

## CHALLENGES AND FUTURE DIRECTIONS FOR SUBMILLIMETER IMAGING

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Submillimeter astronomy stands at the brink of new discovery space with the advent of submillimeter interferometers with subarcsecond resolution. These new instruments include the operational Submillimeter Array (SMA) and the future prospects of the Atacama Large Millimeter Array (ALMA). Along with these fantastic opportunities comes new challenges for submillimeter imaging. Among the most challenging is the need to (1) image large fields of view compared to the size of the primary beam; and (2) recover information on extended structures larger than that sampled by the shortest spacings of the interferometer. These techniques are important because many of the sources of interest are considerably larger than about 1/2 the primary beam (i.e. the field of view) of the array. For example, at 345 GHz, the FWHM primary beam of the the 6-m SMA antennas is only  $\sim 30''$ , while the beam for the 12-m ALMA antennas is a factor of two smaller yet.

In order to observe larger fields of view, multiple overlapping pointings of the desired region must be jointly imaged and deconvolved in a process known as mosaicing. The observing strategy and imaging algorithms adopted for mosaicing must take into account sampling on the sky, as well as in the  $u-v$  plane. For example, optimal (Nyquist or better) spacing of mosaic pointings is necessary to prevent aliasing artifacts in the image, while the deconvolution procedure must take into account any differences in  $u-v$  coverage (and hence in the synthesized beam of the array) between pointings. Though mosaicing naturally recovers more short spacing information than a single interferometric pointing alone, most mosaicing experiments will also require the addition of short and zero spacing information.

Image quality (fidelity) is directly linked to how completely the  $u-v$  plane is sampled. Two methods exist for recovering missing short spacing information: the addition of total power data from a single dish telescope and/or the addition of data from a closely packed array of smaller diameter antennas. The former is sometimes used for the SMA, while the latter in the form of the Atacama Compact Array (ACA) is envisioned for ALMA coupled with total power from four of the 12-m antennas. The best image fidelity is achieved when there is a high degree of overlap between the two datasets in the  $u-v$  plane. The optimal method for adding the two datasets (i.e. image or  $u-v$  plane) is still under investigation. It is clear that pointing errors and relative amplitude calibration have a significant impact and must be taken into consideration.

In this talk, we will present examples of the current state of submillimeter imaging using the SMA, and point out the limitations of the data and algorithms. Looking ahead to ALMA, and its ambitious imaging specifications (e.g. 10000:1 dynamic range, high image fidelity, full beam polarimetry), the advancements in imaging and calibration techniques necessary to realize these goals will be described along with suggested paths for algorithm development.

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