

## BASS2000: ON-GOING PROJECTS AND RESULTS

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**Abstract.** We review the current status of the services proposed by the database BASS2000. Then we describe our main on-going project, i.e. the implementation of the processing, by the BASS2000 team, of a large data set (several Terabytes) of solar multi-line spectropolarimetric data (MTR mode) obtained by many observers at the THEMIS telescope in Tenerife. The implementation of this data processing and the data products are described as well as the future services associated to this processing: data sets of magnetograms, dopplergrams, vector magnetic field maps, organization of workshops. The other projects we are involved in are also briefly described, and concerns the Pic du Midi Coronagraph (HACO, as well as the future new version CLIMSO), the Lunette Jean Rösch of the Pic du Midi (mostly imagery data) and the implications in the Virtual Observatory.

### 1 Introduction

The purpose of the database BASS2000 (<http://bass2000.bagn.obs-mip.fr/>) is to archive most french solar data obtained at groundbased telescopes. The objectives are three-fold. First, it is necessary to standardize the data format in order to facilitate the data processing and the use of a large amount of data by a wide community. Second, the data themselves must be preserved on the long-term and provided to users on request. Last, it is very important to help the users to process their data by providing them informations about the data and, whenever possible, processing codes. It is also crucial to provide processed data in order to reach as many users as possible.

Our teams have worked in these three directions over the past years. BASS2000 is constituted of two archives, one in Tarbes, which is the subject of this paper, and one in Meudon. The first archive contains mostly data from the THEMIS telescope, as well as all raw data from the Nançay Radio Heliograph, processed data from the Pic du Midi Coronagraph, and some data from the Lunette Jean Rösch, also at the Pic du Midi. The second archive, in Meudon, provides an on-line selection of data, mostly full-disk images, which are very useful to prepare observing runs for example.

This paper mostly concerns the data from the THEMIS telescope, which constitute most of the volume archived in our database. In Sect. 2, we describe in more detail the database itself and the solar physics themes related to the THEMIS data. Then in Sect. 3 we present our main on-going project, the implementation of the processing of multi-line spectropolarimetric data obtained at THEMIS. We conclude on our short term priorities in Sect. 4 (see also Meunier et al. 2005a).

### 2 Catalogue and a few selected results

The Tarbes archive currently contains the following data:

- Raw THEMIS data in the MTR mode (multi-line spectropolarimetry) and MSDP mode (spectro-imagery with polarimetric capabilities): since 1999.
- Processed THEMIS data in the MSDP mode: 2002-2004.
- Raw Nançay Radio Heliograph data (visibilities): since 1997.

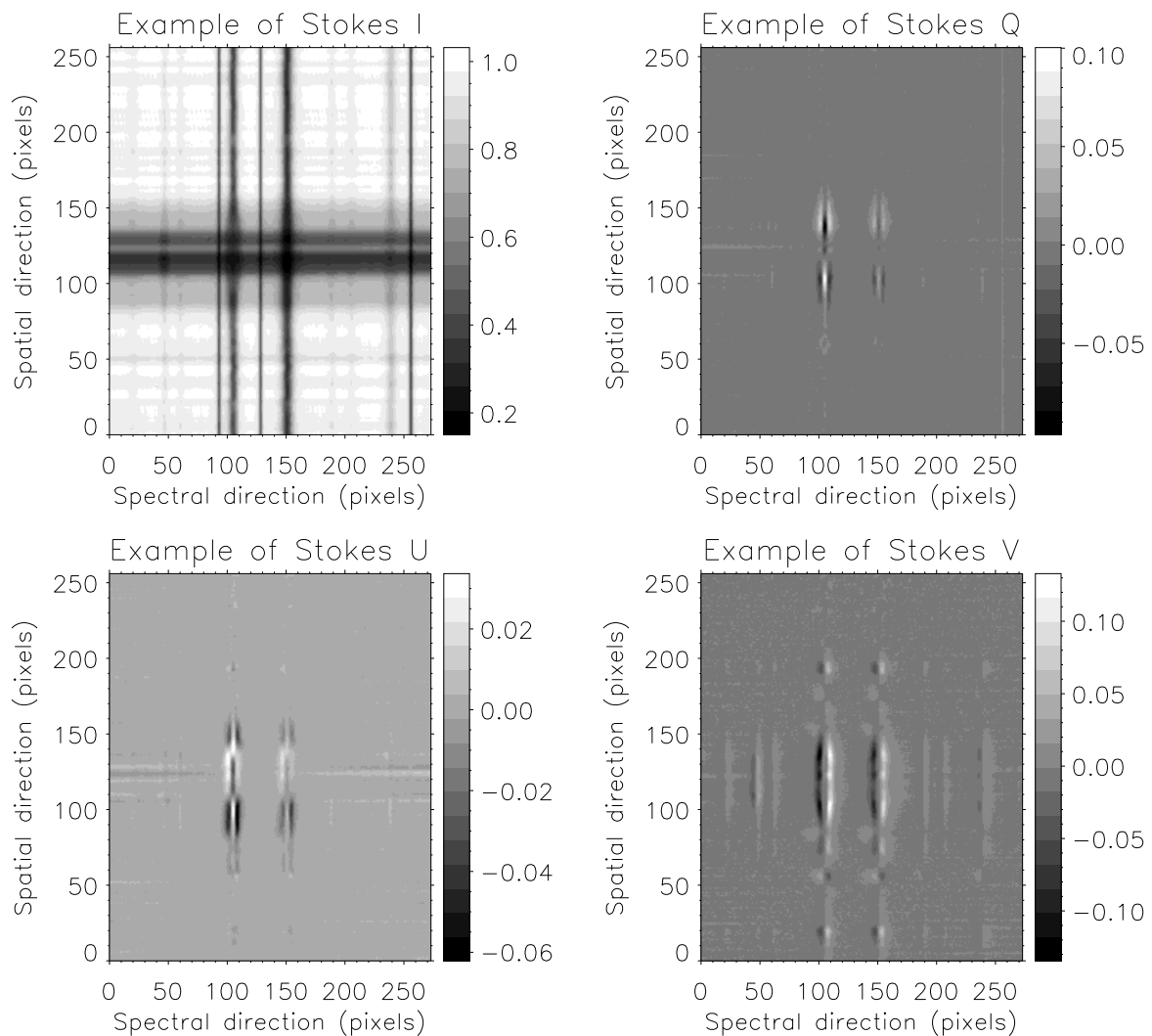
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- Calibrated data from the Pic du Midi Coronagraph (HACO) and catalogue of structures (jets, prominences) derived from this data set: 1997-2001 (1994-1996 and 2002-2006 : on-going).
- Imagery and spectro-imagery data obtained at the Lunette Jean Rösch (Pic du Midi), with a small field-of-view and with the new large-scale camera CALAS (Meunier et al. 2003, 2005b): on-going

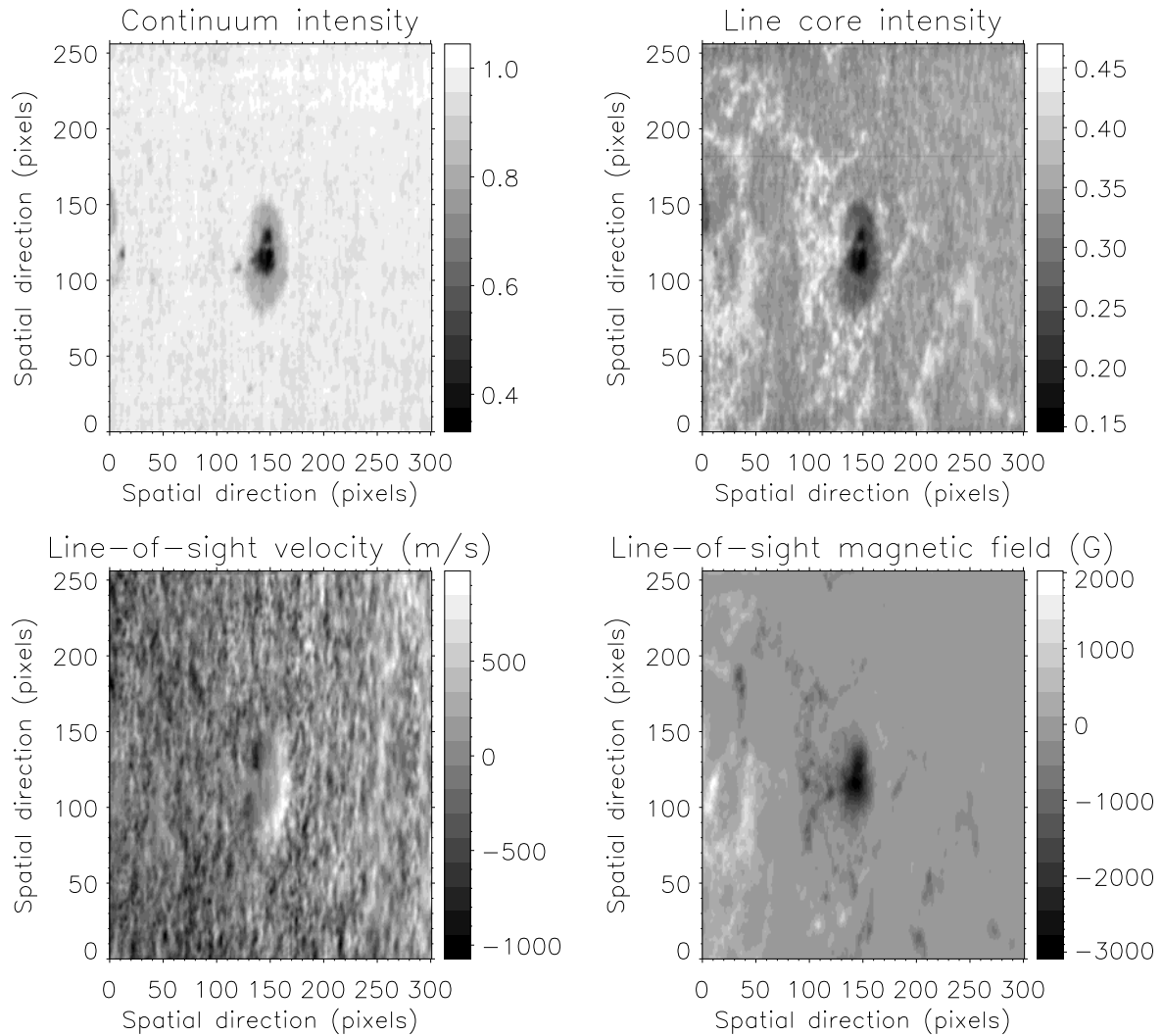
We focus now on the THEMIS data. The total volume of raw data is about 6 Tb. More than 40% of this volume has been provided by BASS2000 to users, mostly to the observers themselves. At this date, 33 refereed publications are using data which are publicly available in our database (access through request on our website). The observations and publications cover a wide range of solar features, from active regions, sunspots and plages to the magnetic network and very quiet regions, as well as prominences and filaments. Note that these spectra do not only include many lines where the Zeeman effect is present, but many runs are also using the Hanle effect close to the limb or in prominences.

### 3 Implementation of THEMIS data processing



**Fig. 1.** Example of Stokes spectra for the 6301.5 and 6302.5 Å lines (first step of a scan).

The final objective of this work is to improve the scientific return of the THEMIS observations. In order to achieve this, we are proposing and will propose ready-to-use data, which should interest a wide community.



**Fig. 2.** Example of maps for the 6302.5 Å line: Intensity in the continuum and line core, doppler map and line-of-sight magnetic field.

In the case of the MSDP data (spectro-imagery), we have used a code developed by P. Mein (see for example Mein 2002). The BASS2000 team has developed an interface in order to process a large amount of data at a time (typically one day of data), and to provide on-line useful JPEG files which should help the users to select the interesting data. So far, 3 years of MSDP data have been processed and are now available in the database, for the runs which correspond to standard observations. We propose intensity maps, dopplergrams and magnetograms, as well as Stokes I and V profiles at a medium spectral resolution.

In the case of the MTR data processing, the situation is quite different as the observations can be very different from one another: more variety in the observed objects and in the instrumental configuration, including three modes, and more than 100 observed spectral domains covering most of the visible spectrum. Our aim is to provide ready-to-use Stokes profiles (for each pixel of the map derived from the scans), intensity maps, dopplergrams and magnetograms, and, in the case the Fe 630 nm lines have been observed, vector magnetic field maps associated to other measurements (in particular thermodynamical parameters). Two softwares have been provided by the THEMIS team: a code allowing to obtain Stokes profiles from the raw data (Sainz Dalda & Lòpez Ariste 2006) and a code allowing to compute the vector magnetic field using a PCA algorithm, starting from the Stokes profiles (e.g. Rees et al. 2000). The first code can be applied to all data while the second one is applied to the 630 nm domain only.

The work of the BASS2000 team has then been to develop a number of routines to perform automatically several steps of the complete analysis:

- Organize the files of an observing run depending on the various modes.
- Eliminate bad data (intrinsically bad data, data which are not standard, ...).
- Prepare the inputs for the processing codes, which include a comparison of the raw spectrum with a reference spectrum in order to calibrate the spectra in term of wavelength, as well as to extract the position of the useful spectral lines for which we want to optimize the processing.
- Compute the intensity maps, dopplergrams and magnetograms.
- Compute some additionnal parameters that will help the users to select the data.
- Finalize the formatting of the data and prepare the on-line jpeg files.

These different steps has been tested for the various modes and will be finalized shortly. An example of Stokes spectra obtained with a standard processing is shown in Fig. 1. The corresponding maps of intensities, line-of-sight velocity fields and magnetic fields are also illustrated in Fig. 2. We plan to finish the developement of this code by September 2006. The processing of 2004 and 2005 data will start during Fall 2006, with priority given to active region and filaments observations. Depending on the amount of requests following this implementation (all these data will be publicly available), it will be necessary to identify, in the near future, what kind of additionnal data level would be useful to the solar community.

#### 4 Conclusion

On the short term, we will focus our efforts on the processing of a large amount of spectropolarimetric data obtained at the THEMIS telescope. These processed data will be publicly available. Data from other instruments will also be included or continue to be included in the database: data from the Lunette Jean Rösch, including old granulation images which have been numerized (covering more than a solar cycle), more recent granulation images obtained with a CCD, and future observations at high spatial resolution and on a large field-of-view obtained with CALAS ; data from the Pic du Midi Coronagraph (HACO), including observations obtained with the new instrument (CLIMSO) which will replace HACO by the end of 2006. Of course current and future THEMIS and NRH observations will continue to be included in the catalogue.

On a longer term, it is very important that the solar databases BASS2000 and MEDOC get involved in a Virtual Observatory in relation with the plasma community (Earth and planets of the Solar System), as shown in Jacquey et al. (2006). In order to follow the implementation fo the data processing and possible new data levels, it will be necessary that the solar community gets more involved in BASS2000, and all these projects will be developed only if that it the case.

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