

National Radio Astronomy Observatory  
Tucson, Arizona

June 12, 1984

MEMORANDUM

TO: Bob Brown, John Payne, Paul Rhodes, Chris Salter,  
Betty Stobie

FROM: Phil Jewell

SUBJECT: Update of Spectral Line Calibration Procedure

This summer, I would like to revise and update the procedure used for spectral line calibration at the 12m. In this memo, I have outlined my ideas for the changes and would appreciate your opinions and advice on it, particularly since I will need assistance from some of you in implementing it.

The heart of chopper wheel calibration is the proper determination of the scale factor TC. Since time immemorial, most observers have set TC to the canonical magic number of 800 for SSB observations. As outlined by Ulich and Haas (1976) and Kutner and Ulich (1981), TC is actually a function of 10 parameters:  $R_x$  sideband gain ratio  $G_i/G_s$ , signal frequency  $\nu$ , mean atmospheric temperature  $T_m$ , background temperature  $T_{BG}$ , spillover temperature  $T_{SPILL}$ , chopper temperature  $T_{CHOP}$ , signal and image band atmospheric optical depths  $\tau_s$  and  $\tau_i$ , sky efficiency  $\eta$ , and airmass  $A$ . Thus, TC varies with frequency, sky condition, and in particular, with airmass.

My proposal is to install automatic procedures to accurately calculate TC and to update it at the beginning of each scan. Specifically, the procedure should work as follows. Most of the parameters needed for TC can be calculated from tipping scan results and the application of a two-level atmosphere ( $H_2O + O_2$ ) model (see Kutner and Ulich, 1981). The relation between  $\tau_i$  and  $\tau_s$  will require a "look-up table" for a particular frequency. Since the tipping scan will be run in continuum mode, it seems most reasonable to program this into CONDAR.

Once the parameters needed for the calculation of TC have been determined, they will be given to the operator who will enter them into the FORTH control system. At the beginning of each spectral line scan, FORTH will calculate and update TC for the airmass (elevation) of the observation. I will, of course, need Betty's assistance in implementing these routines.

The installation of this procedure should result in a significant improvement in spectral line calibration. In fact, it will finally bring us in line with the recommendations of Ulich and Kutner, that were based largely on work done here!

In closing, I should state that a further important improvement in calibration could be achieved with the installation of a "calibration box" on the telescope. This would be a cold load that rides along with the telescope and could be switched into the beam via mirrors at any elevation angle. Thus, an absolute calibration standard would be available at all times and the sky and receiver noise components could always be distinguished. The construction of such a system would be a very good project as soon as the manpower is available.

PRJ:nlgh