

ALMA Science

Knowledgebase > Project Planning > How do I model the ALMA primary beam, and how can I use that model to obtain the sensitivity profile for an image mosaic?

How do I model the ALMA primary beam, and how can I use that model to obtain the sensitivity profile for an image mosaic?

Jared Anand Crossley - 2021-03-17 - Project Planning

For observation planning, the ALMA 12m antennas have a measured primary beam Half Power Beam Width (HPBW) of $\sim 1.13 * \lambda / D$; see the ALMA [Technical Handbook](#) (Chapter "Principles and Concepts of Interferometry") for further details. Also [ALMA Memo 456](#) (available at the Science Portal under the 'Documentation' tab) has a useful description of the "Characteristics of a Reflector Antenna".

The best way to determine the sensitivity profile of a mosaicked field is to use the [CASA simulation](#) tasks (simobserve and simanalyze). [CASA Guides](#) are available to help you become familiar with these tasks. Using simobserve, you can specify the pattern of pointings for your intended mosaic and generate a Measurement Set (MS) containing simulated visibilities. You can then run the clean task on the simulated MS. Clean will always (even with niter=0) produce a .flux image which shows the relative sensitivity compared to the image center, which is 1.0 (In tclean task, the relative sensitivity map is output to .pb image). For example, one can use the viewer to display the 0.5 contour (50%) of the .flux image to demonstrate the boundary of a mosaic. (When delivered to the PI, ALMA data products include the .flux image already generated.)

The voltage pattern assumed by CASA for the ALMA 12-m primary beam is currently hard coded to a uniformly illuminated 10.7-m dish with 0.75m blockage, resulting in an Airy disk whose FWHM is **similar** to a 12m Gaussian illumination with -12dB taper and 0.75m blockage. However its actual functional form will differ and in particular the sidelobes will be higher than the real ALMA dish sidelobes are.

The **actual** ALMA antenna primary beam shape is a matter of active work, but the main lobe is reasonably well represented as having a FWHM of $1.13 \lambda/D$. This is what you would expect from a 12m with a Gaussian voltage illumination pattern that is tapered to -10 dB (rather than -12 dB as specified in design documents) that has a 0.75m blockage. The reasons for these discrepancies are under investigation.

Related Knowledgebase article:

- ["What primary beam does CASA use for ALMA 12-m antennas? And what is the actual ALMA 12-m antenna primary beam, for that matter?"](#)