Full-Mueller Mosaic Imaging with ALMA

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Due to small field of view (FoV) of ALMA antennas (100 – 10 arcsec), mosaic imaging is a popular mode among ALMA users. Full-polarization mosaic imaging is significantly affected by the (a) differences in the shapes of the primary beam (PB) of the different antenna types in the array, and (b) the off-axis instrumental polarization effects of the PB. Error due to these effects increase with distance from the center of the PB preventing full-FoV imaging in full Stokes, even for single-pointing observations. In mosaic imaging, outer parts of the PB corrupts the inner parts of the PB (where off-axis effects may be smaller) of all the neighboring pointings, thus spreading these corruption throughout the mosaic image. As a result, no part of a mosaic image is free of these corruptions. This has limited the ALMA imaging performance in terms of achievable dynamic range and prevents wide-field imaging beyond the inner 1/3 of the PB for full Stokes imaging for single pointing observations and entirely prevents full-Stokes mosaic imaging. Imaging performance is also limited due to the significant antenna-to-antenna differences in the measured aperture illumination patterns and antenna pointing errors, both of which affect the PB projected on the sky.

In this talk, we present the characterization of the effects of antenna PB on full-polarization mosaic imaging. We then briefly also describe the full-Mueller imaging approach which we plan to use to correct for these PB effects using the full-polarization direction dependent Mueller matrix, which encodes the precise mixing of the incoming polarized flux vector across the FoV.