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EXERCISE #3
SIGNAL-TO-NOISE CALCULATIONS WITH THE AMBER & MIDI INSTRUMENTS

Fabien Malbet[1]

Abstract. The objective of this exercise is to learn how to compute error bars on visibility estimations computed with the ASPRO software in order to investigate the feasibility of an observations with the VLTI.

1 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, the exercises have been performed without these noises. The present exercise show the level of noise that can be expected with AMBER and MIDI.
Since the instruments are not yet commissioned, the results are subject to change.

2 Input data

We use the homemade simulations of FU Orionis disks `fudisk-[J,H,K,N].fits` that have already been used (cf. Exercises 1 and 2). We will use these models to represent Z CMa, even if it is well-known that this FU Orionis object is a binary.

3 Exercise

3.1 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`

[1] Laboratoire d'Astrophysique, Observatoire de Grenoble, BP 53, F-38041 Grenoble cedex 9, France

DOI: (will be inserted later)

and create a catalog with that object using the *WHAT.Define Object Catalog* menu.

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.

3.2 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?

3.3 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 2 mas using the same uv coverage as previously. Plot the visibility versus the radius without error bars.

2. Select the AMBER instrument, and choose some parameters for the ETC parameters that lead to error bars of about 0.1 (absolute of 10%). Then in the *MODEL/FIT.Model Parameter Error Calculator*, mask the first 2 parameters of function one and type GO, this tells ASPRO not to fit the off-center parameters. You will get on the command screen the errors on the determination of the size 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.