ARBIS 3: A Software Package for Automated Radio Burst Identification

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1. Introduction

Solar flares and CMEs are major solar weather events. They are often accompanied by solar type II and III radio bursts. The radio bursts can be used for real-time automated prediction of space weather.

Previously, we have developed methods for automatic detection of type II and type III bursts and implemented them in ARBIS 2 [Lobzin et al., 2009, 2010]. ARBIS 2 works with real-time data provided by the Learmonth Solar Observatory.

The aim of this poster is to present a new extended version, ARBIS 3, which works with radio spectra provided by two Australian solar observatories: Learmonth and Culgoora. In addition, it processes X-ray fluxes measured by GOES and is able to automatically download and process recent lists of CMEs detected by CACTUS in image sequences from LASCO and SECCHI.

2. Data

Learmonth Solar Observatory: dynamic spectra in the frequency range 25-180 MHz with 3 s time resolution

Culgoora Solar Observatory: dynamic spectra in the frequency range 57-180 MHz with 3 s time resolution

GOES 15: X-ray fluxes in the 1-8 Å passband, 1 mn time resolution

Latest CMEs detected by CACTUS in the images from LASCO and SECCHI

Note that now CACTUS detections are NOT available in real time.

3. ARBIS modes of operation and its output

There are 2 main ARBIS modes: (1) real-time mode and (2) survey mode. In the both modes, ARBIS processes available data (near-real-time or daily) and creates a pictorial summary showing the data availability and events detected. If there are any detections, it creates the corresponding text files (separate files for different kinds of events) which are copied to the ARBIS online folder and emailed to subscribers. In addition, for type II and III bursts, their "portraits" are created. In real-time mode, the portraits are copied to the online folder for recent detections. In the survey mode, the portraits, event lists and pictorial summaries are copied to an archive available online.
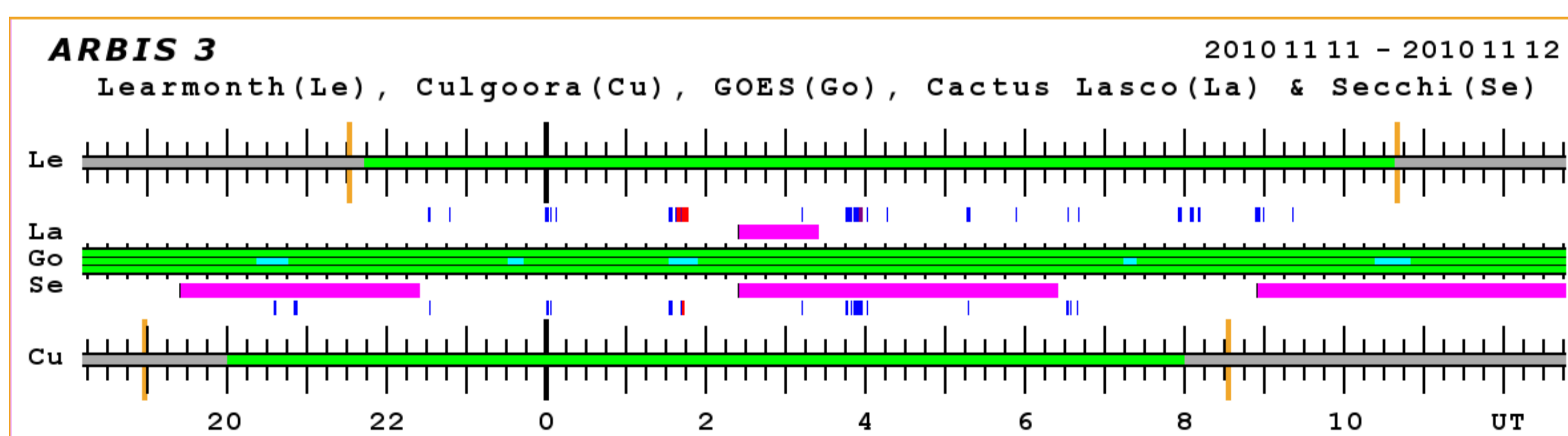

Figure 1. A typical pictorial summary. Orange vertical dashes show sunrise/sunset times. Green color shows available data. For X-rays, green is replaced by aqua, blue and red if peak flux corresponds to C, M and X classes of flares, respectively. Type II and III burst are shown by red and blue vertical dashes between the axes. Purple bands with black left edges correspond to CMEs detected by CACTUS. Note, real-time CACTUS detections were not available; they were added later.
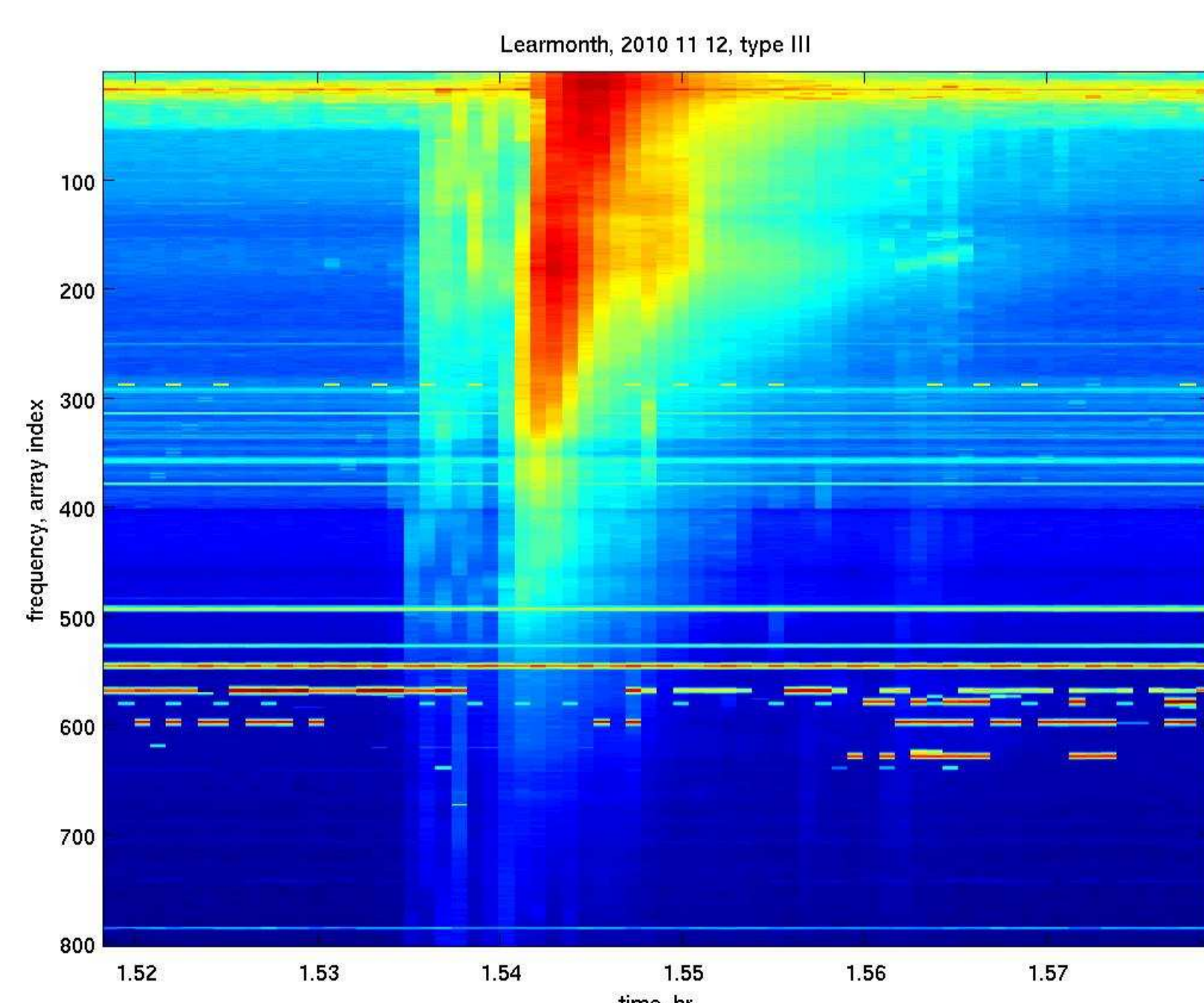

Figure 2. The Learmonth dynamic spectrum for a type III radio bursts found by ARBIS 3 on 12 November 2010.

4. Fragments of event listings produced by ARBIS

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-----------------------------------------------------------------------------------------
   Learmonth - Type II bursts
        Daily summary
  from 20101111 2143 to 20101112 1038  (YYYYMMDD hhmm UT)

    date       start-end time   shock speeds      arrival dates & times
 (YYYYMMDD)    (hhmm UT)       (km/s km/s)  (YYYYMMDD hh  YYYYMMDD hh)
   20101112    0138 - 0146     543  858        20101115 23   20101114 19

 The results are preliminary. The Newkirk model is used to estimate the shock speeds
   and arrival times. The 2 values are obtained under the assumption that the emission is
   fundamental and harmonic, respectively. The actual detections are shown in pictures
   with dynamic spectra.
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   GOES - X-ray flare-like events
        Daily summary
  from 20101111 0000 to 20101112 2359  (YYYYMMDD hhmm UT)

    date       start-end time    class   log10(X)
 (YYYYMMDD)    (hhmm UT)
 …
   20101112    0133 - 0139       C     -5.3298
 …
 Used are solar X-ray fluxes measured by GOES 15 in the 1-8 Angstrom passband.
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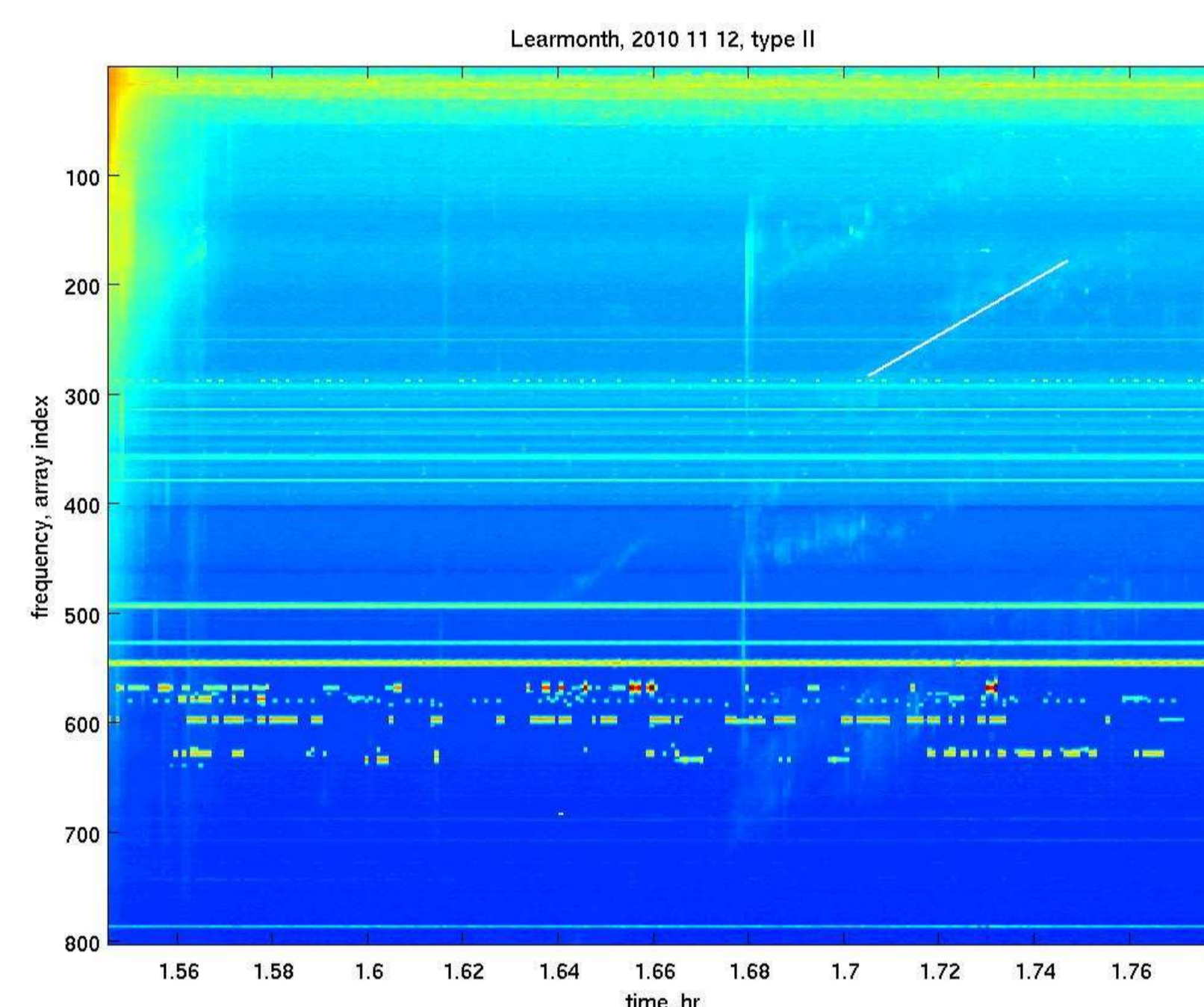

Figure 3. The Learmonth dynamic spectrum for type II radio bursts found by ARBIS 3 on 12 November 2010. The white line shows the longest segment used for estimation of the shock speed.

5. Conclusions

The 3rd version of ARBIS works with radio spectra provided by two Australian solar observatories: Learmonth and Culgoora. In addition, it processes X-ray fluxes measured by GOES and is able to automatically download and process recent lists of CMEs detected by CACTUS in image sequences from LASCO and SECCHI. ARBIS 3 combines all the data and provides near-real time and daily summaries of radio bursts, X-ray flare-like events and CMEs observed at the same time.

Currently CACTUS data are provided with a big delay and therefore are not useful for forecasting purposes. When real-time CACTUS results become available, it will be possible to compare radio-derived shock speeds with the CME speeds estimated by CACTUS, thereby improving estimates of times when disturbances will arrive at Earth.

References

Lobzin, V. V., I. H. Cairns, P. A. Robinson, G. Steward, and G. Patterson (2009), Automatic recognition of type III solar radio bursts: Automated Radio Burst Identification System method and first observations, Space Weather, 7, S04002, doi:10.1029/2008SW000425.

Lobzin, V. V., I. H. Cairns, P. A. Robinson, G. Steward, and G. Patterson (2010), Automatic recognition of coronal type II radio bursts: the Automated Radio Burst Identification System method and first observations, Astrophys. J. Lett., 710, L58–L62, doi:10.1088/2041-8205/710/1/L58.

Links

http://www.physics.usyd.edu.au/~lobzin/arbis	ARBIS home web page
http://www.physics.usyd.edu.au/~lobzin/arbis/output3	folder with recent detections
http://www.physics.usyd.edu.au/~lobzin/arbis/output3/images	folder with portraits of recent detections
http://www.physics.usyd.edu.au/~lobzin/arbis/archive	archive folder with historical data
http://www.ips.gov.au/Solar/3/9	stable version of ARBIS at IPS Radio and Space Services