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# IBIS-A: The IBIS Solar Spectro-polarimetric Data Archive

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**Abstract.** We review the efforts undertaken to set up the archive of the IBIS ground-based solar spectro-polarimetric observations into the VO framework, according to the SOLARNET standards, by using SOAP/XML and RESTful Web Services.

## 1. IBIS-A: The IBIS data Archive

The IBIS data Archive (IBIS-A hereafter) contains data acqiured with IBIS (Interferometric BIdimensional Spectropolarimeter), an imaging spectro-polarimeter based on a dual Fabry-Perot interferometric system (Cavallini 2006). IBIS allows spectro-polarimetric observations of the solar photosphere and chromosphere at high spatial (pixel scale of 0.09 arcsec), spectral (> 200000), and temporal resolution (8-15 fps). A typical IBIS data set consists of measurements taken in sequence over multiple spectral lines (e.g. Fe I at 6302 Å and 6173 Å, and Ca II at 8542 Å); each line is sampled at several spectral positions (e.g. often between 10 and 30), each position at six polarimetric states (I+Q, I-Q, I+V, I-V, I+U and I-U). Therefore, a single scientific observation consists of many data (e.g. hundreds of image files, 1000 x 1000 pixel each, with variable cadence).
The IBIS-A has been designed to realize the storage, the management, and the retrieval of the IBIS data. Currently, IBIS-A includes 7.7 TB of data taken during 8 observing campaigns carried out from 2012 to 2016 on 39 days.
The raw data in FITS format derived from the observations are transferred and stored on a RS24S3 SuperNAS server (96 TB, 64 GB Ram, 2 CPU Haswell 4C E5-2623V3 3G) at the INAF Osservatorio Astronomico di Roma, following the data definition and file arrangement given at the telescope.

The metadata of the stored files are ingested into a MySQL[1] database (DB hereafter), by using a Python application that allows to perform the two following operations: 1) extract the metadata from the FITS headers and insert them into the DB, 2) create h.264/mp4 movies for all managed data. We used the object-relational mapper of Django (version 1.9.1) to model the layout of the IBIS-A DB, as shown in Figure 1.

[1]`https://www.mysql.it/`

Movies for quick look purposes are created by using the 2D plotting library Matplotlib (version 1.5.2)[2].

The IBIS-A user interface is a HTML/Javascript based web page to allow simple queries. Figure 2 shows the interface that allows to search data according to various criteria: solar target, disc position, observational mode, data range; criteria can be combined in order to refine searches. Based on the metadata stored on the IBIS-A DB, the data search dynamically generates a HTML page with information about the available data. This task is accomplished by using the Django template language (DTL). The products of the data search also include movies and plots of the atmospheric seeing during observations (Figure 3), as basic information to allow users to assess the data quality.

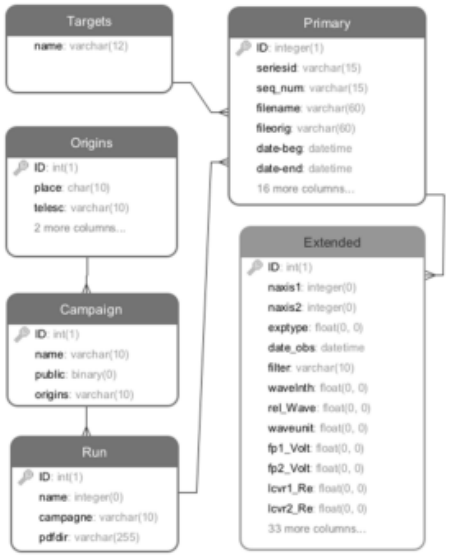


Figure 1. Entity-Relationship model of the IBIS-A DB.

Browsing the IBIS-A does not require authentication, but users have to register and log-in in order to be able to request and download data. Principal Investigators of proposals for IBIS observations have exclusive access to their data for the duration of a proprietary period, normally of one year, after which the data becomes available to the community at large.

## 2. Future steps

The IBIS-A is realised in the framework of the FP7 SOLARNET[3] 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[4] European Solar Telescope (Collados et al. 2010, 2013). SOLARNET WP20.3 and WP50.3 are centered on the definition of the data standards[5] and the setup of the SOLARNET Virtual Observatory (SVO) prototype archive.

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[2] `http://www.matplotlib.org/`

[3] `http://www.est-east.eu/solarnet/`

[4] `http://www.est-east.eu`

[5] `http://sdc.uio.no/open/solarnet-20.3/`


Figure 2. IBIS-A user interface.

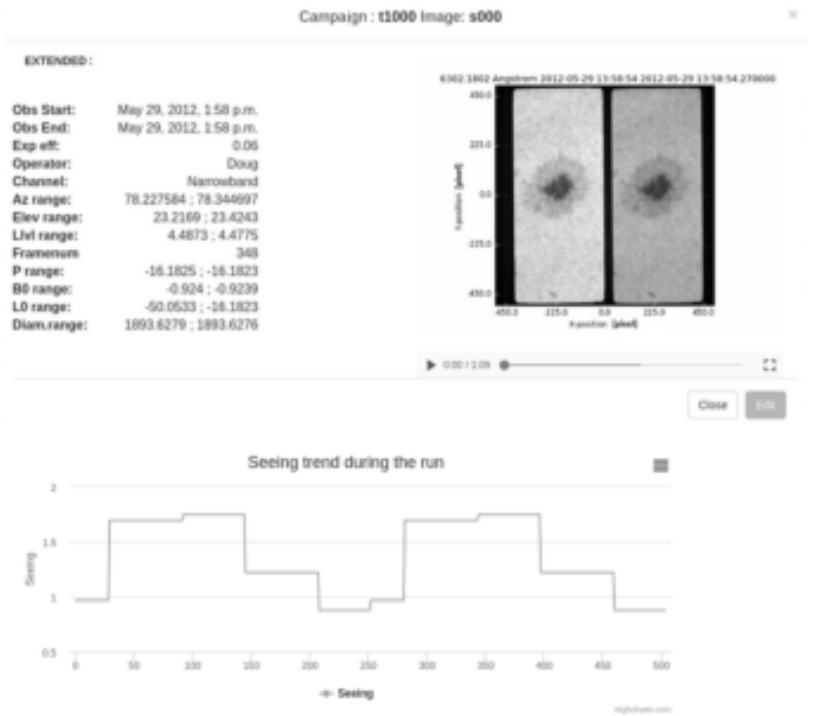


Figure 3. Modal window with information about the searched data, movies and plots for quick look purposes.

The integration of the IBIS-A into both the SOLARNET-SVO and the US-VSO Virtual Solar Observatory (Hill et al. 2009; Davey 2014) is in progress by using SOAP web services. The latter archives allow users to search data in several repositories of solar ground- and space-based observations, across multiple instruments and events. Apart from the interoperability with solar

VO archives, we plan to develop some additional tools to improve usability and accessibility of the IBIS-A. In particular, we will refine the web interfaces following end-users feedbacks, with a Usage Centered Design approach. Besides, in order to facilitate the scientific use of the data stored in the archive, we will also add some tools for the fast visualization of the data and evaluation. In particular, we plan to add zooming, scaling, profile and histogram computations, statistics on the searched data, by using Highcharts[6] and Sunpy[7], respectively for the visualization and computational tasks. The possibility of applying standard data reduction by using local resources may also be implemented in the future. Finally, on-line access to project documentation, with a detailed description of the IBIS-A access system, will be added, and improved help features to assist new users in basic searches and interface usage.

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Hill, F., et al. 2009, Earth Moon and Planets, 104, 315

[6] `http://www.highcharts.com/`

[7] `http://sunpy.org/`