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CALIBRATION AND TEST PROGRAMS FOR 1977

B. G. Clark

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Perhaps the currently most pressing item in the program of testing and calibration is getting some observing experience at frequencies other than six centimeters. Some of this will come naturally when observers attempt to calibrate their observations of unknowns. However, we should implement a parallel program in test time. Interferometer pointing mode observations of strong sources at the high frequencies yield information not only about system reliability and about the coincidence of 6 cm and high frequency beams, but also can be used to investigate relationships between elevation and gain, focus and system temperature.

It seems likely that some effort will have to go to diagnosing problems with antennas -- pointing and efficiency. Measurement of the beam pattern will tell the cause of low efficiency. Pointing problems may be more conveniently investigated with the interferometer system than any other way.

An important part of the test/calibration program revolves around measurements of the relative phase between right and left polarized correlators. This measurement is independent of atmospheric problems, baseline errors, and a large variety of software errors. It checks the performance of the entire system with the exception of the stability of the 600 MHz at the antenna. As currently observed at 6 cm, it exhibits slow drifts of up to 50^0, and discontinuities of any magnitude at all. The most difficult problems in the LO system lie in establishing the stability of the 600 MHz, but it seems unlikely that much progress can be made in studying this question until the serious problems revealed by the easier right-minus-left measurement are understood and resolved.

The polarization properties of the feeds need considerable further study. Much of this can be extracted from the interferometer pointing mode data. There is currently no software to do this, but it appears probable that it should be written. If necessary, an eight point cycle could be programmed, to provide polarization information at 45^0 as well as in the cardinal directions. The polarization properties of the 2 cm and 1.3 cm feeds urgently need remeasurement. The circular polarization problem should be attacked at 6 cm, either by the helical correctors or by mode generators in the throat of the horn. When a satisfactory correction is made, the same technique should be extended to the other frequencies. If no good correction is available by February, an intensive effort should be made to find a solution to the problem by one of the more radical modifications.

It should be noted that making sensible studies of the 21 cm polarization properties must await a good polarization diplexer and possibly even a circular polarizer.

The properties of the dichroic reflectors should be analysed by careful observations of net gain at several frequencies across the bands.

Some interesting experiments can be suggested for measuring the perturbability of the system. Among the more interesting ones are the coefficients of phase vs vertex room temperature, phase vs D rack temperature, phase vs waveguide length (via trombone, say), phase vs B rack power supplies, phase vs control building LO distribution amplifiers power supply and temperature, and amplitude vs waveguide coupling (or padding).

When the new versions of the LO generating modules, L6, F2 and F3, are available, the operating properties of the system should be investigated by operating briefly at all possible frequencies of the 3 GHz synthesizer, and of the 20 GHz LO. Actual observation is a sensitive way to detect coherent birdies, which, because of the phase switching, appear as an increase of the r.m.s. when the

fringe rate is slow, or as a real signal when it is very slow. Those birdies seen should be understood, and if possible, corrected.

Plots of phase and amplitude across the 50 MHz band should be developed using the 100 MHz synthesizers to investigate the broad spectrum of the IF system.

A straight-forward investigation of the question of whether use of the noise diode calibration system improves the short and long term stability of the system is a fairly urgent item, and must be repeated in all bands. The question must be investigated in considerable detail. It is possible, for instance, that use of the noise calibration will increase the long term stability but have deleterious effects on the short term stability. We must see if the receiver temperature is stable enough that the observed system temperature variations are entirely due to atmospheric thermal noise, which calls for a corresponding correction in opacity.

Amplitude stability observations at various bandwidths will hint at bandpass stability and let us look directly at the effect of the finite delay steps.

An appreciable part of the test and calibration effort must go to the determination of antenna pointing and location as new antennas are turned on and moved onto their array stations. The baselines should be altered, as soon as possible, from instantaneous pole to CIO coordinates. The axis intersection defect should be investigated, probably by the method of plunging.

In addition to the above, there are several corrections to the source and baseline ephemerides - body tides, general relativity, and retarded baselines - which should be debugged before the long and medium term stability of the LO system may be evaluated.

It is not reasonable to expect that this program can be totally accomplished in a single year - this memorandum should be taken as a shopping list of those projects which may be profitably started before the end of 1977.