



SimDAL

Implementations at Paris Observatory

David Languignon & Franck Le Petit



SimDAL version 1.0

New version of WD SimDAL 1.0

Previous version:

- presented at Sesto InterOp
- WD published in September 2015

New version:

- Integration of most feedbacks (some remain for version 2.0)
 - pagination
 - API homogenization / REST
 - datasetID, ...
- Clarifications of several points

Implementations

(end 2015 - beginning 2016):

- Paris
- Madrid



Simulation Data Access Layer

Version 1.0

IVOA Working Draft 03 May 2016

Working group

DAL

This version

[http://www.ivoa.net/documents/simdal/03 May 2016](http://www.ivoa.net/documents/simdal/03%20May%202016)

Latest version

<http://www.ivoa.net/documents/simdal>

Previous versions

WD-SimDAL-1.0-20150907

Author(s)

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

Editor(s)

David Languignon, Franck Le Petit

Abstract

Status of This Document

This is an IVOA Working Draft for review by IVOA members and other interested parties. It is a draft document and may be updated, replaced, or obsoleted by other documents at any time. It is inappropriate to use IVOA Working Drafts as reference materials or to cite them as other than "work in progress".

A list of current IVOA Recommendations and other technical documents can be found at <http://www.ivoa.net/Document>

Contents

1	Introduction	4
1.1	Role within the VO Architecture	4
2	Overview	5
2.1	Rationale	5
2.2	SimDAL	5
2.3	SimDAL and the Simulation Data Model	6

SimDAL version 1.0

SimDAL has 3 components:

SimDAL Repository:

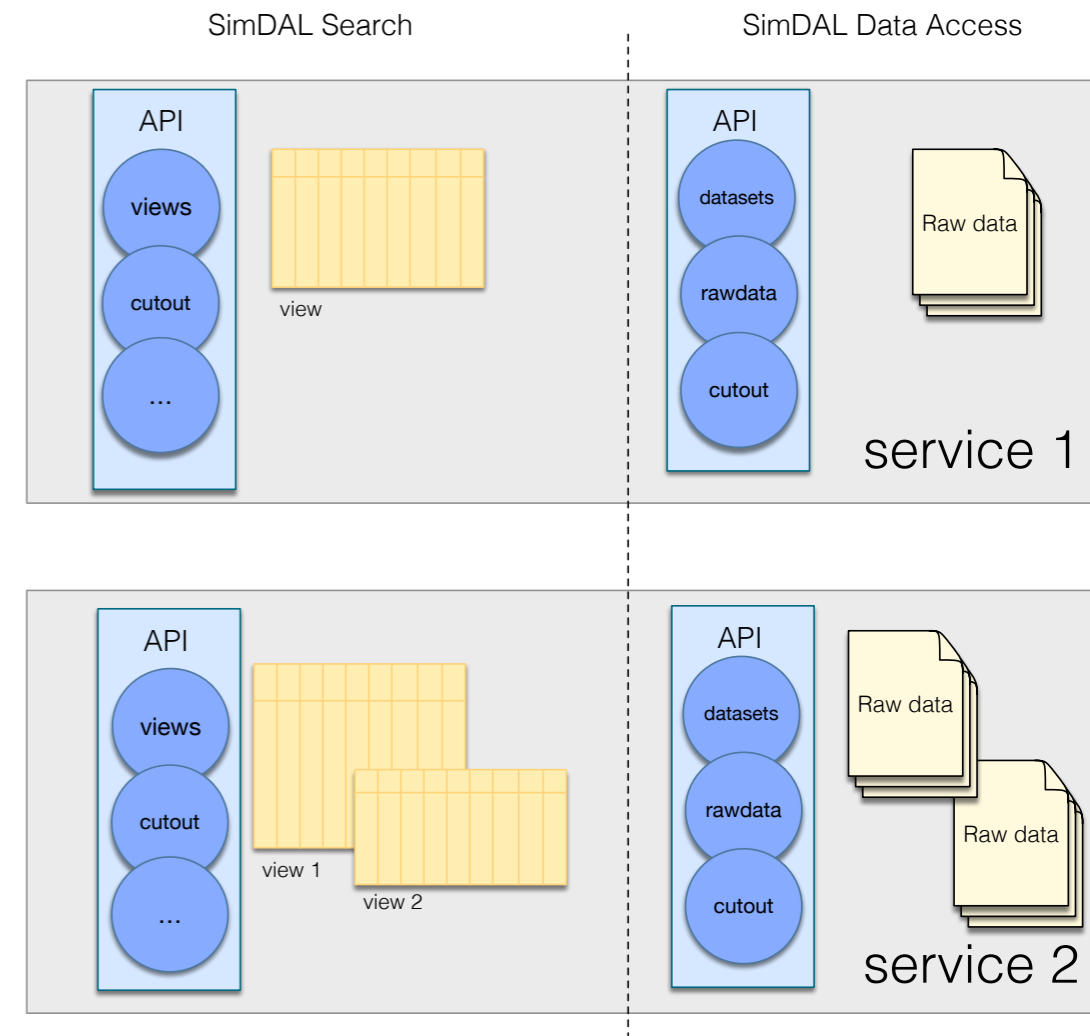
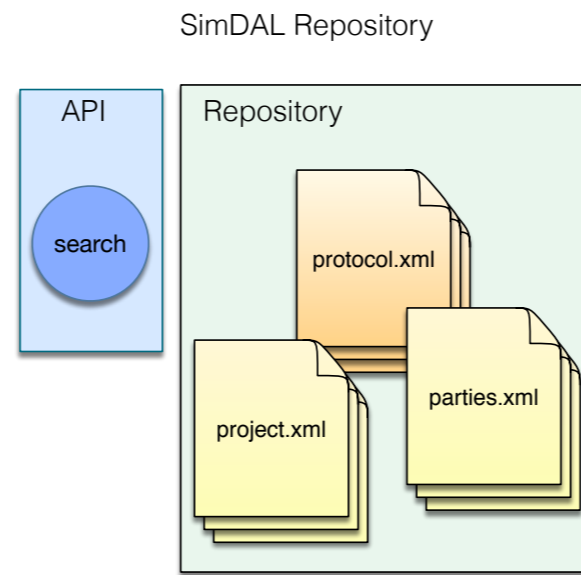
- Discover services publishing simulations in the VO
- Get the SimDM descriptions of codes and projects

SimDAL Search:

- Discover simulations / datasets in a project
- Search on precise quantities (range / values):
 - Input parameters
 - Statistics

SimDAL Data Access:

- Access simulation raw data
- Extraction / cutout to access part of the raw data



SimDAL APIs design

Manage large & heterogeneous data

Level of raw data

Simulations can produce

- large output data files
- heterogeneous data

SimDAL answer:

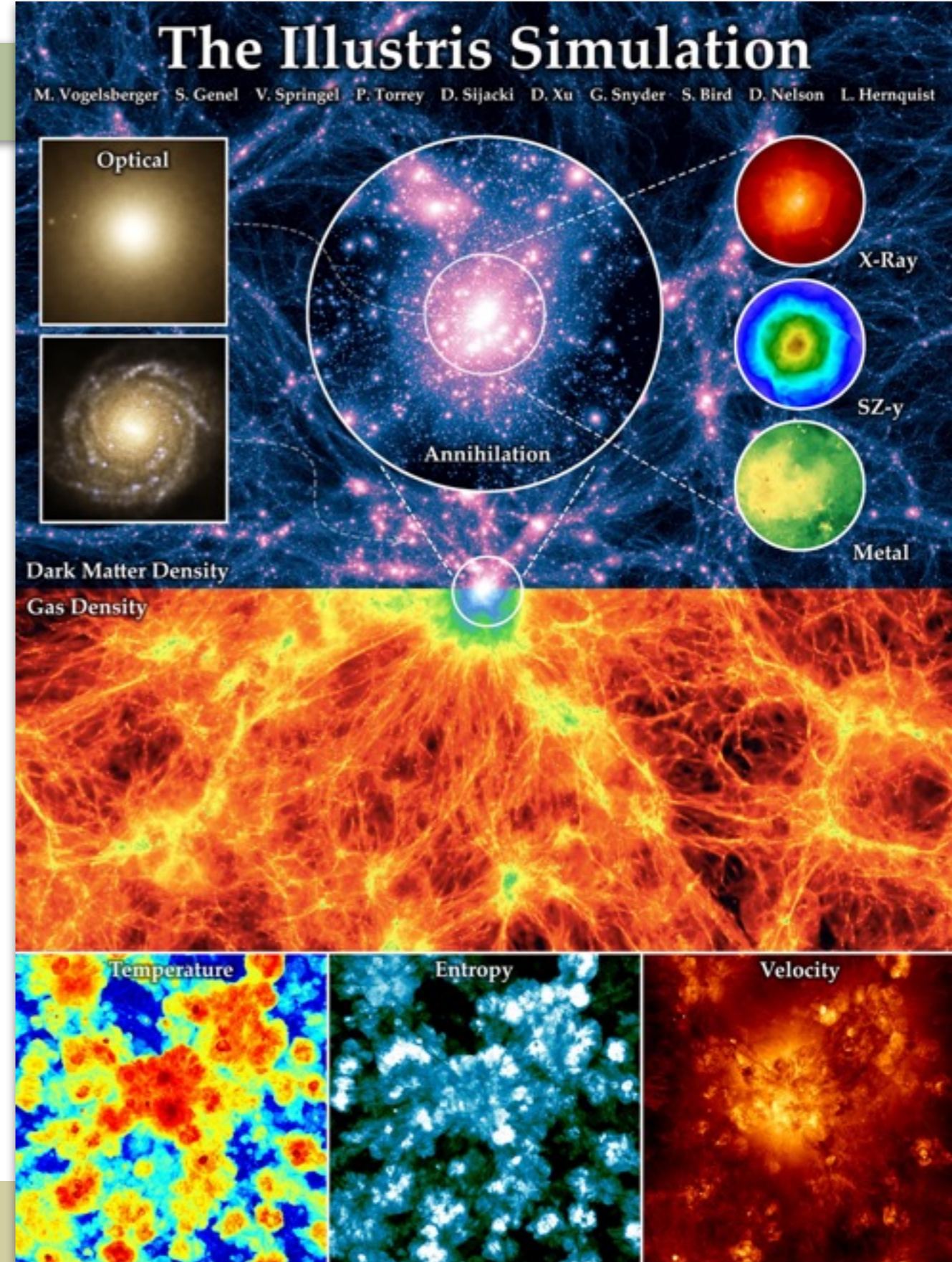
- asynchronous cutout

Level of meta-data

- Simulations can be characterized by large number of quantities
- High dimensionality databases

SimDAL answers:

- notion of views
- no connexion between the standard and the implementation
- pagination



Illustris simulation
Vogelsberg et al.
Data volume: 250 Tb

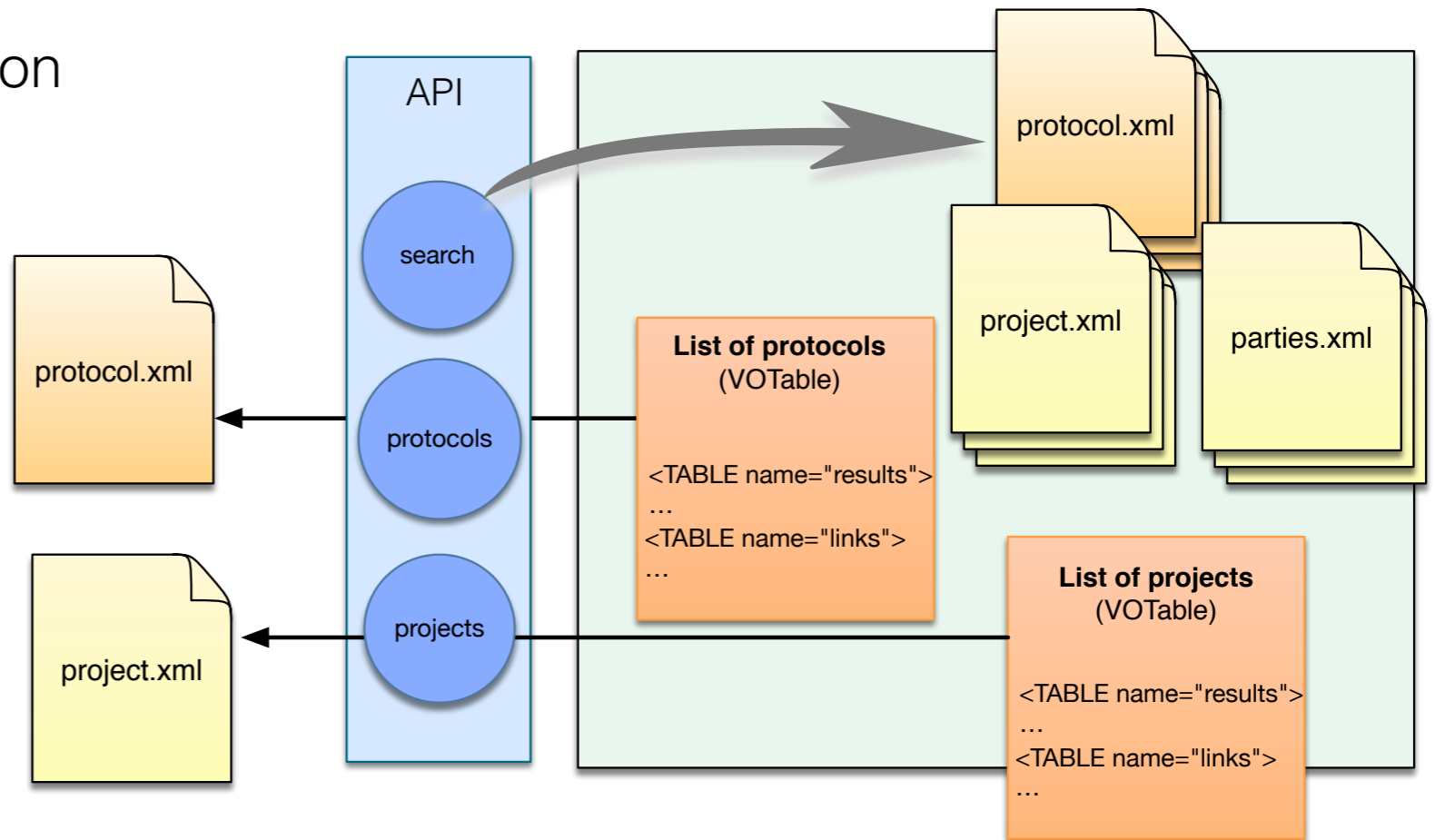
SimDAL Repository

Goal: discover services publishing theoretical data / projects

Repository stores SimDM serialization of protocols and projects

Contains

- full description of codes
- full description of projects published in the VO



{search}

- Text search in whole documents

<http://<SimDAL Repository URI>/search?q=spectra&q=star>

➔ VOtable with publisher, project ID, document, match, rank, ...

{projects}

- Access to SimDM serialization of projects

{protocols}

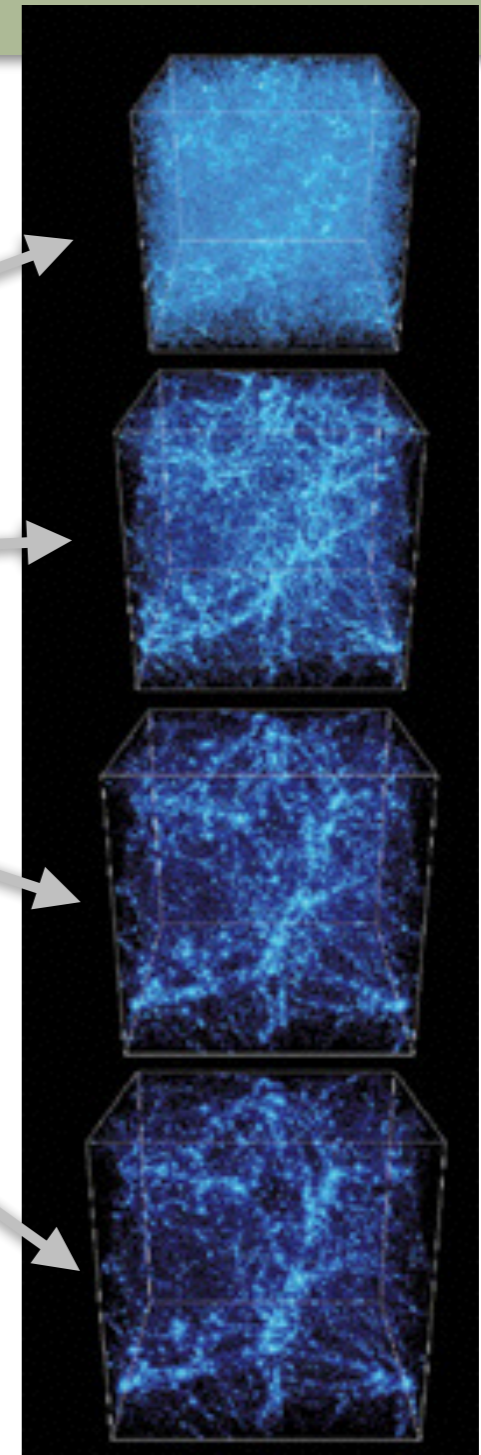
- Access to SimDM serialization of protocols

Example for N-body simulations

cosmology	resolution	redshift	outputdataset_pubdid
ΛCDM	1024	0.0	MyDataset_cube_1
ΛCDM	1024	1.0	MyDataset_cube_2
ΛCDM	1024	4.0	MyDataset_cube_3
ΛCDM	1024	8.9	MyDataset_cube_4
Ratra-Peebles	2048	0.0	MyDataset_cube_5
Ratra-Peebles	2048	1.0	MyDataset_cube_6
Ratra-Peebles	2048	4.0	MyDataset_cube_7
Ratra-Peebles	2048	8.9	MyDataset_cube_8
ΛCDM	2048	0.0	MyDataset_cube_9
...

Input Parameters

Property value

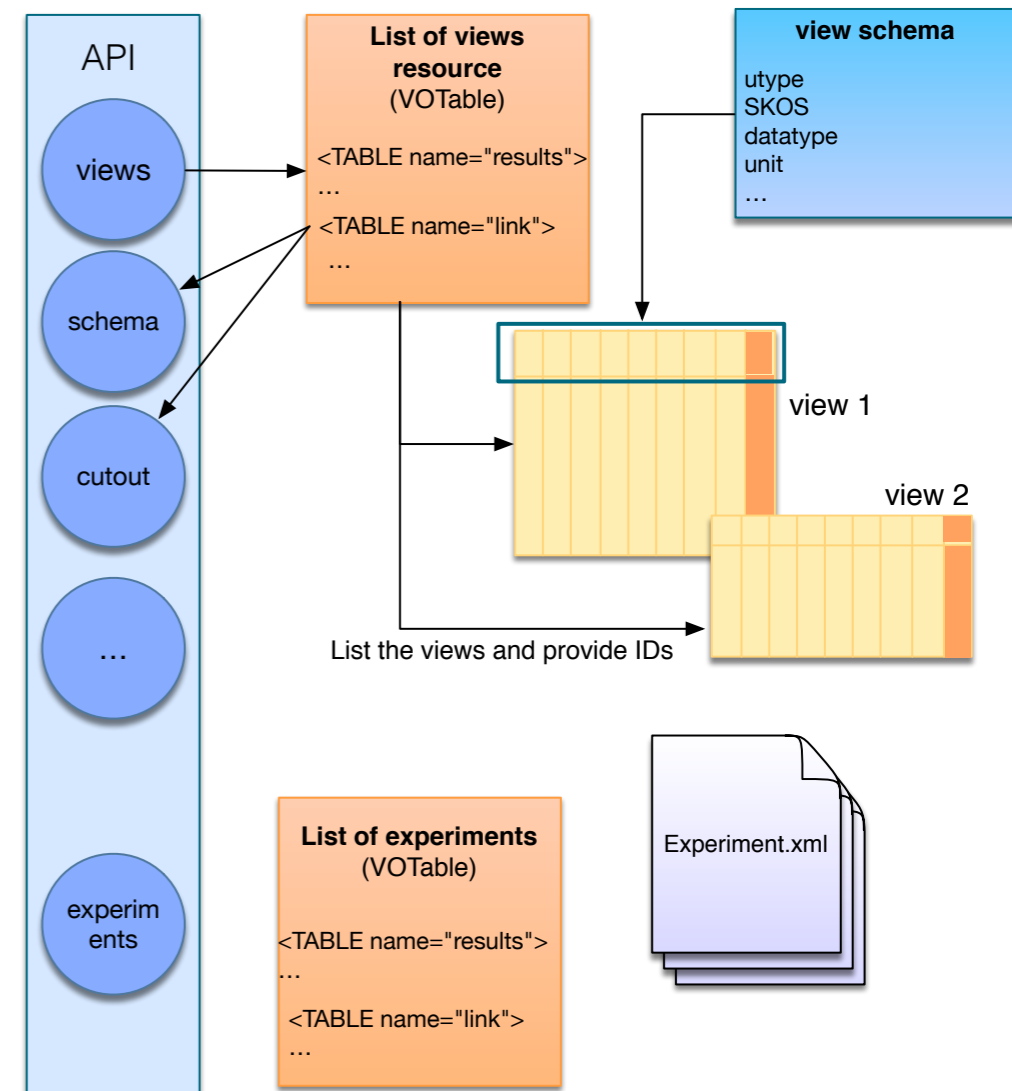


Piece of universe at various redshifts

SimDAL Search

Resources of SimDAL Search API:

- {views}**
 - Provide the list of views to discover simulations
- {experiments}**
 - list of the experiments
- {fields}**
 - get information on a specific field of a view
- {cutouts}**
 - Search / cutout in a view
- {cutouts-preview}**
 - Preview summary of the cutout



SimDAL Search

{cutouts}

- Search / cutout in a view

Example: Query to find stellar spectra with effective temperatures between $5 \cdot 10^4$ and $8 \cdot 10^4$ K

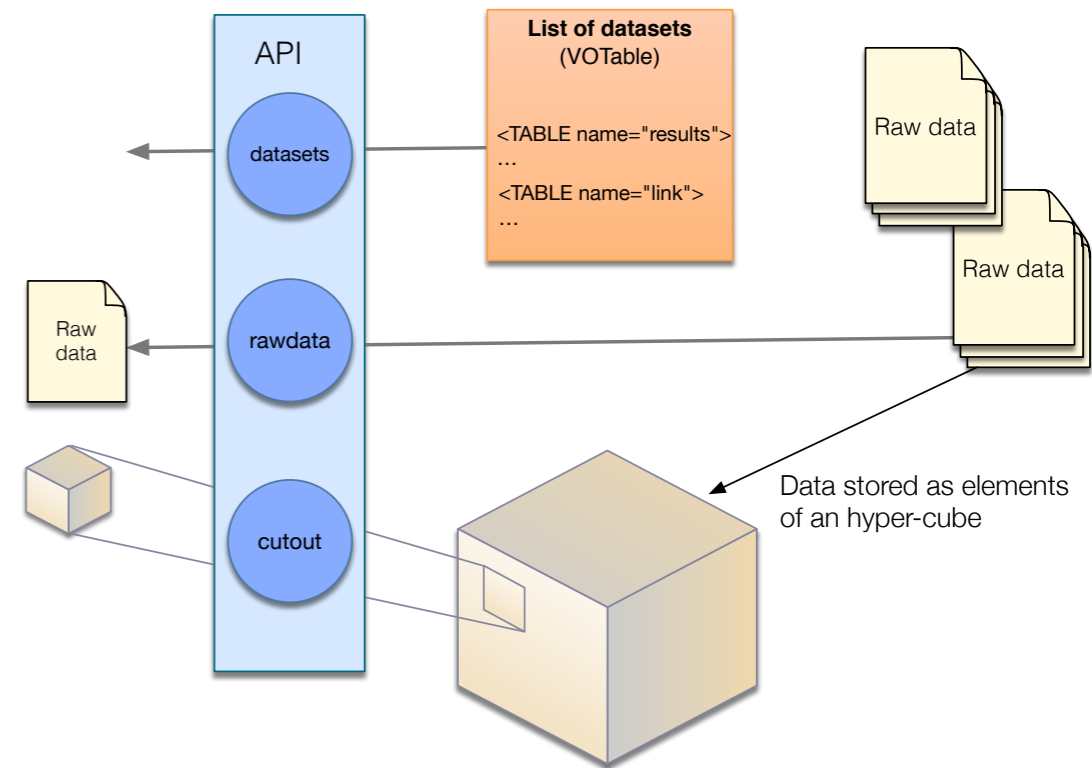
```
curl -H "Content-Type: application/JSON" -d '{
  "where": [
    {":att": "c:effec_temp", ":val": 8E4, ":op": "<="},
    {":att": "c:effec_temp", ":val": 5E4, ":op": ">="}
  ],
  "select": [
    "c:outputdataset_pubdid",
    "c:effect_temp",
    "c:gravity"
  ],
  "orderby": ["c:effect_temp", "asc"]
}'
http://<cutouts_resource>?page_size=5
```

Effec.	Gravi	Mass	Lumino	vturb	Fe/H	...	outputdataset_pubdid
1E+04	1.0	30	4.0	7.0	-2.0	...	MyDataset1
3E+04	1.0	30	4.0	7.0	-2.0	...	MyDataset2
5E+04	1.0	30	4.0	7.0	-2.0	...	MyDataset3
7E+04	1.0	30	4.0	7.0	-2.0	...	MyDataset4
1E+04	2.0	30	4.0	7.0	-2.0	...	MyDataset5
3E+04	2.0	30	4.0	7.0	-2.0	...	MyDataset6
5E+04	2.0	30	4.0	7.0	-2.0	...	MyDataset7
7E+04	2.0	30	4.0	7.0	-2.0	...	MyDataset8
...	

SimDAL Data Access

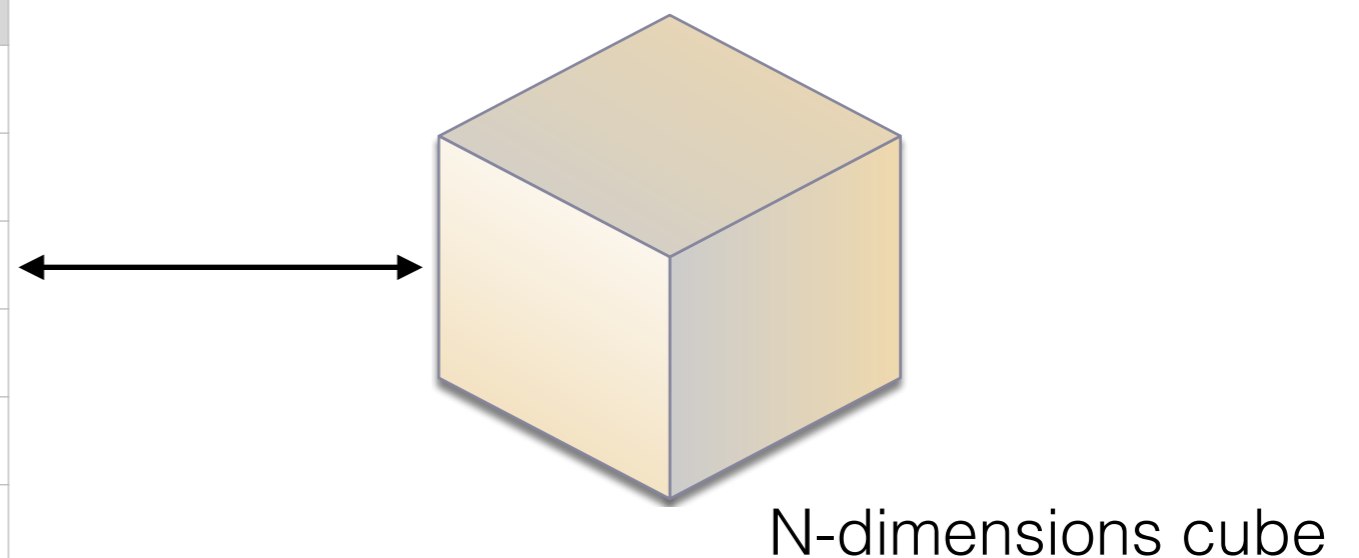
Goal: Retrieve raw data

- {datasets}** • Provide the list of available datasets
- {rawdata}** • Retrieve a full data set / raw data
- {cutouts}** • Extract a sub-set of a dataset / raw data
- {fields}** • Get descriptions of datasets FIELDS



SimDAL Data Access works exactly as the SimDAL Search API
views \leftrightarrow datasets

ID	CO 1-0	CO 2-1	CO 3-2	CO 4-3	...	H ₂ O 111-000	H ₂ O 110-101	H ₂ O 202-111	H ₂ O 212-101	...
1										
2										
3										
4										
5										
...										



- SimDAL Repository
- SimDAL Search
- SimDAL Data Access
- Client

Implementations at Paris Observatory

PDR Code : computation of the atomic and molecular structure of clouds and analysis of physical processes

Computed quantities:

At each position in the cloud:

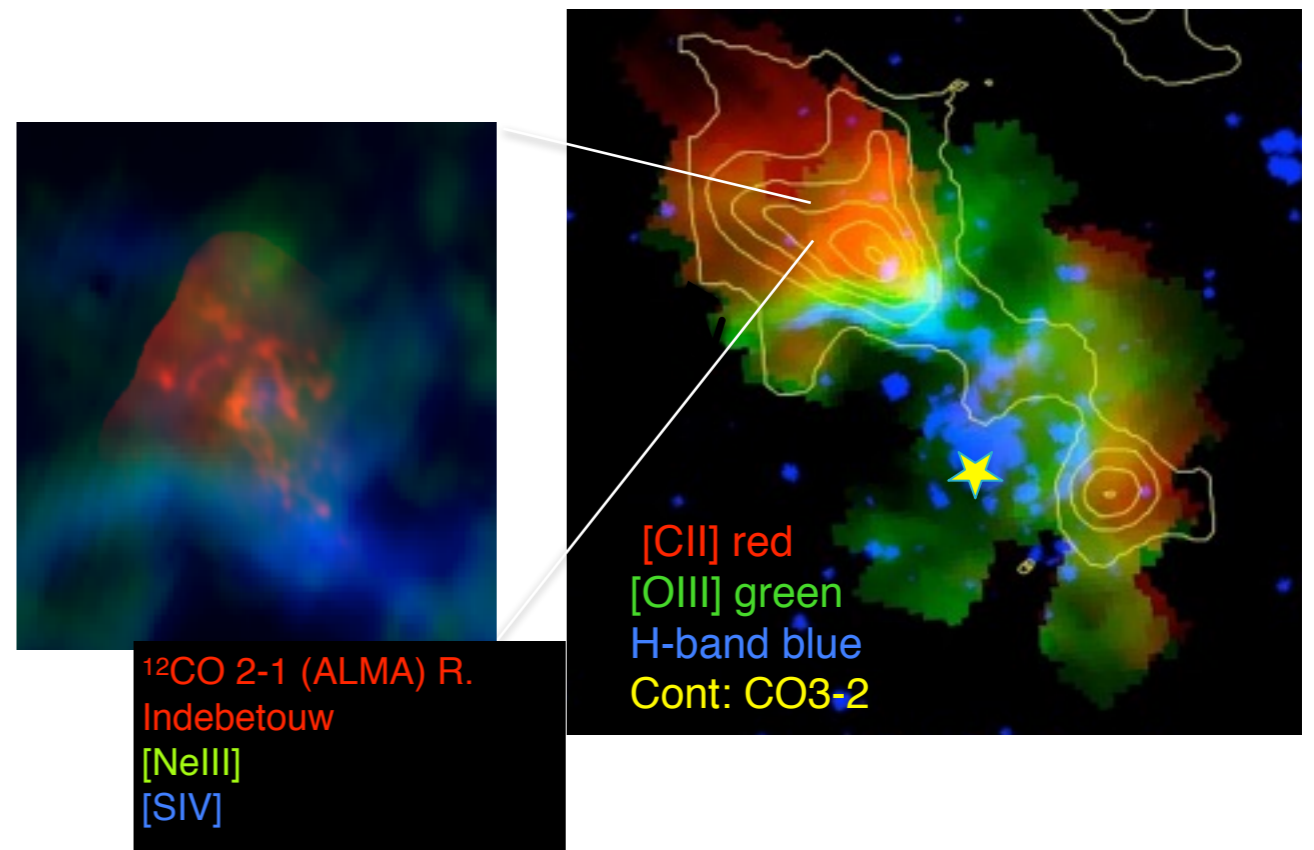
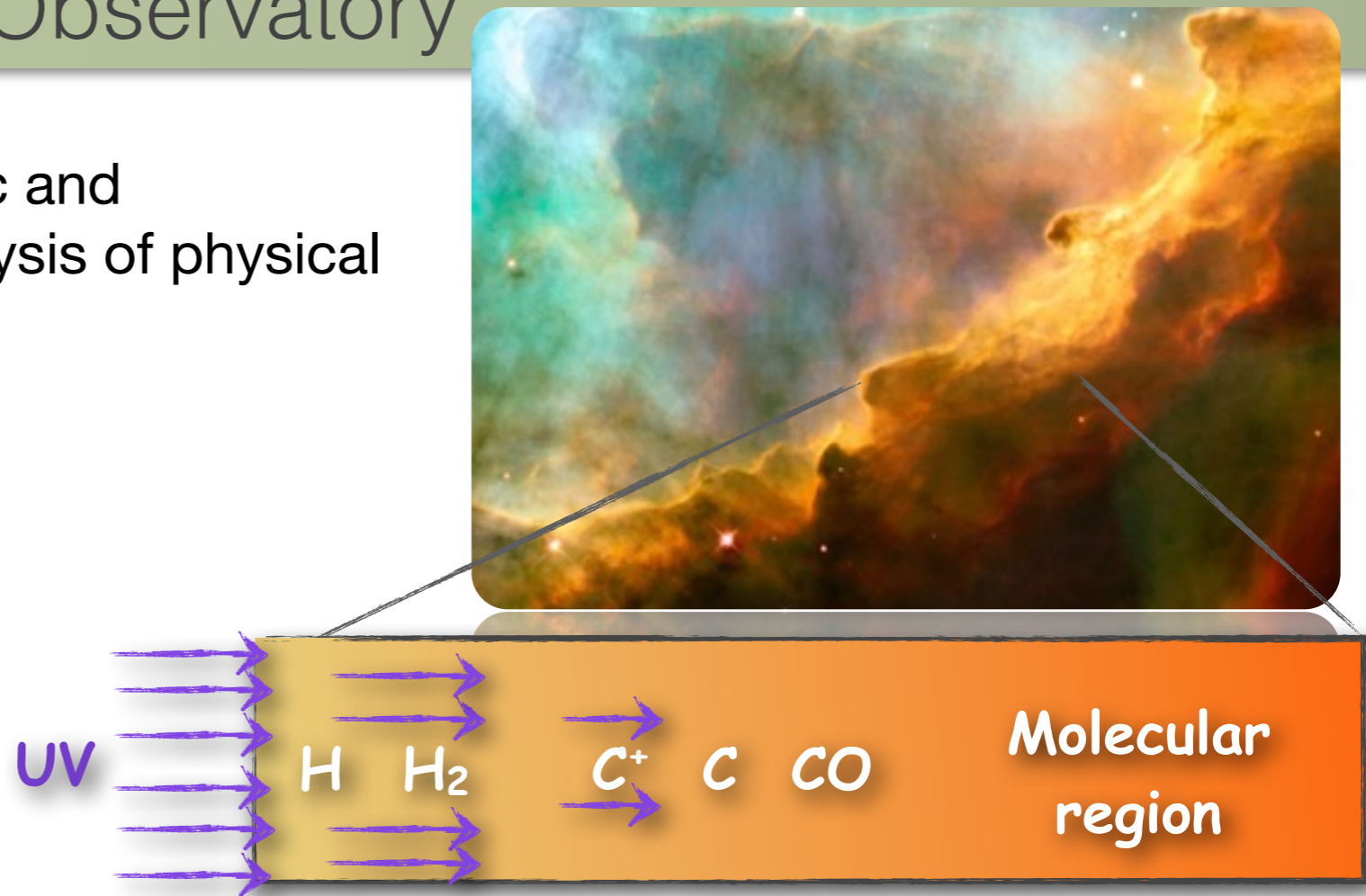
- abundances of chemical species
- excitation in quantum levels
- temperatures (gas & grains)
- ...

On the whole cloud:

- Line intensities (H_2 , CO, H_2O , ...)
- Column densities

Database of PDR models

- thousands models published
- several thousands different physical quantities for each model



Example: Proposal for ALMA

A scientist wants to ask observation time on ALMA

- observation of N159W in the LMC
- wants to observe line intensities of
 - C I at 609 micrometers
 - CO in the transition $J = 2-1$
 - ^{13}CO in the transition $J = 2-1$



To estimate exposure times, he needs theoretical estimations of these line intensities

He wants to find theoretical predictions of these line intensities for interstellar clouds with a pressure 10^7 K cm^{-3} and illuminated by a radiation field ~ 100 times the mean UV radiation field

Implementations at Paris Observatory

Search for theoretical services in the VO - (SimDAL Repository)

`http://<simdal_repos.URI>/api/simdal/search?q=pdr 1.5.2`

This XML file does not appear to have any style information associated with it. The document tree is shown below.

```
<?xml version="1.0" encoding="UTF-8" standalone="no" ?>
<VOTABLE xmlns="http://www.ivoa.net/xml/VOTable/v1.3" xmlns:stc="http://www.ivoa.net/xml/STC/v1.30"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <RESOURCE type="results">
    <INFO name="QUERY_STATUS" value="OK"/>
    <TABLE name="results">
      <FIELD datatype="text" id="document" name="document"/>
      <FIELD datatype="text" id="match" name="match"/>
      <FIELD datatype="text" id="attribute" name="attribute"/>
      <FIELD datatype="text" id="publisher" name="publisher"/>
      <FIELD datatype="text" id="project" name="project"/>
      <FIELD datatype="text" id="rank" name="rank"/>
    </TABLE>
    <DATA>
      <TABLEDATA>
        <TR>
          <TD>PDR_152_1528_ch1509_iso_mathis</TD>
          <TD>PDR 1.5.2 rev 1528</TD>
          <TD>name</TD>
          <TD>ism.obspm/ism</TD>
          <TD>ism.obspm/DIFF51_n_ERLH_isot</TD>
          <TD>0.0247758</TD>
        </TR>
        <TR>
          <TD>PDR_152_1528_ch1509_iso_mathis</TD>
          <TD>
            <TD>The Meudon PDR code is an astrochemical code designed to simulate the interaction between neutral interstellar gas and radiation field under a broad range of conditions (Le Petit et al. 2006). The code considers a stationary 1D slab of dust and gas illuminated by an interstellar radiation field. It computes the chemical and thermal structure of the gas and provides column densities and line intensities of main interstellar species. It is designed to interpret observations from far-UV to mm domain. Version 1.5.2 of the Meudon PDR code introduces many new physical processes compared to previous versions. Absorption in the UV by atomic species as C has been improved. The code considers now a PAH distribution that contributes to heating and surface chemistry. A metallicity parameter has been introduced to model more easily extragalactic media. Atomic and molecular data as well as chemical reaction rates have been updated. The default chemical network takes into account 231 species (including C and O isotopes) linked by 6374 chemical reaction. Surface reactions are not considered by default excepted for H2 and HD. H2 formation model takes into account Eley-Rideal and Langmuir-Hinshelwood mechanisms as described in Le Bourlot et al. (2012).
              <TD>doc</TD>
              <TD>ism.obspm</TD>
              <TD>ism.obspm/DIFF51_n_ERLH_isot</TD>
              <TD>0.000915798</TD>
            </TD>
          </TR>
        </TABLEDATA>
      </DATA>
    </TABLE>
    <TABLE name="documents">
      <FIELD datatype="text" id="document" name="document"/>
      <FIELD datatype="text" id="attribute" name="attribute"/>
      <FIELD datatype="text" id="value" name="value"/>
      <GROUP name="foreign_key" ref="results">
        <PARAM name="local_field" value="document"/>
        <FIELDref ref="document"/>
      </GROUP>
    </TABLE>
  </RESOURCE>
</VOTABLE>
```

localhost:3931/repo/search

Search

PDR 1.5.2 rev 1528
0.0247758, project: ism.obspm/DIFF51_n_ERLH_isot, publisher: ism.obspm

referenceURL	version	doc	publisherid	code	utype	updated	name
	rev 1528	The Meudon PDR code is an astrochemical code designed to simulate the interaction between neutral interstellar gas and radiation field under a broad range of conditions (Le Petit et al. 2006). The code considers a stationary 1D slab of dust and gas illuminated by an interstellar radiation field. It computes the chemical and thermal structure of the gas and provides column densities and line intensities of main interstellar species. It is designed to interpret observations from far-UV to mm domain. Version 1.5.2 of the Meudon PDR code introduces many new physical processes compared to previous versions. Absorption in the UV by atomic species as C has been improved. The code considers now a PAH distribution that contributes to heating and surface chemistry. A metallicity parameter has been introduced to model more easily extragalactic media. Atomic and molecular data as well as chemical reaction rates have been updated. The default chemical network takes into account 231 species (including C and O isotopes) linked by 6374 chemical reaction. Surface reactions are not considered by default excepted for H2 and HD. H2 formation model takes into account Eley-Rideal and Langmuir-Hinshelwood mechanisms as described in Le Bourlot et al. (2012).	PDR_152_1528_ch1509_iso_mathis	PDR 1.5.2	SimDM/resource/protocol/Simulator	2015-12-03T15:09:31.148904	PDR 1.5.2 rev 1528

The Meudon PDR code is an astrochemical code designed to simulate the interaction between neutral interstellar gas and radiation field under a broad range of conditions (Le Petit et al. 2006). The code considers a stationary 1D slab of dust and gas illuminated by an interstellar radiation field. It computes the chemical and thermal structure of the gas and provides column densities and line intensities of main interstellar species. It is designed to interpret observations from far-UV to mm domain. Version 1.5.2 of the Meudon PDR code introduces many new physical processes compared to previous versions. Absorption in the UV by atomic species as C has been improved. The code considers now a PAH distribution that contributes to heating and surface chemistry. A metallicity parameter has been introduced to model more easily extragalactic media. Atomic and molecular data as well as chemical reaction rates have been updated. The default chemical network takes into account 231 species (including C and O isotopes) linked by 6374 chemical reaction. Surface reactions are not considered by default excepted for H2 and HD. H2 formation model takes into account Eley-Rideal and Langmuir-Hinshelwood mechanisms as described in Le Bourlot et al. (2012).

0.000915798, project: ism.obspm/DIFF51_n_ERLH_isot, publisher: ism.obspm

referenceURL: <http://ism.obspm.fr>

Implementations at Paris Observatory

Get the description of the project - (SimDAL Repository)

http://.../api/simdal/projects?project=ism.obspm/DIFF51_n_ERLH_isot

- ➔ description of the projet
- ➔ links towards associated services

This XML file does not appear to have any style information associated with it. The document tree is shown below.

```
<VOTABLE xmlns="http://www.ivoa.net/xml/VOTable/v1.3" xmlns:stc="http://www.ivoa.net/xml/STC/v1.30"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <RESOURCE type="results">
    <INFO name="QUERY_STATUS" value="ok"/>
    <TABLE name="results">
      <FIELD arraysize="*" datatype="char" id="ident" name="ident"/>
      <FIELD arraysize="*" datatype="char" id="created" name="created"/>
      <FIELD arraysize="*" datatype="char" id="publisherid" name="publisherid"/>
      <FIELD arraysize="*" datatype="char" id="publis.../>
      <FIELD arraysize="*" datatype="char" id="name" .../>
      <FIELD arraysize="*" datatype="char" id="doc" s.../>
    </TABLE>
    <DATA>
      <TABLEDATA>
        <TR>
          <TD>ism.obspm/DIFF51_n_ERLH_isot</TD>
          <TD>2016-04-21 12:29:28.821136</TD>
          <TD>DIFF51_n_ERLH_isot</TD>
          <TD>ism.obspm</TD>
          <TD>Grid of diffuse clouds at constant den...</TD>
        </TR>
        <TR>
          <TD>
            This grid of isochoric PDR 1.5.2 models
            are proton density, UV field intensity a
            models. Parameteres range are: n from 10
            the ISRF, and size (AV) from 0.2 to 3 ma
            radiation field. In this grid of PDR mod
            following the prescription by Bakes and
            3E-7 cm to 3E-5 cm. The chemistry takes
            linked by 6243 chemical reaction. No sur
            formation model takes into account Eley-
            in Le Boulrot et al. (2012). These publi
            PDR 1.5.2 (line intensities, column dens
            </TD>
          </TR>
        </TABLEDATA>
      </DATA>
    </TABLE>
    <TABLE name="links">
      <FIELD arraysize="*" datatype="char" id="projec...>
      <FIELD arraysize="*" datatype="char" id="link-r...>
      <FIELD arraysize="*" datatype="char" id="link-c...>
    </TABLE>
    <GROUP name="foreign_key" ref="results">
      <GROUP>
        <PARAM name="local_field" value="project"/>
        <FIELDRef ref="ident"/>
      </GROUP>
    </GROUP>
  </DATA>
  <TABLEDATA>
    <TR>
      <TD>ism.obspm/DIFF51_n_ERLH_isot</TD>
      <TD>simdal/search</TD>
    </TR>
    <TR>
      <TD>
        http://localhost:3132/api/simdal/440d0ed
      </TD>
    </TR>
  </TABLEDATA>
</VOTABLE>
```

localhost:3931/repo/projects?project=ism.obspm/DIFF51_n_ERLH_isot

DIFF51_n_ERLH_isot ism.obspm

Grid of diffuse clouds at constant density

This grid of isochoric PDR 1.5.2 models covers diffuse clouds conditions. Explored parameters are proton density, UV field intensity and size of the clouds. The full grid contains 924 models. Parameteres range are: n from 10 to 1000 cm⁻³, radiation field from 0.5 and 10 times the ISRF, and size (AV) from 0.2 to 3 mag. Both sides of the clouds are illuminated by the same radiation field.

In this grid of PDR models, heating by photo-electric effect on grains is done following the prescription by Bakes and Tielens (2009) with a grain size distribution between 3E-7 cm to 3E-5 cm.

The chemistry takes into account 222 species, including C and O isotopes, linked by 6243 chemical reaction. No surface reactions are considered excepted for H₂. H₂ formation model takes into account Eley-Rideal and Langmuir-Hinshelwood mechanisms as described in Le Boulrot et al. (2012).

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

publisherid	DIFF51_n_ERLH_isot
created	2016-04-21 12:29:28.821136

Links

simdal/search	http://localhost:3132/api/simdal/440d0ed4-b034-506a-90e1-cce40a5e6200
simdal/data_access	http://127.0.0.1:3435/api/simdal/DIFF51_n_ERLH_isot

Implementations at Paris Observatory

Search for specific numerical models - (SimDAL Search)

VOSI - capabilities

<http://localhost:3132/api/simdal/440d0ed4-b034-506a-90e1-cce40a5e6200/capabilities>

```
<vos:capabilities xmlns:vosi="http://www.ivoa.net/xml/VOSICapabilities/v1.0"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:vod="http://www.ivoa.net/xml/VODDataService/v1.1">
  <capability standardID="ivo://ivoa.net/std/VOSI#capabilities">
    <interface xsi:type="vod:ParamHTTP" version="1.0">
      <accessURL use="full">
http://localhost:3132/api/simdal/440d0ed4-b034-506a-90e1-cce40a5e6200/capabilities
      </accessURL>
    </interface>
  </capability>
  <capability standardID="ivo://ivoa.net/std/VOSI#availability">
    <interface xsi:type="vod:ParamHTTP" version="1.0">
      <accessURL use="full">
http://localhost:3132/api/simdal/440d0ed4-b034-506a-90e1-cce40a5e6200/availability
      </accessURL>
    </interface>
  </capability>
  <capability standardID="ivo://ivoa.net/std/SimDALSearch#{views}-1.0">
    <interface xsi:type="vod:ParamHTTP" role="std" version="1.0">
      <accessURL use="base">
http://localhost:3132/api/simdal/440d0ed4-b034-506a-90e1-cce40a5e6200/views
      </accessURL>
      <queryType>GET</queryType>
      <resultType>application/x-votable+xml</resultType>
    </interface>
  </capability>
</vos:capabilities>
```

Get

- resources list
- URLs

Implementations at Paris Observatory

Search for specific numerical models - (SimDAL Search)

<http://localhost:3132/api/simdal/440d0ed4-b034-506a-90e1-cce40a5e6200>

This XML file does not appear to have any style information

```
<?xml version="1.0" encoding="UTF-8" ?>
<VOTABLE xmlns="http://www.ivoa.net/xml/VOTable" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:schemaLocation="http://www.ivoa.net/xml/VOTable http://www.ivoa.net/xml/VOTable.xsd">
  <RESOURCE type="results">
    <INFO name="QUERY_STATUS" value="ok"/>
    <TABLE name="results">
      <FIELD arraysize="*" datatype="char" name="ident"/>
      <FIELD arraysize="*" datatype="char" name="created"/>
      <FIELD arraysize="*" datatype="char" name="objecttype"/>
      <FIELD arraysize="*" datatype="char" name="protocol"/>
      <DATA>
        <TABLEDATA>
          <TR>
            <TD>v2</TD>
            <TD>2016-03-21 12:30:39.324347</TD>
            <TD>cloud</TD>
            <TD>PDR_152_1598_ch1512_iso_mathis</TD>
          </TR>
        </TABLEDATA>
      </DATA>
    </TABLE>
    <TABLE name="links">
      <FIELD arraysize="*" datatype="char" name="view"/>
      <FIELD arraysize="*" datatype="char" name="link-rel"/>
      <FIELD arraysize="*" datatype="char" name="link-uri"/>
      <GROUP name="foreign_key" ref="results">
        <GROUP>
          <PARAM name="local_field" value="view">
            <FIELDRef ref="ident"/>
          </GROUP>
        </GROUP>
      <DATA>
        <TABLEDATA>
          <TR>
            <TD>v2</TD>
            <TD>view/schema</TD>
            <TD>http://localhost:3132/api/simdal/440d0ed4-b034-506a-90e1-cce40a5e6200/views/v2/schema</TD>
          </TR>
          <TR>
            <TD>v2</TD>
            <TD>view/cutouts</TD>
            <TD>http://localhost:3132/api/simdal/440d0ed4-b034-506a-90e1-cce40a5e6200/views/v2/cutouts</TD>
          </TR>
          <TR>
            <TD>v2</TD>
            <TD>view/data_access</TD>
            <TD>http://localhost:3435/api/simdal/DIFF51_n_ERLH_isot</TD>
          </TR>
        </TABLEDATA>
      </DATA>
    </TABLE>
  </RESOURCE>
</VOTABLE>
```

localhost:3931/search/views

{views}

results

ident	created	objecttype	protocol
v2	2016-03-21 12:30:39.324347	cloud	PDR_152_1598_ch1512_iso_mathis

links

view	link-rel	link-uri
v2	view/schema	http://localhost:3132/api/simdal/440d0ed4-b034-506a-90e1-cce40a5e6200/views/v2/schema
v2	view/cutouts	http://localhost:3132/api/simdal/440d0ed4-b034-506a-90e1-cce40a5e6200/views/v2/cutouts
v2	view/data_access	http://localhost:3435/api/simdal/DIFF51_n_ERLH_isot

Implementations at Paris Observatory

Search for specific numerical models - (SimDAL Search)

views schema

```
<?xml version="1.0" ?>
<VOTABLE xmlns="http://www.ivoa.net/xml/VOTable/v1.3"
  xmlns:stc="http://www.ivoa.net/xml/STC/v1.30"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <RESOURCE name="" type="view_schema">
    <TABLE name="">
      <FIELD arraysizes="*" datatype="char" id="c/radm"
        name="Radiation field intensity"
        publisherid="radm"
        utype="simdm:/resource/experiment/parameter_setting.numeric_value.value">
        <LINK content-role="skos" href="TODO"/>
        <VALUES><OPTION value="100.0"/></VALUES>
        <DESCRIPTION>External source name (Spectracl type or data file)</DESCRIPTION>
      </FIELD>
      <FIELD datatype="double" id="c/pressure"
        name="Pressure"
        publisherid="pressure"
        unit="mag"
        utype="simdm:/resource/experiment/parameter_setting.numeric_value.value">
        <LINK href="http://www.ivoa.net/xml/Vocab/PhysicalQuantities/ThermalPressure"/>
        <VALUES>
        <DESCRIPTION>
```

view

pressure	radm	Avmax	fmrc	vturb	Z	...	outputdataset_pubdid
1E+05	1E+03	1E+01	3E-16	2E+00	1E+00	...	MyCloud_1
3E+05	1E+03	1E+01	3E-16	2E+00	1E+00	...	MyCloud_2
1E+06	1E+03	1E+01	3E-16	2E+00	1E+00	...	MyCloud_3
3E+06	1E+03	1E+01	3E-16	2E+00	1E+00	...	MyCloud_4
1E+07	1E+03	1E+01	3E-16	2E+00	1E+00	...	MyCloud_5
3E+07	1E+03	1E+01	3E-16	2E+00	1E+00	...	MyCloud_6
1E+05	5E+03	1E+01	3E-16	2E+00	1E+00	...	MyCloud_7
3E+05	5E+03	1E+01	3E-16	2E+00	1E+00	...	MyCloud_8
1E+06	5E+03	1E+01	3E-16	2E+00	1E+00	...	MyCloud_9
...

schema

Implementations at Paris Observatory

Search for specific numerical models - (SimDAL Search)

<http://localhost:3132/api/simdal/440d0ed4-b034-506a-90e1-cce40a5e6200/views/v2/schema>

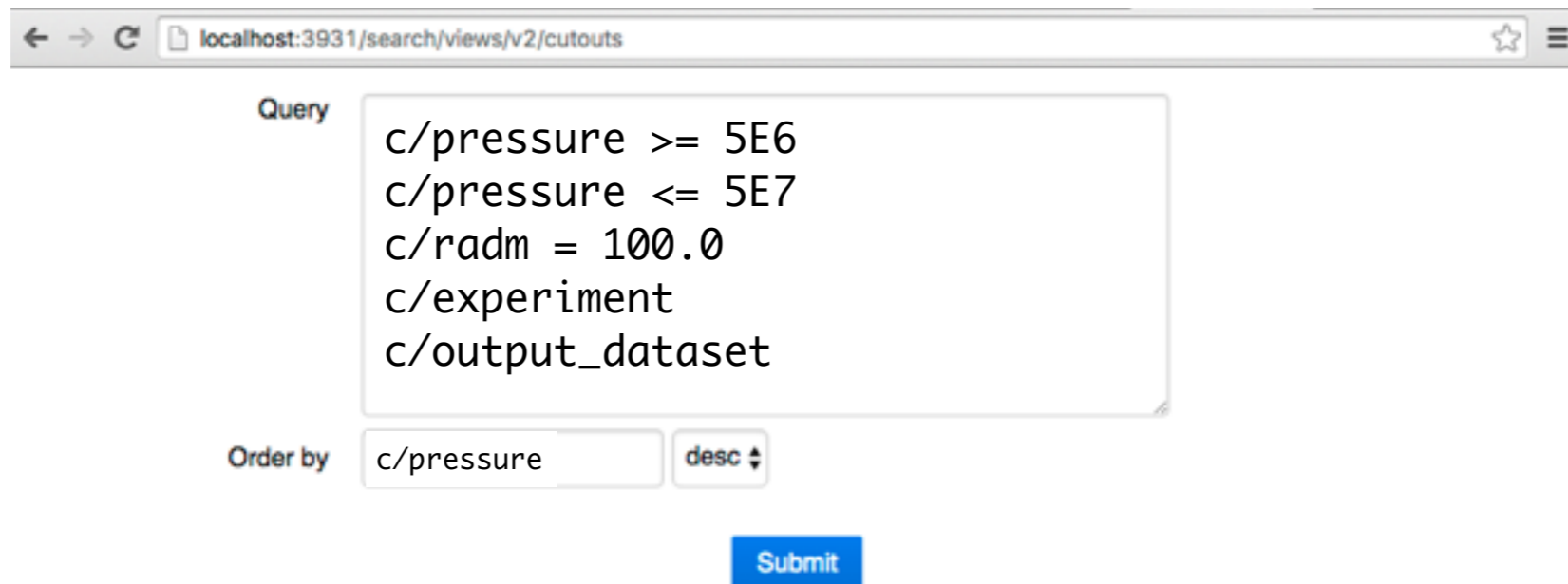
```
<?xml version="1.0" ?>
<VOTABLE xmlns="http://www.ivoa.net/xml/VOTable/v1.3"
  xmlns:stc="http://www.ivoa.net/xml/STC/v1.30"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <RESOURCE name="" type="view_schema">
    <TABLE name="">
      <FIELD arraysize="*" datatype="char" id="c/radfield"
        name="Radiation field intensity"
        publisherid="radm"
        utype="simdm:/resource/experiment/parameter_setting.numeric_value.value"
        <LINK content-role="skos" href="TODO"/>
        <VALUES><OPTION value="100.0"/></VALUES>
        <DESCRIPTION>External source name (Spectral
      </FIELD>
      <FIELD datatype="double" id="c/pressure"
        name="Pressure"
        publisherid="pressure"
        unit="mag"
        utype="simdm:/resource/experiment/parameter_setting.numeric_value.value"
        <LINK content-role="skos"
          href="http://purl.org/astronomy/vocab/PhysicalQuantity/pressure"
        <VALUES><OPTION value="1.0E5"/></VALUES>
        <DESCRIPTION>Thermal pressure</DESCRIPTION>
      </FIELD>
    </TABLE>
  </RESOURCE>
</VOTABLE>
```

Field Name	Documentation	Unit	Datatype
Star c/additional_radfield	no documentation simdm:/resource/experiment/parameter_setting.numeric_value.value	unit	n/a char
AVmax c/avmax	no documentation simdm:/resource/experiment/parameter_setting.numeric_value.value	unit	mag double
NH/E(B-V) (Z=1) c/cdunit_0	no documentation simdm:/resource/experiment/parameter_setting.numeric_value.value	unit	cm-2_mag-1 double
Chemistry file name c/chemistry_file	no documentation simdm:/resource/experiment/parameter_setting.numeric_value.value	unit	n/a char
Star distance c/d_sour	no documentation simdm:/resource/experiment/parameter_setting.numeric_value.value	unit	pc double
State equation c/equation_of_state	no documentation simdm:/resource/experiment/parameter_setting.numeric_value.value	unit	n/a char
experiment c/experiment	no documentation simdm:/resource/experiment.publisherid	unit	no_unit char
ISRF c/f_isrf	no documentation simdm:/resource/experiment/parameter_setting.numeric_value.value	unit	n/a char
m(dust)/m(gas) (Z=1) c/g_ratio_0	no documentation simdm:/resource/experiment/parameter_setting.numeric_value.value	unit	no_unit double

Implementations at Paris Observatory

Search for specific numerical models - (SimDAL Search)

<http://localhost:3132/api/simdal/440d0ed4-b034-506a-90e1-cce40a5e6200/views/v2/cutouts>



localhost:3931/search/views/v2/cutouts

Query

```
c/pressure >= 5E6
c/pressure <= 5E7
c/radm = 100.0
c/experiment
c/output_dataset
```

Order by c/pressure desc

Submit

c/pressure	c/radm	c/experiment	c/output_dataset
5E+06	100	DIFF51_r1e2A1e1P5e6_s20	DIFF51_r1e2A1e1P5e6_s20_cloud
7E+06	100	DIFF51_r1e2A1e1P7e6_s20	DIFF51_r1e2A1e1P7e6_s20_cloud
1E+07	100	DIFF51_r1e2A1e1P1e7_s20	DIFF51_r1e2A1e1P1e7_s20_cloud
3E+07	100	DIFF51_r1e2A1e1P3e7_s20	DIFF51_r1e2A1e1P3e7_s20_cloud
5E+07	100	DIFF51_r1e2A1e1P5e7_s20	DIFF51_r1e2A1e1P5e7_s20_cloud

Implementations at Paris Observatory

Get data - (SimDAL Data Access)

dataset ID is known from the previous step

http://localhost:3435/api/simdal/DIFF51_n_ERLH_isot

SimDAL Data Access works as SimDAL Search

localhost:3931/data_access/datasets?dataset=DM51NoPAH_A2e0p3p5e5r1e2_20_

{datasets}

results

ident	created
DIFF51_r1e2A1e1P5e6_s20	2016-03-29 15:03:03

links

ident	link-rel	link-uri
DIFF51_r1e2A1e1P5e6_s20_cloud	dataset/schema	http://localhost:3435/api/simdal/DIFF51_n_ERLH_isot/datasets/DIFF51_r1e2A1e1P5e6_s20_cloud/schema
DIFF51_r1e2A1e1P5e6_s20_cloud	dataset/cutouts	http://localhost:3435/api/simdal/DIFF51_n_ERLH_isot/datasets/DIFF51_r1e2A1e1P5e6_s20_cloud/cutouts
DIFF51_r1e2A1e1P5e6_s20_cloud	dataset/async/cutouts	http://localhost:3435/api/simdal/DIFF51_n_ERLH_isot/datasets/DIFF51_r1e2A1e1P5e6_s20_cloud/async/cutouts
DIFF51_r1e2A1e1P5e6_s20_cloud	dataset/rawdata	http://localhost:3435/api/simdal/DIFF51_n_ERLH_isot/datasets/DIFF51_r1e2A1e1P5e6_s20_cloud/rawdata

This XML file does not appear to have any style information associated with it. The document tree is shown below.

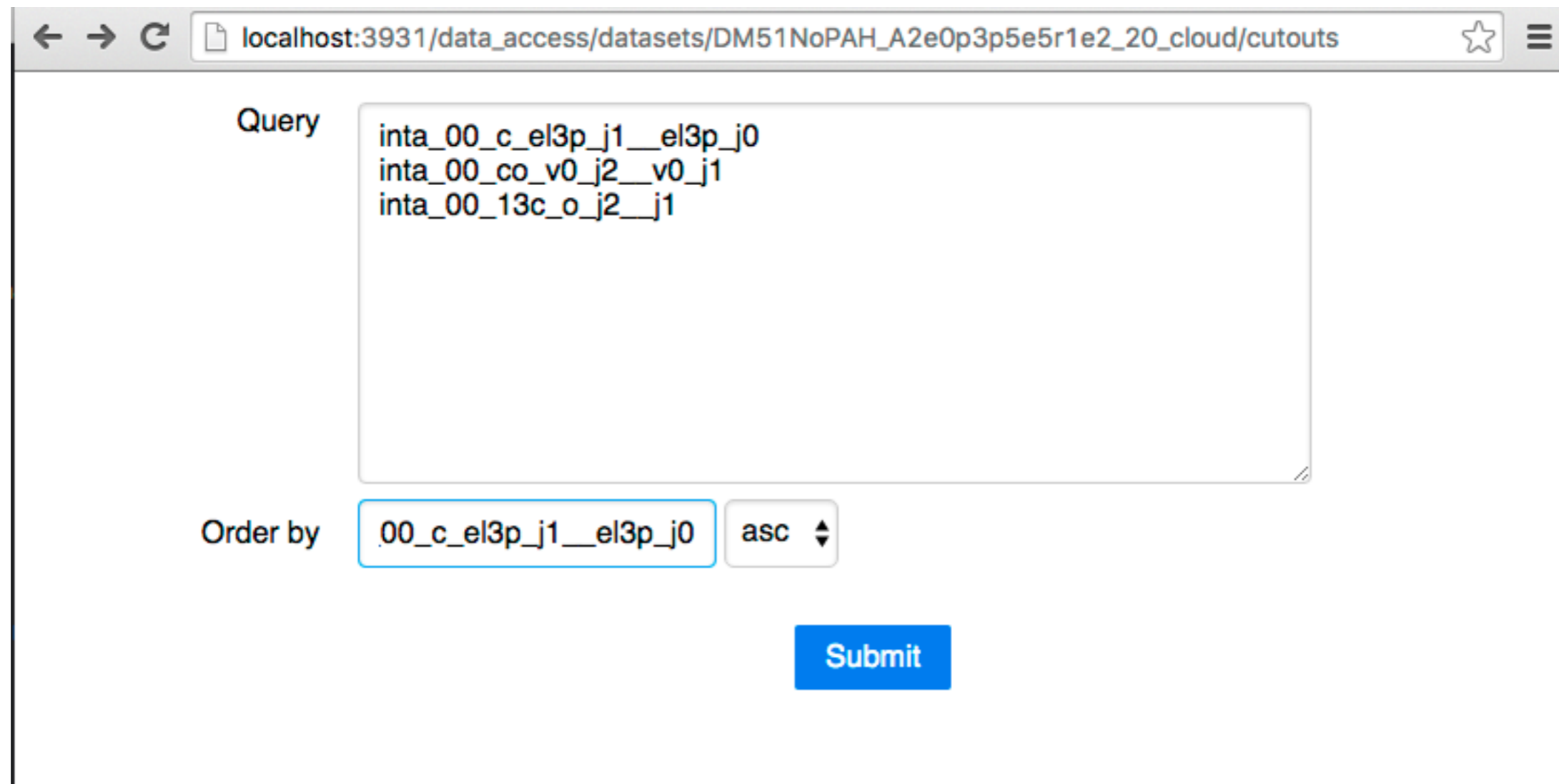
```
<?xml version="1.0" encoding="UTF-8" standalone="no" ?>
<VOTABLE xmlns="http://www.ivoa.net/xml/VOTable/v1.3" xmlns:stc="http://www.ivoa.net/xml/STC/v1.30"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <RESOURCE type="results">
    <INFO name="QUERY_STATUS" value="ok"/>
    <PARAM name="dataset" value="DM51NoPAH_A2e0p3p5e5r1e2_20_cloud"/>
    <TABLE name="results">
      <FIELD arraysize="*" datatype="char" name="ident"/>
      <FIELD arraysize="*" datatype="char" name="created"/>
      <DATA>
        <TABLEDATA>
          <TR>
            <TD>DM51NoPAH_A2e0p3p5e5r1e2_20_cloud</TD>
            <TD>2016-03-29 15:03:03</TD>
          </TR>
        </TABLEDATA>
      </DATA>
    </TABLE>
    <TABLE name="links">
      <FIELD arraysize="*" datatype="char" name="dataset"/>
      <FIELD arraysize="*" datatype="char" name="link-rel"/>
      <FIELD arraysize="*" datatype="char" name="link-uri"/>
      <GROUP name="foreign_key" ref="datasets">
        <GROUP>
          <PARAM name="local_field" value="dataset"/>
          <FIELDRef ref="ident"/>
        </GROUP>
      </GROUP>
      <DATA>
        <TABLEDATA>
          <TR>
            <TD>DM51NoPAH_A2e0p3p5e5r1e2_20_cloud</TD>
            <TD>dataset/schema</TD>
            <TD>http://localhost:3435/api/simdal/DIFF51_n_ERLH_isot/datasets/DIFF51_r1e2A1e1P5e6_s20_cloud/schema</TD>
          </TR>
          <TR>
            <TD>DM51NoPAH_A2e0p3p5e5r1e2_20_cloud</TD>
            <TD>dataset/cutouts</TD>
            <TD>http://localhost:3435/api/simdal/DIFF51_n_ERLH_isot/datasets/DIFF51_r1e2A1e1P5e6_s20_cloud/cutouts</TD>
          </TR>
          <TR>
            <TD>DM51NoPAH_A2e0p3p5e5r1e2_20_cloud</TD>
            <TD>dataset/async/cutouts</TD>
            <TD>http://localhost:3435/api/simdal/DIFF51_n_ERLH_isot/datasets/DIFF51_r1e2A1e1P5e6_s20_cloud/async/cutouts</TD>
          </TR>
          <TR>
            <TD>DM51NoPAH_A2e0p3p5e5r1e2_20_cloud</TD>
            <TD>dataset/rawdata</TD>
            <TD>http://localhost:3435/api/simdal/DIFF51_n_ERLH_isot/datasets/DIFF51_r1e2A1e1P5e6_s20_cloud/rawdata</TD>
          </TR>
        </TABLEDATA>
      </DATA>
    </TABLE>
  </RESOURCE>
</VOTABLE>
```

Implementations at Paris Observatory

Cutout in raw data - (SimDAL Data Access)

dataset ID is known from the previous step

http://localhost:3435/api/simdal/DIFF51_n_ERLH_isot/datasets/DM51NoPAH_A2e0p3p5e5r1e2_20_cloud/async/cutouts



The screenshot shows a web browser window with the address bar containing the URL: localhost:3931/data_access/datasets/DM51NoPAH_A2e0p3p5e5r1e2_20_cloud/cutouts. The main content area features a 'Query' section with a text input field containing the following text:

```
inta_00_c_el3p_j1__el3p_j0  
inta_00_co_v0_j2__v0_j1  
inta_00_13c_o_j2__j1
```

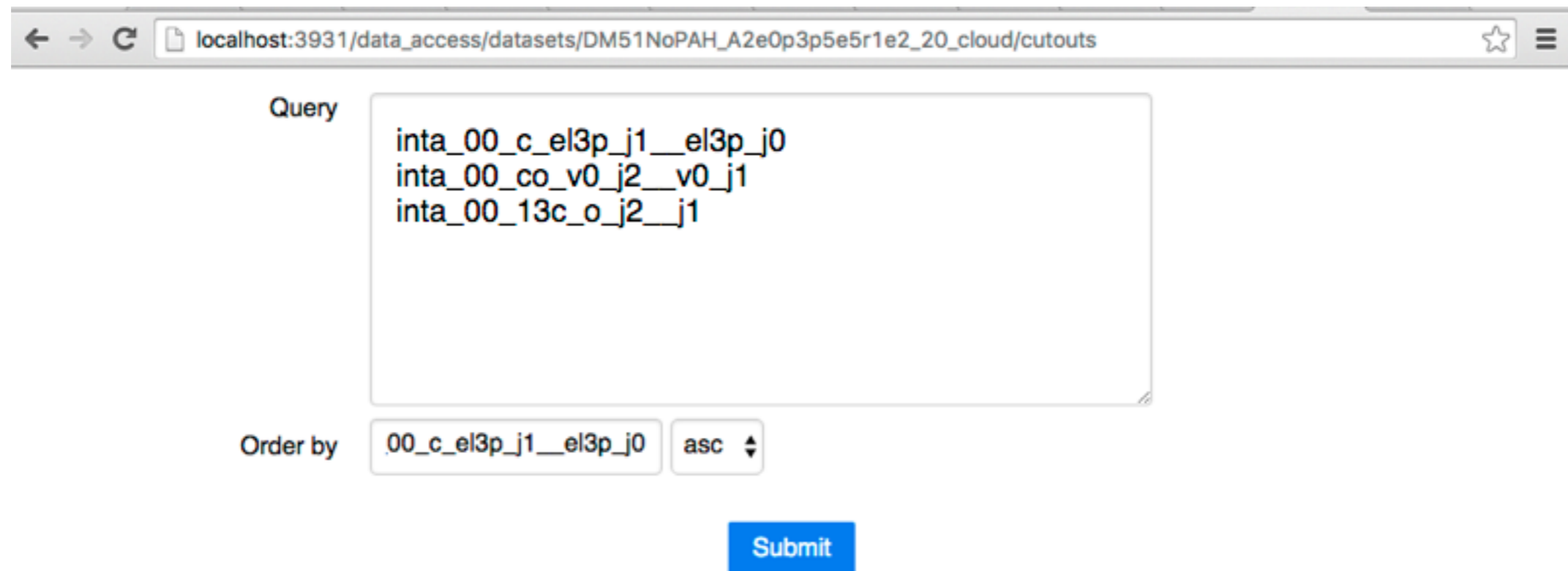
Below the query field is an 'Order by' section with a dropdown menu showing '.00_c_el3p_j1__el3p_j0' and a direction selector set to 'asc'. A blue 'Submit' button is located at the bottom center of the form.

Implementations at Paris Observatory

Cutout in raw data - (SimDAL Data Access)

dataset ID is known from the previous step

http://localhost:3435/api/simdal/DIFF51_n_ERLH_isot/datasets/DM51NoPAH_A2e0p3p5e5r1e2_20_cloud/async/cutouts



localhost:3931/data_access/datasets/DM51NoPAH_A2e0p3p5e5r1e2_20_cloud/cutouts

Query

```
inta_00_c_el3p_j1__el3p_j0
inta_00_co_v0_j2__v0_j1
inta_00_13c_o_j2__j1
```

Order by .00_c_el3p_j1__el3p_j0 asc

Submit

Your job have been submitted successfully.

You can **access** it through the UWS protocol at:

<http://localhost:3435/api/uws/jobs/19ee35e1-b693-4529-8091-283b71a9cd08>

Implementations at Paris Observatory

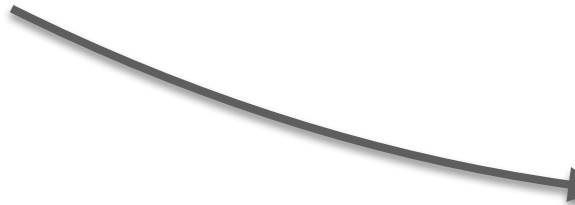
Cutout in raw data- (SimDAL Data Access)

dataset ID is known from the previous step

UWS answers:

This XML file does not appear to have any style information associated with it. The document tree is shown below.

```
▼<uws:job xmlns:uws="http://www.ivoa.net/xml/UWS/v1.0" xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:uwsc="urn:uwscustom" version="1.1"
xsi:schemaLocation="http://www.ivoa.net/xml/UWS/v1.0 UWS.xsd">
  <uws:jobId>19ee35e1-b693-4529-8091-283b71a9cd08</uws:jobId>
  <uws:ownerId xsi:nil="true"/>
  <uws:runId>test2</uws:runId>
  <uws:phase>COMPLETED</uws:phase>
  <uws:startTime>2016-05-02 16:57:16.186864</uws:startTime>
  <uws:endTime>2016-05-02 16:57:16.333936</uws:endTime>
  <uws:executionDuration>n/a</uws:executionDuration>
  <uws:destruction/>
  ▼<uws:parameters>
    <uws:parameter id="dataset">"DM51NoPAH_A2e0p3p5e5r1e2_20_cloud"</uws:parameter>
    ▼<uws:parameter id="select">
      ["inta_00_c_el3p_j1_el3p_j0", "inta_00_co_v0_j2_v0_j1", "inta_00_13c_o_j2_j1"]
    </uws:parameter>
    <uws:parameter id="project">"DIFF51_n_ERLH_isot"</uws:parameter>
    <uws:parameter id="where">[]</uws:parameter>
  </uws:parameters>
  ▼<uws:results>
    <uws:result id="19ee35e1-b693-4529-8091-283b71a9cd08_1" name="cutout"
      xlink:href="http://localhost:3435/api/simdal/results/19ee35e1-b693-4529-8091-283b71a9cd08_1" size="0.4" mime-
      type="application/xml">null</uws:result>
  </uws:results>
</uws:job>
```



I(CO, 2-1)	=	1.9E-6	erg	cm-2	s-1	sr-1
I(C, 609 microns)	=	3.7E-7	erg	cm-2	s-1	sr-1
I(13CO, 2-1)	=	2.0E-6	erg	cm-2	s-1	sr-1

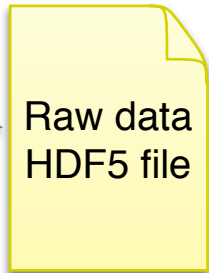
Implementations at Paris Observatory

Access the raw data - (SimDAL Data Access)

http://localhost:3435/api/simdal/DIFF51_n_ERLH_isot/datasets/DM51NoPAH_A2e0p3p5e5r1e2_20_cloud/rawdata

This XML file does not appear to have any style information associated with it. The document tree is shown below.

```
<VOTABLE xmlns="http://www.ivoa.net/xml/VOTable/v1.3" xmlns:stc="http://www.ivoa.net/xml/STC/v1.30"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <RESOURCE type="results">
    <INFO name="QUERY_STATUS" value="OK"/>
    <FIELD arraysize="*" datatype="char" name="link-uri"/>
    <FIELD arraysize="*" datatype="char" name="link-mimetype"/>
    <TABLE>
      <DATA>
        <TABLEDATA>
          <TR>
            <TD>
              http://localhost:3435/DIFF51_n_ERLH_isot/rawdata/DIFF51_n_ERLH_isot/data/cloud/DM51NoPAH_A2e0p3p5e5r1e2_20.hdf5
            </TD>
            <TD>application/x-hdf</TD>
          </TR>
        </TABLEDATA>
      </DATA>
    </TABLE>
  </RESOURCE>
</VOTABLE>
```



Raw data
HDF5 file

Download raw data

Implementations - dedicated client

- SimDAL Design
- Most of complexity is on server side
 - Simple to develop dedicated clients

- Simulations are heterogenous
- dedicated clients will be required

Implementations - dedicated client

SimDAL Design

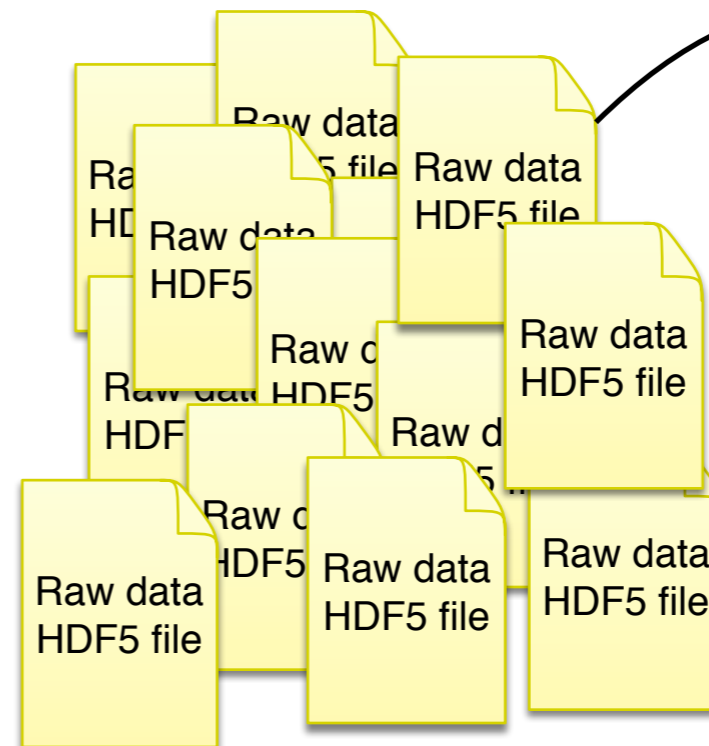
- Most of complexity is on server side
- Simple to develop dedicated clients

Dedicated client:

Line intensities interpretation in the interstellar medium and the intergalactic medium

Thousands line intensities in each model

- H₂, C⁺, C, CO
- H₂O, HCO⁺
- HCN, HNC,
- ...



Several thousands interstellar clouds models

- various pressures
- various UV illuminating conditions
- ➔ several weeks of computation
- ➔ cover many galactic & extragalactic conditions

ISM Services CODES & DATABASES TECHNOLOGIES PARTNERS LOGIN

PDR DataBase - Inverse Search service Beta

Grid of isobaric PDR 1.5.2 models
2016.02.29

1 - search among two parameters

x Pgas_0 (cm-3_X) log scale

y chi front (Mathis_unit) log scale

2 - fix all the other parameters

AVmax (mag) 1

3 - observational constraints

search for available quantities here. Ex: N(H)

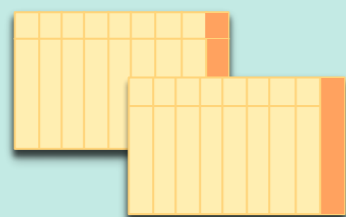
Type quantities to plot here, with optional constraint.
(click Search to view the example result)

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
N(H2)

I(CO v=0,j=1->v=0,j=0 angle 00 deg)
name: I(CO v=0,j=1->v=0,j=0 angle 00 deg)
range: [1.71e-26, 5.67e-7]
unit: erg cm-2 s-1 sr-1

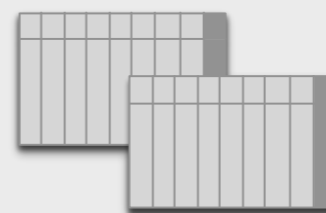
Implementations - dedicated client

Meudon PDR code database



SimDAL Search API

SimDAL Data Access API



SimDAL Search API

SimDAL Data Access API

ISMServices CODES & DATABASES TECHNOLOGIES PARTNERS LOGIN

PDR DataBase – Inverse Search service beta Help Contact

Grid of isobaric PDR 1.5.2 models
2016.02.29

1 – search among two parameters

x Pgas_0 (cm-3_K) log scale
y chi front (Mathis_unit) log scale

2 – fix all the other parameters

AVmax (mag) 1

3 – observational constraints

search for available quantities here. Ex: N(H)

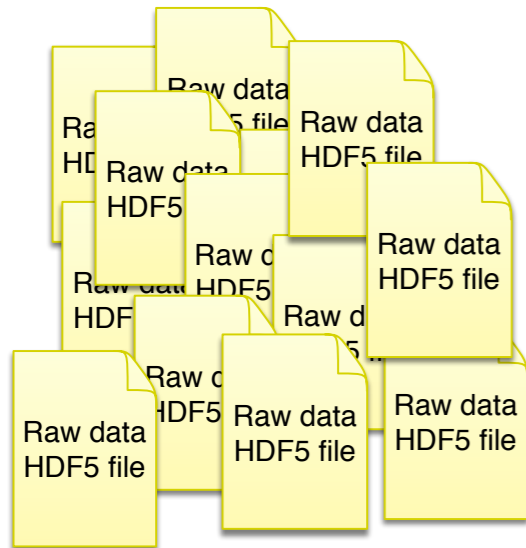
Type quantities to plot here, with optional constraint.
(click Search to view the example result)

$I(CO\ v=0, J=1 \rightarrow v=0, J=0\ \text{angle}\ 00\ \text{deg}) > 2.4e-9$
 $I(CO\ v=0, J=1 \rightarrow v=0, J=0\ \text{angle}\ 00\ \text{deg}) < 7.2e-8$
N(H2)

$I(CO\ v=0, J=1 \rightarrow v=0, J=0\ \text{angle}\ 00\ \text{deg})$
name: $I(CO\ v=0, J=1 \rightarrow v=0, J=0\ \text{angle}\ 00\ \text{deg})$
range: [1.71e-26, 5.67e-7]
unit: erg cm-2 s-1 sr-1

Implementations - dedicated client

The mass of data is characterized by a large view in the SimDAL Search



~ 200 000 columns

ParameterSetting StatisticalSummary / PropertyValue

pressure	radm	...	I(CO, 1-0)	I(CO, 2-1)	I(CO, 3-2)	...	outputdataset_pubdid
1E+05	1E+03	...	...	...	...	...	MyCloud_1
3E+05	1E+03	...	...	...	...	...	MyCloud_2
1E+06	1E+03	...	...	...	...	...	MyCloud_3
3E+06	1E+03	...	...	...	...	...	MyCloud_4
1E+07	1E+03	...	...	...	...	...	MyCloud_5
3E+07	1E+03	...	...	...	...	...	MyCloud_6
1E+05	5E+03	...	...	...	...	...	MyCloud_7
3E+05	5E+03	...	...	...	...	...	MyCloud_8
1E+06	5E+03	...	...	...	...	...	MyCloud_9
...

several thousands lines

Implementations - dedicated client

ISMServices CODES & DATABASES TECHNOLOGIES PARTNERS LOGIN

Help Contact

PDR DataBase – Inverse Search service Beta

Grid of isobaric PDR 1.5.2 models
2016.02.29

1 - search among two parameters

x Pgas_0 (cm-3_K) log scale
y chi front (Mathis_unit) log scale

2 - fix all the other parameters

AVmax (mag) 1

3 - observational constraints

search for available quantities here. Ex: N(H)

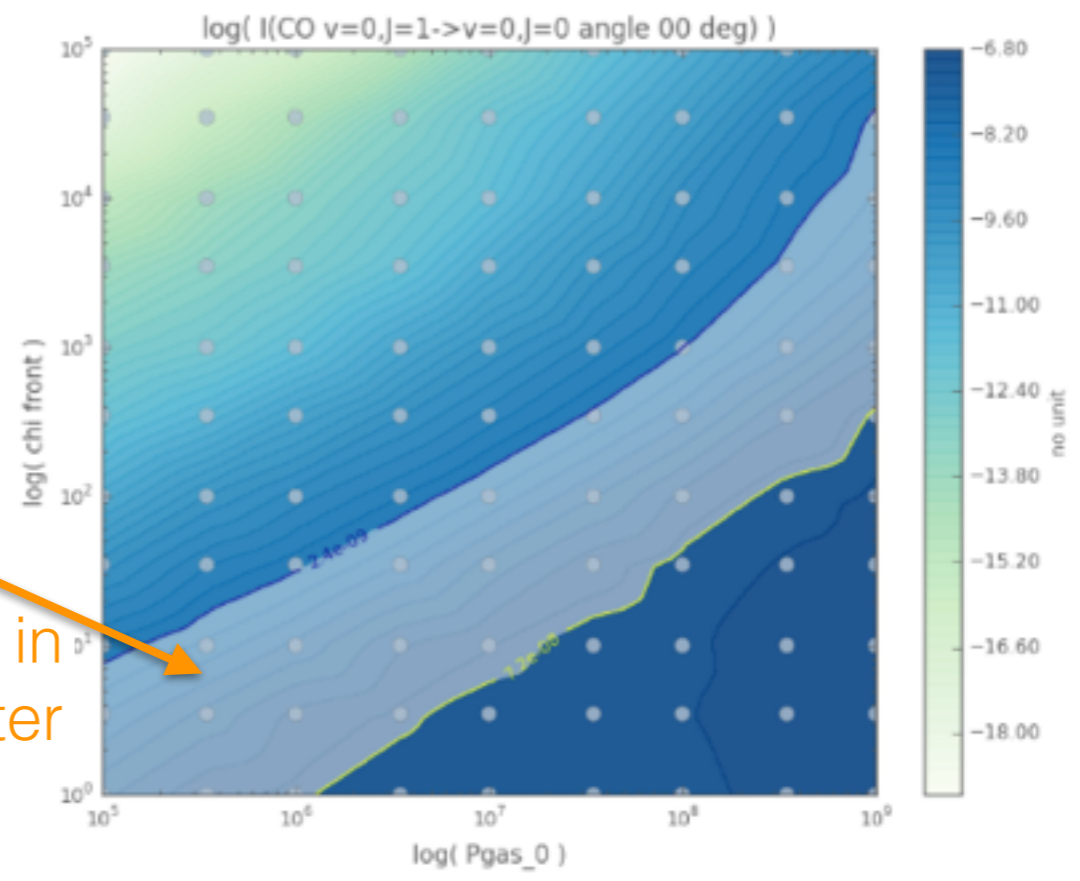
Type quantities to plot here, with optional constraint.
(click Search to view the example result)

```
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  
N(H2)
```

```
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  
N(H2)
```

I understood the following query:

```
I(CO v=0,J=1->v=0,J=0 angle 00 deg) > 2.4e-09  
I(CO v=0,J=1->v=0,J=0 angle 00 deg) < 7.2e-08  
N(H2)
```

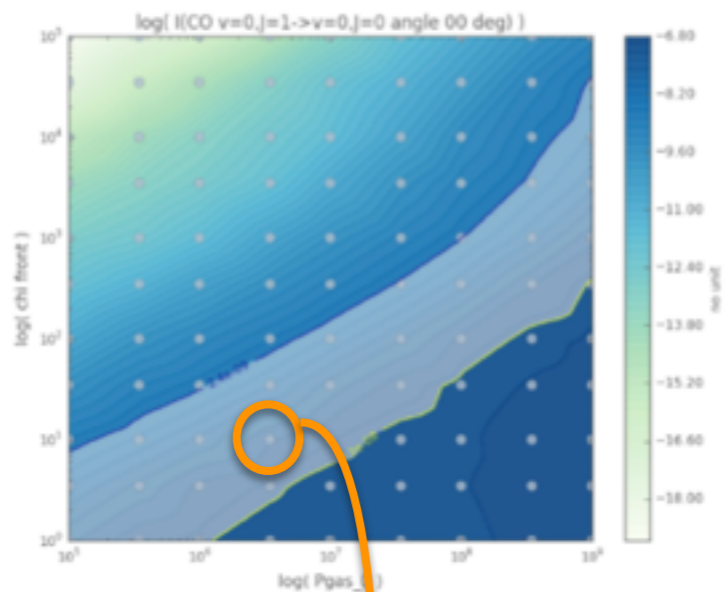


Cutout

Representation of results in the space parameter

Implementations - dedicated client

Select a model



Raw data
HDF5 file

{rawdata}

PDR DataBase - Inverse Search service beta

Grid of isobaric PDR 1.5.2 models

This grid of isobaric PDR 1.5.2 models covers photo-dominated regions conditions. Explored parameters are thermal pressure, UV field intensity and size of the clouds. The full grid contains 1372 models. Parameters range are: P from 1E5 to 1E9 K cm⁻³, radiation field from 1 and 1E5 times the ISRF, and size (AV) from 1 to 40 mag. For all models, back side is illuminated by the ISRF. In this grid of PDR models, heating by photo-electric effect on grains is done following the prescription by Bakes and Tielens (2009) without a PAH component. The chemistry takes into account 222 species, including C and O isotopes, linked by 6243 chemical reaction. No surface reactions are considered excepted for H2. H2 formation model takes into account Eley-Rideal and Langmuir-Hinshelwood mechanisms as described in Le Bourlot et al. (2012). These published models give access to all quantities computed by PDR 1.5.2 (line intensities, column densities, densities, temperature of gas and grains, ...).

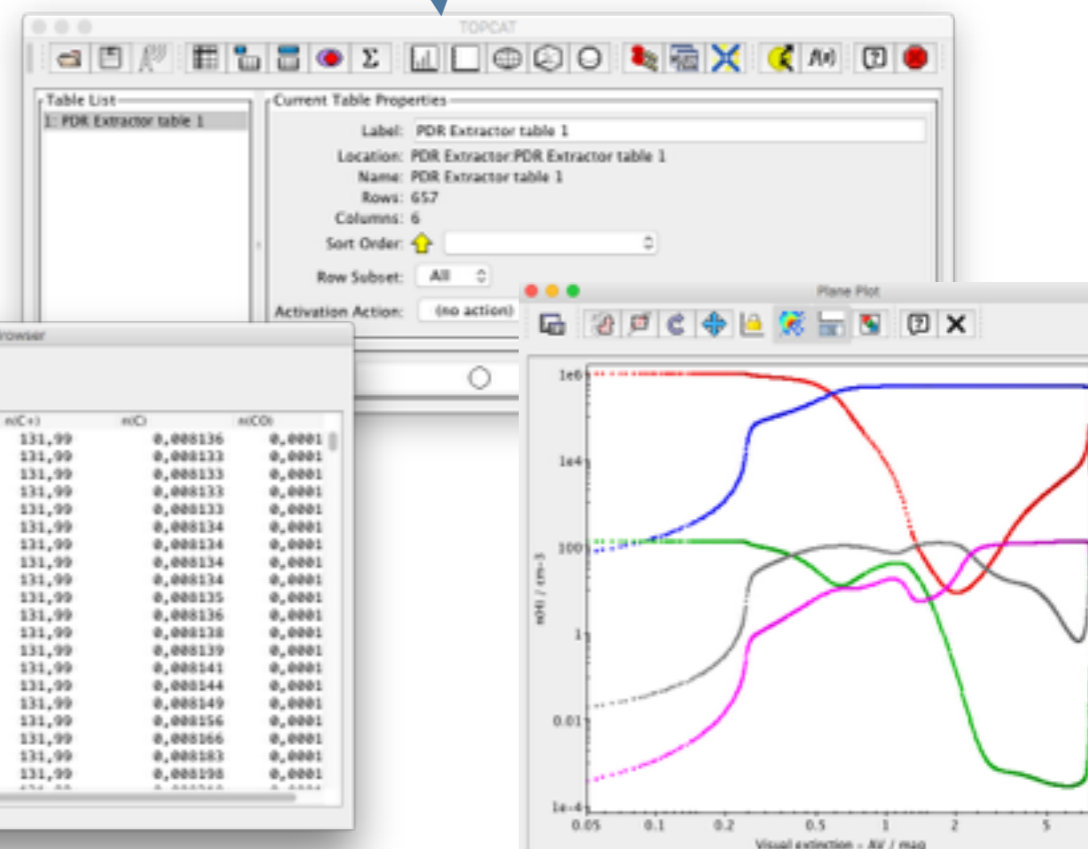
date: 2016-02-29
code: PDR_152_1508_chi_1512_iso_mathis

Download raw data

DM52NoPAH_A1e0p3p5e6r3p5e1_s_20

Star	none.txt
AVmax	1.0 mag
NH/E(B-V) (Z=1)	5.8e+21 cm ^{-2_mag-1}
Chemistry file name	ch1512_iso_Mathis.chi
Star distance	0.0 pc
State equation	isobaric, thermal balance
ISRF	Mathis
Pgas_0	3500000.0 cm ^{-3_K}
m(dust)/m(gas) (Z=1)	0.01 no_unit
Extinction curve	Galaxy
Z	1.0 no_unit
m(PAH)/m(dust)	0.0 no_unit
chi front	35.0 Mathis_unit
chi back	1.0 Mathis_unit
RV	3.1 no_unit
vturb	200000.0 km_s-1
zeta	1e-16 s-1_per_H2

SAMP



Conclusions

SimDAL 1.0 status at Paris Observatory

- Document SimDAL 1.0
 - still need better explanations on some points
 - typo corrections
- SimDAL Repository ✓
- SimDAL Search ✓
- SimDAL Data Access ✓
- Client (reference ?) ✓
- Dedicated client ✓

Registration of SimDAL services in registries

Detailed registration (Markus)

- requires XSLT transformation of parts of SimDM serializations
- (Gerard proposed to do it)

Simple registration

- register SimDAL services with main descriptive elements
 - Title
 - publisher
 - description
 - ...

In progress at Paris Observatory (David & Pierre Le Sidaner)

Limitations of SimDAL version 1.0

SimDAL version 1.0 answers to the most common scientific use cases.

Nevertheless, it has some limitations that could be addressed in future versions.

SimDAL Repositories

It is not possible to do easily fine searches.

For example: find simulations with *densities as input parameter* and *computing CO line intensities*.

Possible in practice since this information is in the protocol.xml files but require to download these files and search into them.

This could be more convenient.

Limitations of SimDAL version 1.0

SimDAL Search

Not possible to query on other quantities than the ones in the *views*

It would be useful to be able to query on results of operation on these quantities

P1	P2	S1	S2	...	dataset ID
1E+05	1E+03	100	2435	...	
3E+05	1E+03	750	6792	...	
1E+06	1E+03	340	234	...	
3E+06	1E+03	2000	4213	...	
...	

Queries:

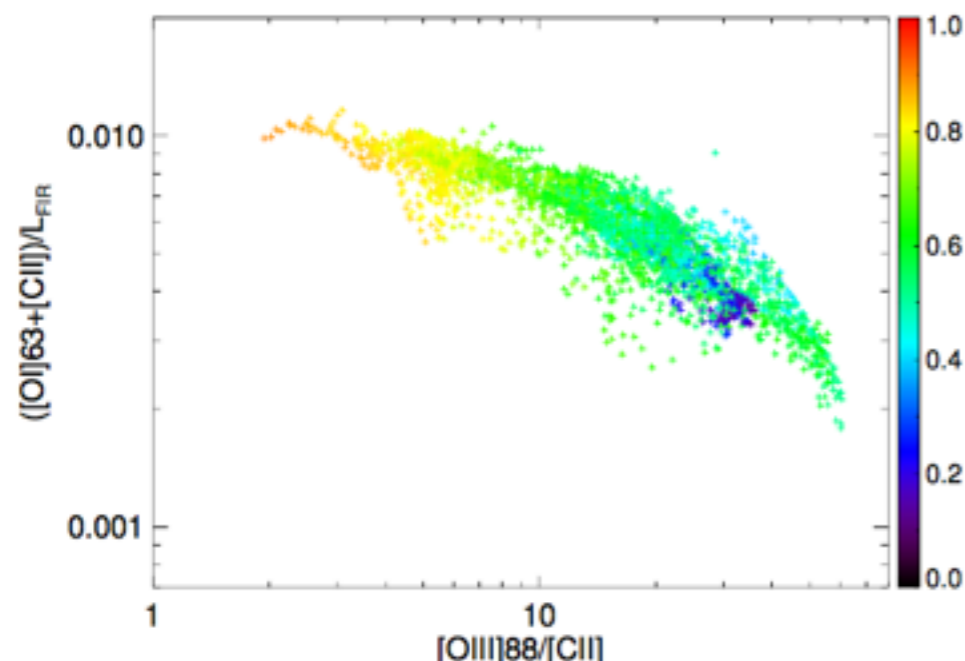
$$100 < S1 < 1000 \text{ \& } 1E3 < S2 < 1E4$$

possible

$$0.01 < S1/S2 < 1$$

not possible

Example:



Interesting quantities are:

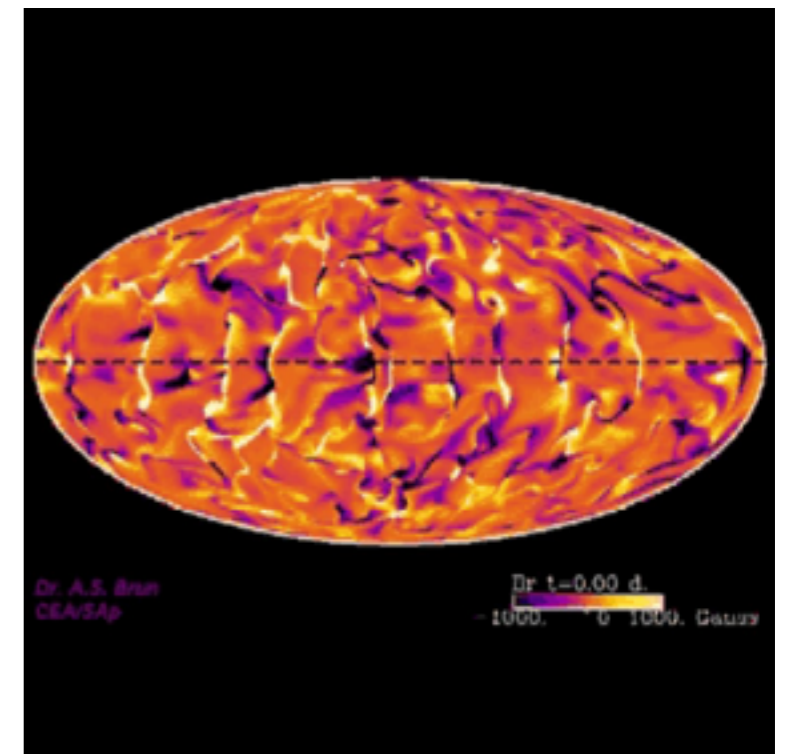
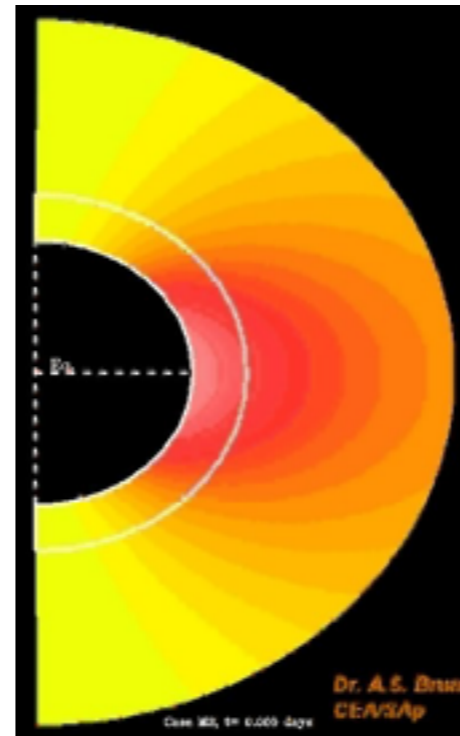
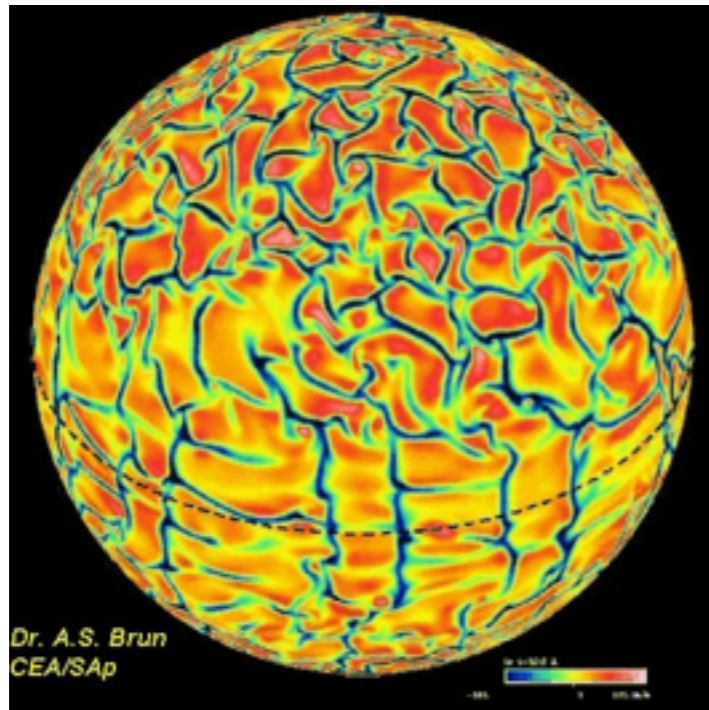
$$\frac{I(O\ 63\ \mu m) + I(C^+)}{L_{FIR}} \quad \text{and} \quad \frac{I(OIII\ 88\ \mu m)}{I(C^+)}$$

Requires to improve the query language

Limitations of SimDAL version 1.0

SimDAL Data Access

- Previews are not part of SimDAL 1.0
- Cutout in spherical, polar etc. coordinates may be useful



Conclusions

SimDAL 1.0 status at Paris Observatory

- Document SimDAL 1.0
 - still need better explanations on some points
 - typo corrections
- SimDAL Repository ✓
- SimDAL Search ✓
- SimDAL Data Access ✓
- Client (reference ?) ✓
- Dedicated client ✓