The IBIS solar spectro-polarimetric data Archive

IBISA

Ilaria Ermolli[1], Silvio Giordano[2], Fabrizio Giorgi[1], Vincenzo Guido[3], Alessandro Marassi[4], Antonio Volpicelli[2], Paolo di Marcantonio[4], Francesca Zuccarello[5]

[1]INAF-Roma, [2]INAF-Torino, [3]FGG-TNG, [4]INAF-Trieste, [5]INAF-Catania

Abstract

We review the efforts undertaken to set up an archive of ground-based solar spectro-polarimetric observations into the VO framework according to the SOLARNET standards as well as its web interface, by using IBIS data, SOAP/XML and RESTful Web Services and a Usage-Centered Design approach.

IBIS data

The **IBIS** (Interferometric BIdimensional Spectropolarimeter, Cavallini 2006, Solar Physics 236, 415) is a high cadence imaging spectro-polarimeter based on a dual Fabry-Perot interferometric system. Fig.1 summarises the instrumentl characteristics of the IBIS. The IBIS, which has been constructed by a consortium of Italian institutes, is installed at the Dunn Solar Telescope at NSO/Sacramento Peak, USA. The instrument allows for s**pectro-polarimetric observations of the solar photosphere and chromosphere at high spatial, spectral, and temporal resolution.**

Spatial Resolution	≤ 0.18 arcsec
Spectral Resolution	212 000 – 274 000
Temporal Resolution	3 images s^{-1}
Field of View	45 x 85 arcsec
Operating Range (λ)	2800 Å (5800 – 8600 Å)
Available Wavelengths	5896 Å Na D1 6302 Å Fe I 7090 Å Fe I 7224 Å Fe II 8542 Å Ca II
Range Width	2.0 Å (5800 Å – 7500 Å) 3.5 Å (7500 Å – 8600 Å)
Exposure Time	7 – 18 ms

Figure 1. IBIS instrumental characteristics.

A **typical IBIS data set** consists of measurements taken in sequence over 3 spectral lines (e.g. 6302 Å, 6173 Å, and 8542 Å); each line is sampled at several spectral points (e.g. 30, 24, and 25), each point at six polarimetric states (I+Q, I-Q, I+V, I-V, I+U and I-U), for a total of **many data** (e.g. 349 images, 1000 x 1000 pixel each, in 67 sec).

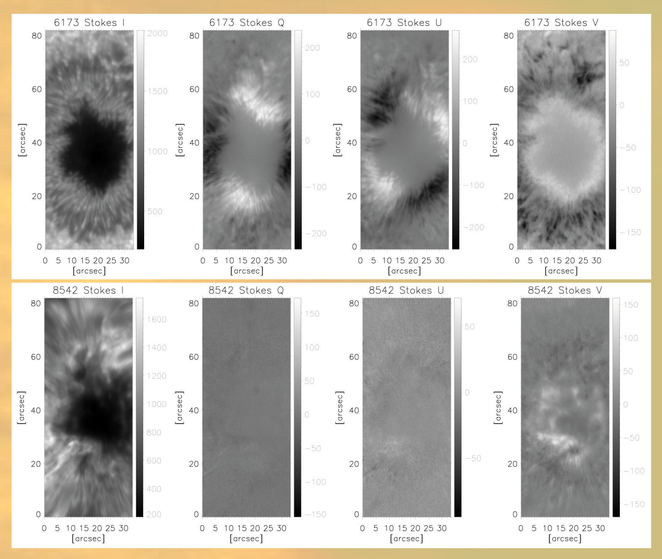

Figure 3. Example of the photospheric (top) and chromospheric (bottom) data acquired on 20 May 2016 on a large sunspot in active region NOAA 12546.

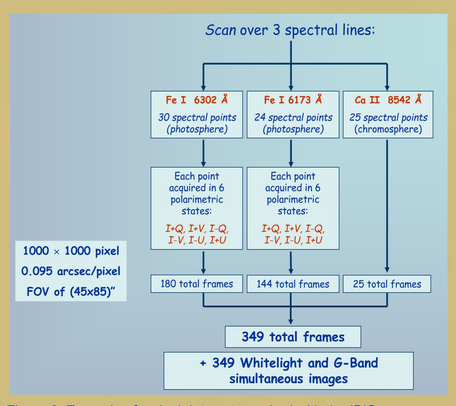

Figure 2. Example of typical data set acquired with the IBIS.

At present, the **IBIS archive includes 5.15 Tb** of data taken during 5 observing campaigns carried out from 2012 to 2016 on 22 days. Find in Fig. 3 some examples of IBIS data.

IBIS-A using Django-Python Framework

IBIS-A is a new MySQL archive to access IBIS data. It is powered by **Django 1.9.1**, which is a free and open-source web framework written in Python. Django allows to create dynamic high-security web applications; its high-level Python Web framework encourages rapid development and clean, pragmatic design. We used its object-relational mapper to model the layout of the IBIS-A DB, as shown in Fig. 4.

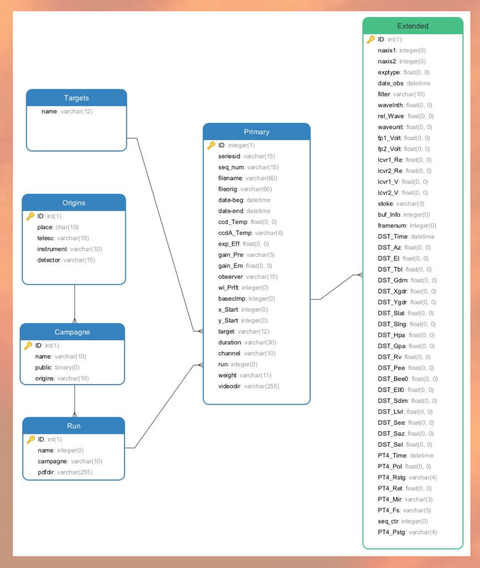

Figure 4. Entity-Relationship Model of the IBIS-A database.

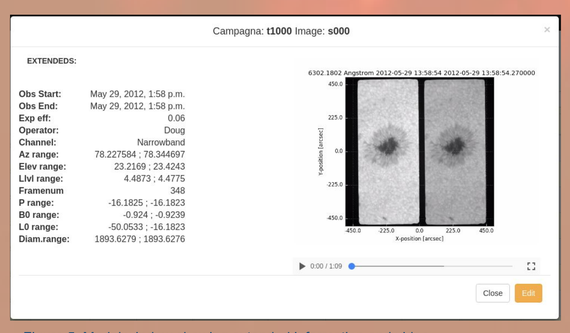

Figure 5. Modal window showing extended information and video.

The **DB query** allows to search data depending on e.g. solar target, disc position, observational mode, date range. Fig. 6 shows an example of the results from a DB query.

A **Python script** allows to ingest the data into the DB, and to create h.264/mp4 **movies for all the managed data** (see e.g. Fig. 5). The movies are created for quick look purposes by using the 2D plotting library Matplotlib version 1.5.2.

Figure 6. Example of the results from a database query. The log file of the observations is available for download as PDF.

IBIS-A integration into the SOLARNET Archive

The IBIS-A is realised in the framework of the **FP7 SOLARNET High-resolution Solar Physics Network** that aims at integrating the major European infrastructures in the field of high-resolution solar physics, as **a step towards** the realisation of the **4m EST European Solar Telescope**. SOLARNET WP50.3 is centered on the setup of a the SOLARNET Virtual Observatory Prototype (SVO) archive of high resolution solar data acquired with the current most advanced instrumentation. The integration of the IBIS-A into the SOLARNET-SVO is work in progress.

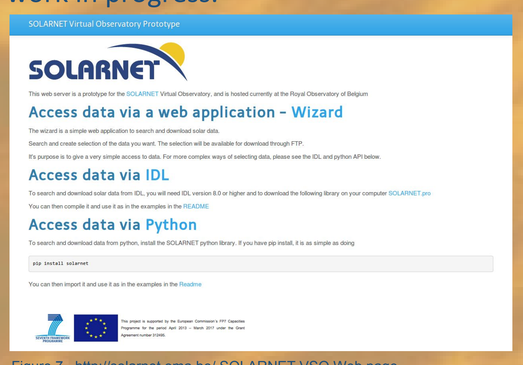

Figure 7. http://solarnet.oma.be/ SOLARNET VSO Web page.

The **SVO archive** was designed as a searchable database of all the meta-data available from the observations, allowing for cross database searches (Fig. 7). The data will be made available through the Representational state transfer (REST) protocol making it accessible through the SVO web app, IDL, Python based technology stack (Fig. 8). Efforts are spent to make the **meta-data produced** by the different telescopes **as uniform as possible** by using the most generally accepted standards available (e.g. FITS standards such as the World Coordinate System).

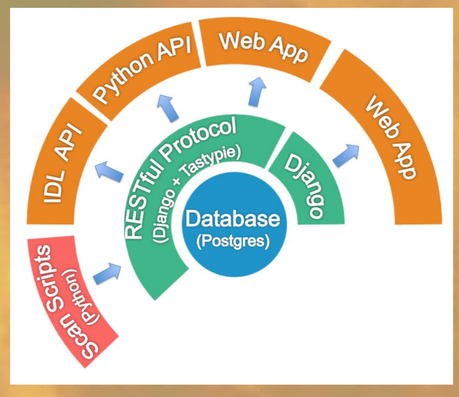

Figure 8. SOLARNET Data access structure.

Future steps: US-VSO and pre-EST

Coming soon also the **integration of IBIS-A into the US-VSO Virtual Solar Observatory** that allows users to search data in several archives of solar ground- and space-based observations. The US-VSO user can search data across multiple instruments and events. We are ready with all SOAP web services required for the IBIS-A integration into the US-VSO. Future work will also include refinement of current IBIS-A web interfaces by using an Usage Centered Design approach.

This work is carried out as a step towards the realisation of the data archive of the 4m EST European Solar Telescope (*www.est-east.eu*).

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