ALMA Science

Why can't I specify that my source should be unresolved in the OT?

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The OT does not allow users to specify a minimum angular resolution (i.e. restrict the range of angular resolutions such that a source will definitely be unresolved) because this considerably narrows the range of configurations that can be used, and complicates scheduling of the observations without any scientific gain.

Consider the case where

- very extended flux is not present,
- only the 12m baseline array will be used
- the observing frequency is fixed by the science
- expected source sizes are well within the range of 12m baseline array resolutions
- only the integrated source properties are of interest in the science proposal

To make sure that all the flux is captured (in a single pixel), a user may feel they should request the observations be done in configurations yielding synthesized beams that are broader than the expected angular size. However, there is no reason to do this.
Resolving sources does not hurt the S/N when the angular resolution of the array configuration is appropriate for the angular size of the sources. Resolving a source appropriately and summing its flux over map pixels is very different from the case where the synthesized beam must be tapered after the fact in an experiment where too many overly-long baselines (that did not reliably detect any flux) are degrading the S/N. Note that ALMA delivers data achieving the sensitivity requested within the beam corresponding to the angular resolution requested, rather than that achieved in the actual observations (which may sometimes be smaller in order to facilitate scheduling).
When the sources are resolved, all the source flux is there in the map and can be recovered by spatial averaging (summing) of pixels: in fact, this can be done more precisely with a resolved source, because an unresolved source is somewhat diluted within the beam which contains it. Moreover, observing with the appropriate resolution returns more information, perhaps for later archival use, and better serves to separate sources that might overlap.Therefore, users should not be worried about spatially resolving sources.
Spatially resolving the source structure can even prove beneficial. In one rather special case, a PI was insistent on not resolving a close double, only one component of which was expected to be absorbed by a faint spectral line whose detection was the object of the experiment. The PI wished to be able to treat the project as a point source absorption spectrum, because those are in principle very straightforward and precise: one may vector-

average all visibilities to produce a point-source absorption spectrum without mapping or cleaning and a strong point source can serve as its own phase calibrator, although ALMA observing and pipelining do not exactly recognize this.

A problem arose in that only the much weaker of the pair of sources was expected to be absorbed, so treating the pair together would result in a much weaker apparent absorption -- the same absorbed flux would be measured relative to a stronger continuum. Moreover, the unabsorbed continuum component was so strong that spectral dynamic range became an issue, whereas it was not a problem if the absorption were to be measured only against the weaker source. Lastly, the sources were known separately to be somewhat variable, so failing to resolve them would introduce additional error in determining the true absorption line strength. In the end, the project was observed so that the double would be resolved and the continuum and line contributions could be separated.