

# VAMDC

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## Virtual Atomic & Molecular Data Centre

<http://www.vamdc.eu>

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Pierre et Marie Curie, Paris

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# VAMDC in a Nutshell

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- Atomic & Molecular data underpins a wide range of basic and applied research and industrial development
  - VAMDC will provide the extensible scientific data infrastructure enabling cost effective access to the increasingly large, distributed and complex A&M resources
  - VAMDC will provide flexible interfaces to A&M resources supporting improved producer/ consumer linkages
- Existing European wide grid, network and application infrastructures form the baseline to create the VAMDC infrastructure
- VAMDC is FP7 funded and commenced July 2009

# Atomic & Molecular Databases

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- Contain Atomic and Molecular Data
  - Data from laboratory experiments & calculations
  - Spectroscopic data: linelists and their characteristics
  - Rate coefficients as a function of temperature
  - Cross-sections as function of energy, angles, ...
  - Many processes: reaction, collisional excitation, photo-reaction
- Very Different Chemical Species from atomic (various stages of ionisation) to molecules (various energetics) and even to surfaces or solids
- Usually maintained by Physicists or Chemists

# Molecules and Astrophysics

Table 2: Typical physical conditions in astrophysical sources

Name	Density $\text{cm}^{-3}$	Temperature K	Ionisation	Main gas	Main molecules
Photodissociation regions (PDR) XDR <sup>1</sup>	$10^2 - 10^6$	20 - 100	$10^{-7} - 10^{-4}$	H, H <sub>2</sub>	CO, CO <sup>+</sup> , CH, CH <sup>+</sup> CN, HCO <sup>+</sup> , H <sub>2</sub> O, C <sub>2</sub> H C <sub>2</sub> , (C <sub>4</sub> , C <sub>5</sub> , C <sub>6</sub> ?)
Dense cores (DC) <sup>2</sup>	$10^4 - 10^7$	5 - 30	$10^{-9} - 10^{-6}$	H <sub>2</sub>	CO, NH <sub>3</sub> , HCO <sup>+</sup> HCN, HNC, N <sub>2</sub> H <sup>+</sup> SO, H <sub>3</sub> O <sup>+</sup> , CS, HC <sub>3</sub> N
Star-forming regions (SFR) <sup>3</sup> for low and high mass stars & Disks <sup>4</sup>	$10^5 - 10^{10}$	30 - 500	$\sim 10^{-7}$	H <sub>2</sub>	CO, CN, HCN HNC, SO, SO <sub>2</sub> N <sub>2</sub> H <sup>+</sup> , H <sub>3</sub> O <sup>+</sup> , C <sub>2</sub> H H <sub>2</sub> CO, H <sub>2</sub> O, HC <sub>3</sub> N CH <sub>3</sub> OH, CS
Shocks <sup>5</sup>	$10^3 - 10^7$	10 - 1000	$\leq 10^{-6}$	H, H <sub>2</sub>	CO, H <sub>2</sub> O, CH <sup>+</sup> SO, SO <sub>2</sub> , SiO CH <sub>3</sub> OH, H <sub>2</sub> S
Evolved stars O & C rich <sup>6</sup>	$10^3 - 10^{11}$	10 - 1500	$\sim 10^{-7}$	H <sub>2</sub>	CO, H <sub>2</sub> O, HCN, HNC, CN SO, SiO, SO, SO <sub>2</sub> , SiS CS, H <sub>2</sub> S, C <sub>2</sub> H, C <sub>3</sub> C <sub>2</sub> H <sub>2</sub> , C <sub>4</sub> H, CH <sub>4</sub> OH, NH <sub>3</sub> , HC <sub>3</sub> N
Comets <sup>7</sup>	$10^3 - 10^{11}$	10 - 200		H <sub>2</sub> O	H <sub>2</sub> O, CO, CO <sub>2</sub> CH <sub>3</sub> OH, H <sub>2</sub> CO H <sub>2</sub> S, HCN

Page last updated at 09:28 GMT, Tuesday, 21 April 2009 10:28 UK

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# Complex molecules seen in space

By Paul Rincon  
Science reporter, BBC News, Hatfield

**Astronomers have detected two of the most complex carbon-rich molecules ever found in interstellar space.**

Their models suggest even more complex await to be discovered, including amino acids - which are essential for life.

The results were presented at the European Week of Astronomy and Space Science meeting being held in the UK.

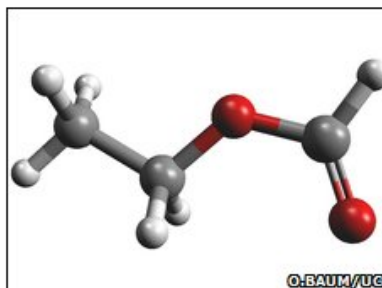
Researchers detected the organic molecules in the star-forming region of space known as Sagittarius B2, close to the centre of our galaxy.

Large carbon-rich molecules of many different types have been seen in this cloud in the past, including alcohols, aldehydes, and acids.

The two new molecules - ethyl formate and n-propyl cyanide - were found in a hot, dense cloud of gas which contains a luminous newly formed star. They represent two different classes of molecule: the esters and alkyl cyanides.

Atoms and molecules emit radiation at different frequencies, which appear as characteristic lines in the light "spectrum" from an astronomical source.

"The difficulty in searching for complex molecules is that the best astronomical sources contain so many different molecules that their 'fingerprints' overlap, and are difficult to disentangle," says Arnaud Belloche, from the Max Planck Institute for Radio Astronomy in Bonn, Germany.



A model of Ethyl formate: Complexity can be built up step by step



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# Galaxy's centre tastes of raspberries and smells of rum, say astronomers

The hunt for chemicals in deep space that could seed life on other planets has yielded a large, fruity molecule

Ian Sample, science correspondent  
guardian.co.uk, Tuesday 21 April 2009 00.05 BST  
Article history



Ethyl formate, which gives raspberries their flavour and smells of rum, has now been found in deep space. Photograph: Tim Graham/Getty

Astronomers searching for the **building blocks of life** in a giant dust cloud at the heart of the Milky Way have concluded that it tastes vaguely of raspberries.

The unanticipated discovery follows years of work by astronomers who trained their 30m radio telescope on the enormous ball of dust and gas in the hope of spotting complex molecules that are vital for life.

Finding amino acids in interstellar space is a Holy Grail for astrobiologists, as this would raise the possibility of life emerging on other planets after being seeded with the molecules.

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# Example Atomic DBs: VALD

<http://vald.astro.univie.ac.at/>

Vienna VALD server  
Version 0.3.6  
09.Jan.2008

Request type :

Registered name : Nicholas Walton

**Rationale**

The Vienna Atomic Line Database (VALD) is of great astronomical interest and provides tools for a wide range of astrophysical applications: line identification, model atmosphere calculations, etc.

The VALD Electronic Mail Service (VALD-EMS) allows external users to request VALD data sets and to register for VALD access.

- subsets of spectral line lists are available for astronomical problem. VALD also provides an external access to the data sets and extraction procedures.
- VALD provides data sets and extraction procedures for a wide range of applications.
- VALD is regularly updated with new data sets. The team experts investigate the status of the results obtained with different sources and each new source.
- VALD computers are not dedicated to a single scheduling is important.

Mail access lets VALD automatically extract data from VALD computers at the most convenient size of the data traffic and to register for VALD access.

Apart from the mail service, this WWW interface allows extraction of data from VALD and to register for VALD access.

Vienna VALD server  
Version 0.3.6  
09.Jan.2008

Request type :

Registered name : Nicholas Walton      Email address : [naw@ast.cam.ac.uk](mailto:naw@ast.cam.ac.uk)

**VALD**

```

===== job.005492 =====
# begin request
# default configuration
# show line
# 4491.405, 0.02,
# Fe 2
# 6439.07, 0.01,
# CaI
#
# end request
=====
Central wavelength:      4491.405 [A]ngstrom
Wavelength range:       0.020 [A]
Size of scan window:    0.050 [A]
Highest ion number allowed: 5
Maximum excitation potential
for lower energy level: 50.000 [eV]
Species requested:      Fe 2
=====
Configuration file used:  default.cfg
Date and time of extraction: 1999-02-24 at 12:53 (+01:00 relative to UTC)
=====

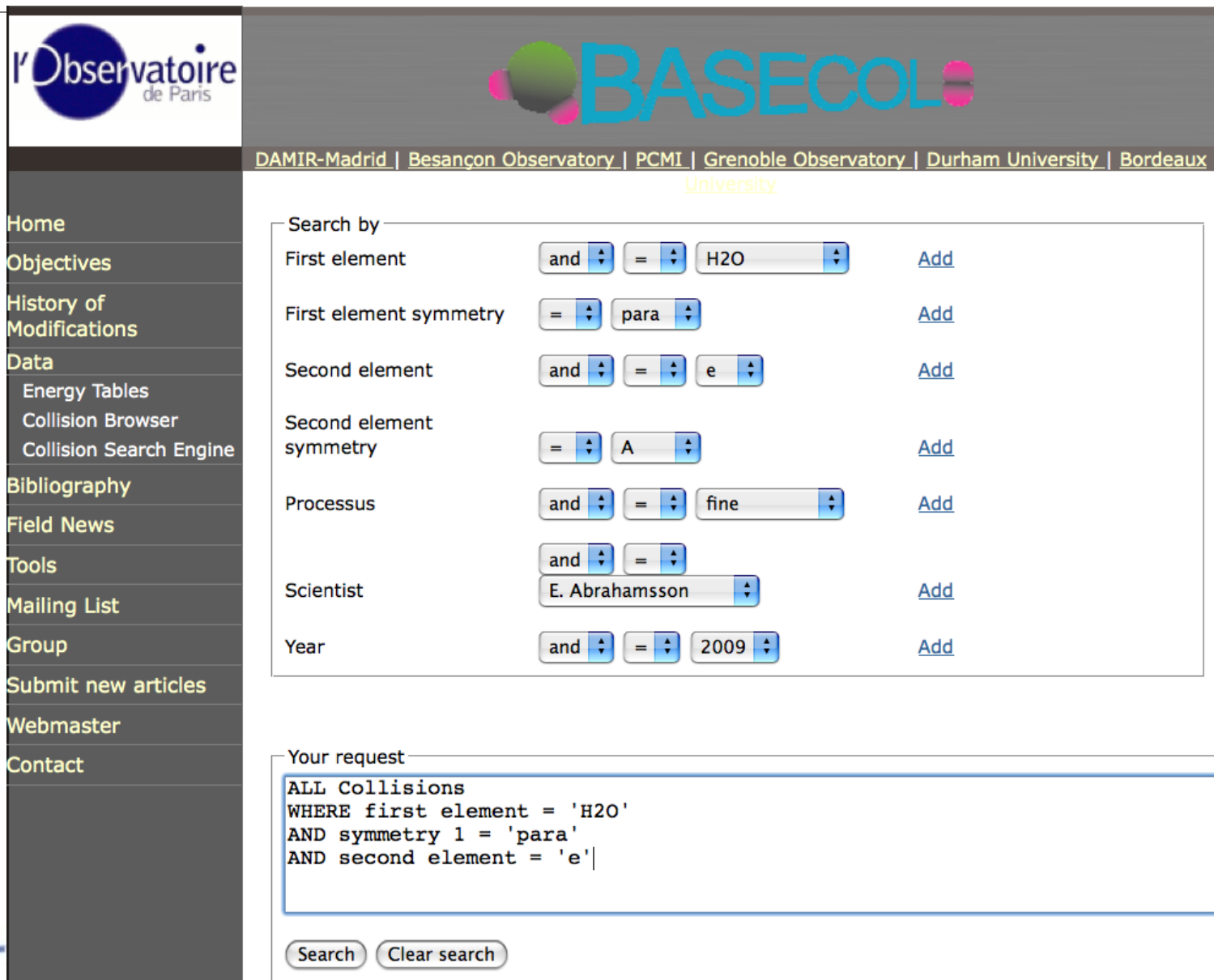
Spectral lines found (4 text lines per transition listed in a given source, the
VALD internal ranking parameter is provided in parentheses next to each value):
=====
1) Database reference for the line
2) Wavelength[A] Element/Ion log gf E(low)[eV] J(low) E(high)[eV] J(high)
3) Lande: eff. low high Gamma.Rad Gamma.Stark Gamma.VdW
4) term design. (lower -> upper) accuracy (multiplet or comments)
=====
NBS: Iron
 4491.400 ( 0) Fe 2 -2.700 ( 5) 2.855 ( 0) 1.5 5.615 ( 0) 1.5
   99.00 ( 0) 99.00 99.00 0.000 ( 0) 0.000 ( 0) 0.000 ( 0)
                b 4F z 4F* C (37) ( 2)

GFIRON obs. energy level: Fe
 4491.405 ( 3) Fe 2 -2.684 ( 3) 2.856 ( 3) 1.5 5.615 ( 3) 1.5
   0.42 ( 3) 0.40 0.44 8.481 ( 3) -6.599 ( 3) -7.946 ( 3)
                (3F)4s b4F (5D)4p z4F ( 3)

```

# Example Molecular DBs: Basecol

<http://basecol.obspm.fr/>



The screenshot shows the Basecol website interface. On the left is a navigation menu for 'l'Observatoire de Paris' with links to Home, Objectives, History of Modifications, Data (Energy Tables, Collision Browser, Collision Search Engine), Bibliography, Field News, Tools, Mailing List, Group, Submit new articles, Webmaster, and Contact. The main content area features the 'BASECOL' logo and a list of participating institutions: DAMIR-Madrid, Besançon Observatory, PCMI, Grenoble Observatory, Durham University, and Bordeaux University. Below this is a 'Search by' section with several criteria: First element (H2O), First element symmetry (para), Second element (e), Second element symmetry (A), Processus (fine), Scientist (E. Abrahamsson), and Year (2009). Each criterion has dropdown menus for logical operators (and, =) and an 'Add' button. At the bottom of the search section is a 'Your request' box containing a query: `ALL Collisions WHERE first element = 'H2O' AND symmetry 1 = 'para' AND second element = 'e'`. Below the query box are 'Search' and 'Clear search' buttons.

# Example Spectroscopic DB: JPL

<http://spec.jpl.nasa.gov/ftp/pub/catalog/catform.html>



## JPL Catalog Search Form

You need a Browser with Forms Capability to use this.

See [README](#) for output format.

What is the **minimum** frequency ?

What is the **maximum** frequency ?

The frequency units can be  GHz or  wavenumbers. If GHz is checked, the format of the output will in standard catalog form (with MHz units). If wavenumber is checked, the frequency and error fields of the output will be in wavenumbers.

What is the common log of the **minimum** strength in catalog units ?

What molecules should be included ? (use mouse control click to select multiple values)

- All
- 1001 H-atom
- 2001 D-atom
- 3001 HD
- 4001 H2D+
- 7001 Li-6-H

**Response will be limited to 1000 lines.** Press this button to submit the query:

To reset the form, press this button:

Return to [home page](#).

## Catalog Directory

ID	Name	# lines	Ver.	Catalog	Documentation
1001	H-atom	1	1	<a href="#">c001001.cat</a>	<a href="#">pdf</a> or <a href="#">Tex</a> format
2001	D-atom	1	1	<a href="#">c002001.cat</a>	<a href="#">pdf</a> or <a href="#">Tex</a> format
3001	HD	1	2	<a href="#">c003001.cat</a>	<a href="#">pdf</a> or <a href="#">Tex</a> format
4001	H2D+	19	1	<a href="#">c004001.cat</a>	<a href="#">pdf</a> or <a href="#">Tex</a> format
7001	Li-6-H	33	1	<a href="#">c007001.cat</a>	<a href="#">pdf</a> or <a href="#">Tex</a> format
8001	LiH	40	1	<a href="#">c008001.cat</a>	<a href="#">pdf</a> or <a href="#">Tex</a> format
8002	Li-6-D	40	1	<a href="#">c008002.cat</a>	<a href="#">pdf</a> or <a href="#">Tex</a> format
9001	LiD	40	1	<a href="#">c009001.cat</a>	<a href="#">pdf</a> or <a href="#">Tex</a> format
12001	C-atom	2	2	<a href="#">c012001.cat</a>	<a href="#">pdf</a> or <a href="#">Tex</a> format
13001	C-13-atom	7	2	<a href="#">c013001.cat</a>	<a href="#">pdf</a> or <a href="#">Tex</a> format
13002	CH	324	1	<a href="#">c013002.cat</a>	<a href="#">pdf</a> or <a href="#">Tex</a> format
13003	CH+	9	1	<a href="#">c013003.cat</a>	<a href="#">pdf</a> or <a href="#">Tex</a> format
14001	N-atom	2	1	<a href="#">c014001.cat</a>	<a href="#">pdf</a> or <a href="#">Tex</a> format
14002	N-atom-D-st	6	3	<a href="#">c014002.cat</a>	<a href="#">pdf</a> or <a href="#">Tex</a> format
15001	NH	1416	1*	<a href="#">c015001.cat</a>	<a href="#">pdf</a> or <a href="#">Tex</a> format
16001	O-atom	2	2	<a href="#">c016001.cat</a>	<a href="#">pdf</a> or <a href="#">Tex</a> format
17001	OH	1160	4*	<a href="#">c017001.cat</a>	<a href="#">pdf</a> or <a href="#">Tex</a> format
17002	NH3	446	3	<a href="#">c017002.cat</a>	<a href="#">pdf</a> or <a href="#">Tex</a> format
17003	CH3D	80	1	<a href="#">c017003.cat</a>	<a href="#">pdf</a> or <a href="#">Tex</a> format
17004	NH3-v2	442	1	<a href="#">c017004.cat</a>	<a href="#">pdf</a> or <a href="#">Tex</a> format
17005	OH-v1,2	1765	1*	<a href="#">c017005.cat</a>	<a href="#">pdf</a> or <a href="#">Tex</a> format
18001	OD	912	1	<a href="#">c018001.cat</a>	<a href="#">pdf</a> or <a href="#">Tex</a> format
18002	N-15-H3	235	2	<a href="#">c018002.cat</a>	<a href="#">pdf</a> or <a href="#">Tex</a> format
18003	H2O	3086	6*	<a href="#">c018003.cat</a>	<a href="#">pdf</a> or <a href="#">Tex</a> format
18004	NH2D	5036	1	<a href="#">c018004.cat</a>	<a href="#">pdf</a> or <a href="#">Tex</a> format
18005	H2O v2,2v2,v	28832	4*	<a href="#">c018005.cat</a>	<a href="#">pdf</a> or <a href="#">Tex</a> format
19001	HO-18	295	2	<a href="#">c019001.cat</a>	<a href="#">pdf</a> or <a href="#">Tex</a> format
19002	HDO	1401	3	<a href="#">c019002.cat</a>	<a href="#">pdf</a> or <a href="#">Tex</a> format
19003	H2O-17	404	1	<a href="#">c019003.cat</a>	<a href="#">pdf</a> or <a href="#">Tex</a> format
19004	H3O+	420	1	<a href="#">c019004.cat</a>	<a href="#">pdf</a> or <a href="#">Tex</a> format

# A&M Challenges

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- A&M data underpins many areas of research
  - Providing access to a wide range of users (astronomy, nuclear, climatology, biology) in academia and industry
- Data is complex and increasingly large
- Handling of data (often) involves use of applications
- Issues with ensuring data completeness & quality
- Coordination and standards – organising the A&M community

**Challenge:** provide data access to **all** A&M data to **all** end user communities

# VAMDC: Seamless A&M data access

- Proposal to EU FP7
- Wide spread of partners
- Wide spread of data
- PI: Marie-Lise Dubernet (Paris)
- 7/09 – 12/12

		LPMAA, VOPARIS, LERMA, LPG, L3AB, GSMA, ICB BASECOL, KIDA, STSP, CH4, O3, PAH, TipTopBase, Technological Node Contact NIST, EuroPlanet, IVOA + all WP (apart WP3) ISM, Planetology, Plasma, Atmosphere, Stellar, Solar
1	CNRS (FR)	
2	UCAM (UK)	CHIANTI, AstroGrid (Euro-Vo) - QA - Solar, Stellar (2 departments)
		HITRAN, GEISA, AstroGrid (Euro-VO)- Software - Support to users (2 departments)
3	UCL (UK)	Atmosphere, Planetology, Solar, Plasmas Dissemination/Training - Software -
4	OU (UK)	Plasma, Industry, EuroPlanet
		VALD - Standards/Software
5	UW-A (Austria)	Stellar, Solar, Plasma, Planetology, Atmosphere
		VALD - Training/Dissemination - Interoperability
6	UU (Sweden)	Stellar, Solar, Plasma, Planetology, Atmosphere
		CDMS and JPL - Software - Interoperability
7	KOLN (Germany)	ISM, Planetology, Atmosphere
		PAH and LASP (2 Institutes) - Software
8	INAF (IT)	ISM, Planetology
		UMIST Reaction Database - Dictionaries/XML
9	QUB (UK)	ISM, Planetology, Atmosphere
		BELDATA - Training/Dissemination
10	AOB (Serbia)	Solar, Stellar
		VALD - Training Tools- User Requirements
11	INASAN (Russia)	Stellar, Solar, Plasma, Planetology,, Atmosphere
		SPECTR-W3 - Quality Assurance - Monitoring - Software - Support to users -
12	RFNC-VNIITF (R)	Plasma, Stellar, Solar, Plasma
		CO2, O3 - Software - Training/Dissemination
13	IAO (Russia)	Atmosphere
		TipTopBase- Training/Dissemination - GRID -
14	IVIC (Venezuela)	Stellar, Solar, Plasma, Planetology,, Atmosphere - (2 Instituts)
		VALD - Quality Assurance -
15	ISAN (Russia)	Stellar, Solar, Plasma, Planetology,, Atmosphere
	NIST (USA)	
	CFA (USA)	

# Key VAMDC Objectives

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- implement VAMDC interface for accessing major existing databases containing heterogeneous data and aimed at different users
- enable data queries across multiple DBs that are focussed on specific research topic(s)
- enable data publishing/quality control process for major A&M data producers
- involve wide user and producer communities in development and use of VAMDC

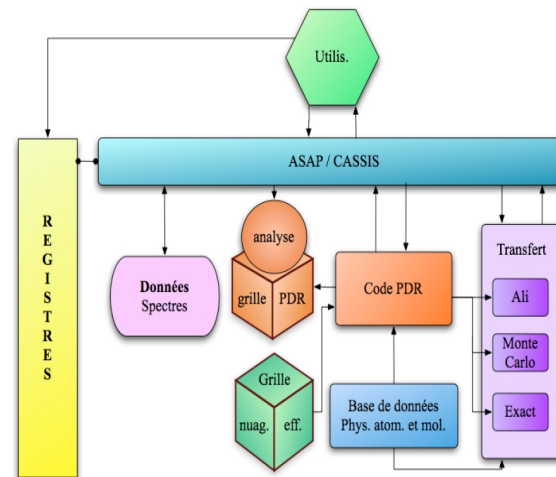
# VAMDC End User Communities

- Astrophysical, atmospheric, plasma, combustion media
- Simulations, Observations, Diagnostics
- Industrial Applications, e.g. lighting, etching, e.g. PLASIMO
- Teaching Outreach
- **Range of Complexity of user requirements**

End User: Comparison Models/Observations for Interstellar Medium

### Usecase

Next generation of instruments : huge amount of data  
 ↳ need efficient tools to analyse and interpret the observations

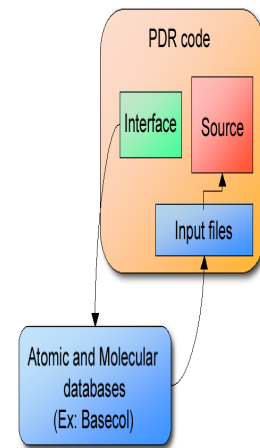


### Step 1 : Use of the VO :

Link : PDR code / databases (1)

#### Data used by PDR codes :

- Atomic and molecular properties :
  - Energy levels
  - Einstein coefficients
- Reactions between elements
  - collision rates
  - chemical reaction
    - gas phase reactions
    - surface reactions
  - photo-process cross sections



Courtesy of F. Le Petit (LUTH, Obs. Paris)

# VAMDC project organisation

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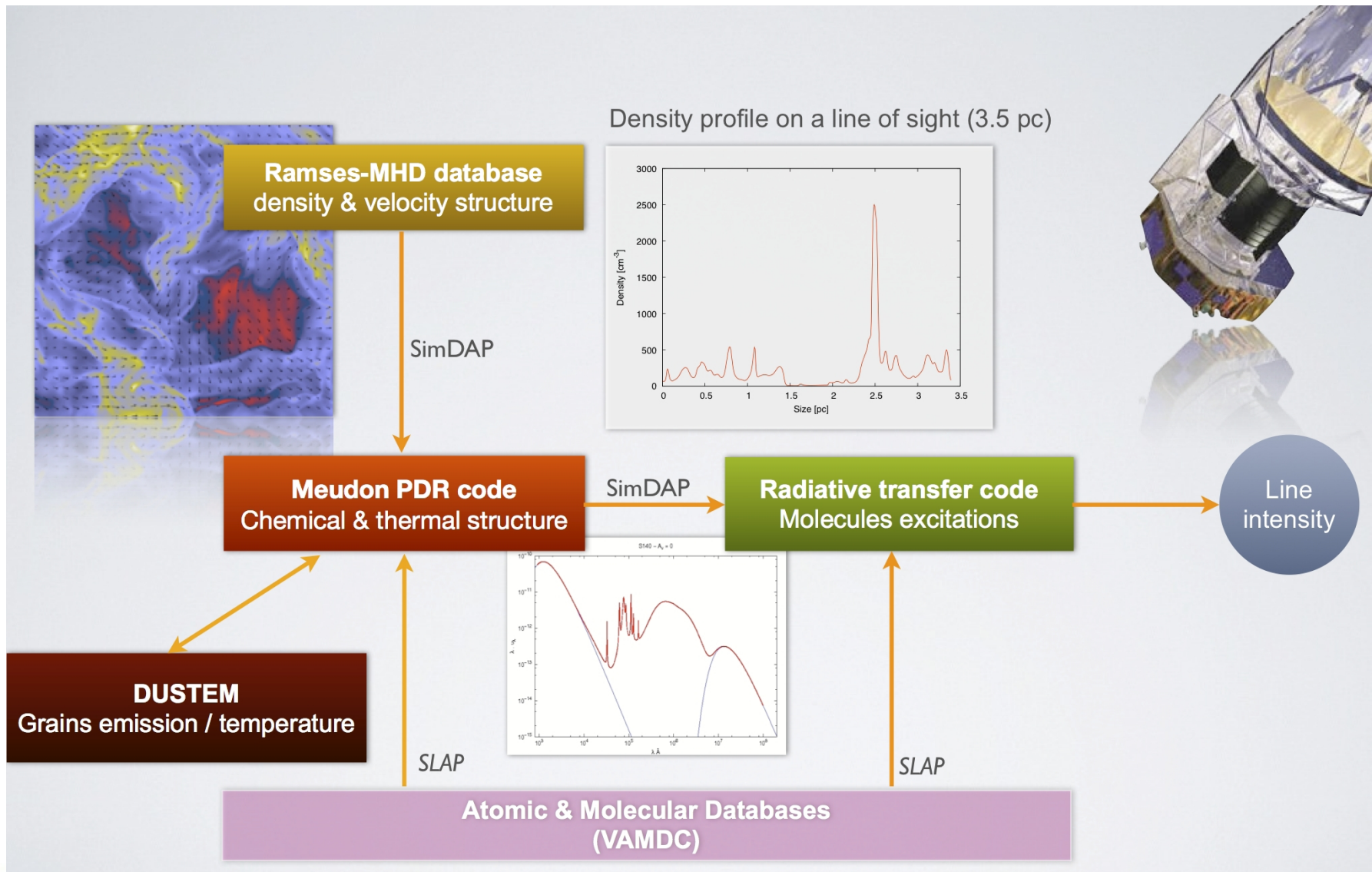
- Networking Activities
  - Training, workshops
  - Science requirements, strategy
  - Interface to external groups (VO, Grid, etc)
- Service Activities
  - Deployment of A+M services
  - Support to the service and user communities
- Research Activities
  - Standards
  - Publishing Tools
  - Data Mining

# VAMDC: developed from existing infrastructure

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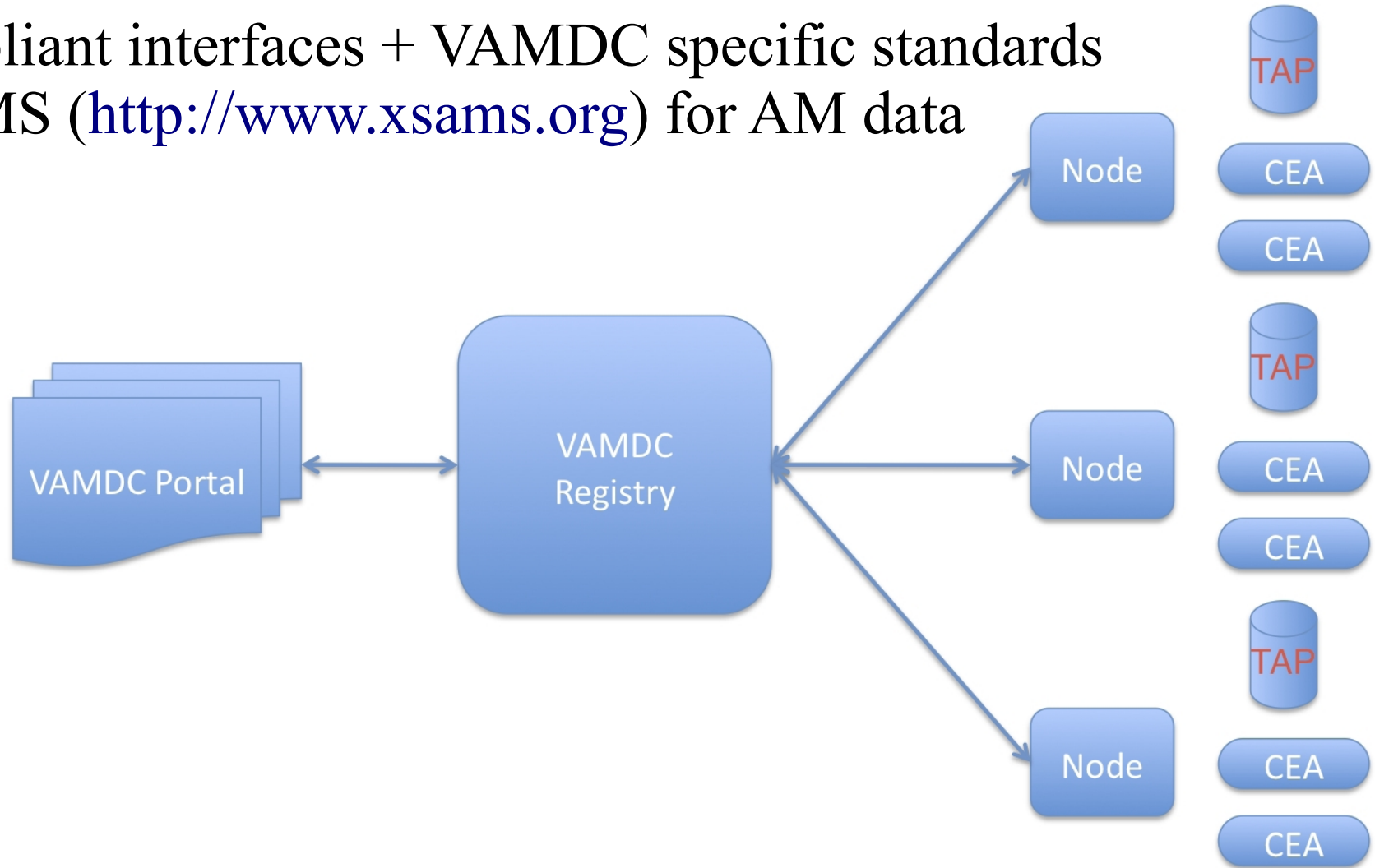
- Utilise existing technologies to enable the cost effective construction of VAMDC
- Grid – EGEE – for computation
- GEANT – for high speed networks
- Euro-VO – for service architecture
  - Use of and extension of UK AstroGrid components for data access and applications environment
    - <http://www.astrogrid.org>
  - Use of applications conforming to IVOA standards
    - <http://www.ivoa.net>

# VAMDC: use case driven development

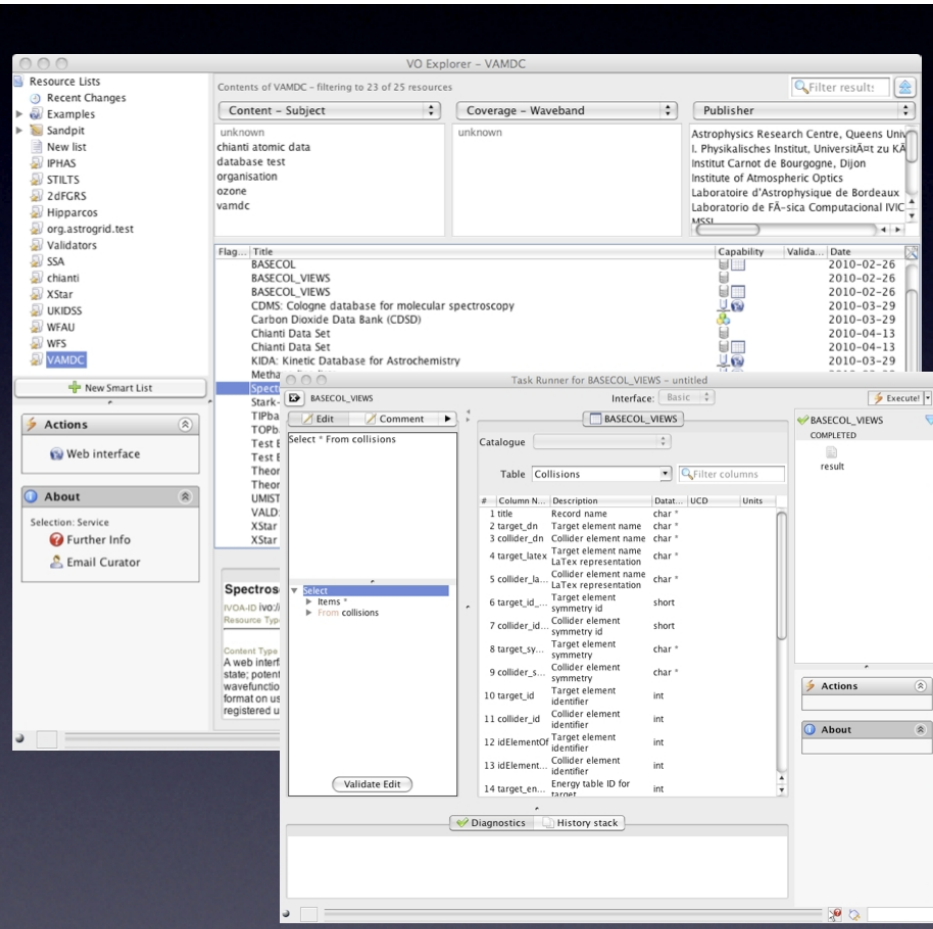


# VAMDC: a working infrastructure

IVOA compliant interfaces + VAMDC specific standards  
 XSAMS (<http://www.xsams.org>) for AM data



# VAMDC Level One Service Release



VO Explorer - VAMDC

Contents of VAMDC - filtering to 23 of 25 resources

Content - Subject: unknown, Coverage - Waveband: unknown, Publisher: Astrophysics Research Centre, Queens Univ, I. Physikalisches Institut, Universität zu Köln, Institut Carnot de Bourgogne, Dijon, Institute of Atmospheric Optics, Laboratoire d'Astrophysique de Bordeaux, Laboratorio de Física Computacional IVIC, MSSL

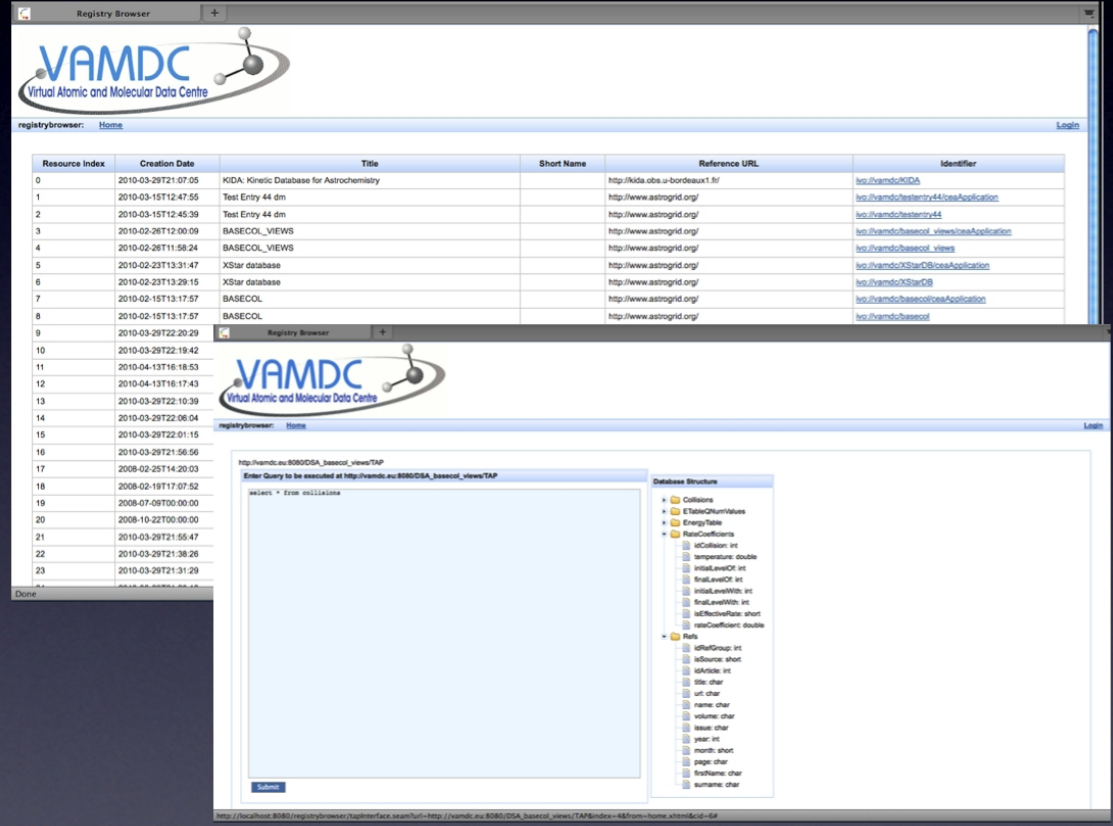
Flag	Title	Capability	Valida...	Date
	BASECOL			2010-02-26
	BASECOL_VIEWS			2010-02-26
	BASECOL_VIEWS			2010-02-26
	CDMS: Cologne database for molecular spectroscopy			2010-03-29
	Carbon Dioxide Data Bank (CDSB)			2010-03-29
	Chianti Data Set			2010-04-13
	Chianti Data Set			2010-04-13
	KIDA: Kinetic Database for Astrochemistry			2010-03-29

Task Runner for BASECOL\_VIEWS - untitled

Interface: Basic

Table: Collisions

#	Column Name	Description	Data...	UCD	Units
1	title	Record name	char *		
2	target_dn	Target element name	char *		
3	collider_dn	Collider element name	char *		
4	target_latex	Target element name LaTeX representation	char *		
5	collider_latex	Collider element name LaTeX representation	char *		
6	target_id	Target element symmetry id	short		
7	collider_id	Collider element symmetry id	short		
8	target_sy...	Target element symmetry	char *		
9	collider_sy...	Collider element symmetry	char *		
10	target_id	Target element identifier	int		
11	collider_id	Collider element identifier	int		
12	idElementOf	Target element identifier	int		
13	idElement...	Collider element identifier	int		
14	target_en...	Energy table ID for target	int		



Registry Browser

Virtual Atomic and Molecular Data Centre

Resource Index	Creation Date	Title	Short Name	Reference URL	Identifier
0	2010-03-29T21:07:05	KIDA: Kinetic Database for Astrochemistry		http://kida.obs.u-bordeaux1.fr/	http://vamdc.kida
1	2010-03-15T12:47:55	Test Entry 44 dm		http://www.astrogid.org/	http://vamdc/testentry44/oaApplication
2	2010-03-15T12:45:39	Test Entry 44 dm		http://www.astrogid.org/	http://vamdc/testentry44
3	2010-02-26T12:00:09	BASECOL_VIEWS		http://www.astrogid.org/	http://vamdc/basecol_views/oaApplication
4	2010-02-26T11:58:24	BASECOL_VIEWS		http://www.astrogid.org/	http://vamdc/basecol_views
5	2010-02-23T13:31:47	XStar database		http://www.astrogid.org/	http://vamdc/XStarDB/oaApplication
6	2010-02-23T13:29:15	XStar database		http://www.astrogid.org/	http://vamdc/XStarDB
7	2010-02-15T13:17:57	BASECOL		http://www.astrogid.org/	http://vamdc/basecol/oaApplication
8	2010-02-15T13:17:57	BASECOL		http://www.astrogid.org/	http://vamdc/basecol

Registry browser: Home

Enter Query to be executed at http://vamdc.eu:8080/DGA\_basecol\_views/TAP

SELECT \* FROM collisions

Database Structure

- Collisions
- ETableNumValues
- EnergyTable
- RateCoefficients
  - ICoefficients int
  - temperature: double
  - initialLevelOf int
  - finalLevelOf int
  - initialLevelWith int
  - finalLevelWith int
  - initialRateFactor short
  - rateCoefficient: double
- Rate
  - rateGroup int
  - idSource short
  - title char
  - url char
  - name char
  - volume: char
  - issue: char
  - year: int
  - month: short
  - page: char
  - firstName: char
  - surname: char

VODesktop

VAMDC web-portal

Released internally to VAMDC Beta Testers  
1 Oct 2010

# VAMDC virtual-data URIs

<http://some.server/some/data?QUERY=select ...>

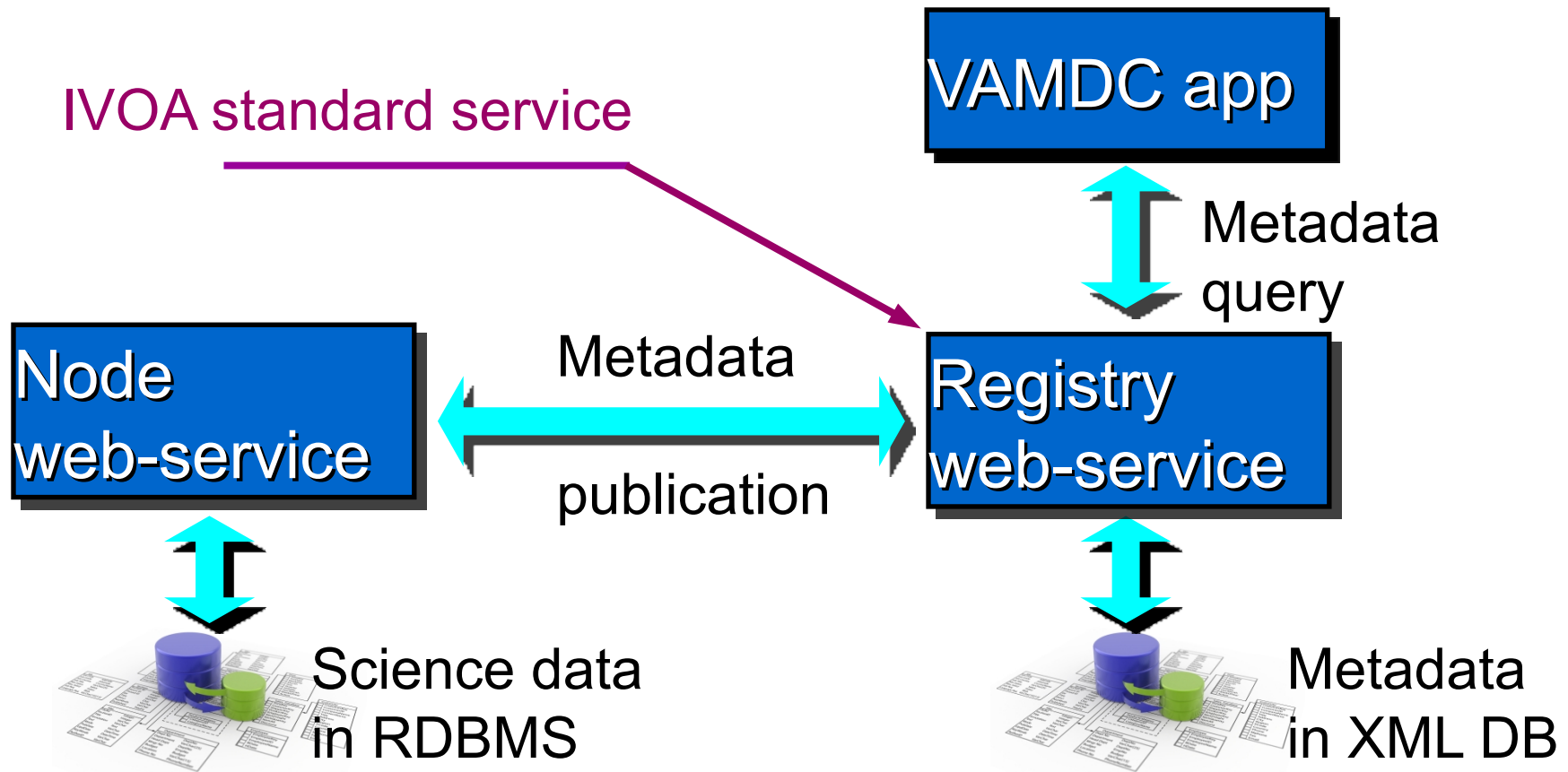
Address of archive

User-defined  
sub-set

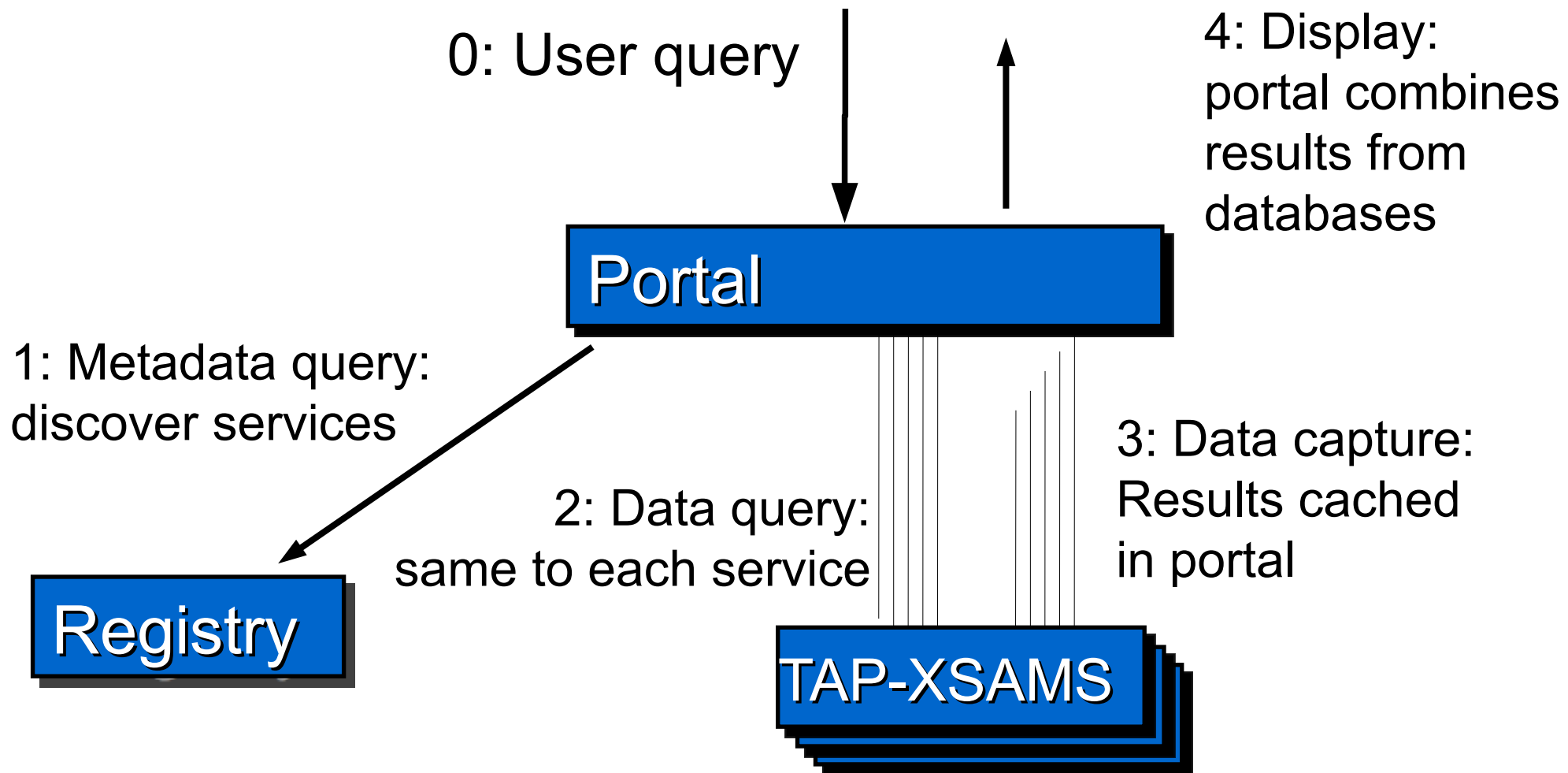
Web service interface is as simple as HTTP-GET

Simple service interfaces:  
robust, easy to implement, easy to support

# VAMDC Registry



# Multiple queries



Query Type	Query	Resource	Query ID	Status	View	View
xsams	SELECT * WHERE RadTransWavelengthExperimentalValue >= 2e-8 AND RadTransWavelengthExperimentalValue <= 2.2e-8	http://vamdc.fysast.uu.se:8888/node/vald/tap/sync/?	8d158853-8089-426a-a220-d72ddc233446	Finished	<a href="#">View</a>	<a href="#">Download</a>
xsams	SELECT * WHERE RadTransWavelengthExperimentalValue >= 2e-8 AND RadTransWavelengthExperimentalValue <= 2.2e-8	http://www.astro.uni-koeln.de:8098/DjCDMS/tap/sync/?	35c79c2d-2749-4011-a6a3-4c2cd5c30292	Executing		

#### Enter XSAMS Query to be executed at

Databases exposes the XSAMS data-model. Only standard parts of the database are accessible in this way

Atomic (elemental) symbol:

Molecular Species InChIKey:

Molecular Species Stoichiometric Formula:

Atomic number: from  to

Ionization state: from  to

Energy of atomic state: from  to

Wavelength of radiative transition: from  to

Molecular State Energy Value: from  to

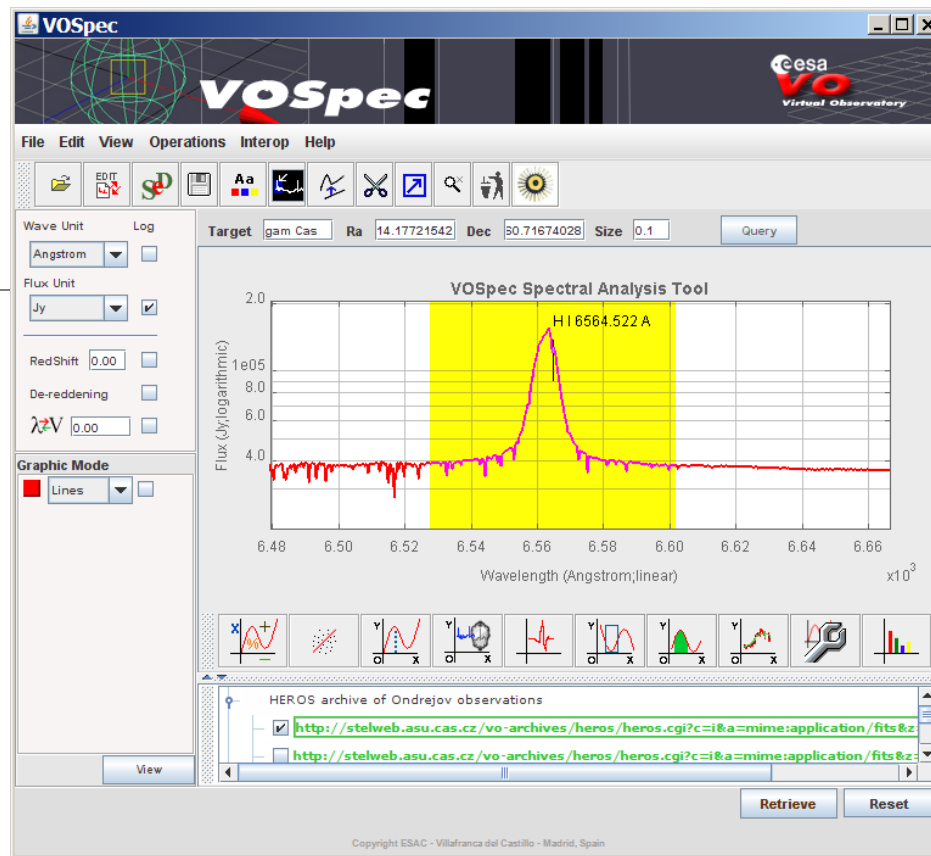
- Vienna Atomic Line Database (UU mirror)
- Cologne Database for Molecular Spectroscopy: TAP-XSAMS service
- TAP/XSAMS for XstarDB
- BASECOL: TAP-XSAMS interface

Query Result Format  VOTable  XSAMS

**Submit Query**

Query: SELECT \* WHERE RadTransWavelengthExperimentalValue >= 2e-8 AND RadTransWavelengthExperimentalValue <= 2.2e-8 submitted. Please check Query Log.

# Use of SLAP for VALD



VOTable

SLAP  
web-service

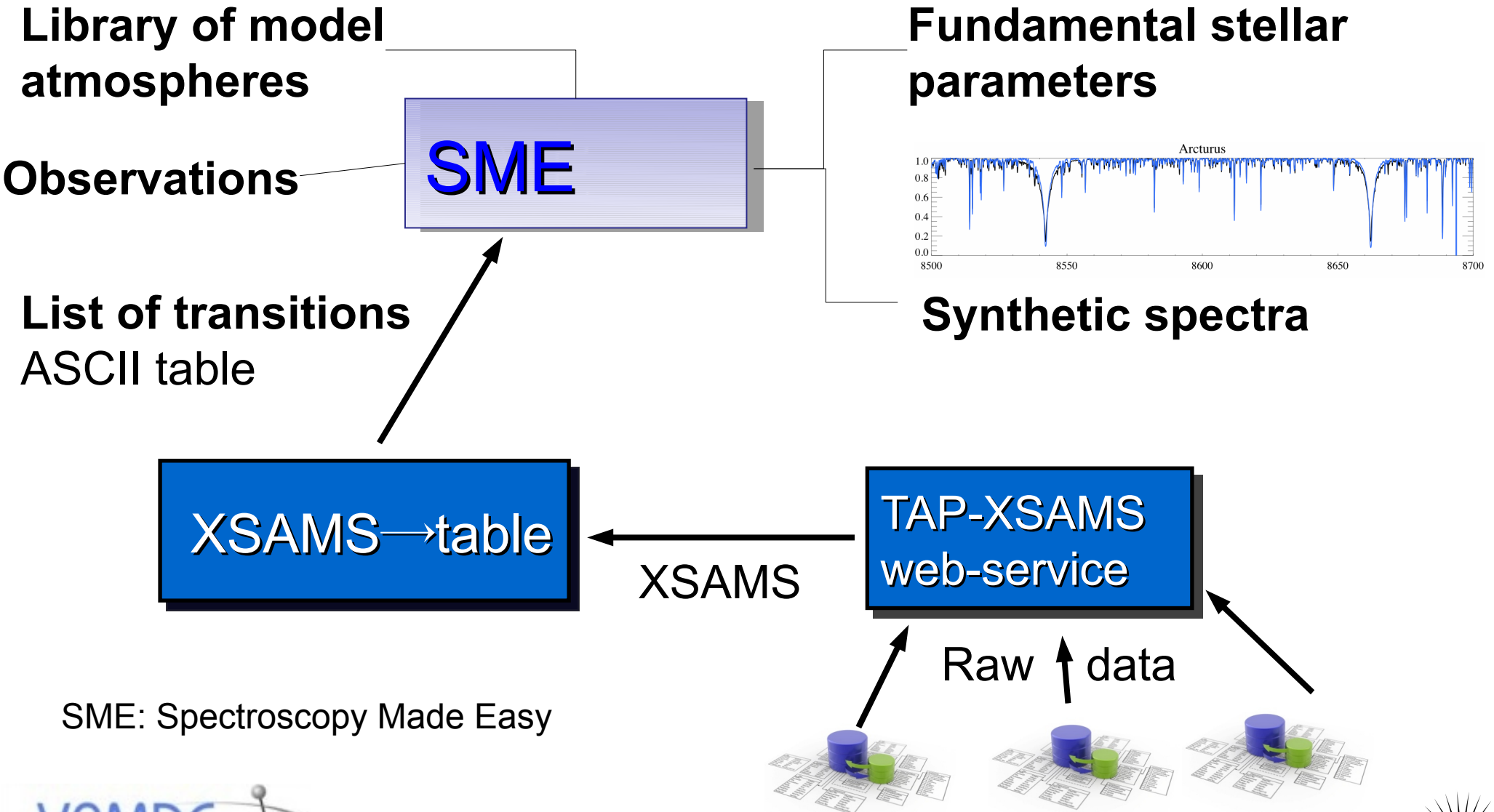
XSAMS

TAP-XSAMS  
web-service

Raw data

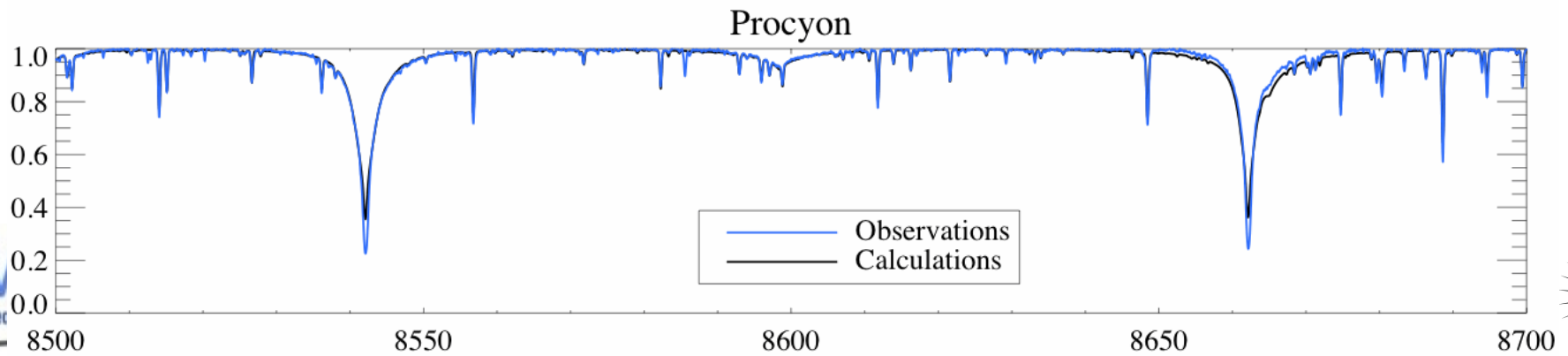
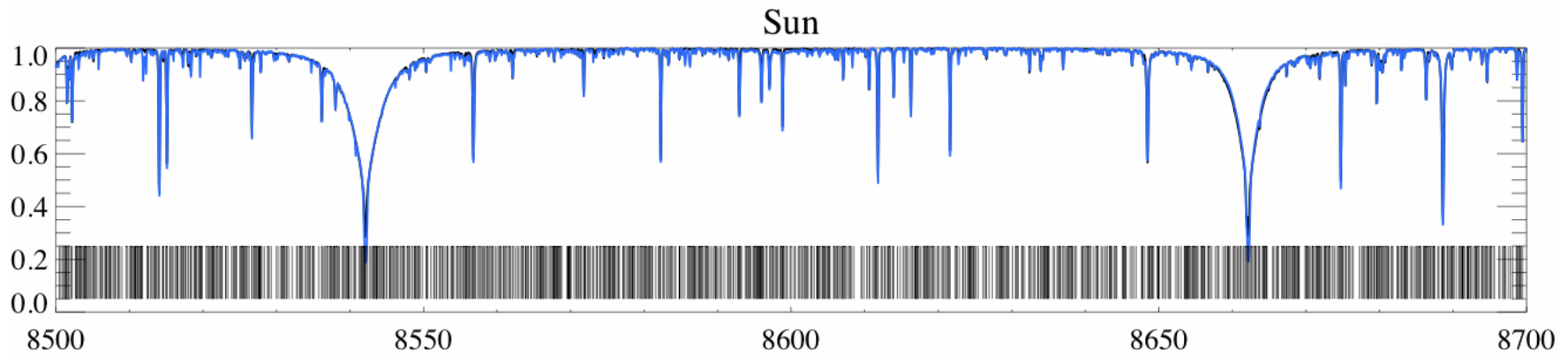
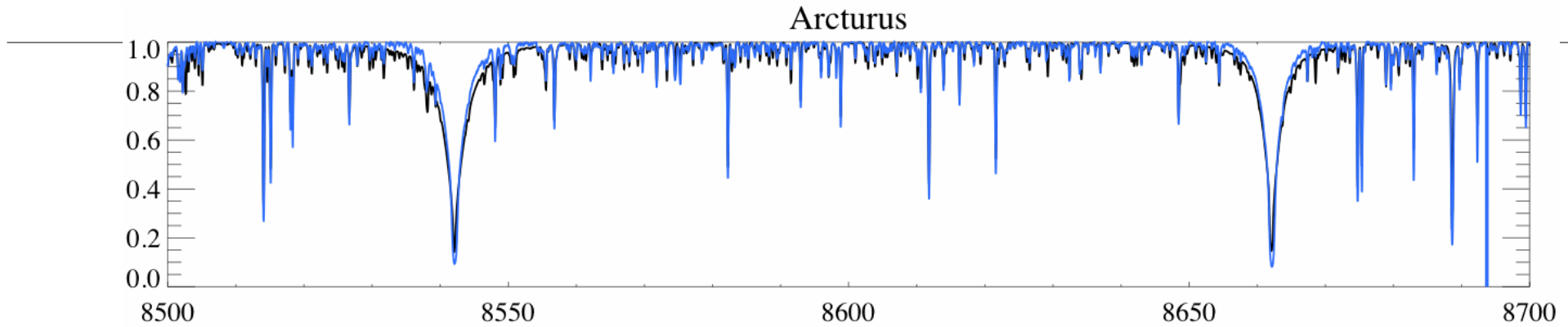


# Example VAMDC user application



SME: Spectroscopy Made Easy

# Results from the example app



# VAMDC future releases

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- Level 1: Preliminary VAMDC service with simple data access to the core VAMDC data resources
- Level 2: Enhanced interoperable data access to VAMDC data resources, all resources accessible
- Level 3: Interoperable VAMDC data access with VAMDC tools available (client side or server side accessible via through workflow enactment engines)
- VAMDC Service: Final full service, including access to resources from the wider community

<http://www.vamdc.eu>