Theoretical models in the VO

Carlos Rodrigo Blanco[1,2]
Enrique Solano[1,2]

[1]CAB (CSIC-INTA) LAEX,
Aptdo Correos 78,
28691 Villanueva de la Cañada, Madrid

[2]Spanish Virtual Observatory

Euro-VO AIDA Workshop,
How to publish data in the VO
Madrid , June 22 -26, 2009

What is the VO?

- An international effort in astrophysics for:
  - **Standardization**
    - common data formats (VOTable, Data Models,...)
      (how the data are represented, written...)
  - **Interoperability**
    - common protocols (SIAP, SSAP, TSAP...)
      (how to make questions and how to answer them)

Theoretical Models not in VO

Theoretical models available in internet:

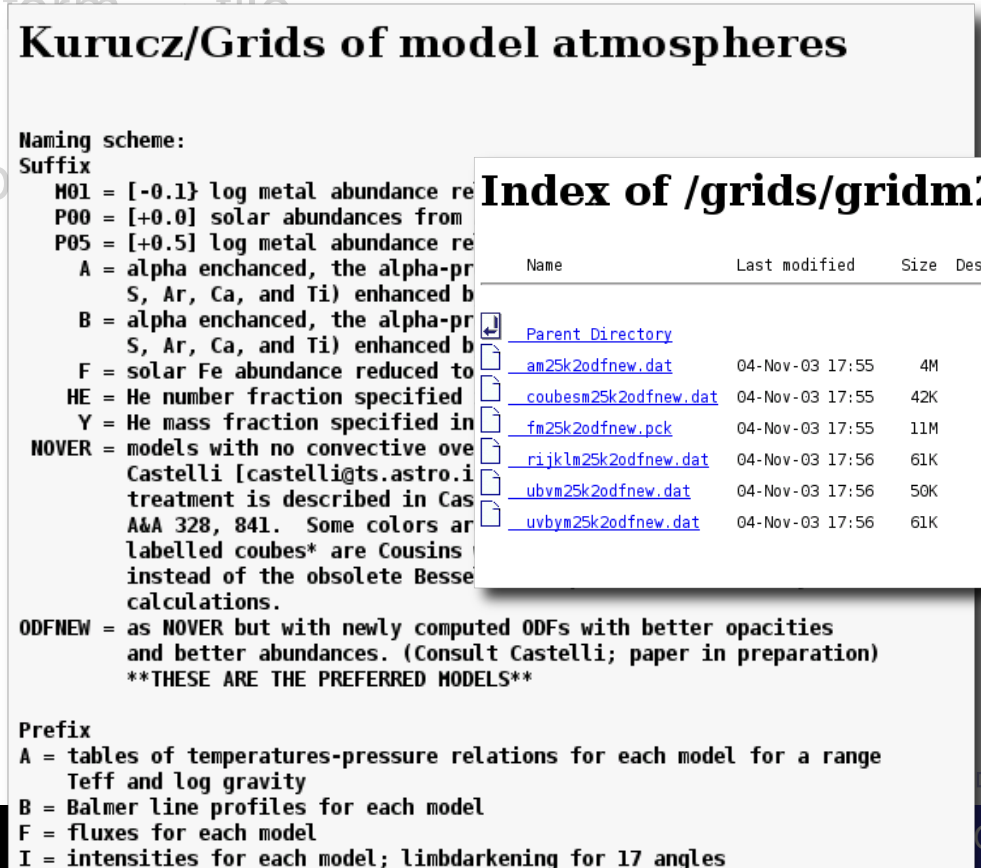
- as a collection of files
- search form $\longrightarrow$ file

- ASCII or FITS files
- special data format for each model

Theoretical Models not in VO

Theoretical models available in internet:

- as a collection of files
- search form → file
- ASCII o
- special



Kurucz/Grids of model atmospheres

```
Naming scheme:
Suffix
   M01 = [-0.1} log metal abundance re
   P00 = [+0.0] solar abundances from
   P05 = [+0.5] log metal abundance re
     A = alpha enchanced, the alpha-pr
         S, Ar, Ca, and Ti) enhanced b
     B = alpha enchanced, the alpha-pr
         S, Ar, Ca, and Ti) enhanced b
     F = solar Fe abundance reduced to
    HE = He number fraction specified
     Y = He mass fraction specified in
 NOVER = models with no convective ove
         Castelli [castelli@ts.astro.i
         treatment is described in Cas
         A&A 328, 841.  Some colors ar
         labelled coubes* are Cousins
         instead of the obsolete Besse
         calculations.
ODFNEW = as NOVER but with newly computed ODFs with better opacities
         and better abundances. (Consult Castelli; paper in preparation)
         **THESE ARE THE PREFERRED MODELS**

Prefix
A = tables of temperatures-pressure relations for each model for a range
    Teff and log gravity
B = Balmer line profiles for each model
F = fluxes for each model
I = intensities for each model; limbdarkening for 17 angles
```

Index of /grids/gridm25ODFNEW/

Name	Last modified	Size	Description
Parent Directory			
am25k2odfnew.dat	04-Nov-03 17:55	4M	
coubesm25k2odfnew.dat	04-Nov-03 17:55	42K	
fm25k2odfnew.pck	04-Nov-03 17:55	11M	
rijklm25k2odfnew.dat	04-Nov-03 17:56	61K	
ubvm25k2odfnew.dat	04-Nov-03 17:56	50K	
uvbym25k2odfnew.dat	04-Nov-03 17:56	61K	

Theoretical Models not in VO

Theoretical models available in internet:

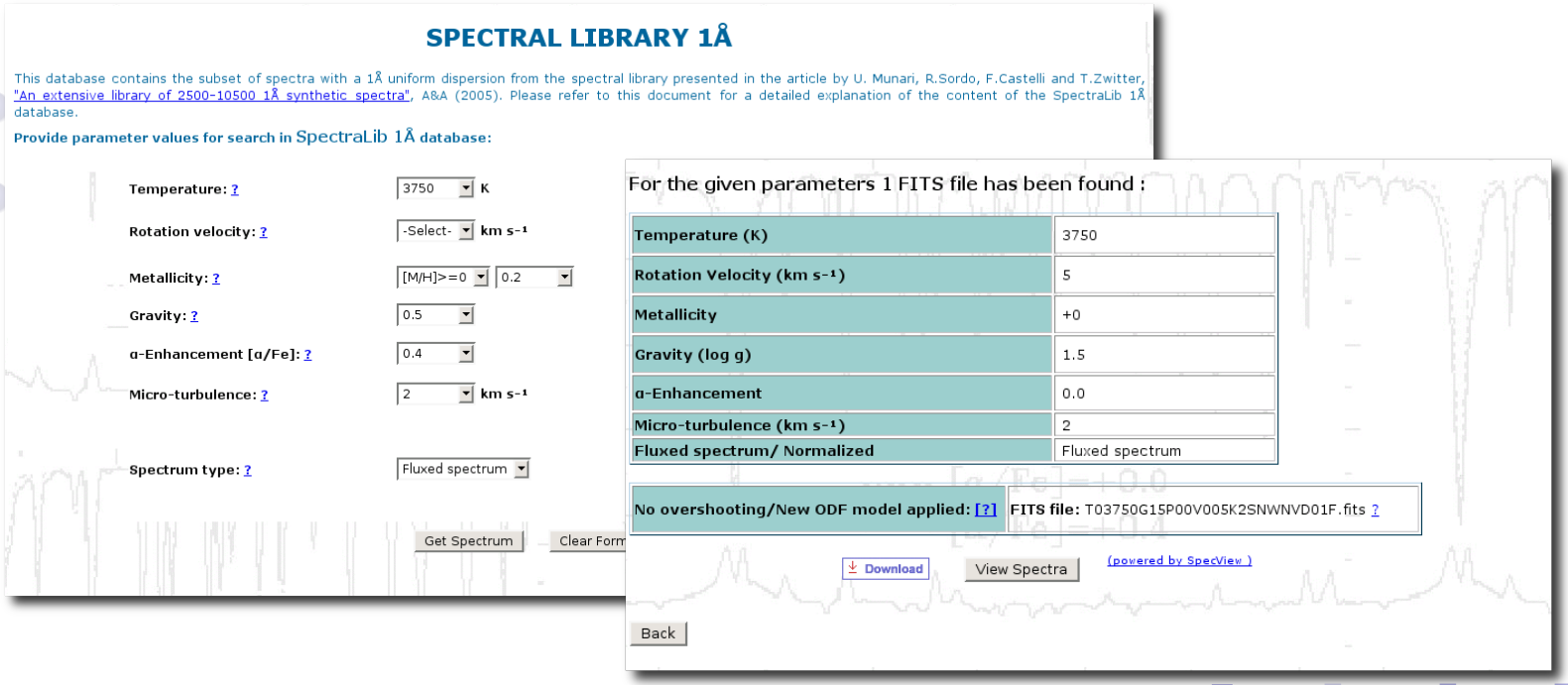
- as a collection of files
- search form $\longrightarrow$ file

- ASCII or FITS files
- special data format for each model

Theoretical Models not in VO

Theoretical models available in internet:

- as a collection of files
- search form → file



Theoretical Models not in VO

Theoretical models available in internet:

- as a collection of files
- search form $\longrightarrow$ file

- ASCII or FITS files
- special data format for each model

Theoretical Models not in VO

- It's difficult to **compare models** with each other and to compare them with observational data.
- It's difficult to **develop tools** that work with several different models.
- It's impossible to develop generic tools able to work with theoretical models **on-the-fly**.

Theoretical Models in VO

- Final aim: Full interoperability between observational and theoretical data.
- Efficiency
  - easier and faster to **compare models** with observations and with other models.
  - easier characterization
- Visibility
  - More people will have an **easier access** to the models.
  - The models will, eventually, be **more used** and referenced.

Theoretical models in VO?

- **VO protocols for observational data**
  - (ConeSearch, SIAP, SSAP,...)
  - are built around coordinates and/or real objects.
    - http://.../ssap.jsp?POS=336.5228,-48.43854&SIZE=0.2
  - **Not valid for theoretical models.**

Theoretical models in VO?

- **A theoretical model:**
  - Is not related with a real object or with spatial coordinates.
  - Is defined by a set of parameters and the allowed values for each of them.
  - Those parameters and values are not the same for different models.
  - Even models describing similar physics are often characterized using different types of parameters.

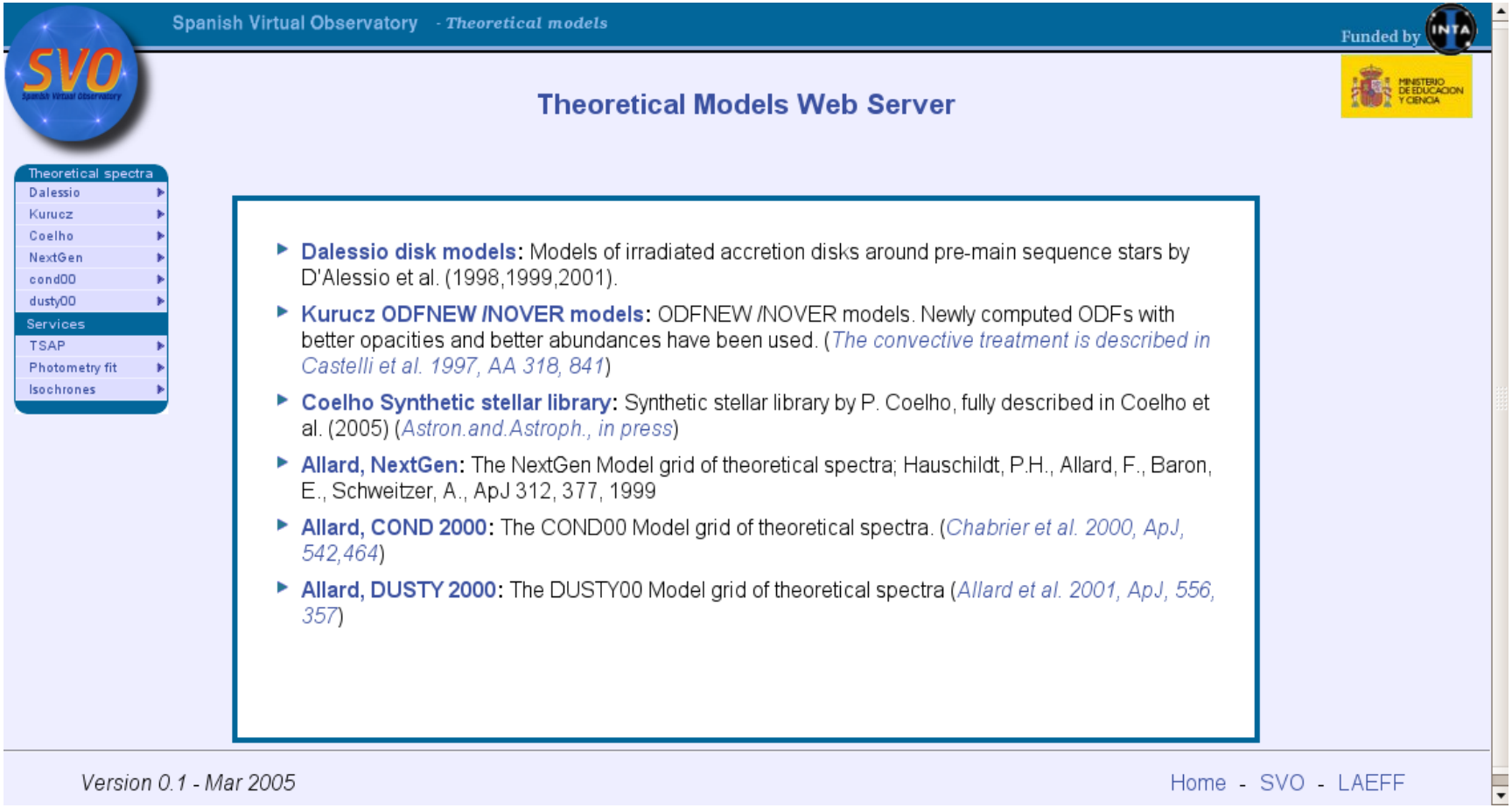
Theoretical models in the VO

- **Theoretical spectra: TSAP**
  - Included in the SSAP standard (use case for theoretical spectra)
  - A simple protocol.
  - Dialog server-application.
  - Easy to develop.

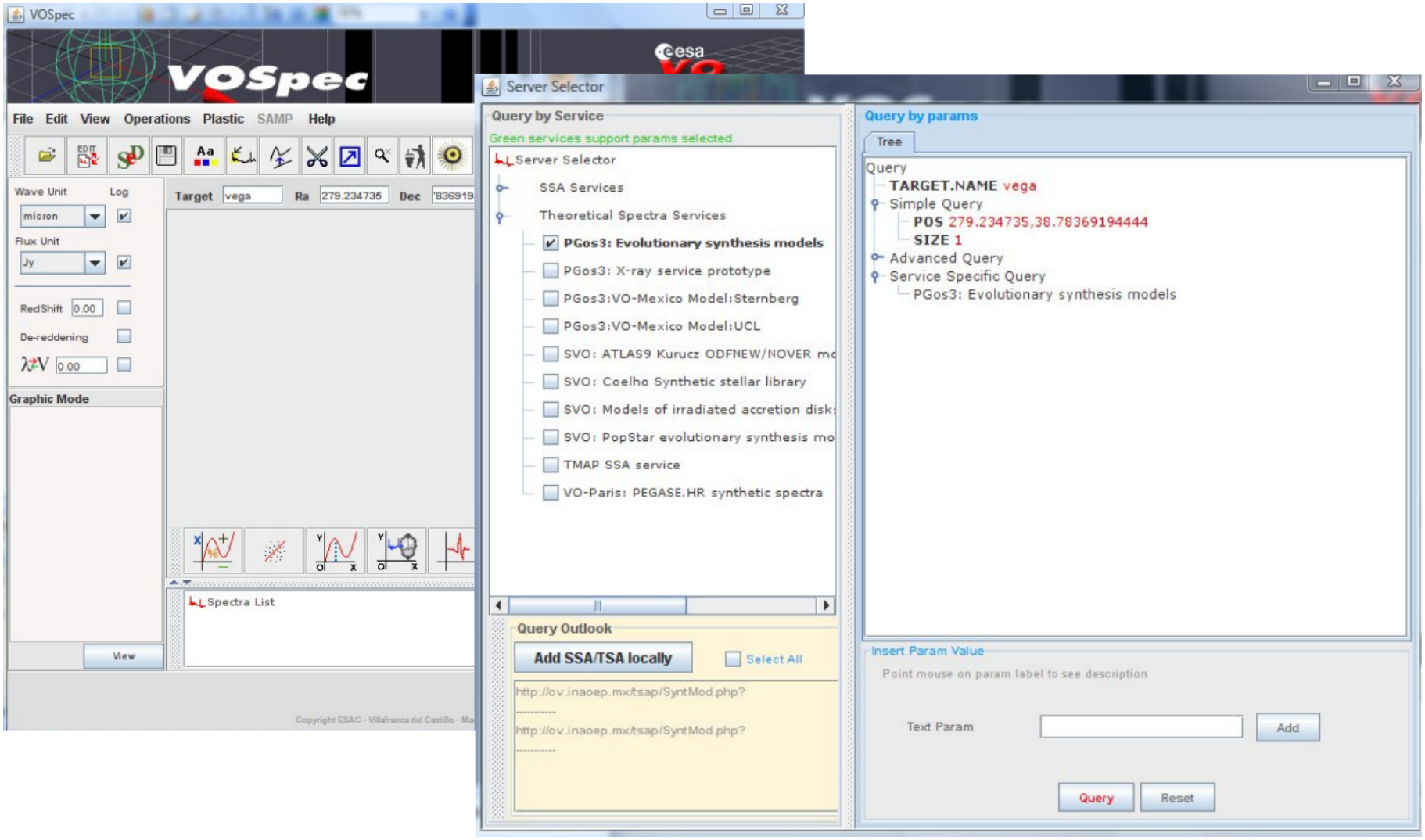
TSAP: a working protocol

- **Servers** of theoretical models with TSAP
  - LAEFF, Pgos3(Mex), PEGASE, etc
  - Kurucz, NextGen, COND, DUSTY, PEGASE, Dalessio, etc...
- **Applications** accessing TSAP services
  - VOSpec
- **Analysis** tools
  - VOSed, VOSA
- **Science** with VO using TSAP
  - SED analyzer for the case of Collinder 69 (Bayo et al 2008)

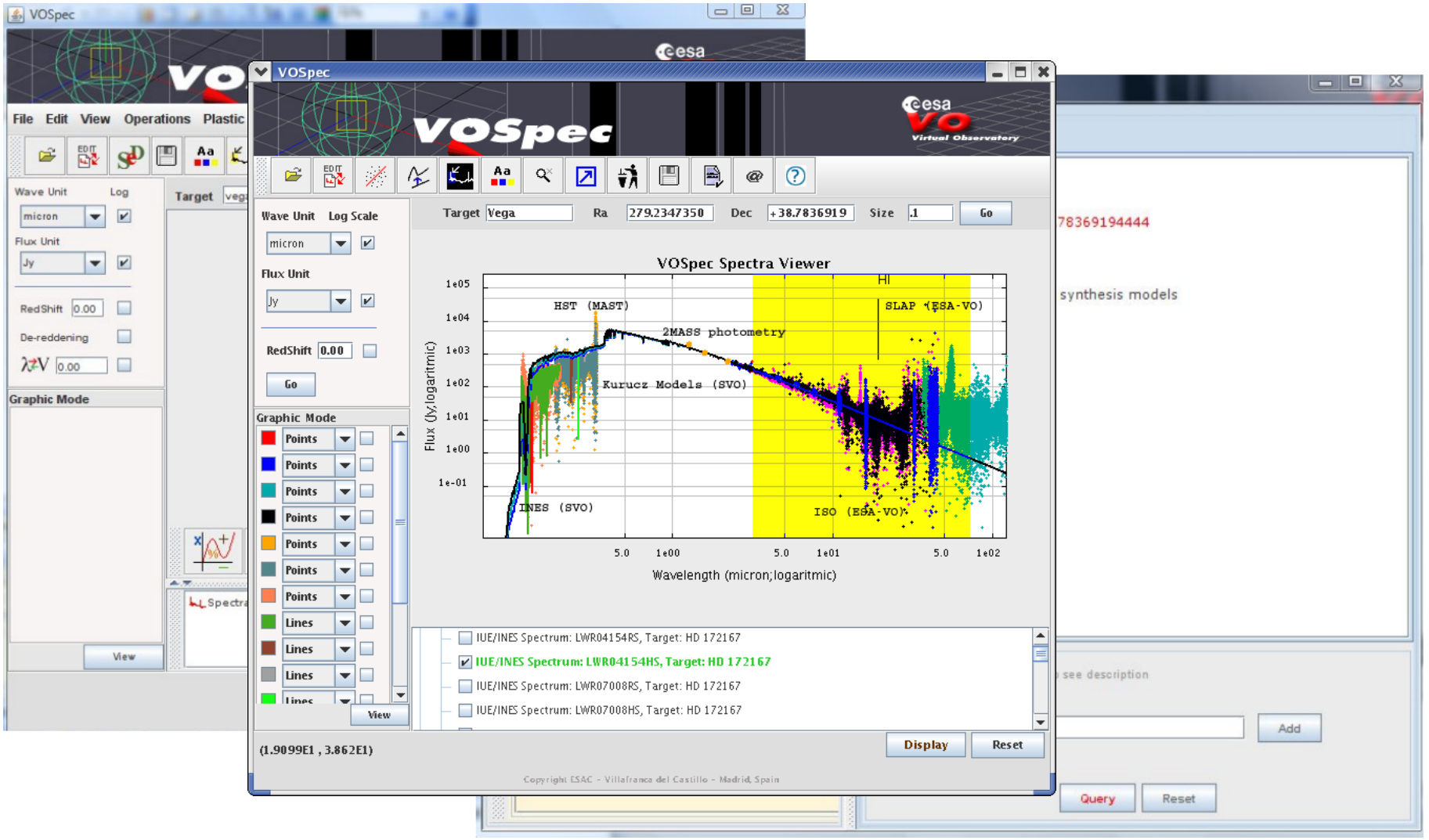
TSAP Server (LAEFF)



Using TSAP: VOSpec



Using TSAP: VOSpec



TSAP in real life: VO-Science

A&A 492, 277–287 (2008)
DOI: 10.1051/0004-6361:200810395

Astronomy & Astrophysics

VOSA: virtual observatory SED analyzer

An application to the Collinder 69 open cluster⋆

A. Bayo[1,2], C. Rodrigo[1,2], D. Barrado y Navascués[1,2], E. Solano[1,2], R. Gutiérrez[1,2], M. Morales-Calderón[1], and F. Allard[3]

[1] Laboratorio de Astrofísica Espacial y Exoplanetas, Centro de Astrobiologia (LAEFF-CAB, INTA-CSIC), European Space Astronomy Center (ESAC), PO Box 78, 28691 Villanueva de la Cañada, Madrid, Spain
e-mail: abayo@laeff.inta.es
[2] SVO Thematic Network, Spain
[3] Centre de Recherche Astronomique de Lyon (CRAL), École Normale Supérieure de Lyon, 69364 Lyon, France

Received 16 June 2008 / Accepted 1 August 2008

More general protocols for theory

(under development)

- **SimDB/SimDAP**.
  - Complex data model + protocol.
  - Designed for 3+1 (“cosmological”) simulations.
  - In the process to be extended to microsimulations.
- **S3**.
  - Same approach than TSAP.
  - Designed for microsimulations.
  - A simple protocol.
- Trying to converge.

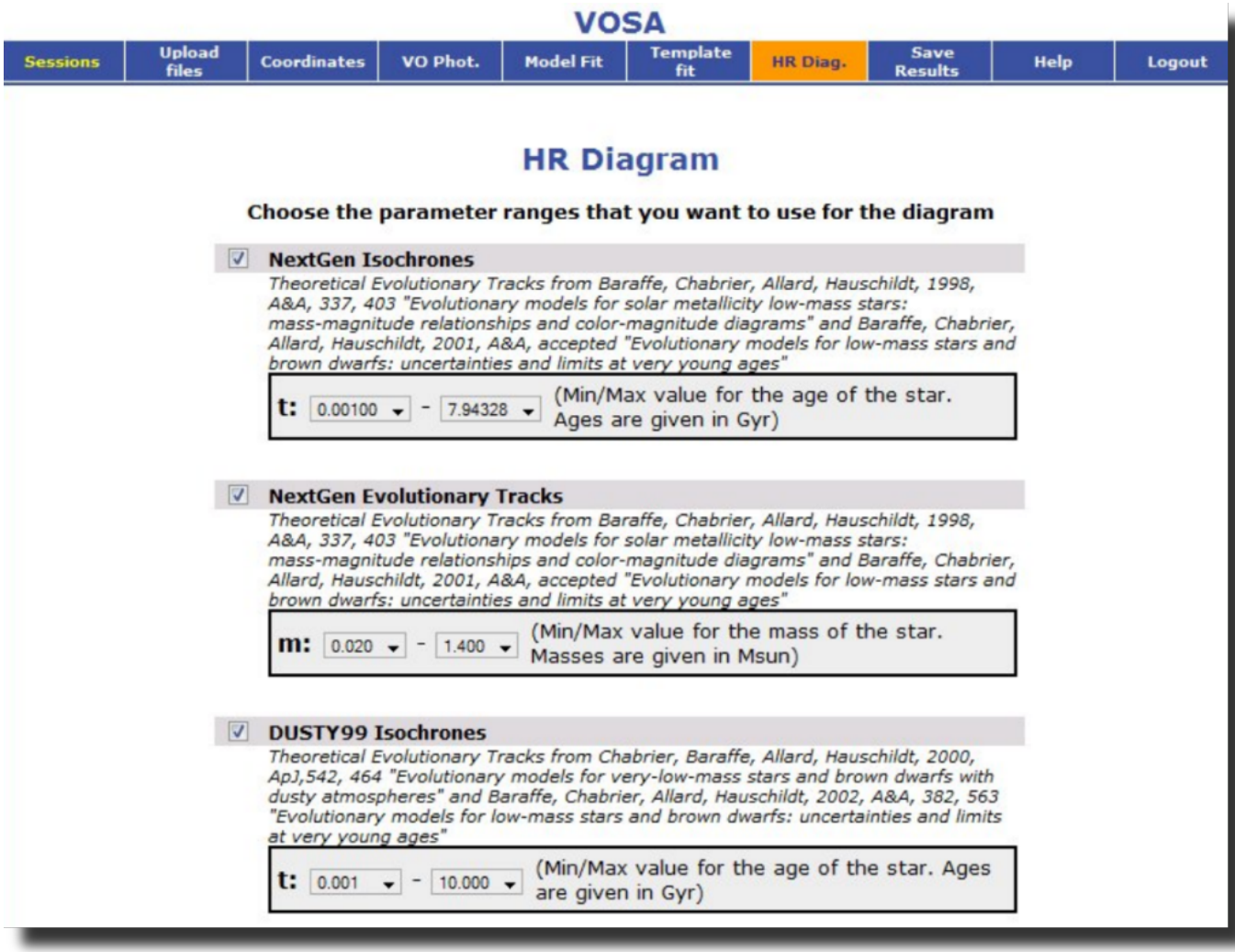
Using SimDB/SimDAP

- Cosmological simulations
  - Prototypes for GalMER, Horizon
- PDR simulations
  - Test implementation of Meudon PDR code
- Isochrones/evolutionary tracks
  - BaSTI
- Visualization tools
  - VisIVO

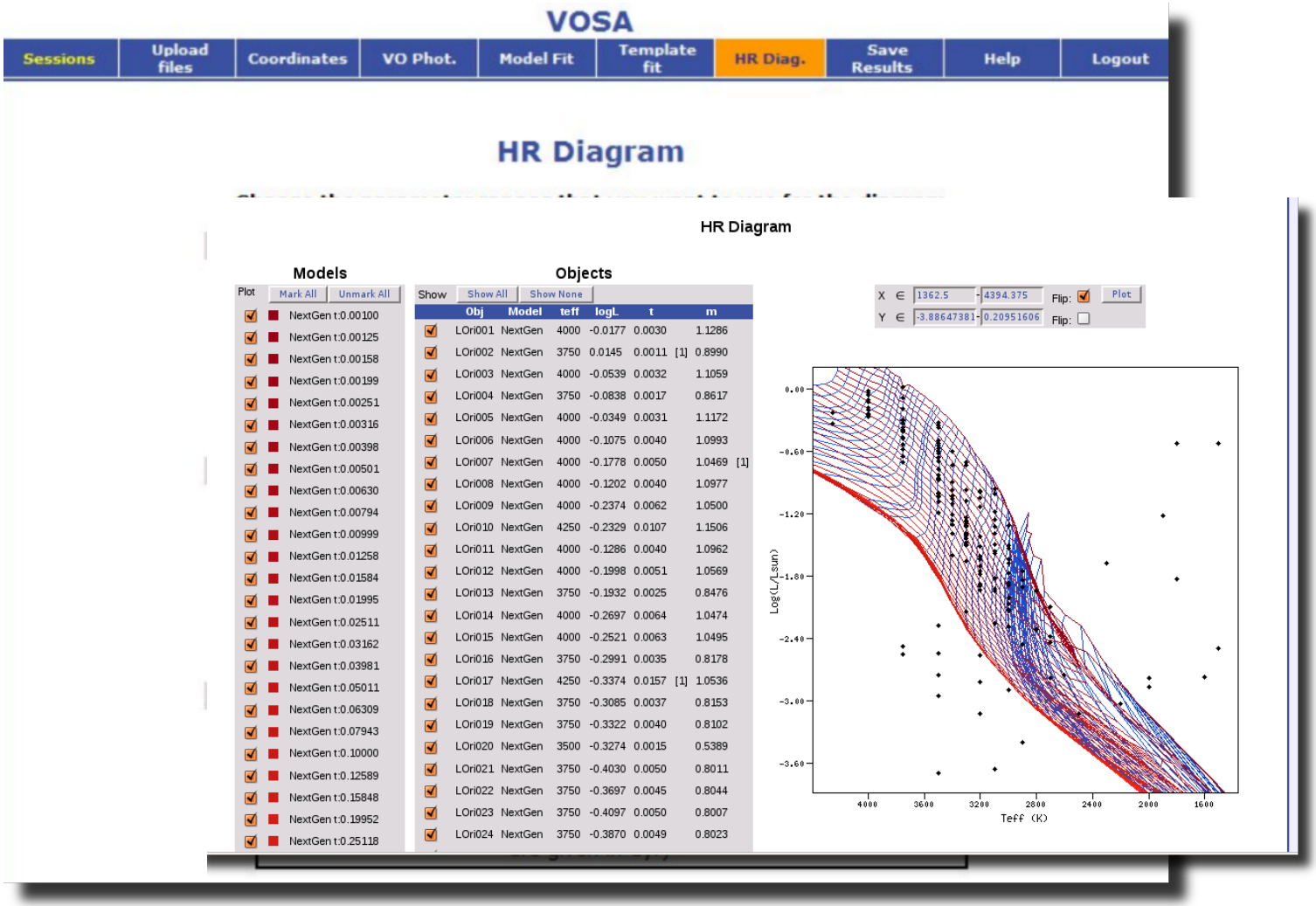
Using S3

- Servers for isochrones and evolutionary tracks
  - NextGen, COND, DUSTY, Siess (SVO)
  - BaSTI (IVO)
- Synthetic photometry for diferent models
  - NextGen, COND, DUSTY, Kurucz...
- Analysis tools using S3 data
  - VOSA
- Astrosismology models
  - *in progress*

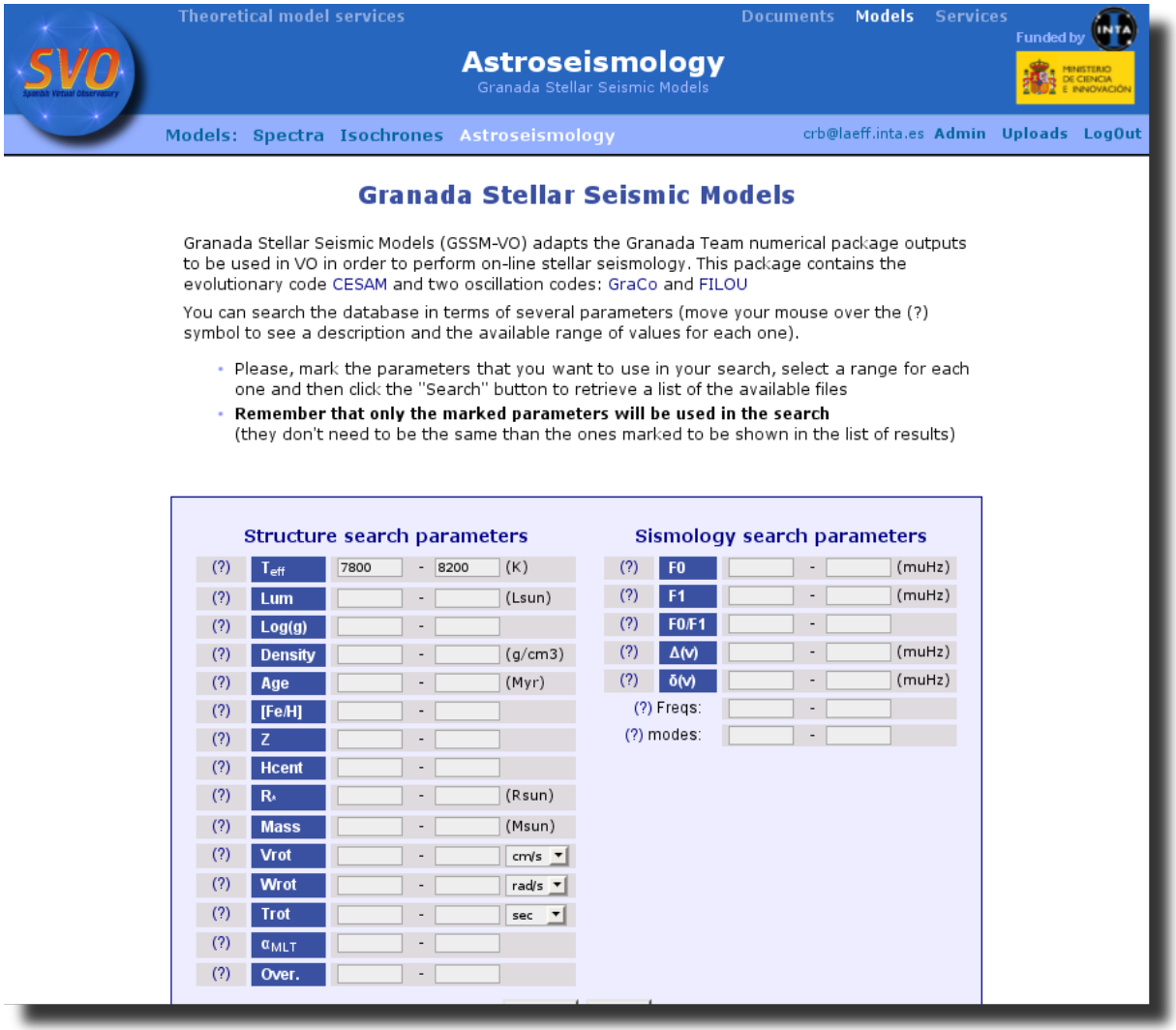
Using S3: VOSA



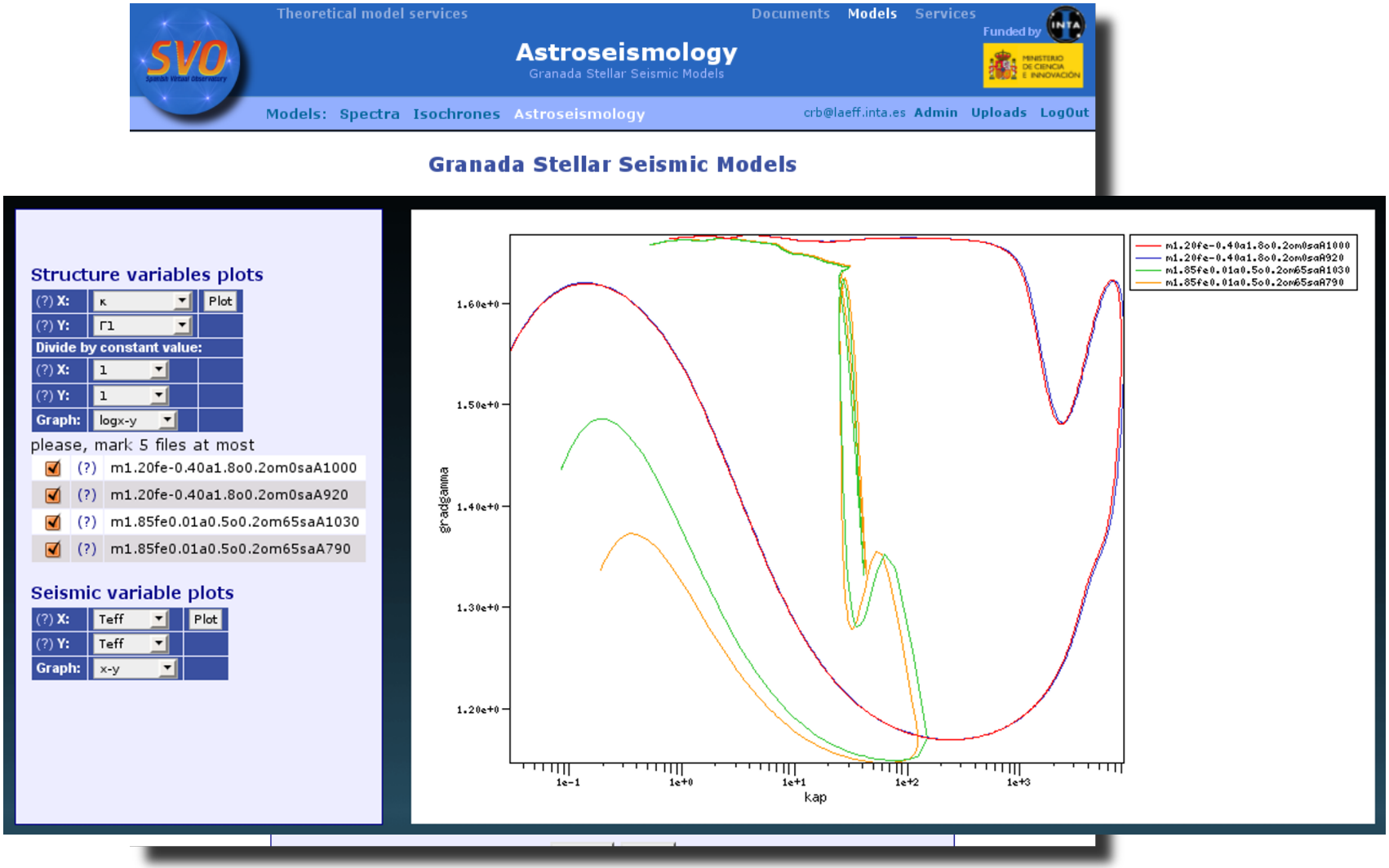
Using S3: VOSA



Using S3: Astroseismology



Using S3: Astroseismology



Using S3: BaTSI

Micro-simulations inside the VO: the BaSTI case

P. Manzato(1), M. Molinaro(1), F. Gasparo(1), F. Pasian(1), A. Pietrinferni(2), S. Cassisi (2), C. Rodrigo(3), M. Cerviño(4), E. Solano (3)
INAF - SI / Trieste Astronomical Observatory; (2) INAF – Teramo Astronomical Observatory; (3) LAEFF-INTA / Spanish VO; (4) Instituto de Astrofísica de Andalucía – CSIC / Spanish VO

S3P (Simple Self-Described Service Protocol) implementations

In collaboration with SVO (the Spanish Virtual Observatory) we presented S3P in the last IVOA Interoperability Meeting. S3P (Simple, Self-described Service) is a protocol oriented to handle theoretical data in the VO framework. It is based in the ability of the data server to describe itself in a simple standardized way.
This is a step by step protocol:
1 step: the service described it self (input and output parameters);
http://myservice.com/s3.php?format=metadata
2 step: http query and response in VOTable format;
http://myservice.com/s3.php?param1=value1&param2=value2...
3 step: retrieve the simulated files of interest via http GET;
http://myservice.com/s3.php?id=12

We developed two prototype implementations of S3P for BaSTI: one for isochrones and one for tracks:
http://albione.oa-teramo.inaf.it/PHPmetadata/BaSTIisochron.php?format=metadata
http://albione.oa-teramo.inaf.it/PHPmetadata/BaSTItrack.php?format=metadata


ITVO Theoretical Data Access Service: BaSTI Isochrones searching
For further information on PARAM(s) and FIELD(s) see: "http://wwwas.oats.inaf.it/IA2/index.php?option=com_wrapper&Itemid=87"

Param	UCD	Description
INPUT:age_min	*time.age*	Min. age of the isochron in Gyr (min value 0.03 Gyr)
INPUT:age_max	*time.age*	Max. age of the isochron in Gyr (max value 19 Gyr)
INPUT:meta_min	*phys.abund.Z*	Min. mass fraction of the initial heavy elements abundance for stellar isochron model (min value 0.0001)
INPUT:meta_max	*phys.abund.Z*	Max. mass fraction of the initial heavy elements abundance for stellar isochron model (max value 0.4)
OUTPUT:age	*time.age*	value for the stellar Age for the model. Age is given in Gyr
OUTPUT:meta	*phys.abund.Z*	value of mass fraction of the initial heavy elements abundance for the model.
OUTPUT:[M/H]	*phys.abund.Z*	The metal abundance in the spectroscopic formalism.
OUTPUT:[Fe/H]	*phys.abund.Fe*	The iron abundance in the spectroscopic formalism.
OUTPUT:Y	*phys.abund.Y*	value of mass fraction of the initial helium abundance. Actually calculated as Y = 1.44*(Z-0.0001).
OUTPUT:MassLoss	*phys.mass.loss*	value of mass loss according to the Reimers (1975) law.
OUTPUT:title	*VOX:Image_Title*	Title.

THANK YOU!