GBT MEMO 83

GBT Spectrometer Requirements

The attached figure shows the bandwidth and number of channels needed for various experiments that are to be performed on the GBT. Typical experiments require a fixed number of contiguous channels over a total bandwidth that varies with the frequency of observations. To measure emission lines from Galaxies, e.g., requires ~ 800 contiguous channels over a bandwidth that varies from ~ 700 MHz (for observations at 50 GHz) down to 20 MHz (for observations at 1.4 GHz). The dashed line on the Figure encloses the capabilities of the current Spectral Processor.

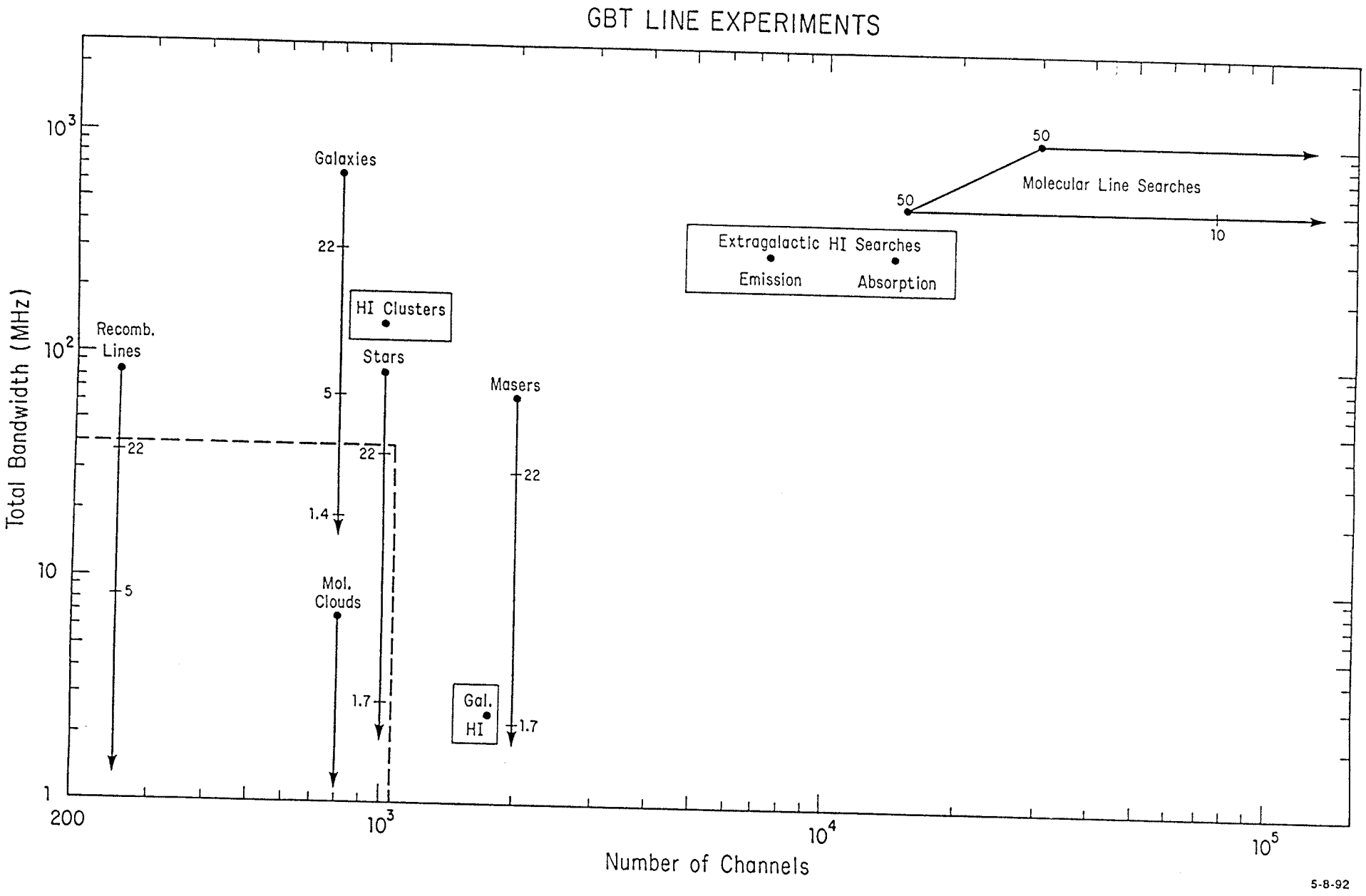
The experimental requirements divide into two classes. Experiments located to the left of the figure, with $N_{ch} \lesssim 2000$, need instantaneous coverage of the band. In contrast, the line searches that lie in the upper right of the Figure can be conducted using many overlapping narrow-band spectrometers. For example, the HI absorption line searches can be done with 15 spectrometers staggered over the band, each covering 20 MHz with 1000 ch.

The maximum total bandwidth needed for any single spectrometer is ~ 700 MHz; the maximum total number of channels needed is $\gtrsim 2000$. A spectrometer should have an equivalent sensitivity no worse than that obtained from 3-level sampling.

The number of spectrometers that are needed (i.e., the number of independent IF inputs) ranges from ≥ 2 at the higher bandwidths to many more at the lower bandwidths. There will be situations where 8 independent spectrometers are needed simultaneously (each with $\gtrsim 1000$ channels), and we would like to be able to configure our devices to achieve performance in the "Molecular Line Searches" area of the Figure. Someday there will be array receivers on the telescope that will have $\gtrsim 16$ separate channels.

Not all capabilities of the spectrometer need be present at first. It would be useful if the spectrometer were easy to expand or duplicate so that it's capabilities could be enhanced as money becomes available. The requirements need not be met by a single device; a set of several different backends, each optimized for some particular area of performance, is also suitable. Tradeoffs between bandwidth, number of channels and sensitivity can be considered.

F.J. Lockman
June 2, 1992


GBT LINE EXPERIMENTS
Total Bandwidth (MHz)
Number of Channels
Recomb. Lines
Galaxies
HI Clusters
Stars
Masers
Mol. Clouds
Gal. HI
Molecular Line Searches
Extragalactic HI Searches
Emission
Absorption
22
5
1.4
1.7
50
10
5-8-92