



How does the new perchanweightdensity parameter in CASA effect my ALMA data?

Sarah Wood - 2023-04-14 - Offline Data Reduction and/or CASA

Beginning in CASA 5.6, `tclean()` has a new parameter **perchanweightdensity** which has a default value of **True**. Previous CASA versions did not offer per-channel UV-density weighting, and so in effect, **perchanweightdensity** was **False**. This Knowledgebase article provides some general information about **perchanweightdensity** as it relates to ALMA data reduction; see also the section in the [CASA 6.4.1 ALMA Science Pipeline User's Guide](#). For more general information about using the parameter, please view the current CASA documentation on [data weighting](#).

perchanweightdensity only affects spectral cubes, not multi-frequency synthesis (MFS) continuum images. Its primary effects are:

1. To make the synthesized beam more uniform (i.e. less variable) as a function of frequency across a cube
2. To make the beam closer to the natural-weight beam (increase the beam size; reduce the noise). On average the beam area is increased by 12%, though for datasets with poor uv-coverage the beam area can increase by as much as 40%. The sensitivity is on average improved by about 5%, though the improvement can be as large as 15%.
3. To increase the influence of the detailed uv-coverage distribution on the beam size and sensitivity obtained.
4. To decrease the influence of the Briggs **robust** parameter on the sensitivity and beam size of the image cube obtained.

The ALMA project aims to deliver to PIs a science product which has user-specified characteristics, in particular, the specified *beam size* and *sensitivity* at a given bandwidth in the representative spectral window and on a representative target. Quality Assurance is done on every dataset by creating a single product with properties as near as reasonably feasible to those requested in order to verify that the science goals have been achieved.

This is the reason for example that the pipeline provides a "representative bandwidth" cube for instances where the representative bandwidth differs significantly from the instrumentally provided channel width. In order to consistently deliver these data, many subsystems-- the observing tool, scheduling software, and the ALMA pipeline-- need to work in concert. In order to allow time for the impact of the new per-channel weight option to be fully accounted for in each subsystem, perchanweightdensity has been set to False for

ALMA Cycle 7 and 8 imaging in operations (i.e. for QA2), and to True for ALMA Cycle 9 imaging operations.

It is important to note that imaging scripts which do not explicitly set perchanweightdensity are likely to deliver different results than were obtained in your delivered data because of default value of perchanweightdensity noted above.

For PL2021, the briggsbwtaper weighting was introduced, allowing for use of perchanweightdensity=True for cube imaging. Using briggsbwtaper and perchanweightdensity=True produces a beam size for the cube that is very similar to the mfs beam size, for the same robust value, bringing consistency between the Pipeline continuum and cube imaging products. The Cycle 9 pipeline therefore uses briggsbwtaper and perchanweightdensity=True.