THE BREAKTHROUGH LISTEN SEARCH FOR INTELLIGENT LIFE: 1.1-1.9 GHZ OBSERVATIONS OF 692 NEARBY STARS

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The Breakthrough Listen Initiative is the largest campaign in human history on the search for extraterrestrial intelligence. The work presented here is a search for engineered signals from a sample of 692 nearby stars within 50 pc.

We used the Robert C. Byrd Green Bank Telescope (GBT) to conduct observations over 1.1-1.9 GHz (L-band). We used an strategy of three sets of 5-minute observations of each single primary target (ON), interspersed with 5-minute observations of secondary targets (OFF). By comparing the "ON" and "OFF" observations we are able to identify terrestrial interference.

We performed a search for narrow bad signals to a drift rate limit of +/- 2 Hz/sec. This improved our sensitivity, by reducing the smearing over frequency, to any signal experiencing the maximum doppler acceleration caused by more than twice the Earth's rotation.

During the analysis, eleven stars show events that passed our thresholding algorithm, but detailed analysis of their properties indicates they are consistent with known examples of anthropogenic radio frequency interference. The small number of false positives and their understood properties give confidence on the techniques used for this search.

We conclude that, at the time of our observations none of the observed systems host high-duty-cycle radio transmitters emitting between 1.1 to 1.9 GHz with an EIRP of 10^{13} W, which is readily achievable by our own civilization. We can place limits on the presence of engineered signals from putative extraterrestrial civilizations inhabiting the environs of the target stars. Our results suggest that fewer than ~0.1% of the stellar systems within 50 pc possess the type of transmitters searched in this survey. This work provides the most stringent limit on the number of low power radio transmitters around nearby stars to date.

We explored several metics to compare our results to previous SETI efforts. We note that the current Breakthrough Listen state-of-the-art digital backend installed at the Green Bank Observatory is the fastest ever used for a SETI experiment by a factor of a few. We developed a new figure-of-merit that can encompass a wider set of parameters and can be used on future SETI experiments for a meaningful comparison.

Here we report on the first Breakthrough Listen search conducted as part of this multi-year program.