

DEUTERIUM ARRAY MEMO #071

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
HAYSTACK OBSERVATORY
WESTFORD, MASSACHUSETTS 01886
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Telephone: 978-692-4764
Fax: 781-981-0590

To: Deuterium Array Group

From: Alan E.E. Rogers

Subject: Calibration of aperture array with a single calibrated element.

In this memo I reformulate the array calibration method described by Little 1958 (AuJPh, 11,70) in terms of 3 baseline normalized correlations on an unresolved point source.

The normalized correlation on baseline ab is given by

$$P_{ab} = \left(\frac{F}{2K} \right) \left(\frac{A_a A_b}{T_a T_b} \right)^{1/2}$$

where A_a, A_b are the effective collecting areas

T_a, T_b are the system temperature

F is the flux density

K is the Boltzman's constant

If we take the ratios

$$\left(\frac{A_b}{T_b} \right) = \left(\frac{P_{bc}}{P_{ac}} \right)^2 \left(\frac{A_a}{T_a} \right)$$
$$\left(\frac{A_c}{T_c} \right) = \left(\frac{P_{bc}}{P_{ab}} \right)^2 \left(\frac{A_a}{T_a} \right)$$

showing that we can get the sensitivity of elements b and c from the known sensitivity of element a . The method is more complex in the case that the elements have different polarization responses. The relation above assumed that all 3 elements had the same polarization. If the elements have different polarizations the sensitivities are no longer "station based" and each baseline has a different sensitivity. A simpler case is where all the elements being calibrated have the same polarization response. If this is the case the sensitivities can be found using 2 "calibration" elements with orthogonal polarizations or a dual point calibration element whose ports present orthogonal polarizations. In this case the correlations on an unpolarized source to each of the orthogonal calibration ports can be used to calibrate the sensitivity and polarization of the array elements.