GBT 3mm Receiver 1

Conceptual Design Review Summary

Held: May 29, 2001 at Green Bank, WV

Present: P. Jewell, J. Ford, R. Prestage, M. Stennes, R. Norrod, J. Condon, D. Egan, R. Lacasse, A. Shelton (in GB). S. Srikanth, B. Turner, A Wootten, J. Webber, J. Payne, J. Mangum (via video conference).

The first subject discussed was the receiver frequency range. It is hoped that many components developed for previous receiver projects can be used, to avoid design costs and delays. It seems that most continuum receivers on other telescopes tend to cover about 80-100 GHz, and spectral line receivers tend toward 90-110 or higher. The GBT 3mm receiver proposal stated the Module 1 frequency goal as 66.5 to 95 GHz. This is a F_H to F_L ratio of 1.43, and presents a technical challenge for several components, including the phase switches, and perhaps the waveguide magic-T's. Bandwidth ratio of 1.25 has been achieved for phase switches produced for the MAP project, approximately 80-100 GHz. Broadband OMTs in WR10 have been prototyped in conjunction with the ALMA project, but they are optimized for the 90-116 GHz range. To get best performance over the 68-93 GHz band, probably WR12 should be used. Difficulity will be encountered in achieving broadband phase and gain match required for best performance of the psuedo-correlation continuum receiver architecture; bandwidth can be greater for total power spectral line receivers. The possibility was raised of covering the 80-100 GHz range (1.25 BW ratio where atmospheric transparency is probably best) with the psuedo-correlation receiver, and adding a single or dual-beam total-power receiver for spectral line, covering 68-93 GHz. Also raised was the idea of building Module 1 to cover about 85-115 GHz, and defer frequency coverage below 80 GHz.

Barry Turner argued that the 70-85 GHz range is quite important for spectral line research, for Deuterium and other lines. Al Wootten made similar arguments in a later written note. Jim Condon argued that 70-90 GHz is optimum for continuum, although if significant delay or cost problems arose due to this selection, 80-100 GHz would be acceptable.

Concensus of the scientific team present seemed to be that Module 1 coverage of about 68-93 GHz , with continuum performance optimized over 70-90 GHz, should be the goal. Mike and Roger were asked to look in detail at cost, schedule, and technical trade-offs for this configuration, and for the 68-93 GHz spectral line / 80-100 GHz continuum arrangement.

J. Webber recommended the proposed phase-switching rate of up to 2.5 kHz should be increased to 10 kHz.

Frequency switching throw and rate were discussed. Throw of ±40 MHz was recommended, at rates up to 10 Hz.

It was agreed that an insertable quarter-wave plate or equivalent, with reduced bandwidth, was acceptable to generate circular polarization (for VLBI). For other observing, the receiver polarization will be linear.

A specification of 10 arcmin throw for the beam switching tertiary was added. It is expected that we will wait until a tertiary is built and tested with the GBT Q-band receiver before deciding how to proceed with a tertiary design for the 3mm receiver.

A goal of providing a 20 GHz wide IF output tap was added to the receiver specification. This could be utilized with low-resolution, ultra-bandwidth spectrometers under development at a couple of university labs.

Receiver calibration was discussed briefly. It was recommended that the feasibility of noise diode injection, and a Hot/Cold/Sky load calibration system should be investigated. The need for Phase Cal injection for VLBI was mentioned. The VLBA and the GBT 7mm front-ends inject the phase cal in the receiver IF, and this will be the default approach for the 3mm front-end.

A parallel project may be underway to construct a psuedo-correlation receiver for Ka-band. We should consider the possibility of combining work on the continuum data acquisition subsystems for these two receivers.

The project organization was reviewed. Project personnel currently named are:

- Project Scientist: Phil Jewell
- Project Manager: Roger Norrod
- Project Engineer: Mike Stennes

A series of four design reviews (including the Conceptual) are planned. The next will be the Preliminary Design Review now planned for September 7, 2001.