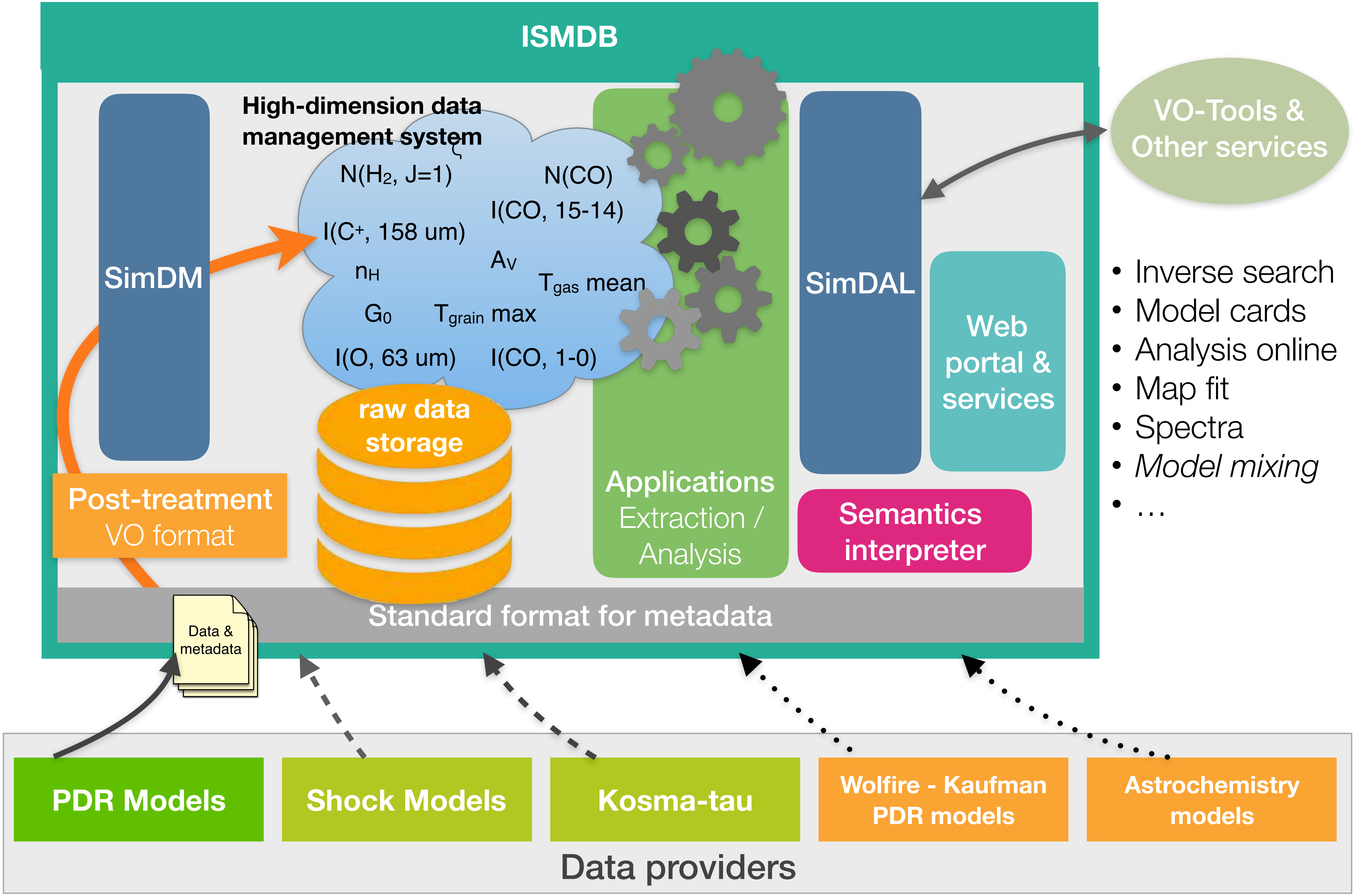
In 2019, our goals:

- Meudon PDR code in extragalactic conditions
- Paris-Durham shock models (A. Gusdorf et al.)
- Kosma-τ PDR models (Cologne PDR code - Markus. Röllig)



Profile of a clump in Kosma-τ (Rollig et al. 2013)

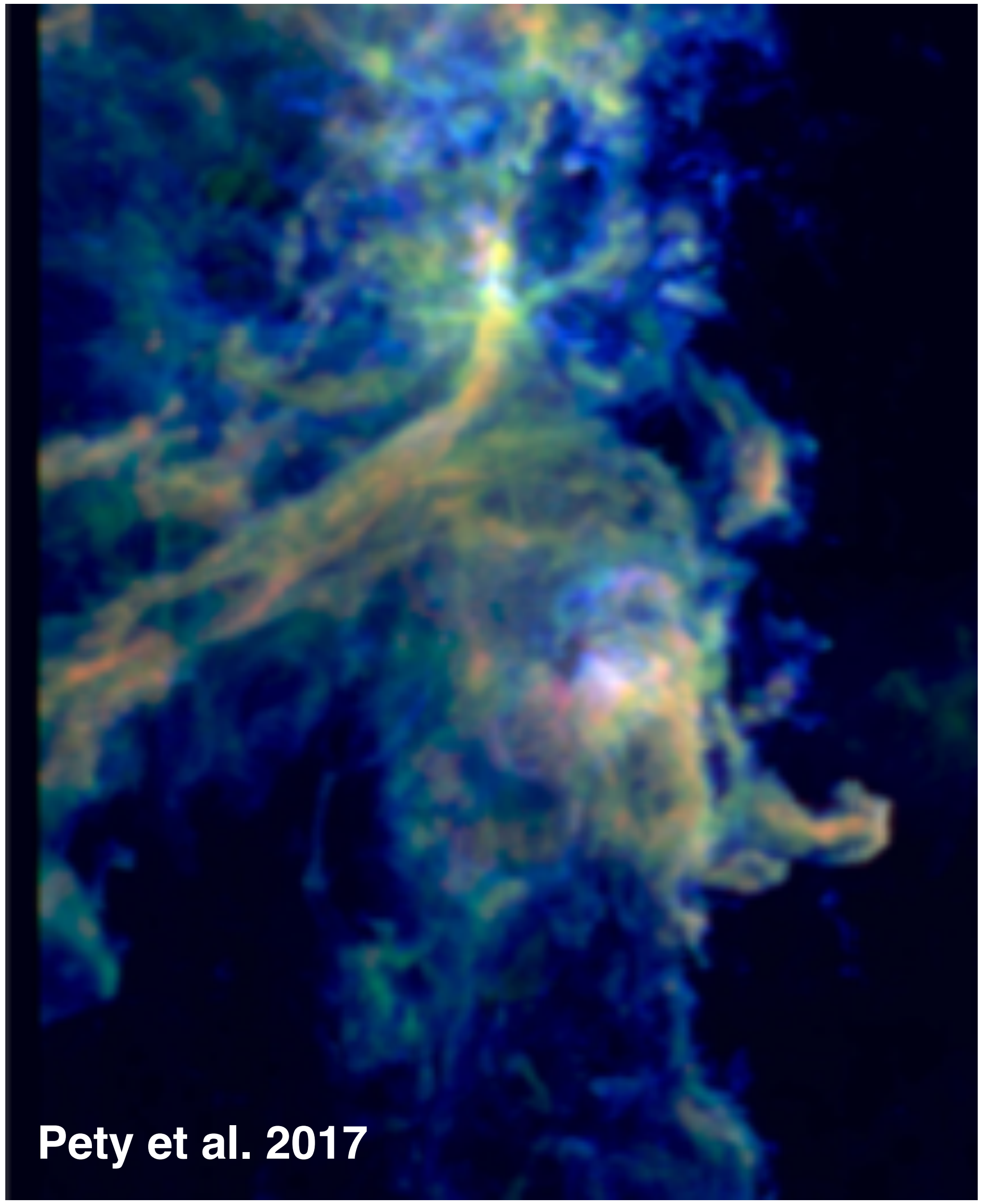
ISMDB


ISMDB
High-dimension data management system
N(H$_2$, J=1)
N(CO)
I(CO, 15-14)
I(C$^+$, 158 um)
A_V
n_H
T_{gas} mean
G_0
T_{grain} max
I(O, 63 um)
I(CO, 1-0)
SimDM
raw data storage
Post-treatment
VO format
Applications
Extraction / Analysis
SimDAL
Web portal & services
Semantics interpreter
VO-Tools & Other services
• Inverse search
• Model cards
• Analysis online
• Map fit
• Spectra
• *Model mixing*
• …
Standard format for metadata
Data & metadata
PDR Models
Shock Models
Kosma-tau
Wolfire - Kaufman PDR models
Astrochemistry models
Data providers

③ New service: interpretation of maps

Motivation: more and more hyper-spectral observations
need tools to interpret them

Instruments: JWST, IRAM, ALMA



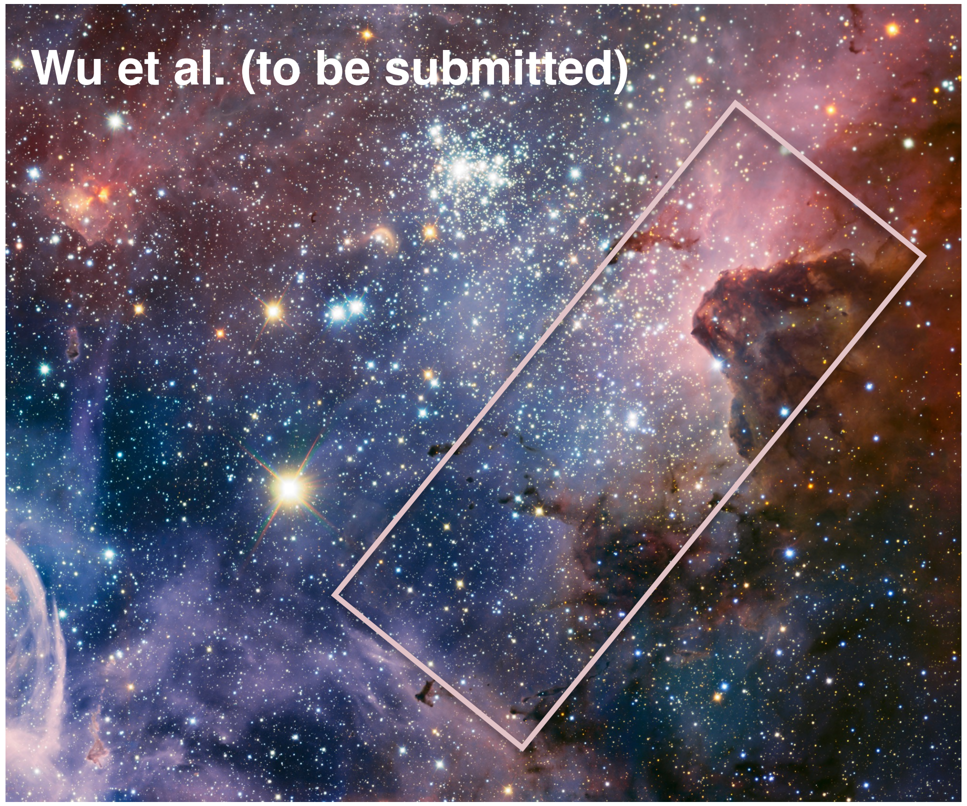
Example of IRAM observations

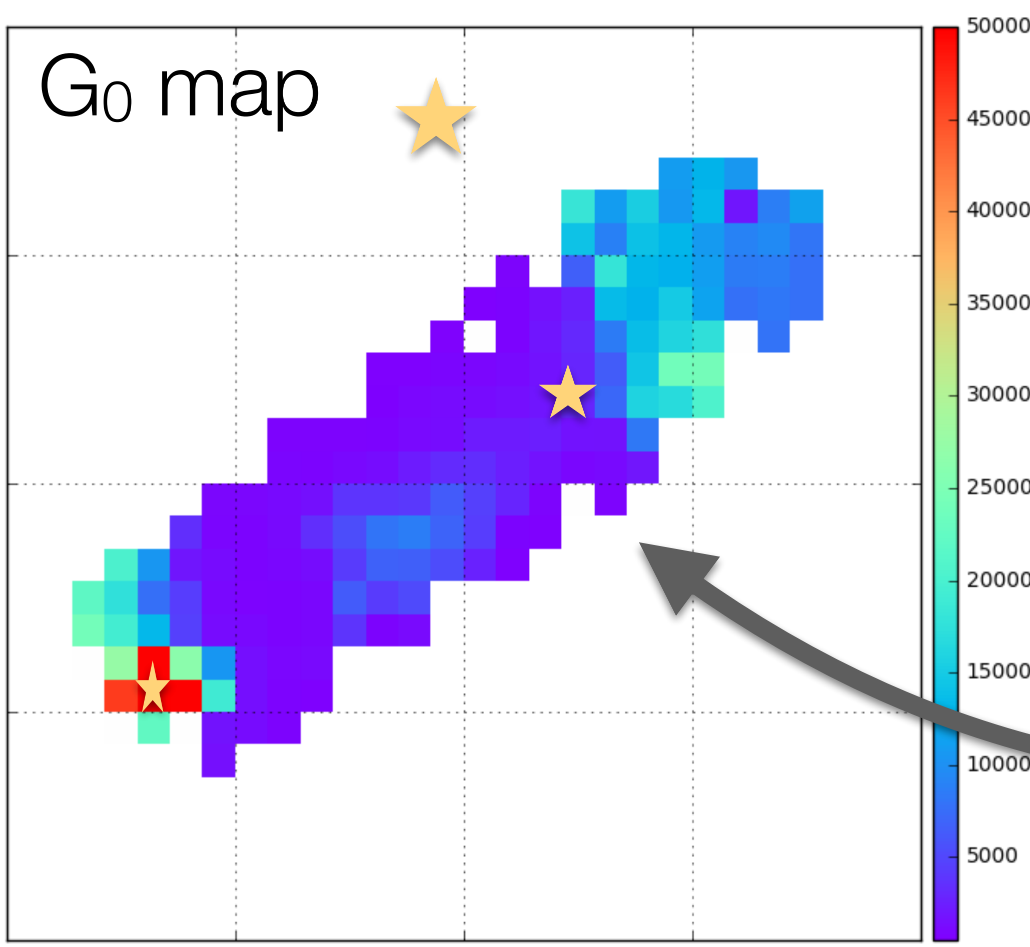
Orion B project (Pety et al. 2017):
- Large program IRAM-30m/EMIR
- 141 050 pixels
- tens of line intensities at each pixel

➔ need new techniques to compare models & observations

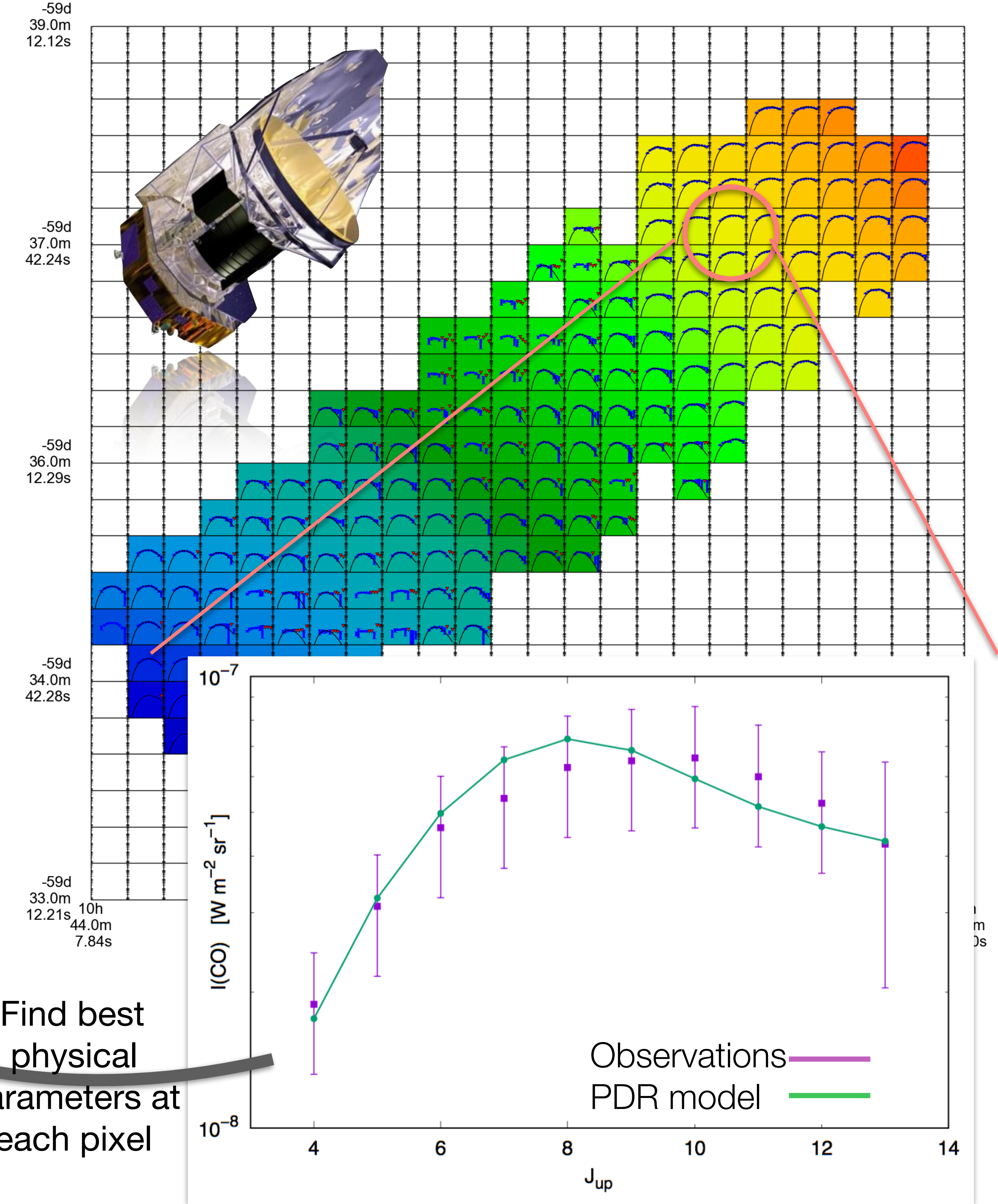
ISMDB

ISMServices



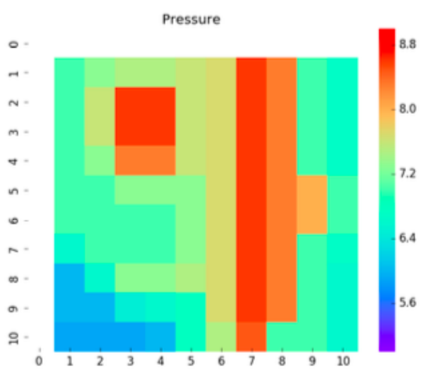


Find best physical parameters at each pixel

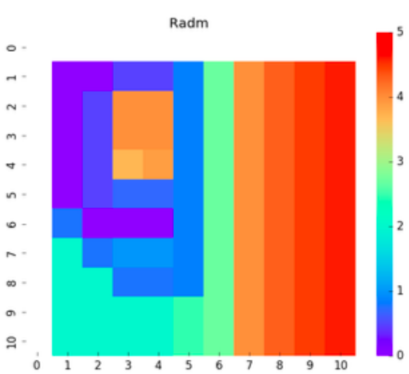


Problem: in low SNR regions, data insufficient to constrain the model.

True physical maps :

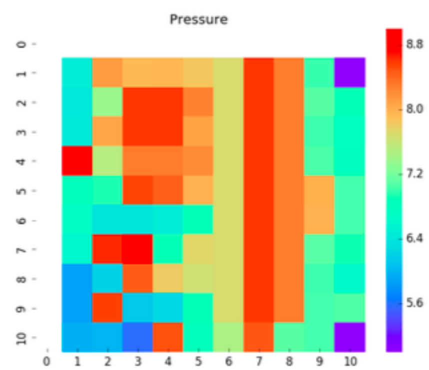


Pressure

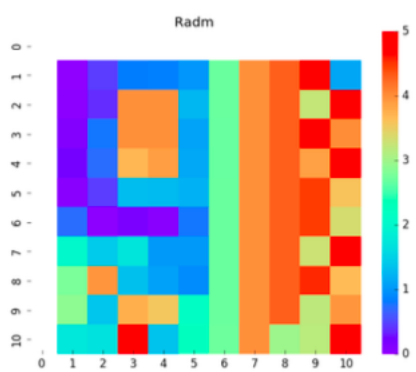


UV illumination

Pixel-by-pixel fit results :



Pressure



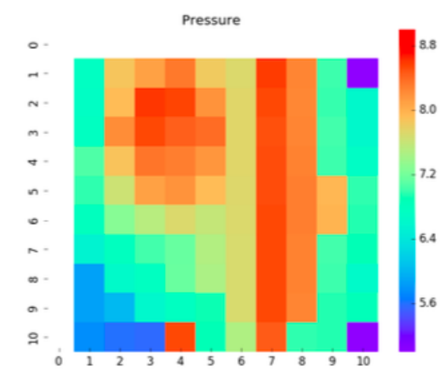
UV illumination

(Based on noisy synthetic observations)

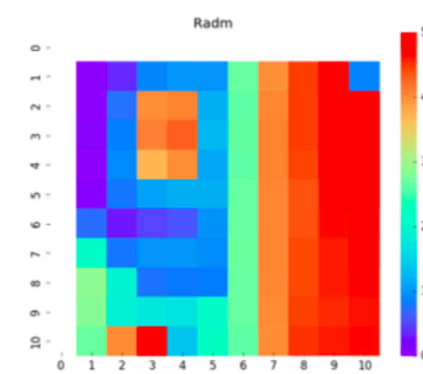
Solution: Regularization

- penalize non-smoothness in the map
- equivalent to bayesian fitting with a smoothness prior
- results in adaptive smoothing in order to have a well constrained fit

Regularized fit results :



Pressure



UV illumination

Work in progress.

Internship of Nicolas Chabalier

ISMServices

Example of what we would like

ISMServices CODES & DATABASES TECHNOLOGIES PARTNERS

help

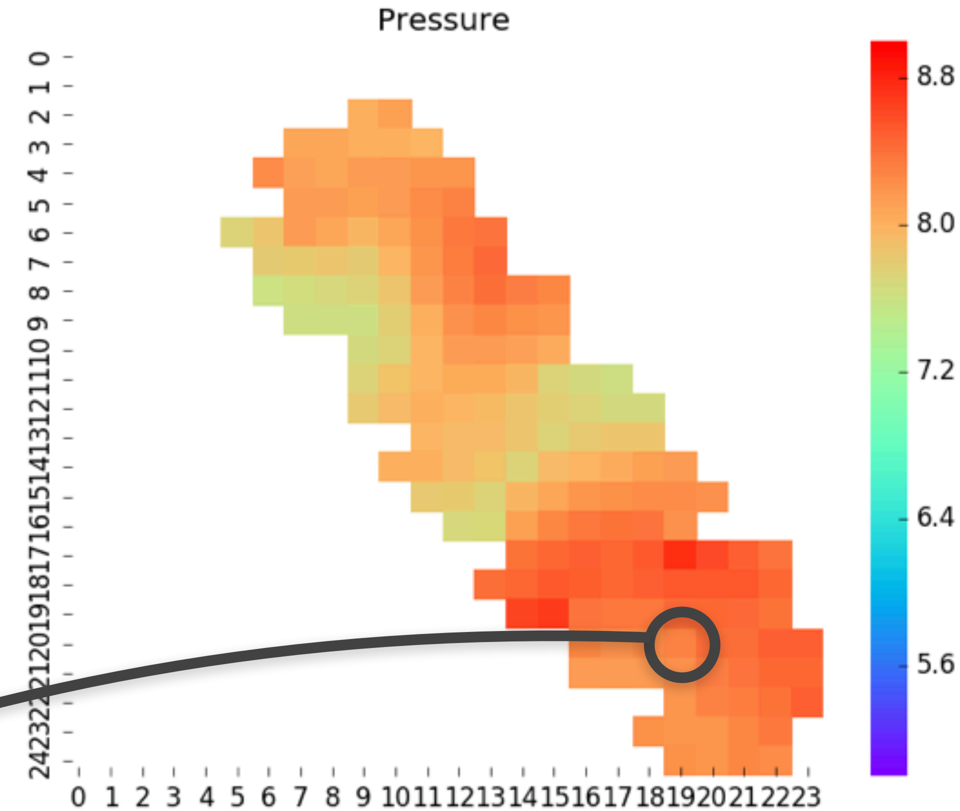
ISMDB Map Fit

Fit map to PDR conditions

Choisir le fichier aucun fichier sél. upload

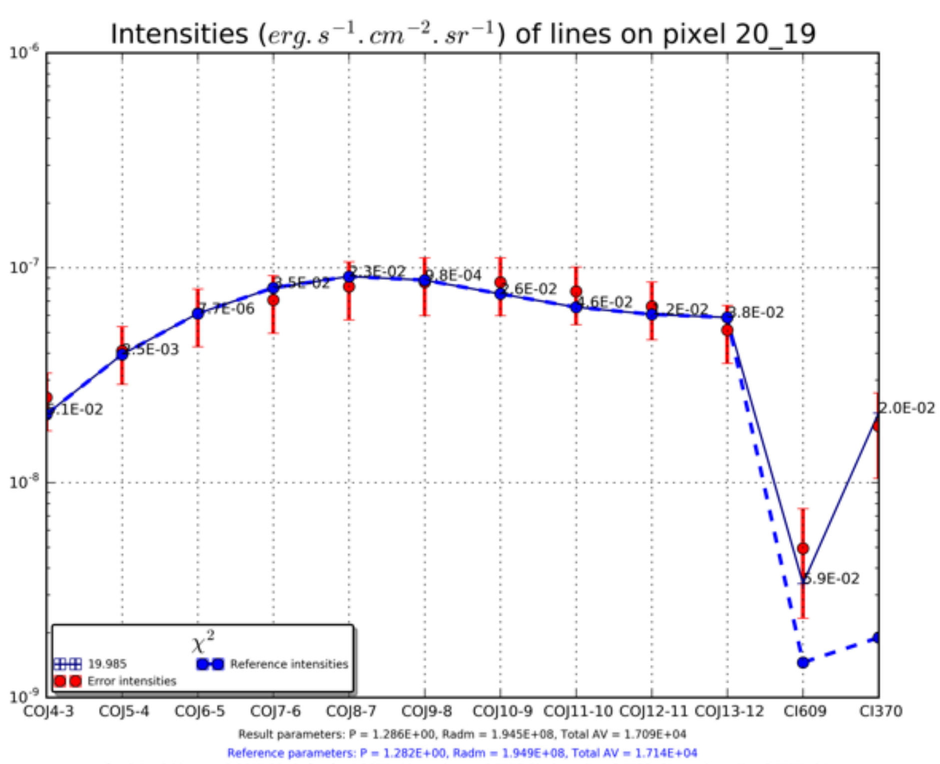
Best fit

click on pixels to view detailed info

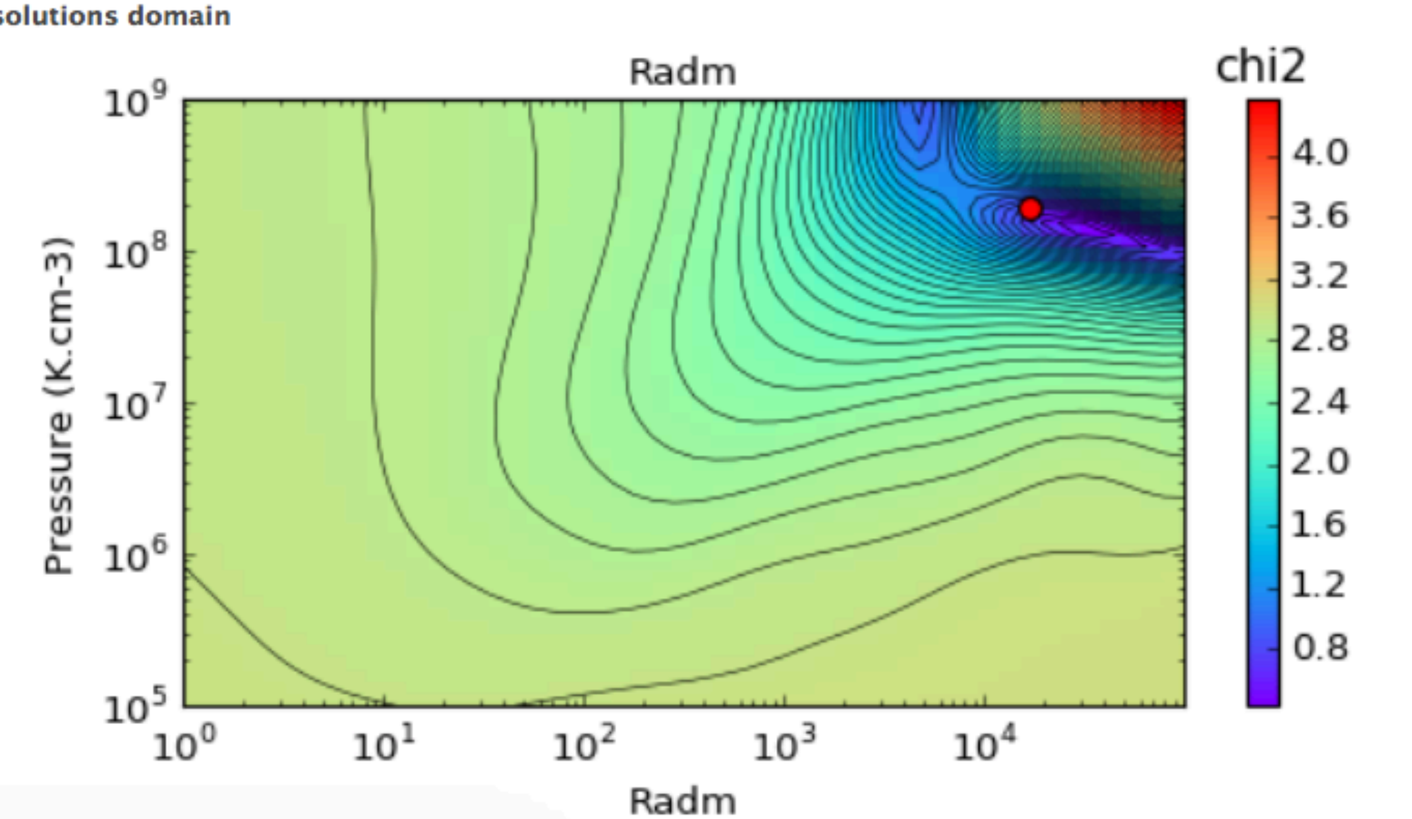


Fit detail for pixel 20,19

Best model fit detail



Fit solutions domain



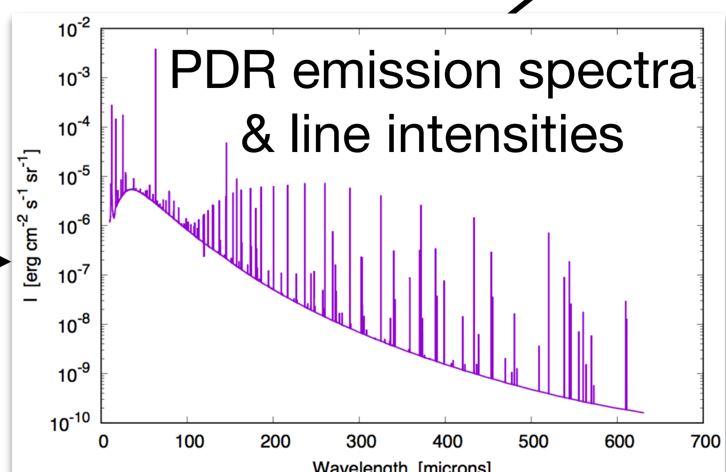
④ Coupling ISMDB with other services

PDR spectra asked by several other services

- **CASSIS** (ANO5 - IRAP)
- **ARTEMIX** (ANO3 - ALMA Regional Center)
- **CIGALE** (ANO5 - GAZPAR)

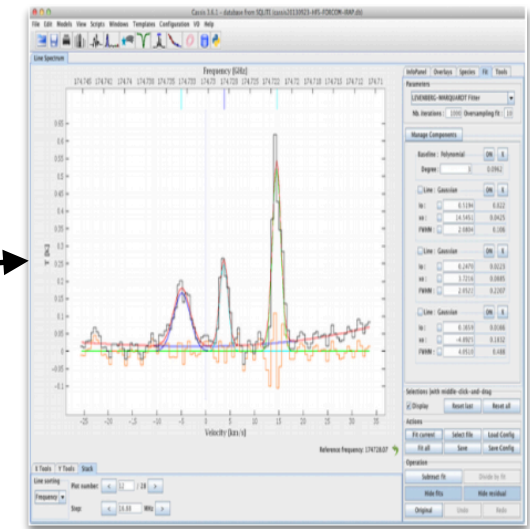
ISMDB

SimDAL

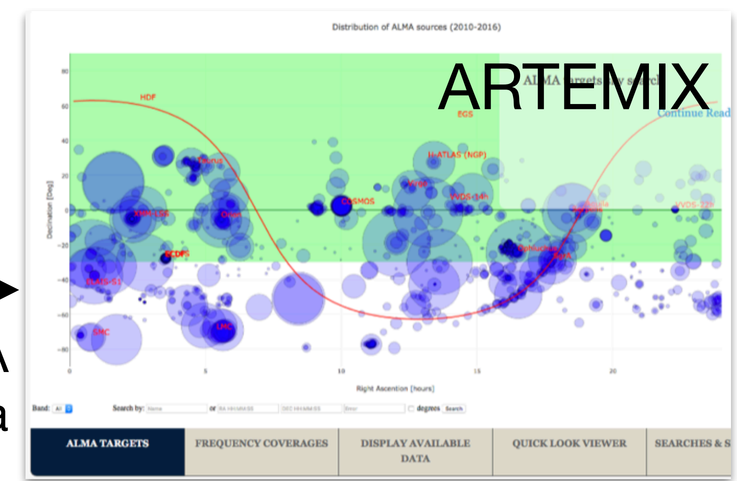


Interpret ISM spectra

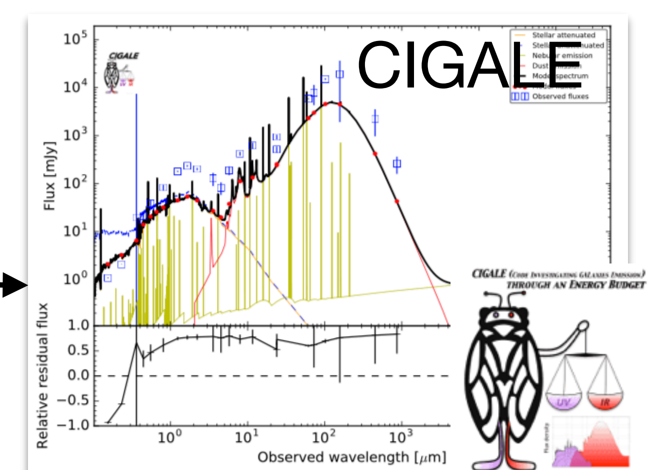
CASSIS



Interpret ALMA archive data



Analyse galaxies molecular emission



Summary of new and upcoming developments

ISMServices

Major new developments:

① Integration of the various services (e.g. extractor tools in web interface)

② Extend content of ISMDB (additional codes)

③ ISMDB evolutions : map interpretation

④ Links with other services