



## How do I combine multiple executions obtained with a single antenna configuration?

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If your observations consist of multiple execution blocks (EBs) for the same target source with the same antenna configuration and spectral setup, combining those executions can help reach your proposed sensitivity. There are two primary methods of imaging multiple EBs in CASA. (For performance reasons, it is strongly advised that you not attempt imaging multiple SPWs with different rest frequencies in the same run of *clean*.)

1. On the fly, using the CASA task *tclean* with individual measurement sets as input visibilities (*vis*),

e.g., `tclean(vis=['EB1.ms', 'EB2.ms', 'EB3.ms', ...], spw='0', ...)`

2. Using the task *concat* to combine calibrated measurement sets, then using *clean*.

(1) Setting all the spectral windows to be combined in *tclean*

Since the observing epoch is different for each execution, the topocentric sky frequency also usually differs. The number of SPWs is thus increased in the concatenated data. For example, if there are 2 EBs with 4 SPWs in each execution, there will be 8 SPWs after *concat*. To make an image of the first SPW, you need to set `spw='0,4'` instead of `spw='0'`.

e.g., `concat(vis=['EB1.ms', 'EB2.ms'], concatvis='calibrated.ms')`

`tclean(vis='calibrated.ms', spw='0,4', ...)`

(2) Setting the parameter *freqtol* in *concat*

In the case of continuum or line observations with a much larger velocity resolution than the frequency difference between the EBs, the *freqtol* parameter of *concat* can be conveniently used to combine SPWs with a slight difference in frequency.

e.g., `concat(vis=['EB1', 'EB2', 'EB3', ...], concatvis='calibrated.ms', freqtol='1MHz')`

`tclean(vis='calibrated.ms', spw='0', ...)`

**The parameter *freqtol* should not be used if the frequency difference between EBs is larger than  $\sim 1/3$  of the velocity resolution** for line observations. The regridding is performed in the task *tclean* to transform channel labels and the visibilities to a spectral reference frame which is appropriate for the science analysis, e.g. from TOPO to LSRK, but the transformation is only accurate for the earliest EB. (The regridding in *tclean* is performed if you have not done *cvel* or *mstransform* before *clean*, or you use the different parameters in *tclean* from those in *cvel/mstransform*.)

You can refer to the article ["What are the frequency reference frames in CASA?"](#) for more information about reference frames and ALMA.

Note that when combining multiple measurement sets obtained with different antenna configurations, or measurement sets reduced with different versions of CASA (earlier than 4.2.2 pipeline, or < CASA 4.3 for manual reduction), it is often necessary to adjust the data weights after using *concat*. Please see the topic in CASA Guides, [Data Weights and Combination](#).