ACCURATE ANTENNA GAIN CALIBRATIONS AT CM AND MM WAVELENGTH

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In the absence of good celestial flux standards, accurate antenna gain calibration and the subsequent determination of new flux standards requires the comparison of an antenna response with that of a known reference antenna. This reference will necessarily be very small and simple, and therefore very different in response from the antenna(s) to which it is compared.

The challenge historically has been accurately to compare the response of antennas whose collecting area might differ by five orders of magnitude and whose beam patterns are very different. Interferometric, rather than total power comparison is much preferable because the measured correlations go as the square root of the collecting areas and the detection of only correlated signal makes the measurement relatively immune to variations in side-lobe response.

These advantages have motivated an experiment which has enabled us to measure the gain of a 6 meter antenna to about 1 percent accuracy at 1 cm wavelength. A similar experiment underway promises comparable results at 3 mm. Extension to 1 mm and shorter wavelengths seems feasible.

While making possible such accurate gain measurements of large antennas, various complications are introduced as well by the interferometry, and must be accounted for.

Several related methods are described that lead eventually to the accurate knowledge of a celestial flux density. Some include mechanical waveguide switches, some don't. Various ways of getting a power reference (a load at known temperature) into the system are considered. Application to the upcoming ALMA array is discussed, along with related requirements on the correlator, pointing accuracy, knowledge of the local weather conditions and other details to worry about.

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