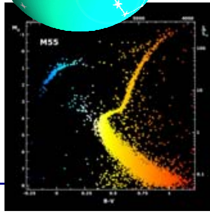
IVOA-Theory
Micro-Simulations



BaSTI:
database and queries
for stellar evolution models

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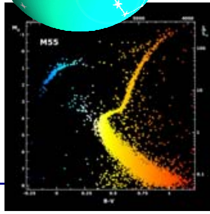
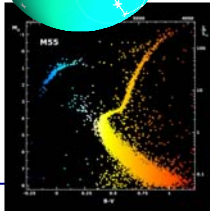


The Italian Theoretical Virtual Observatory

as a test-bed for the inclusion of theory and related tools in the VO

- ITVO project:
  - is develop under EuroVOTECH and EuroVO-DCA WP4 and WP5 and it deals with cosmological and stellar models
- Things to do:
  - Standard format (VOTable and/or FITS binary table)
  - Standard Access Protocol
  - Web services for theoretical data, also using the Grid infrastructure;

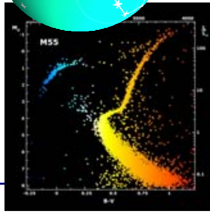
The aims



- Store the theoretical metadata inside a relational DB to allow an easy search of these data on multiple choice of parameters;
- public theoretical data (inside a Registry) so to reuse expensive data in term of CPUs time, like cosmological simulations or output of stellar evolutionary code;
- permit an easy comparison between observational and theoretical data, using the same tools and services for both kind of data (married the VO philosophy);

Information produced by stellar evolution model

(slide by S. Cassisi)



The evolutionary stellar models provide:

- Evolutionary lifetimes ⇒ Star counts

- Bolometric luminosity
- Effective temperature
- Mass – different than the initial one (!)

Gravity

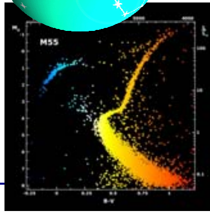
T_{eff}

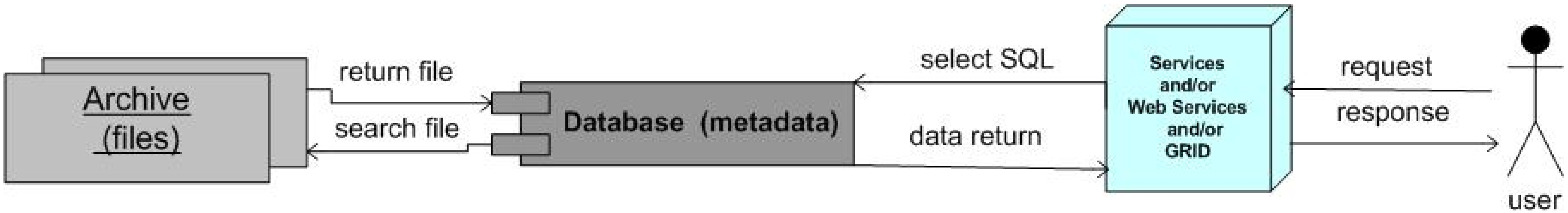
Bolometric correction(s)
+
color-T_{eff} relations

Magnitudes & Colors

- Surface chemical composition predictions ⇒ spectroscopy
- Nuclear yields

Archives + DBs + services



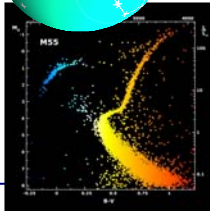


- Archives contain the output files of the simulation;
- Databases contain the metadata of the simulation that should include all the parameters to perform the running not only the physical ones;
- Data access: it could be performed via Web Portal or Web services or in future via Grid infrastructure also creating on demand new simulated data.

Stellar evolutionary computations are extremely time consuming

They are perfecly suited for running on "distributed computing facilities" (GRID)

Uses cases of stellar models

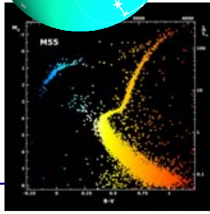


These model are important for:

- testing the “physics” in the regime of high density/low temperature;
- Investigating the IMF in various environments;
- Simulated evolutionary tracks and isochrones;
- Simulated the HB for sampling different evolutionary phases and study pulsating stars;
- Study M/L relation and M/R relation and confrontation with observational data;
- Optical photometric bands / near –infrared one;
- Comparison with star clusters, binary systems;
- Study fundamental ingredient for populaion syntesis;
- Analyze the integrated magnitudes, colours and spectra of composite stellar populations;

(informations taken from S. Cassisi VO-DCA WP4 talk)

The stellar theorists' wishes

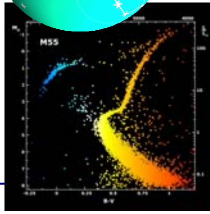


- **Easy "access" to physical inputs databases;**
  - Clear explanations of HOW the physical inputs have been computed;
  - Possibility to perform online computations by using user-specified conditions;
  - standard outputs;
- **Reliable color- Teff relations**
  - As many as possible different calibrations;
  - Possibility to perform online computations for the new photometric systems;
- **Direct access to other stellar model archives**
  - Information about the adopted inputs and physical assumptions;
  - User friendly access;
- **Direct access to suitable empirical constraints**
  - For clusters stars;
  - For single stars;

(informations taken from S. Cassisi VO-DCA WP4 talk)

The stellar model users' dream

(slide by S. Cassisi)



- Updated stellar models
- Accuracy
- Homogeneity
- Completeness
- Standardization
- "User friendly" access
- Online computational facilities

Helper Applications:

TOPCAT: tabular data & manipulation

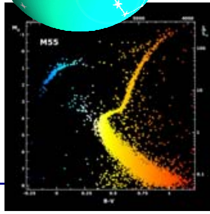
VOPlot: handling with VOTable data

Etc…

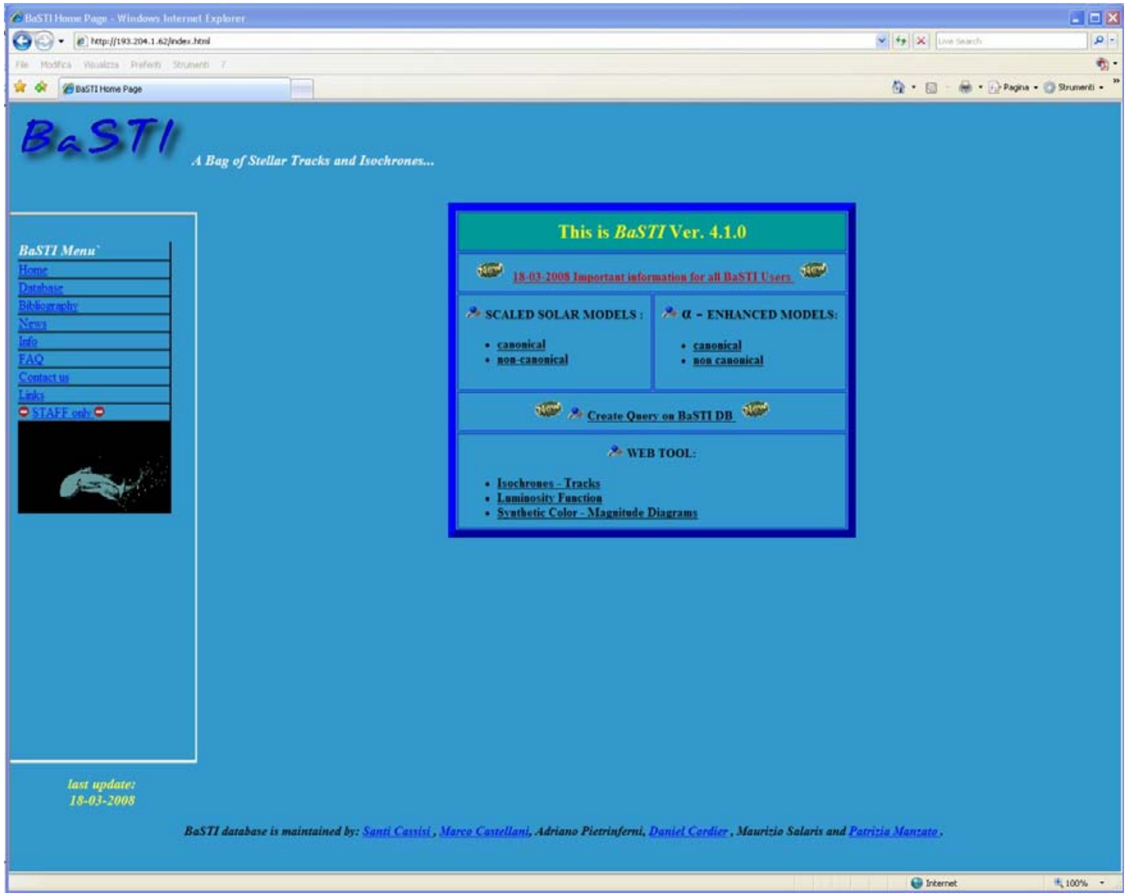
Tools to analyse and visualise end & intermediate data products

BaSTI

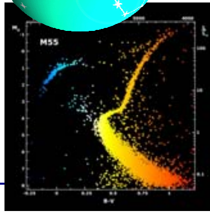
a Bag of Stellar Tracks and Isochrones



Web portal: http://albione.oa-teramo.inaf.it/



Stellar evolution archive



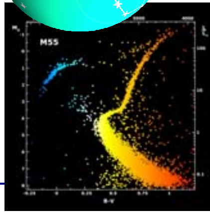
Stellar data

stellar evolution data computed using FRANEC code are stored into **BaSTI :**

- 32010 Isochrones;
- 17489 Tracks;
- 4438 HB (Horizontal Branch) –tracks;
- 121 ZAHB (Zero Age Horizontal Branch);
- 121 end-He (end Helium burning);
- 198 summary tables;

Stellar evolution model: the "building blocks"

(slide of S. Cassisi)



The Evolutionary Code

- Stellar structure equations
- Surface boundary conditions
- …numerics…

physical inputs

- EOS(eq. of state)
- Opacity
- Nuclear reaction Rates
- Neutrino energy losses

(in)famous unknown…

- Mass loss
- Dredge-up efficiency (AGB) .
- Impact of mixing on opacity

Mixing scheme

- Semiconvection
- Overshooting
- Breathing pulses
- Turbulence

Microscopic mechanisms

- Atomic diffusion
- Radiative levitation

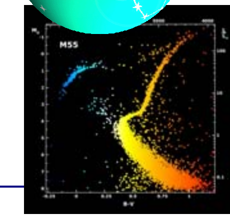
Magnetic field

Rotation & Rotational mixing

1st step: how maps these structure inside a relational DB

2nd step: …(discussion) it fit with the theoretical DM

Stellar evolution DB structure: BaSTI (A Bag of Stellar Tracks and Isochrones)



BaSTI Database

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FK1	ID_CHEMICAL	VARNUMERIC(600;0)
	TYPE	CHAR(40)
	MASS_LOSS	DOUBLE
	PHOT_SYSTEM	CHAR(150)
	HED_TYPE	CHAR(150)

CHEMICAL		
PK,I1	ID_CHEMICAL	VARNUMERIC(600;0)
	Z	DOUBLE
	Y	DOUBLE
	FE_H	DOUBLE
	M_H	DOUBLE

SCENARIO		
PK,I1	ID_SCENARIO	VARNUMERIC(150;0)
	SCENARIO_TYPE	CHAR(20)

OUT_FILE		
PK,I1	ID_OUT	VARNUMERIC(250;0)
FK4	ID_PROP	VARNUMERIC(600;0)
FK2	ID_SCENARIO	VARNUMERIC(150;0)
FK3	ID_PROG	VARNUMERIC(38;0)
	FILENAME	CHAR(100)
	PATH	CHAR(250)
	FILE_TYPE	CHAR(10)
	AGE	DOUBLE
	MASS	DOUBLE

PROGRAM_PARAM		
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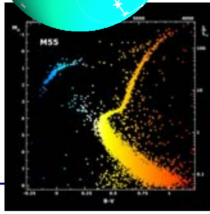
	VERSION	CHAR(10)
	EOS	CHAR(50)
	RAD_OPACITY	CHAR(150)
	COND_OPACITY	CHAR(150)
	NUCL_RATES	CHAR(150)
	NEUTRINO_LOSSES	CHAR(150)
	BOUNDARY_COND	CHAR(150)
	NOTE	CHAR(600)

UNITS		
PK,I1	TABLE_NAME	CHAR(50)
PK,I1	COLUMN_NAME	CHAR(50)
	UNIT	CHAR(100)

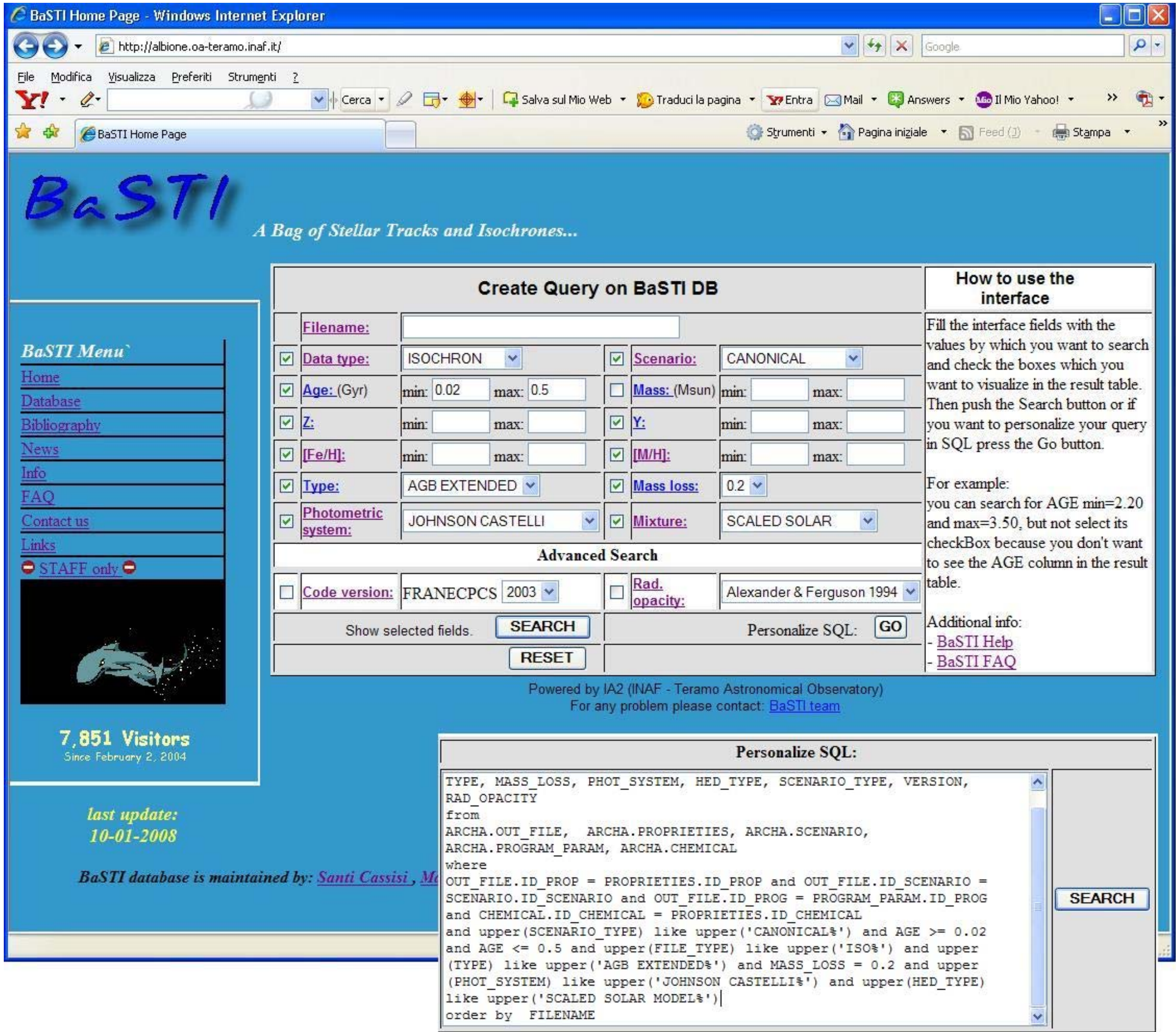
The 1st relational database for a large range of masses and initial chemical composition for stellar evolution models, obtained with FRANEC code.

DB contains 49939 rows in the OUT_FILE table.

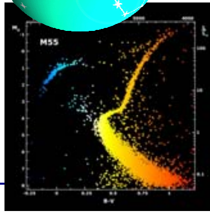
BaSTI web portal



- Query the stellar evolutionary DB;
- Personalized the SQL query;



Queries and access protocol



A simple access protocol to search stellar evolution files

- Tracks:
  - Mass;
  - Metallicity;
  - ….
- Isochrones:
  - Age;
  - Metallicity;
  - ….

These will be matter of discussion…..

Could we use a protocol like TSAP (SSAP for theoretical spectra)? (see Carlos Rodrigo talk)

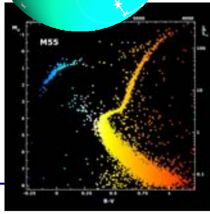
BaSTI tools – developed by OATeramo

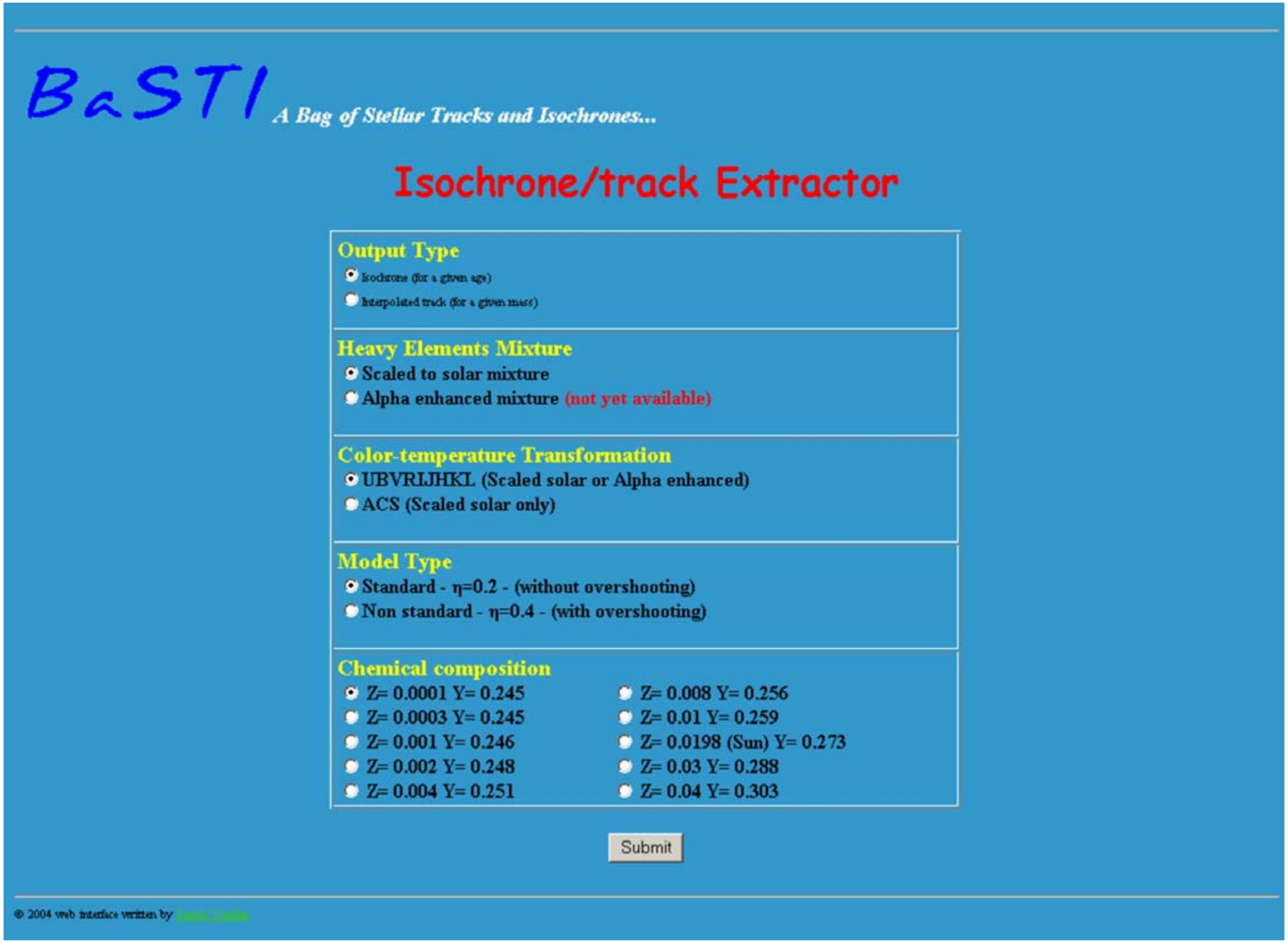
The tools will be transformed in web-services:

- Isochrones- tracks extractor;
- Luminosity function
- Syntetic color – Magnitude diagrams (stellar population synthesis program)

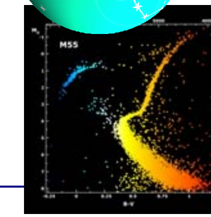
All is written in PERL.

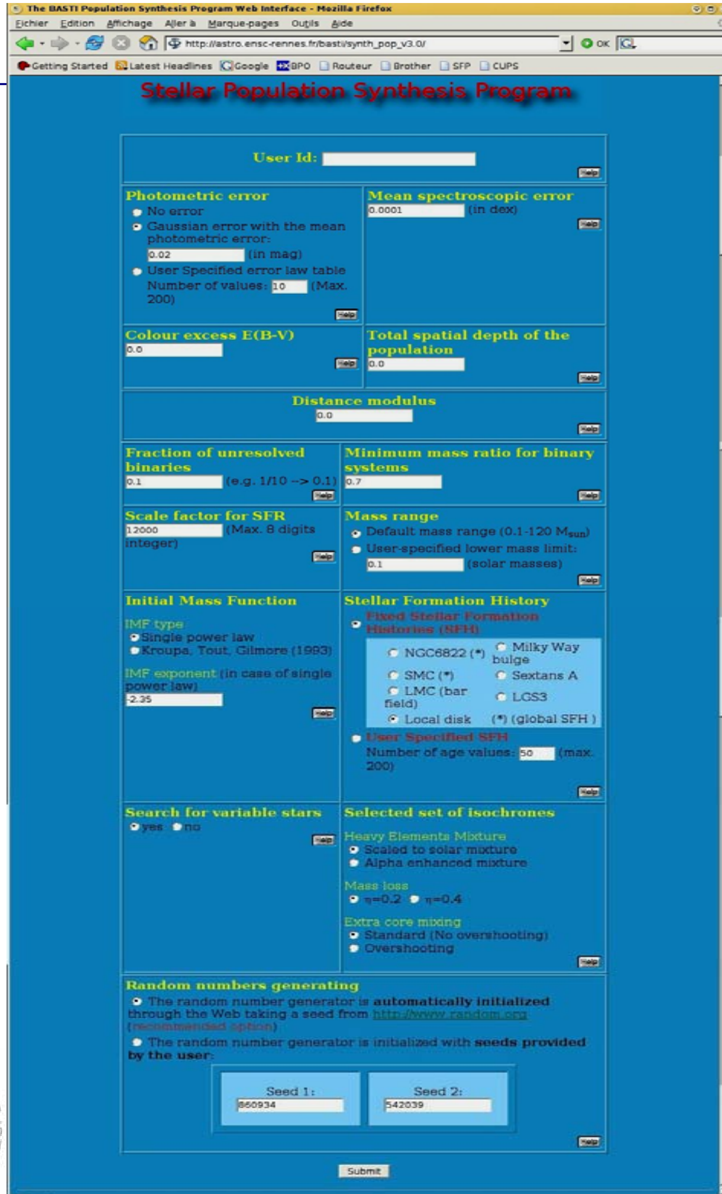
Tool: isochrone/track extractor

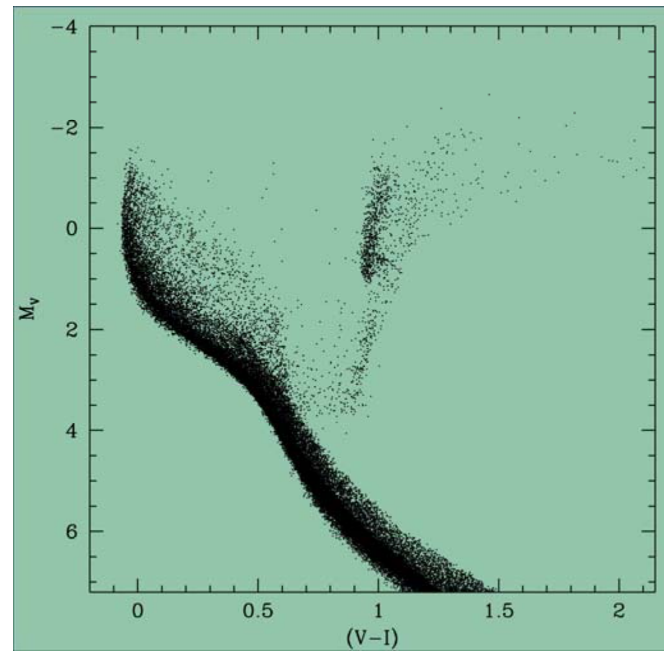




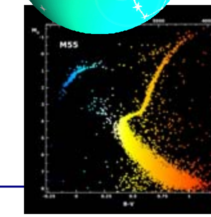
Synthetic Colour-Magnitude diagrams





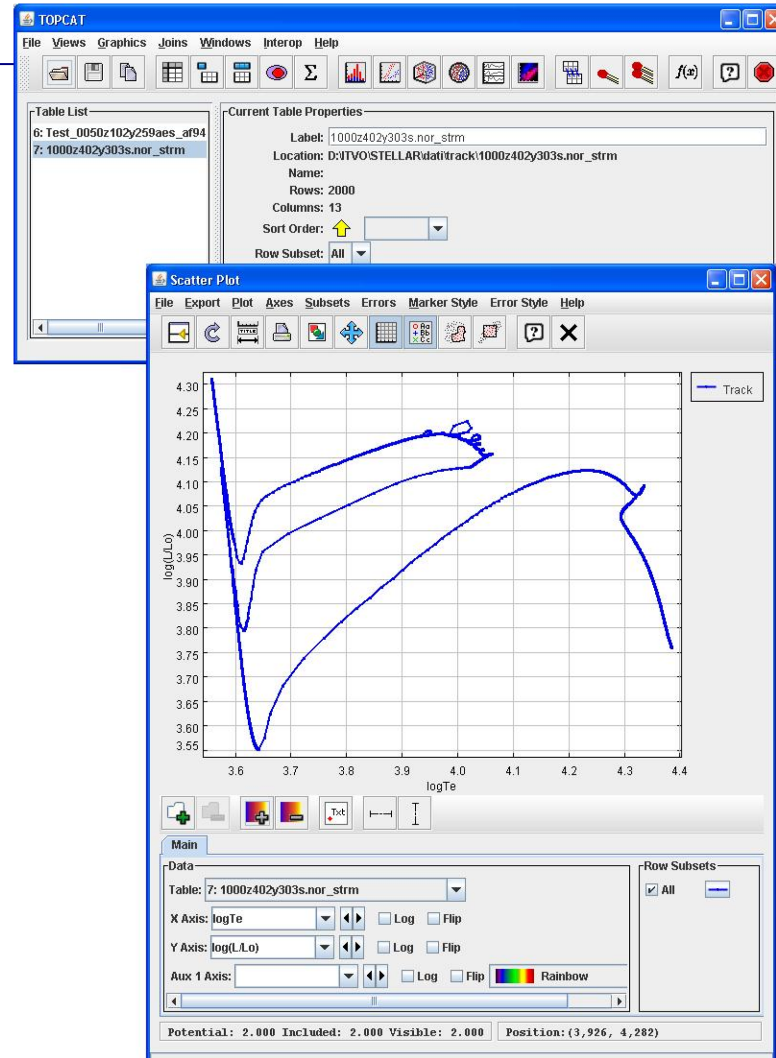


BaSTI and VO tool



The output of BaSTI is an **ASCII file** so the natural tool to analyze these data is TOPCAT.

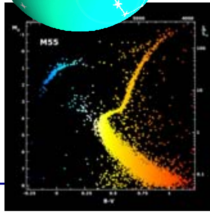
We trasform it in a **VOTable** (or **FITS-Table)**.

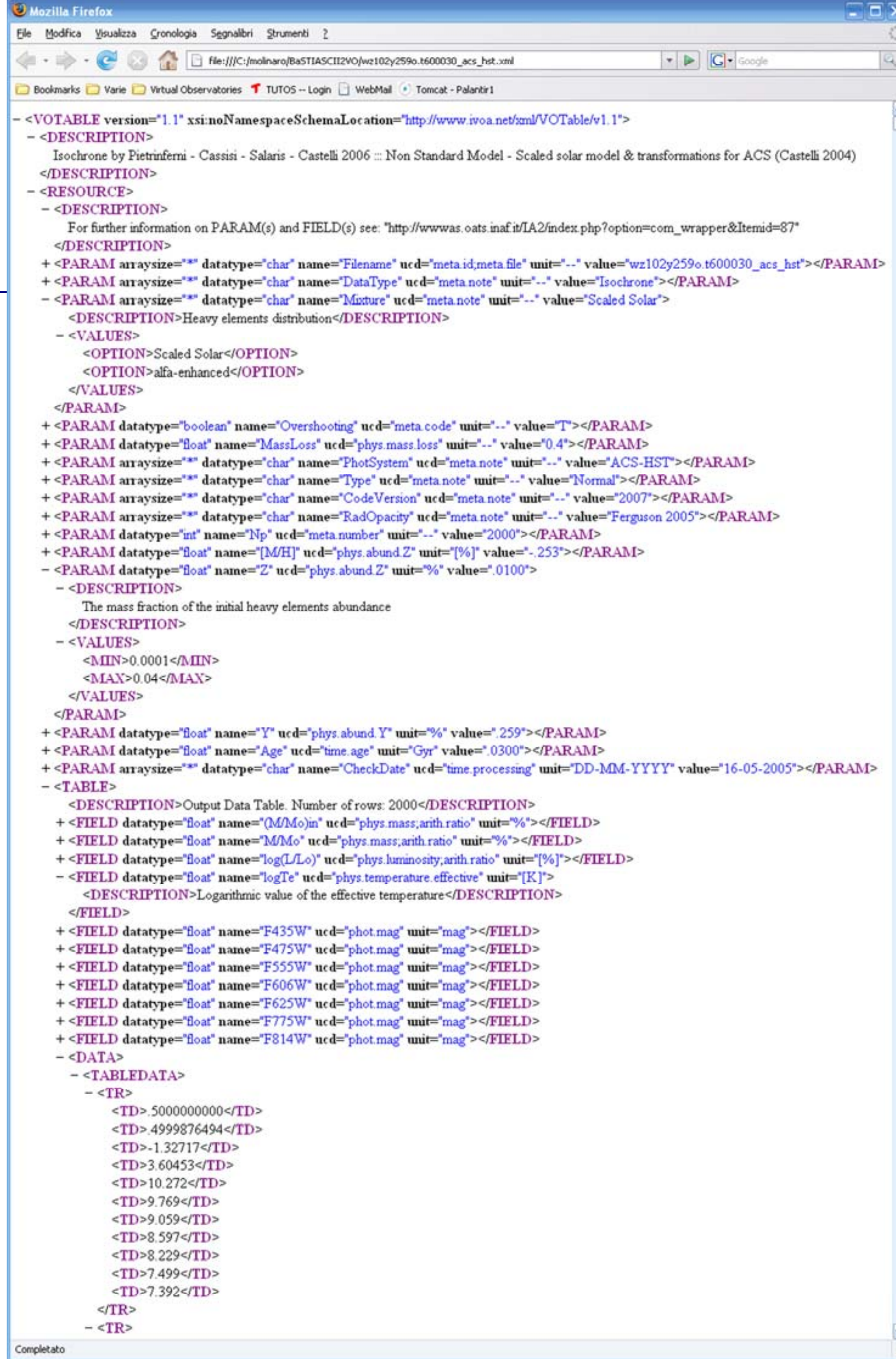


VOTable

Isochron ASCII file
trasform
in a VOTable

(thanks to M. Molinaro)



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  - <RESOURCE>
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      </PARAM>
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20/05/2008

…start the discussion

- Standard format;
- DM….
- Access protocol…
- …..