NATIONAL RADIO ASTRONOMY OBSERVATORY
MEMORANDUM

DATE:
TO: Addressee
FROM: Ron Maddalena
SUBJECT: Initial tests of the GBT I.F. system

This memo summarizes the tests I made of the GBT I.F. system on the night of Dec. 8. The setup of the instrumentation differed from that we would use for observations in that the engineers (W. Grammer, R. Norrod, and M. Stennes) substituted a source of noise for the receiver. We designed the experiments to perform two tests.

(1) The first test was designed to check that the telescope's motion does not affect the new I.F. system. To perform the tests I recorded the detected total power with the standard A/D system for the two receiver channels. Holding the telescope at a constant azimuth, I had the telescope move at a speed of either 6 or 8 deg/min. from it's lowest elevation limit through the zenith and back to the opposing elevation limit. Observations were made at azimuths of 90/270, 45/225, and 135/315 degrees (see Figs. 1.1 - 1.3) with two observations separated by a few hours at an azimuth of 180/0 degrees (Figs. 1.4-1.5). Each observation lasted between 15 and 20 minutes. I also had the telescope point at the zenith for two 15-minute observations (i.e., the telescope was not slewing; Figs 1.6-1.7). [In all the figures, the Y-axis is the total detected power in counts; the X-axis is either telescope elevation (Figs. 1.1-1.5) or time (Fig. 1.6-1.7); the plots are labelled with the channel number (feed number) and telescope's azimuth.]

The observations consistently show a drift in the total detected power that is independent of the telescope position. At the start of my tests the drift was downward but after a few hours the drift either stopped or reversed itself. The detected power drifted in some cases by 1% and sometimes 5% in a 15- to 20-min. observation. In most cases, and especially evident in Figs. 1.4-1.5, the total power jumped by about 1% as the telescope moved near the zenith. We are planning more tests to determine the cause of the drifts and the jumps in the system.

(2) The second test was designed to look for bad spectral-line baseline shapes that might be introduced by the new I.F.system. Both the 1 to 8 GHz first I.F stage and the 100 to 500 MHz second I.F. stage were tested. I split the Autocorrelator into four 80-MHz parts; two parts looked at the first receiver channel and the other two at the second channel. Each observation set consisted of two 5-min scans; the first scan had center I.F. frequencies of 190 and 260 MHz and the second had center frequencies of 330 and 400 MHz. Thus, an observation set covered 150-440 MHz, which is most of the available bandwidth (100-500 MHz) of the second I.F. stage. Between each observation set, the operator changed the local oscillator frequency by 250 MHz so as to step along the 1 to 8 GHz of the first I.F. stage. The telescope was pointing at the zenith for these observations.

Figures 2.1-2.8 show a few representative spectra. The top row of spectra are average bandpasses for a 5-min. scan for the labelled receiver channel at the indicated center I.F. and L.O. frequencies. The lower spectra are the differences between the last and first 20-seconds of the 5-min. scan. The Y-axis of the upper row of spectra is irrelevant since these spectra have been normalized. The Y-axis of the bottom row of spectra would be equivalent to what we would see if the system temperature were 100 K.

One quickly notes the ripples in the bandpasses at all I.F. and L.O. frequencies that, if a byproduct of the I.F. system, would have a magnitude equivalent to about 10% of the system temperature. (The slope in the bandpasses are due to a cable equalizer in the Autocorrelator's I.F. patch panel that will need to be bypassed when the new I.F. system comes into use.) Mostly, as indicated by the difference spectra (Figs. 2.1-2.3), the ripples do not appreciably change in magnitude over a 5-min. period. Sometimes (Figs. 2.4-2.5) the ripple is very evident in the difference spectra. One occasionally sees large baseline shapes (Figs. 2.6-2.8) in the difference spectra which must be due to changes in the large-scale shape of the bandpasses during a 5-min. scan. I have not yet examined closely most of the spectra so other, more subtle problems might exist. We are planning more tests aimed at determining the cause of the ripples and baseline shapes.