AN OPTIMIZED CONFIGURATION FOR ALMA WITH 16 ANTENNAS

INPUT PARAMETERS

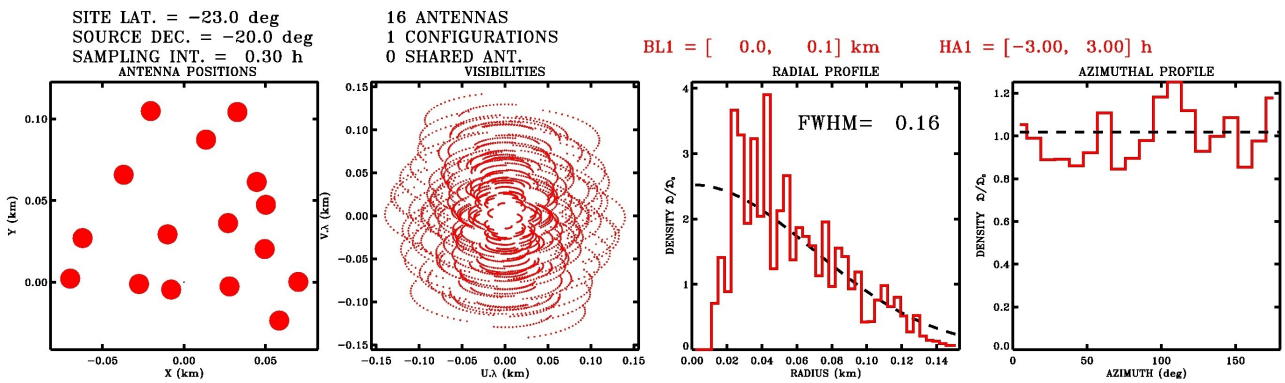
The configuration was optimized based on the document written by R. Hills (1rst november 2010). It uses 16 of the 34 pads available for early science. It was optimized for a source declination of -20 deg and 6 hours of observation around transit.

The optimisation algorithm takes as input the characteristics of a target gaussian distribution of samples in the uv plane. The largest baseline for the available pads is 145m. Given this constraint is can be shown that the number of uv samples is enough to sample the uv plane at a rate Nyquist/1.5 (i.e. The Nyquist rate of a source that is 2/3 the FWHM of the primary beam in size) AND to distribute the samples in a gaussian of FWHM=163m. In principle this corresponds to a resolution of 1.1" but note this is a truncated gaussian so in practice there will be sidelobes.

RESULT

The 16 pads used by the optimized configuraiton are:
A004, A005, A007, A012, A014, A015, A016, A017, A018, A020, A021, A29, A31, A32, A065, A066.

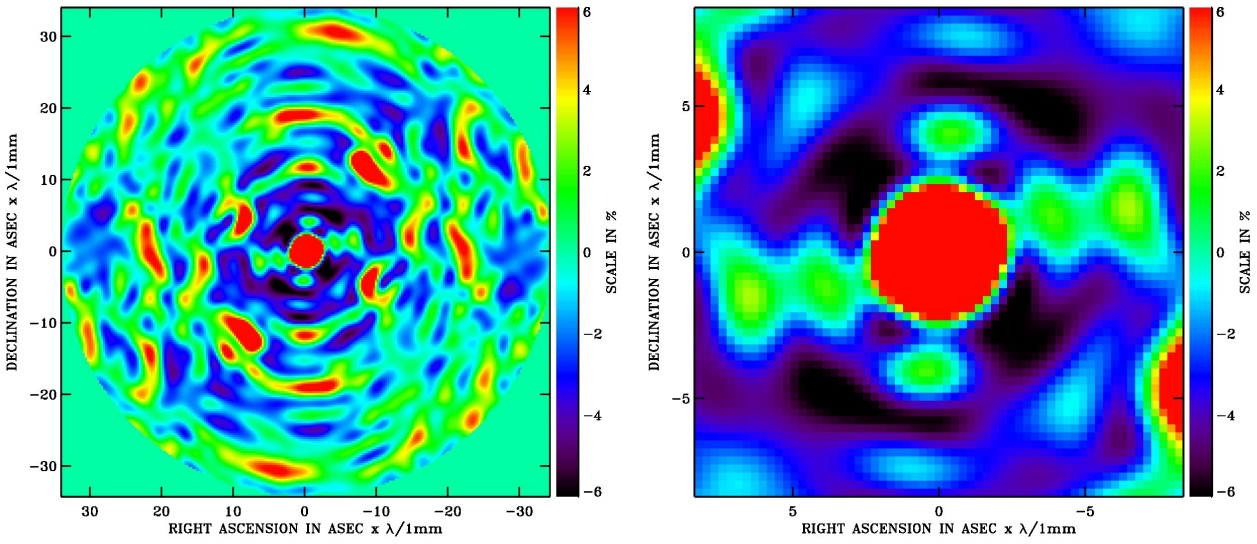
The configuration is displayed below. The left panel shows the antennas, the second panel shows the uv coverage, the 3rd panel shows the radial distribution of samples and the last panel the azimuthal distribution of samples.



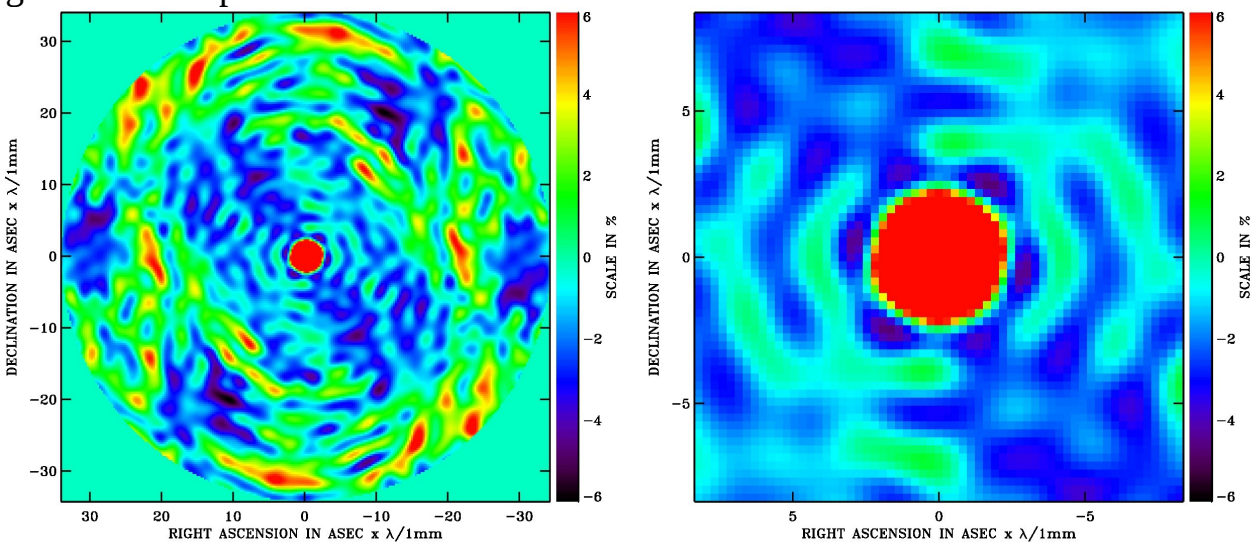
As the optimisation process is sensitive to the initial conditions several optimisations were performed with different initial configurations. This configuration is the best of among all the configurations that were obtained. But some of these other configurations are not much worse, in other words there may be other configurations with similar quality.

THE SYNTHESIZED BEAM

The corresponding beam is displayed in the figure below, the right panel is a zoom.



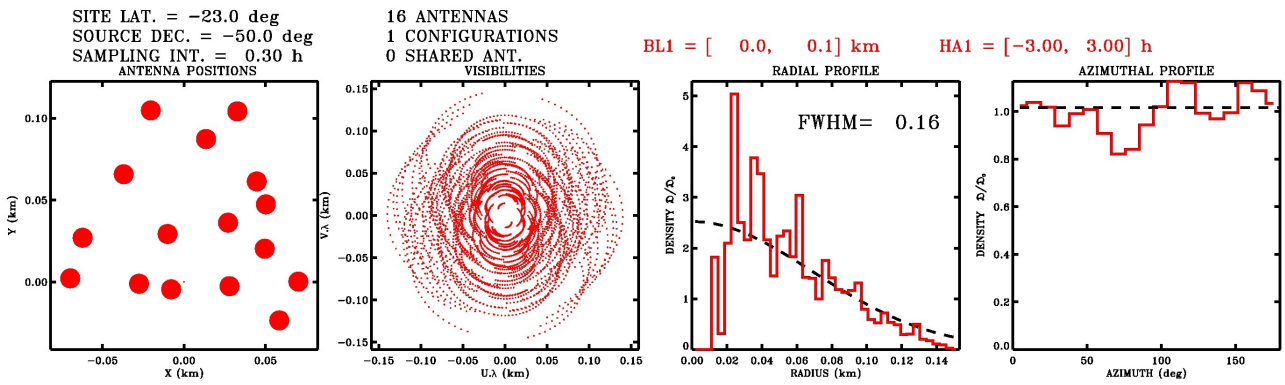
As the uv plane is well sampled the beam shape can be strongly improved simply by adjusting the weights of the data to correct for the irregularities in the distribution and try to approach to a perfect gaussian distribution of weighted data. The figure below gives an example.

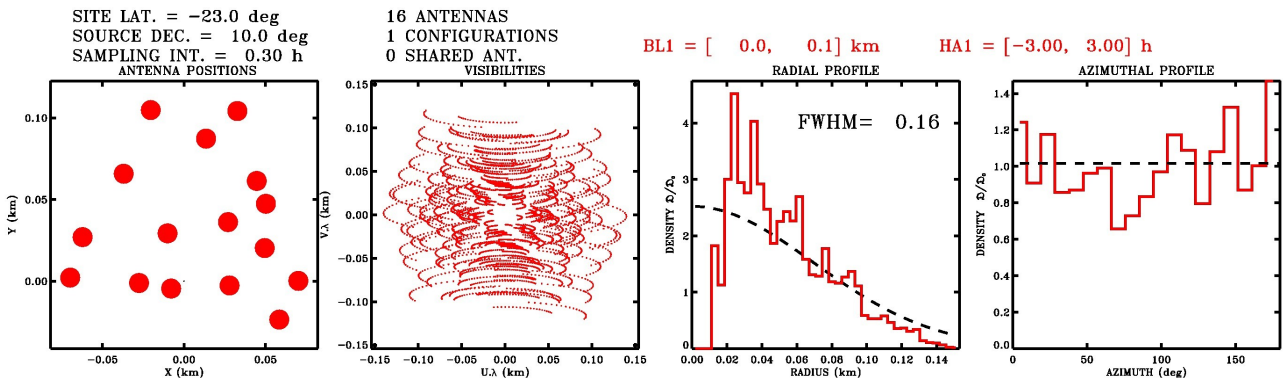


It can be seen how the inner sidelobes are almost cleaned out. The remaining inner sidelobes correspond to the gaussian truncation. A gaussian fit to the beam gives BMAJ=1.17" and BMIN=1.21". Of course this reweighting is at the expense of sensitivity. Here 13% of sensitivity is lost. The far sidelobes cannot be removed by simply reweighting, they are due to holes in the uv coverage.

OBSERVING SOURCES AT OTHER DECLINATIONS

The two figures below show the configuration uv coverage for a source at -50 deg declination and at +10 deg declination respectively.





It shows that the uv sample distributions are still excellent. In fact, optimising a configuration for each of these declinations specifically does not give better results. So this configuration is optimal for these 2 other declinations as well.

SHADOWING

This may need to be checked more carefully but it seems not to be an issue as the antennas are quite distant from each other in the north-south direction (except one of the baselines).

Frédéric Boone, 17th November 2010