Practice Work Session #4 (1h)

Signal-to-noise calculations
with the AMBER & MIDI instruments

EuroWinter School

Observing with the Very Large Telescope Interferometer

Les Houches, France

F. Malbet (LAOG)

February 6^{th}, 2002

Objective of the session

All interferometric observations are limited by the noise of the measurements, due to photon noise, thermal background noise, read-out noise of the detector, the atmospheric perturbations and the global stability of the VLTI and the instrument. Up to now, we have worked without these noise. In the present session, we want you to have a feeling about the level of noise you can expect with AMBER and MIDI.

Since the instruments are not yet commissioned, the results are subject to change.

Input data

We will work with the homemade simulations of FU Orionis disks `fudisk-[J,H,K,N].fits` that you have already used. We will use these models to represent Z CMa, even if it is well-known that this FU Orionis object is a binary.

Exercises

1 Preliminary tasks

1. Using a web browser (e.g. Konqueror in the menu bar of the main window), get the coordinates of Z Canis Majoris (Z CMa) on the SIMBAD site:

   `http://simbad.u-strasbg.fr/sim-fid.pl`

and create a catalog with that object using the *WHAT.Define Object Catalog* menu [1] or by creating the catalog with your favorite editor.

2. Load the Z CMa coordinates and find a VLTI set-up with 2 auxiliary telescopes and a baseline of the order of 100m at an appropriate date.

2 AMBER instrument

1. Select the AMBER instrument in *MODEL/FIT* menu

2. Load the FU Orionis home made model in the J band and plot the visibility versus the time.

3. In the *Exposure Time Calculator AMBER panel*, choose the J band, the Medium resolution, Average seeing, the AT, the J magnitude found in SIMBAD, and 20% for the percentage spent on the Science Target. Then plot visibility versus time with the error bars.

4. What happens if you select an excellent seeing? and when you change the spectral resolution ? Play all the parameters: AT/UT, magnitude, etc...

5. Do the same thing with the K band (do not forget to load the model in the K band). Do you notice a change in the behaviour due to the thermal noise at medium and high spectral resolution?

3 MIDI instrument

1. Select the MIDI instrument in *MODEL/FIT* menu

2. Load the FU Orionis home made model in the N band and plot the visibility versus the time.

3. In the *Exposure Time Calculator MIDI panel*, choose the `MIDI STANDARD` mode, a -1.1 N magnitude, 1 spectral channel. Plot the error bars.

4. Play with the parameters and find an estimation of the limiting magnitude.

4 Fitting Error

We now want to use an **ad-hoc** model and estimate the impact of the error bars on the accuracy on the parameters.

1. Simulate a circular Gaussian model with a diameter of 2mas using the same uv coverage as previously. Plot the visibility versus the radius without error bars.

[1] Warning: blanks in names should be replaced by underscores

2. Select the AMBER instrument, and choose some parameters for the ETC parameters that leads to error bars of about 0.1 (absolute of 10%). Then in the *MODEL/FIT.Model Parameter Error Calculator*, mask (if this not already the case[2]) the first 2 parameters of function one and type GO. You will get on the screen the errors on the determination of the parameter of a circular Gaussian model.

3. Decrease the noise by a factor 4 and see the result on the error of the fitted parameters.

[2]the 2 first parameters are the offset from the center of phase, and it is impossible to use them here in the absence of phase information in optical interferometry