Practice Session 1
VLTI/AMBER Data Reduction
instrument,
algorithms,
limitations.

G. Duvert, J-P. Berger

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During this practice you will use the “amdlib” data-reduction package provided by the JMMC to reduce and calibrate typical AMBER observations.

Nowadays, this is pretty straightforward. But, there are some pitfalls to avoid... After all, nothing resembles more a good visiblity than a bad...

AMBER DATA OVERVIEW

AMBER paradigm: ***spatially coded, spectrally dispersed, photometrically monitored, fringes.***

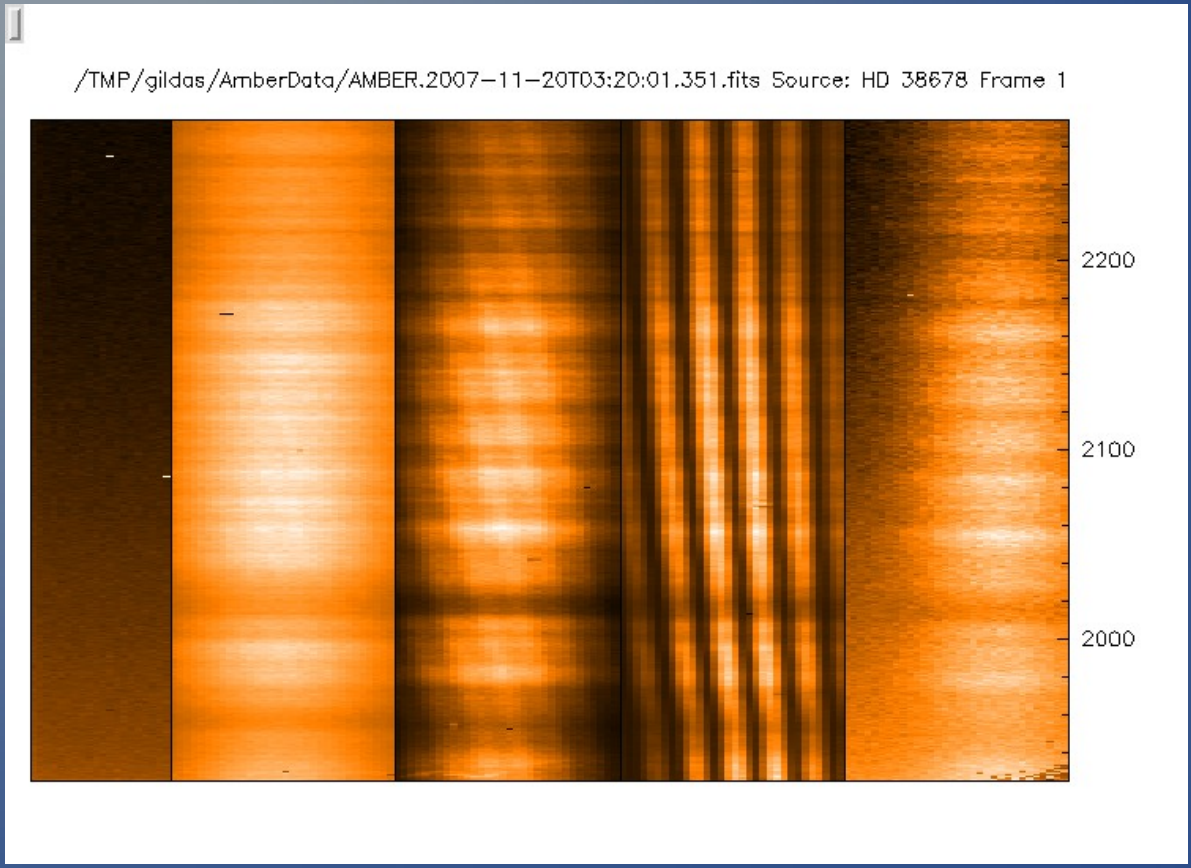
Resolution 1500 and 12000 in K.
Resolution ~70 in [J H K]

- **fringes** on an infrared Camera:
  Cosmetics : *dark frames, bad pixels, flat field.*
- **spectrally dispersed** ... needs *spectral calibration*
- **Photometrically monitored** … needs *crossmatch*

•*between photometry information and interferometry data.*

- **spatially coded** ... needs spatial coding calibration:
  *the **P2VM** (Pixel-to-Visibility Matrix)*

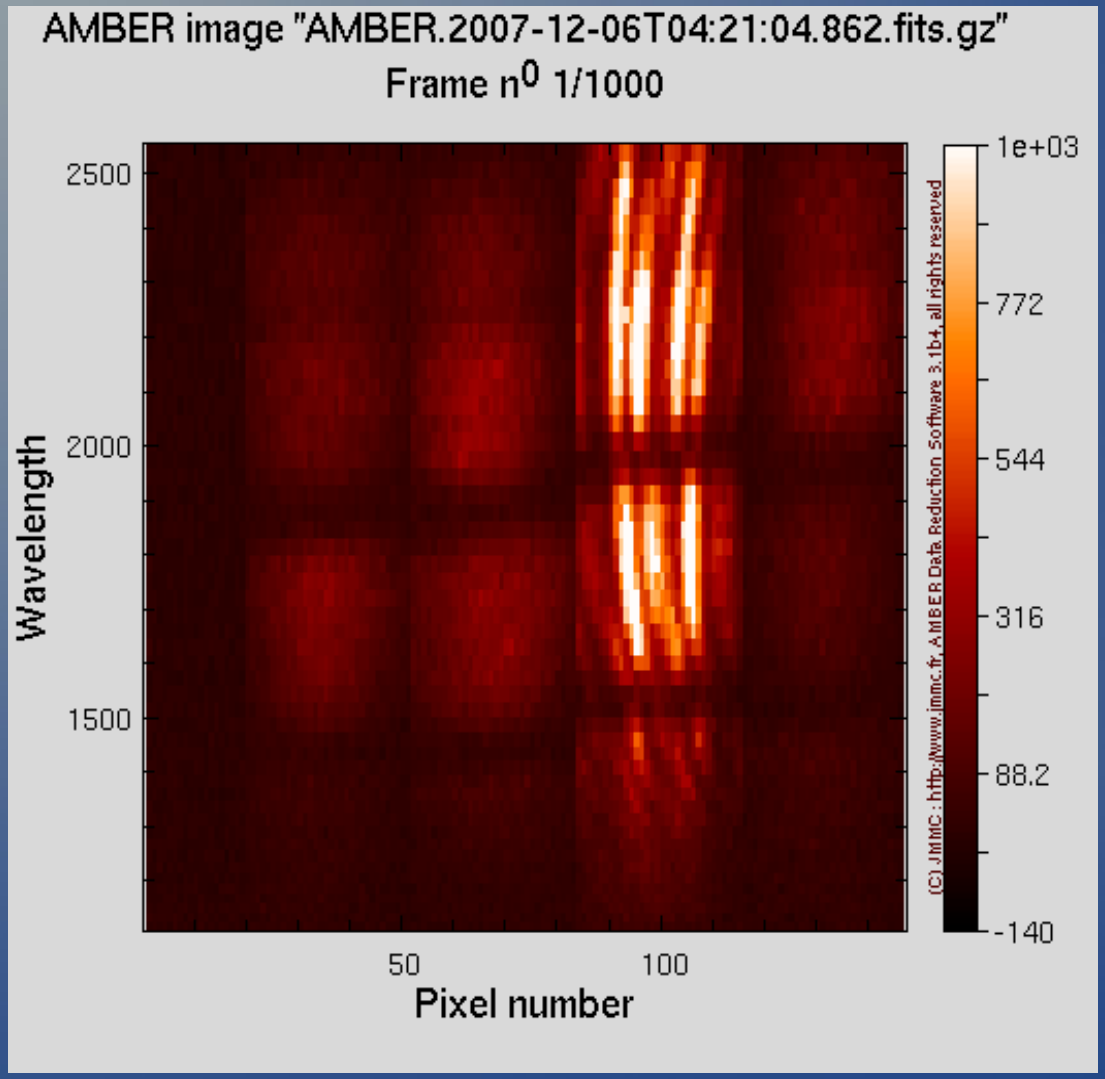
WITH AMBER YOU SEE THE FRINGES



3 telescopes, 3 beams: 3 sets of fringes, one per pair of telescope.

Spatial coding: the spatial frequency of each set is different from the others and do not overlap in fourier plane.

3 baselines: 3 complex coherent flux values per spectral element.



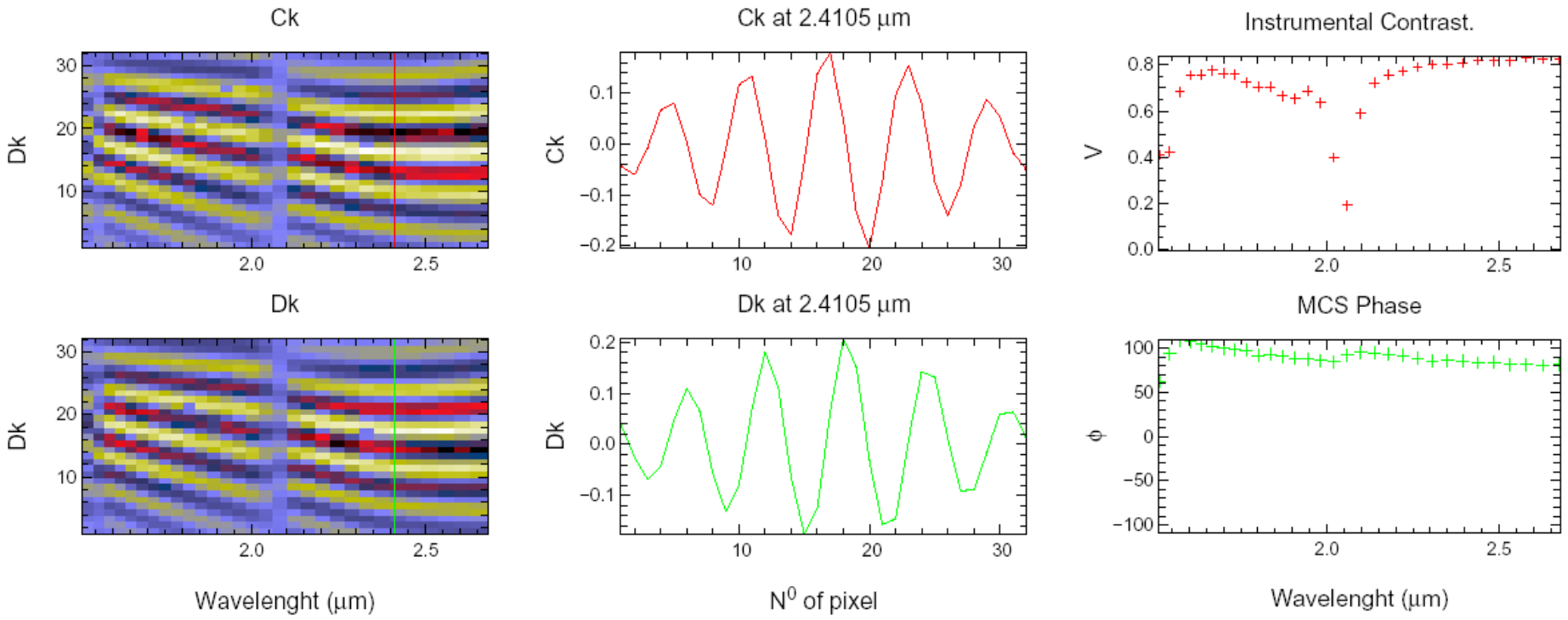
The same in Low resolution JHK mode.

Note the displacement of photometric « channels » : has to be calibrated.

...accurate wavelength calibration of the Interferometric « channel »?
NO for Low Resolution.

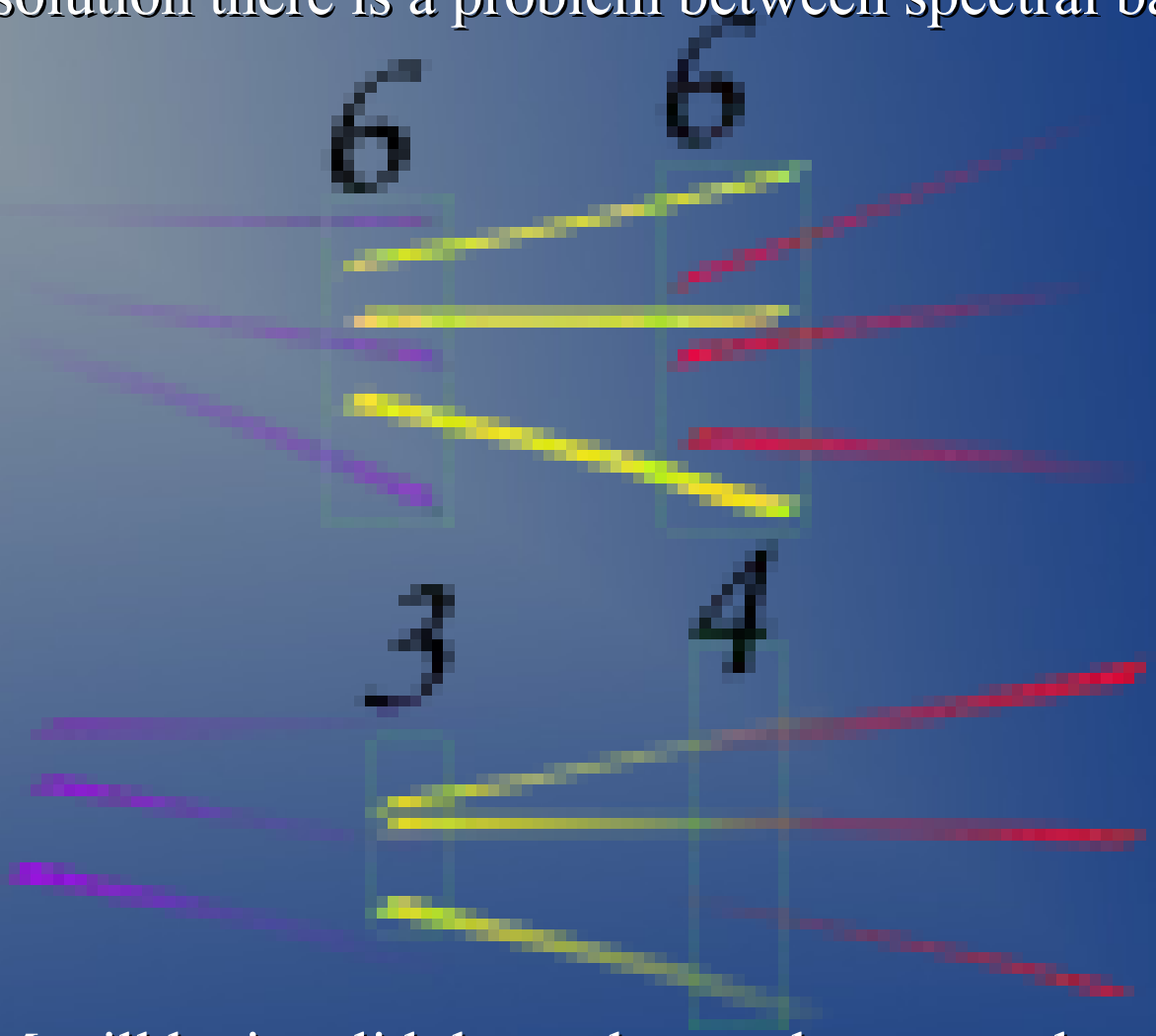
The Pixel-To-Visibility Matrix (P2VM)

Calibrates each of the 3 fringe patterns present in the image.
(gives matrix coefficients ck and dk to convert pixels values to complex visibilities for each baselines)



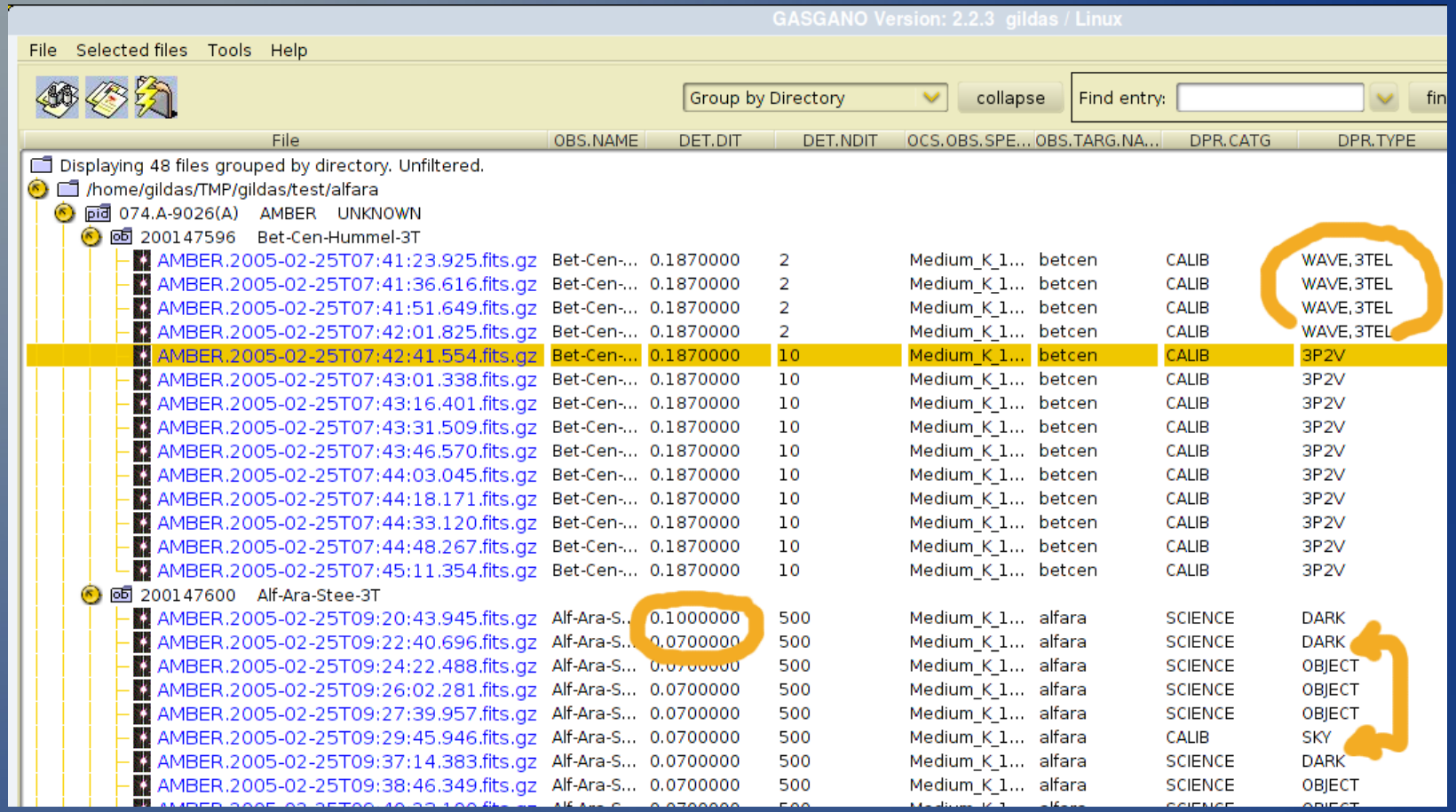
The P2VM calibration file does more: it contains all the calibrations.

In low resolution there is a problem between spectral bands



The P2VM will be invalid there, data at these wavelength must be discarded

Typical Sequence of observations as seen in "gasgano"



The first observations calibrate the P2VM and the spectral dispersion, the DARKs or SKY are needed for the cosmetics of each science frame.

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"gasgano" is a useful ESO Fits Viewer.

Typical data processing Pipeline:

1) Compute the P2VM(s) (`amdlibComputeAllP2vm`) provides all the necessary calibrations;
2) Process each raw data file to compute instantaneous correlated fluxes (complex numbers, typically 3x128x1000 values) with command `amdlibComputeAllOiData`;
3) From all, or a selection of, these values, compute time averaged values of all relevant interferometric observables (V^2, differential visibility, phase closure) with command `amdlibPerformAllFrameSelection`.

Warning! These are not yet 'calibrated visibilities'. One has to remove the adverse effects of atmosphere and instrument by comparing with the results for calibrator stars observed quasi-simultaneously:

4) Calibrate the science with the calibrator using `amdlibCalibrateAllOiData`.

A word about...

Frame selection:

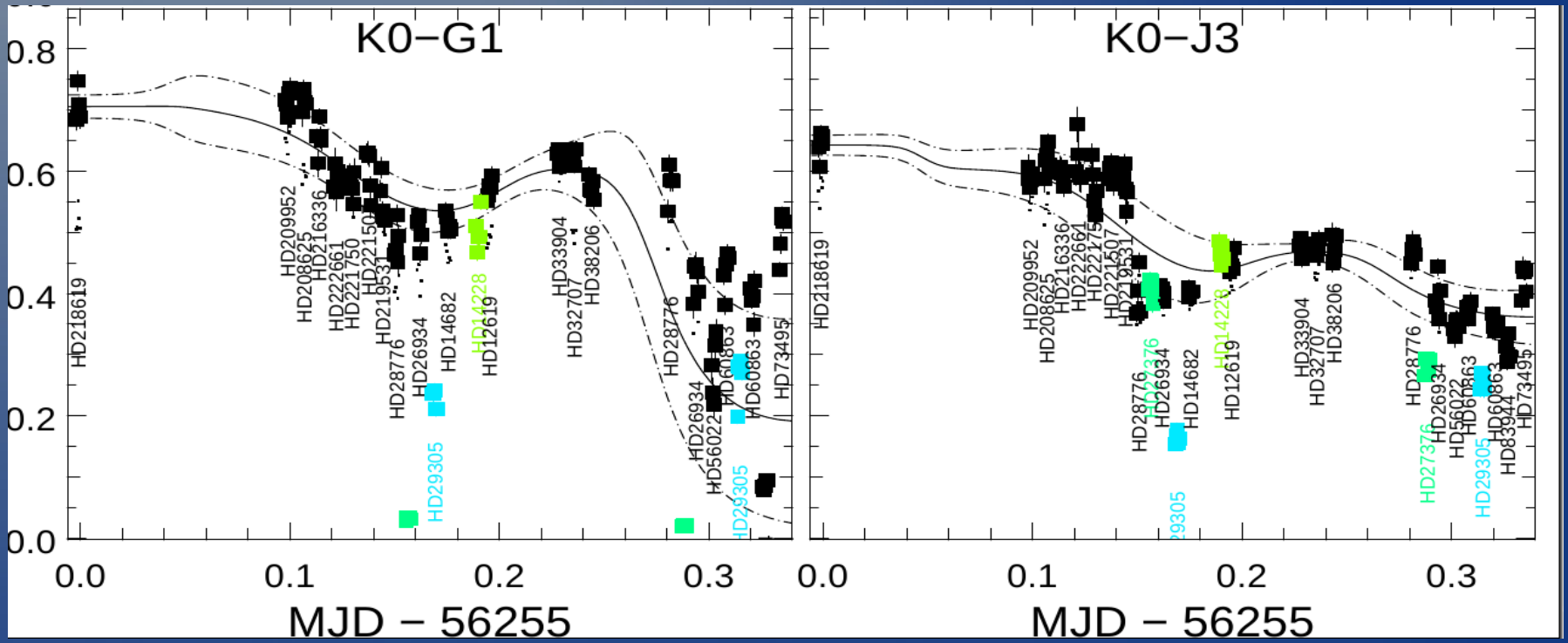
Before averaging 1000's of interferometric observables, amdlib permits to drop some values based on quality criteria.

Fringe S/N : (drops in case of, e.g., clouds, bad seeing, or pison jitter during integration)
Piston between beams: spectral coherence length is only 70 microns for Ambers's LoweRes mode
Photometry flux: varies with seeing

To be used with caution but seems necessary **for low-resolution** (without FINITO -?-) where at least a threshold on maximum piston (say, 15 microns) should be applied.

A word about...

Absolute Calibration with a Calibrator of known diameter: Necessary for V2 and for AMBER's phase closure---which is not free of instrumental effects. Differential values (DiffVis) are more robust, though.



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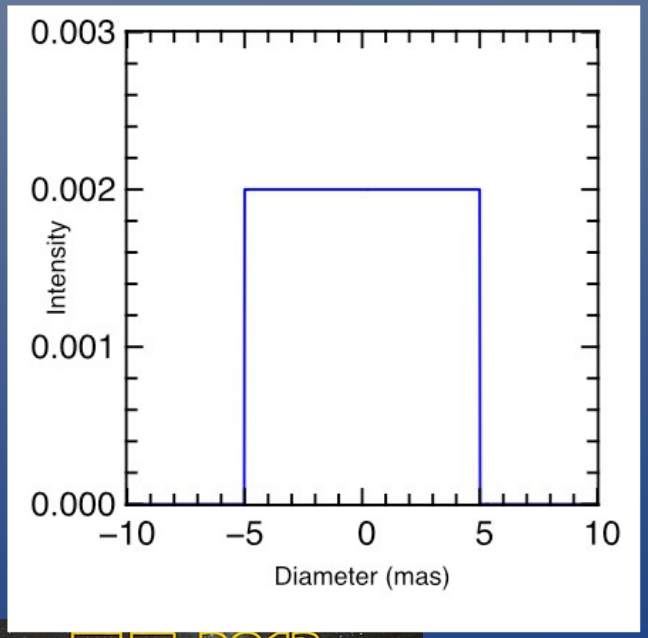
PIONIER “night” --Amber rarely makes it.

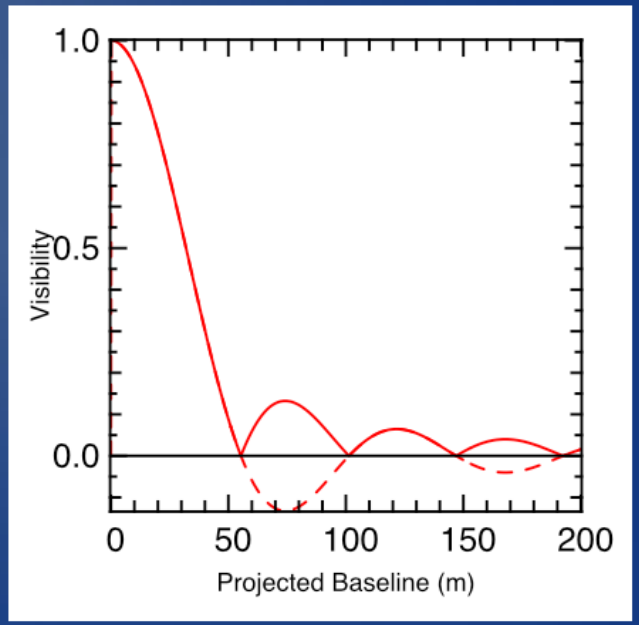
A word about...

Model Fitting.
We'll try to fit a simple model in our calibrated data,
(a star's Uniform Disk), using the 'litpro' program (more on Friday)

$$\begin{aligned} \mathrm{I(r)} &= 4/(\pi a^2), \mathrm{if\,r} = \sqrt{\mathrm{x}^2 + \mathrm{y}^2} \leq \mathrm{a}/2 \\ \mathrm{I(r)} &= 0 \quad \mathrm{otherwise} \end{aligned}$$

$$F(\rho) = \frac{J_1(\pi a \rho)}{\pi a \rho} \mathrm{with} \rho = \sqrt{\mathrm{u}^2 + \mathrm{v}^2}$$





Amdlib

Find the last version at
http://www.mariotti.fr/data_processing_amber.htm

You can subscribe to AmberDRS feed

To keep in touch.
Also, read the manual...
and the Release Notes that are continously updated

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