Absolute Antenna Gain Calibration for ALMA

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Gain calibration for antennas in an array is aided by the fact that the sensitivity in cross-correlation is proportional to the geometric mean of the gains of the separate antennas. One can use as one of the elements an antenna whose gain is small but accurately known. The knowledge of the gain of the small antenna can be transferred to the other, larger, antennas in the course of an observation of a compact radio source. Altogether one obtains the flux of the compact source, and the gains of the larger antennas in the array. In addition to the gain of the small antenna, one must know accurately the output receiver scales of the small antenna and the other antennas. This idea has been applied successfully at both 1 cm and 3 mm wavelengths. We describe the necessary components, some precautions, and some results. We also suggest how the technique may be applied to ALMA.