Memorandum March 7, 1991

To: Distribution
From: George Seielstad GJS

Subject: **First Five Receivers for the GBT**

I. Introduction

The versatility of the GBT will require a full complement of receivers covering all frequencies for which the telescope is usable. Providing that complement remains the ultimate goal. The initial construction budget, however, permits construction of just five receivers; so we need to decide which to build first. This memo offers my recommendations and is circulated to stimulate discussion.

II. Estimates of GBT's Scientific Use

The GBT's use will be determined by proposal pressure and peer review, as always at NRAO. Predictions five years in advance are notoriously unreliable. Nevertheless, we cannot permit inherent uncertainty to cause paralysis; we have to start somewhere.

Major categories of telescope use, together with preferred frequencies and estimated percentage of usage, are summarized below:

Category	Estimated Usage	Frequency (GHz)
Molecular Spectroscopy	42%	All, but see attached drawing
VLBI (incl. OVLBI)	20	0.33,0.61,1.5,2.3,4.8,8.4,15,23,43 (2, 1, 5, 3, (4))
Atomic (HI) Spectroscopy	18	≤1.420
Pulsars	17	≤?
Continuum	3%	5 for source surveys; 50 for dust emission

The attached graph highlights some specific spectral features taken from Table IV-1 of the June 1989 GBT Proposal. On the same graph, the VLBA bands are represented by black blocks on the frequency axis. Of these bands, the ones at 0.3, 1.5, 4.8, and 23 GHz apply also to Orbiting VLBI (RadioAstron and VSOP).

III. Staged Development of GBT Capabilities

GBT plans call for three stages of development: (1) the contractor produces a telescope usable to 15 GHz; (2) NRAO installs an open loop system of surface adjustment and an autocollimator scheme to improve pointing, permitting use to 45-50 GHz; (3) NRAO implements a laser distance-ranging scheme applicable both to closed-loop, accurate surface adjustment and to precision pointing, permitting operation at frequencies as high as the research and development effort enables. Stage 1 is supposed to be operational in early 1995, Stage 2 shortly thereafter, and Stage 3 as soon as the in-house effort develops the necessary new technology. A prudent policy, it seems, would allow some operational experience with the GBT to be acquired before advancing to Stage 3. Therefore, the initial set of five receivers should be for frequencies ≤50 GHz.

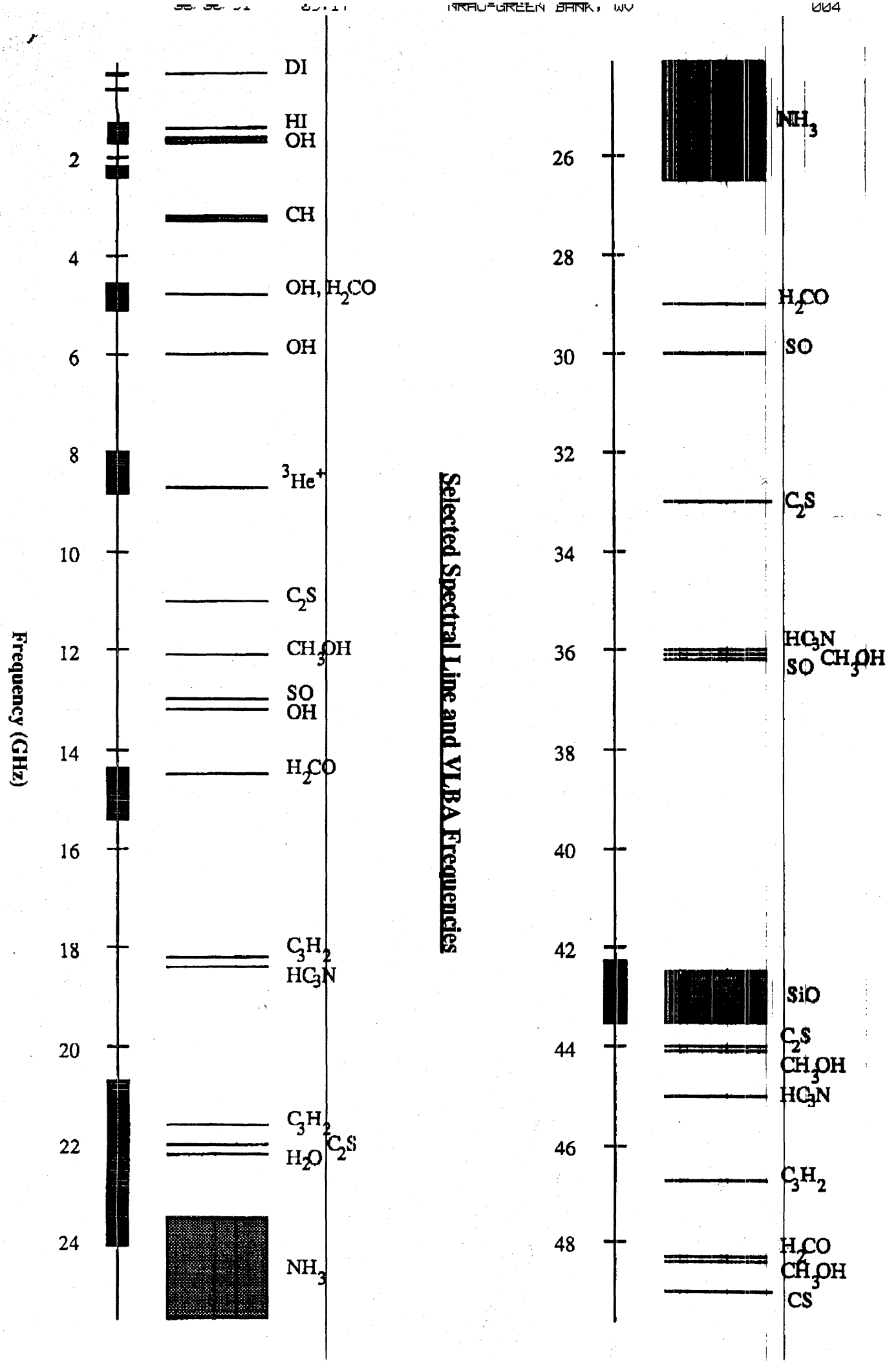
IV. Recommended Receivers

This section attempts to convolve the information from the preceding two. It lists the

receivers in priority, the science driving them, and brief comments about each. The ends of the frequency ranges are only approximate.

Receiver (GHz)	Driving Science	Comments
1.3-1.8	Gal & ExtraGal HI, OH Pulsars, (O)VLBI, Source Survey?	All-weather observations possible; G/T high; test of clear-aperture concept
0.3-1.3	Pulsars, High-z HI, (O)VLBI, deuterium	Prime focus receiver
18-25	Molecular Spectroscopy (esp. water and ammonia), (O)VLBI	Workhorse receiver
45-49	Molecular Spectroscopy	Test of GBT's active surface; band limited by orthomode transition to about 4 GHz; cannot cover both VLBI and desired molecular freqs
12-18	Molecular Spectroscopy VLBI	Difficult choice vs. 4.5-7 GHz

These are "strawman" suggestions on which your comments are welcome. And please note that the need for additional receivers is recognized. No matter how many NRAO builds in the end, though, it begins with a first set.



Selected Spectral Line and VLBA Frequencies