

# Practice Work Session P10 (3h)

## AMBER data reduction

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#### Abstract

Hands on real AMBER data! Impersonate Dr. Stee, receiving freshly observed Science Demonstration Time observations of Alpha Arae!

## 1 Sorting AMBER data

The complete set of observation files for SDT7, containing observations for Alpha Arae, are stored in the “data” directory on your computer. You will browse through this data and reduce it with one of the currently available software.

Have a look to the contents of the “data” directory, which is “as is” received from ESO. Can you make any sense of it?

- browse AMBER data: Now, call “gasgano”, the ESO tool to browse through the raw data files. Use the “File→Add/Remove File” menu to add the contents of “data”. Expand the list of files. Note that uncompressed files show full headers, compressed files only the first header (eventually uncompress a file to see this)<sup>1</sup>.

How is the data organised? Notice the DPR.CATG and DPR.TYPE values. Why do we have data not pertaining to the “Alf-Ara-Stee” project?

What are the observing modes present in the data? Where are the P2VM raw data files associated with the Alf-Ara observations?

Calibrator: Which calibrator was used for these observations? In total, what are the relevant files for a complete calibrated set of observations (science object + calibrator)?. According to the AMBER data reduction scheme, what calibration steps should be taken and in which order?

- headers of raw data: On an uncompressed file, browse through the various headers with gasgano. Better, on any file (zipped or not), call the ‘fv’ utility to explore the contents of the fits file. See fig 1 (page 2) for details.

What are the telescopes used for the file in observing block “200147575”? What is the integration time per frame (DIT)? What indication of the (u,v) values of the baseline are present in the raw data header?

- view raw data files: use the “viewfile” script entry to start a gildas-based dedicated viewer (may take some time to start). Figure 2 (page 3) shows the different windows now available. Peruse the “PLOT AMBER DATA FRAMES” panel to explore the raw data file.

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<sup>1</sup>gasgano refreshes its directory list only once in a while (depending on a “Preferences...” setup). To view new file, use the “File→Refresh” menu

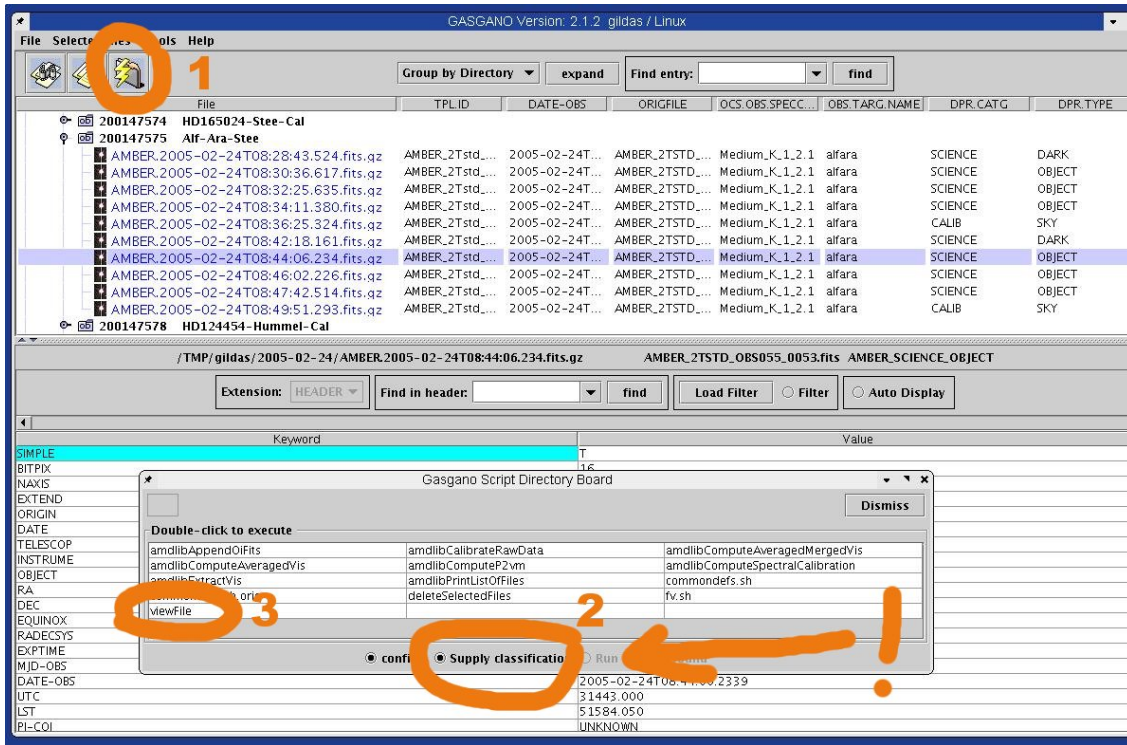


Figure 1: Calling a script (fits viewer) from gasgano

## 2 Standard calibration

- bad pixel map: The associated Bad Pixel Map is located at `/server/softs/amber/amdmsBadPixelMap.fits.gz`. Use `fv` to view this file.
- flat-field map: The associated Flat Field Map is located at `/server/softs/amber/amdmsFlatFieldMap.fits`. Use `fv` to view this file (hint: use histogram equalization). Comment.
- spectral calibration: identify files relates to the (improperly named) spectral calibration step. Eventually run the script `amdlibComputeSpectralCalibration` on the relevant files, and compare values of the *spectral displacement* between interferometric spectrum and photometric spectra (“photometric channels”) returned in `/tmp/ComputeSpectralCalibration.log` with the values stored in the following file’s headers (keyword ‘DET1.P1.OFFSETY’).
- perform a “cosmetic calibration only” on a raw data file. This is if you want to check the raw data “images”, but is normally not needed by the users (fortunately). The result file is still a raw data file, but bad pixels have been set to zero, biases and other detector effects removed and the images corrected from flat and gain. Select the file `AMBER.2005-02-25T09:38:46.349.fits.gz`, the accompanying DARK file, and run “amdlibCalibrateRawData”.

This script produce a file in a new directory in the current directory, named “Calibrated”. Instruct gasgano to check files in that directory if needed.

Use “viewFile” to plot the pixels, and the menu item “AMBER VIEWER→Explore data cube with mview” to plot all the fringes in the observation. What kind of evolution do you see in the fringe pattern from first frame to the last?

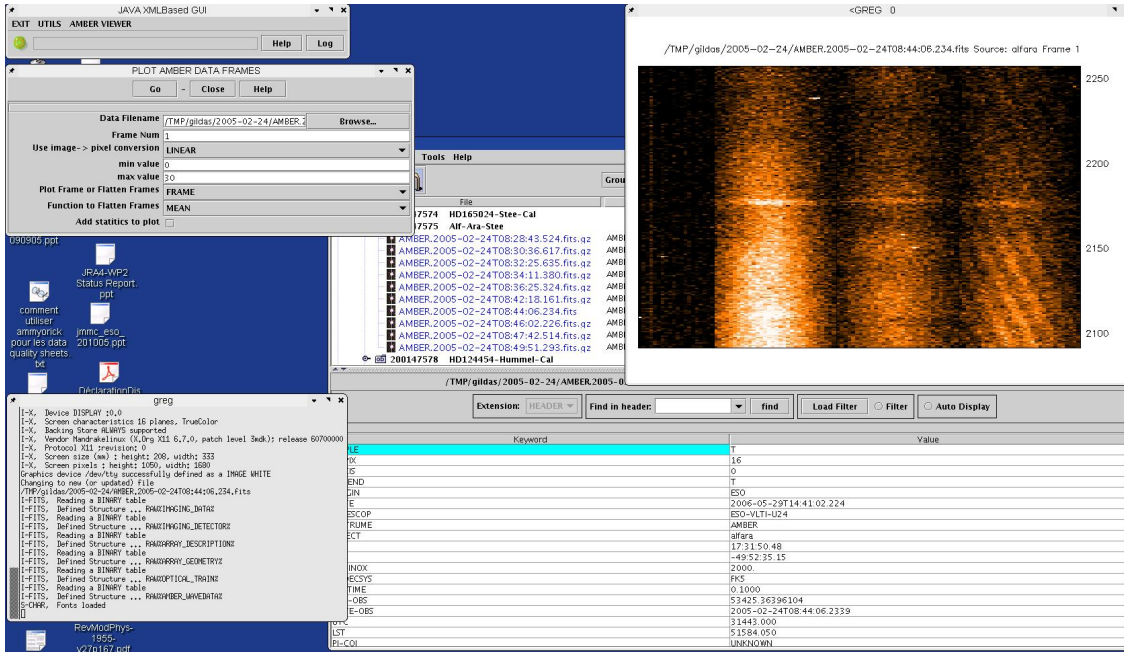


Figure 2: Gildas amber-drs called on a raw file from gsgano

### 3 Interferometric calibration

- view calibration data files.
- build a P2VM: Selecting the relevant set of files, create your first P2VM by using the “amdlibComputeP2vm” script. Use the first available set in the two-telescope data (Medium-K observations), for Low\_JHK observations, and for the 3-telescope observations.
- checking a P2VM: after refreshing gsgano, view each of the p2vm’s content with “viewFile” (opens yet another widget panel). In particular, plot the “VK” and “MATRIX” items. Observe the differences due to the number of observing bands and telescopes.

### 4 Compute interferometric observables

- compute OIFITS files: Use the amdlibExtractVis script to call the amdlib program of same name to process a science raw data file. Take for example the same raw data file as before, AMBER.2005-02-25T09:38:46.349.fits.gz. Note that this script needs only a SCIENCE/OBJECT file and a SCIENCE/DARK file, it finds automatically the corresponding P2VM file.

This script produce a file in a new directory in the current directory, named “Calibrated”. Instruct gsgano to check files in that directory if needed. The filename is the same as the original raw data file, terminated with “\_VIS”.

- view the results: Use “viewfile” which opens an OIFITS explorer panel. Almost any entry in an OIFITS file (which is a 2- or 3-D array) can be viewed against another, with various combinations of frame/spectral channel selections. View especially PISTON vs. TIME (did we see this before?), VIS2DATA vs. FRINGEQUAL, VIS2DATA vs. WAVELENGTH, differential phases (VISPHI vs. WAVELENGTH), closure phases vs. time.

## 5 Frame selection

- SNR selection. The script “amdlibComputeAveragedMergedVis” creates OIFITS files where observables are averaged after frame selection, using a default frame selection criterium based on fringe contrast SNR and a threshold value of 20% best frames. Use and view the corresponding file. For bookkeeping purposes, the result file has the same name as the raw data file, followed by “-XXX-YY\_VIS”, where XXX is the frame selection criterium (FRG in our default case) and YY the percentage of frames selected according to this criterium (0 to 1).

By selecting a number of science raw data files, the resulting file is the concatenation of each observation, individually averaged. Experience the results with this script, view the resulting files with “viewFile”.

- Photometry selection.

Waiting for a more flexible gasgano interface, this is possible only through the command line mode. Retrieve the (long) command used to create the last OIFITS file, it is written in the log file `/tmp/ExtractVis.log`. Use it to modify options “-e” and “-r” to suit your purposes. View result with “viewFile”.

## 6 Using the processed data

Under ideal conditions, the frame-selected averaged values should be sufficient for the normal user. However, a few calibrations steps are not provided in the current software:

- correction of visibility loss due to atmospheric piston (large instrumental OPD), and atmospheric piston jitter.
- visibility absolute calibration using a calibrator.

This can be done afterwards with any general purpose software equipped with an OIFITS reader, such as Yorick, IDL, Gildas, etc...

- reading OIFITS in Yorick
- Averaging in frame, in selection