



The Pulsar Search Collaboratory An Analysis of RFI



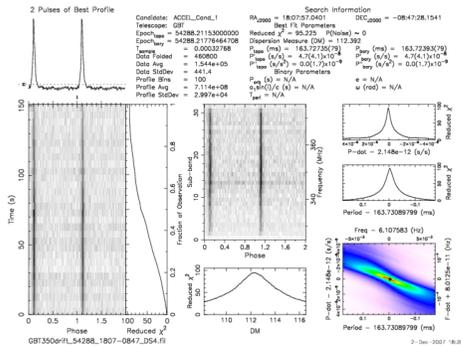
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Introduction

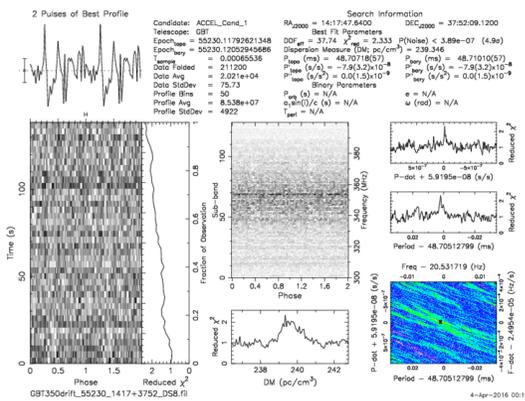
Pulsars are defined as a type of neutron star formed from the explosive removal of the star's outer layers; this leaves only the neutron core of the star intact. With this, pulsars are comprised nearly entirely of neutrons. These neutron stars are far more massive than the Earth's Sun and are usually around 10 km in diameter; the magnetic forces are ejected from the magnetic poles of the star in the form of radio waves. These radio waves are detected and studied by radio astronomers on Earth, who use the star's period and the detected radio peak to analyze the "pulse" of the star¹. Our PSC research group, Group Zwicky, was assigned thirteen datasets that were to be searched for pulsar candidates. We were to answer the following questions: Is the dataset harboring a pulsar or is the data plagued by Radio Frequency Interference (RFI)? What common structures exist in the datasets? What is the proportion of RFI to noise and candidate pulsars?

RFI

Radio Frequency Interference is the contamination of data collected by radio telescopes. These data obstructions present themselves in the charts and graphs studied in radio astronomy².



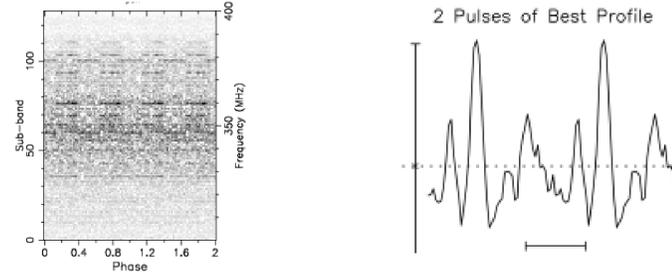
A dataset containing a pulsar candidate³.



A dataset contaminated by RFI. The presence of dark horizontal streaks at a certain Dispersion Measure in the sub-band versus phase plot of a dataset.

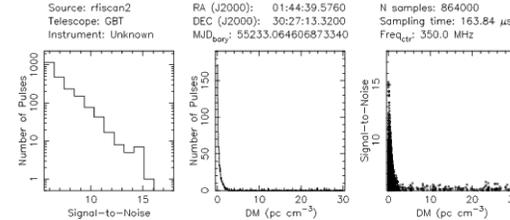
RFI in Dataset Charts

RFI can also be indicated by the presence of sharp, deep bands that traverse a single Dispersion Measure.



A photo of "snake bites" from our datasets and a Pulse Profile with large error bars. The presence of large error bars in the Pulse Profile chart is another signal that illustrates the absence of a pulsar in the dataset.

Single pulse results for 'GBT350drift_55233_0144+3027'



A photo of a DM of 0 in a single pulse profile dataset. A peak at a Dispersion Measure of zero is yet another sign of RFI in a dataset.

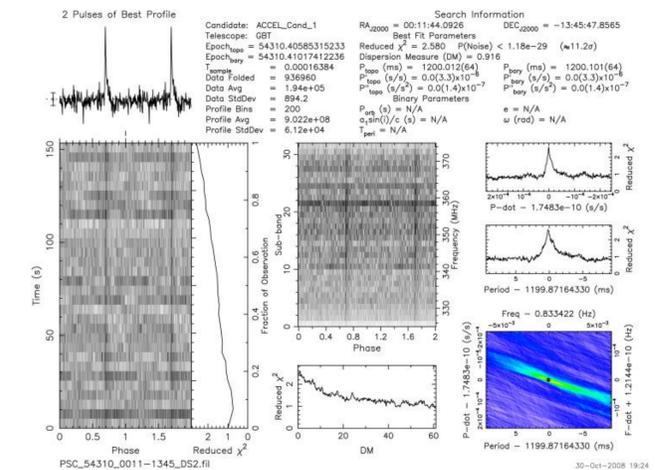
RFI Bandwidth

RFI occurs at frequencies across the radio wave spectrum. The following chart is reveals some of the sources of RFI for the GBT as of 2003⁴. There exists a great possibility that these sources are similar to those affecting our current datasets.

Frequency	Signal Characteristics	Source ID
0330.500	300Hz	Hot Springs, vA
0332.6000	Sig Ch	likely FAA
0353.9000	Sig Ch	FAA air to ground comm; possible tx at Buena Vista, VA

"Rogue" RFI

This classification of RFI masquerades itself as a pulsar in both the pulse profile time domain, and sub-band plots. The distinguishing characteristic of these pieces of RFI are their periods and their DMs. A DM of near zero and a consistent period and its harmonics are common cases of these data pieces⁵.

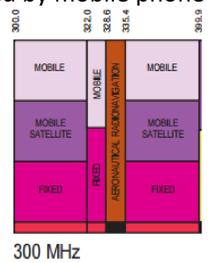


As seen above, our dataset was contaminated by one such "rogue" case of RFI. The near-zero DM of 0.916 cm³ pc and the period of 1200.101(64) ms illustrated that this was not a pulsar.

Discussion

The specific frequencies in the range 340-380 MHz were the most commonly afflicted our data. The sources of these interferences was further explored. After researching the common frequencies utilized by broad-band radio spectrum-using industries across the United States, we discovered that the previously stated frequencies of 340 to 380 MHz are used by mobile phone companies, mobile satellites, and for other fixed uses⁵.

These sources of RFI could also be attributed to the RFI bandwidths previous described in the chart (left). These sources are local sources found outside of the Radio Quiet Zone housing the GBT.



Results

All data conclusions proved to be RFI or noise. The phase versus time plots for many of the plots were affected by interference that covered the entire DM and time spectra. These same plots were affected by narrow-banding, large error-bars, and zero DM values. All of these data maladies allowed us to determine that all of the datasets we studied did not contain any pulsar candidates and were in fact RFI.

References

- Lynch, Ryan S. "Searching For And Identifying Pulsars."
- "Radio Frequency Interference," National Radio Astronomy Observatory.
- "Test 2," Pulsar Search Collaboratory Database.
- "Table of Known RFI," National Radio Astronomy Observatory Wiki.
- "United States Frequency Allocations: The Radio Spectrum," U.S. Department of Commerce.