The Search and Analyzation of Potential Pulsars: PSC Hewish 2016 Research NZM

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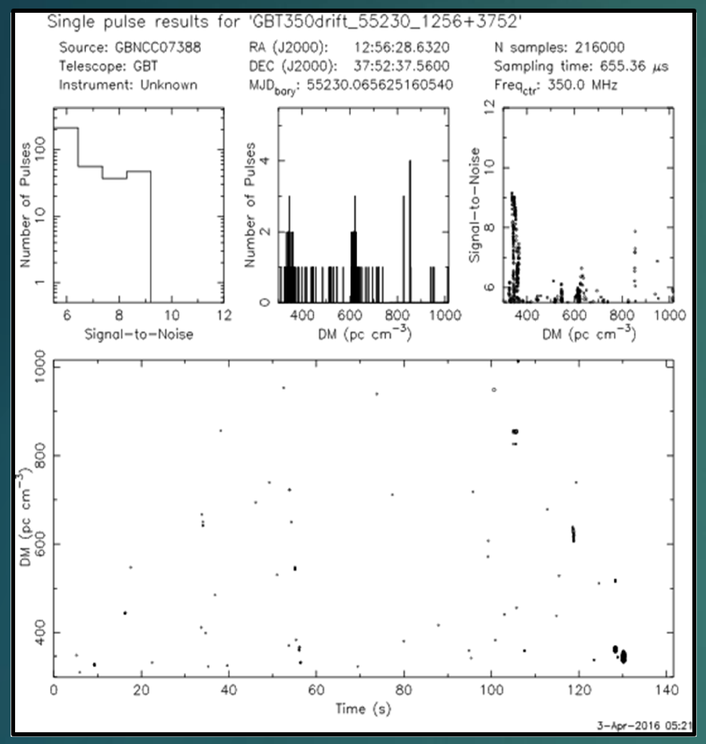
Research:

Through the analyzation of Pulsar candidates using the Pulsar Search Collaboratory datasets, we have been able to aid the search to discover new pulsars and pulsar systems by determining areas where no pulsars exist. Throughout our research, RFI or noise were apparent in almost all datasets we analyzed. The most promising piece of information we found was a possible "FRB", or Fast Radio Burst. Research on the evidence proving this candidate as a FRB are currently pending.



Candidate for Fast Radio Burst (FRB)

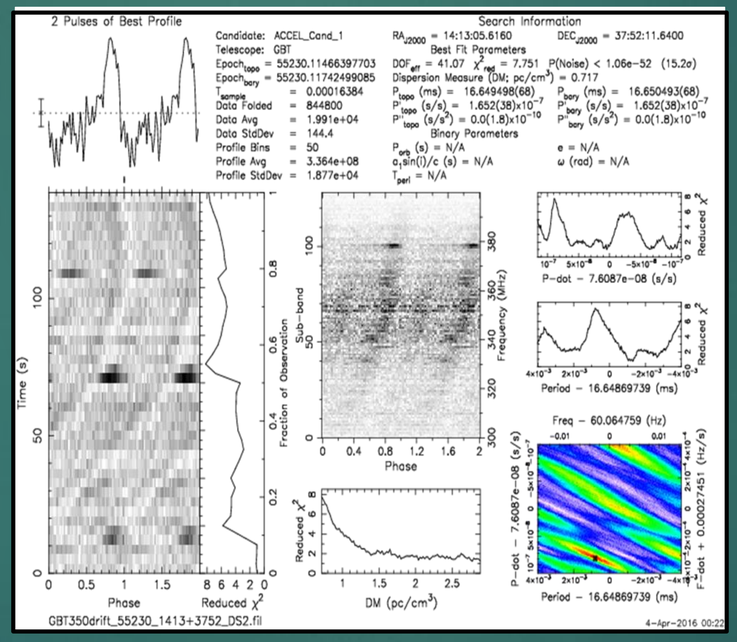
Fast Radio Bursts (FRB's) are transient radio pulses with a millisecond duration and are thought to originate in extragalactic distances; however, their physical origin is still unknown. The proposal for this candidate was discovered when a defined pulse was noticed at an unusually high Dispersion Measure (DM). FRB's are characterized by their high DM due to their great distances. The validation or rejection of this candidate will be determined by a waterfall plot. The visibility of a defined and continuous sweep from high to low frequency will provide evidence either proving or disproving the existence of this FRB candidate. With only 17 known FRB's in existence, this would help further our knowledge of the extragalactic universe and its cosmology.

Radio Frequency Interference (RFI)

Radio Frequency Interference (RFI) occurs when an external source creates a disturbance within the radio frequency spectrum, which causes false pulsar representations in the data. This is visualized by high spikes, numerous fluctuation above and below the average frequency intensities, and narrow bands seen in the time domain plot and the sub-band plot.

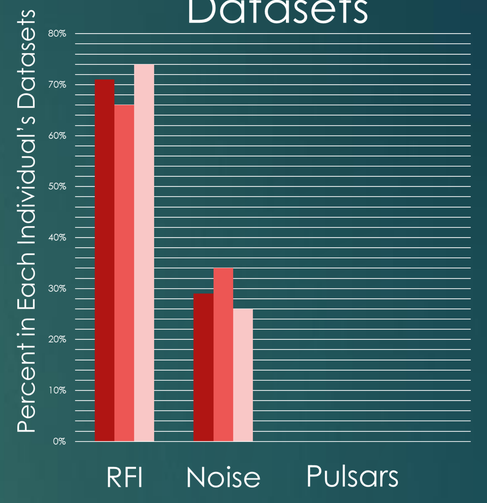
Distinguishing RFI

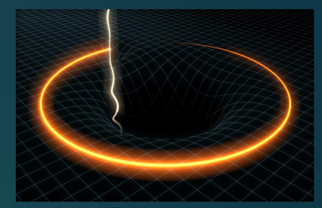
Multiple factors contribute to the distinction of an RFI. A low Dispersion Measure (DM) and "snake bites" are key characteristics in this identification. While RFI's were highly prominent throughout our research, the majority of RFI's had different characteristics. Another obstacle encountered was an unideal fold. In the time domain plot below, the period has shifted, which is evident in the curved bands. This is caused because the period is 16.649 milliseconds, which is a 1/60 Hz Frequency. This frequency is very common in RFI's due to the fact that this is the same frequency as power and telephone lines.



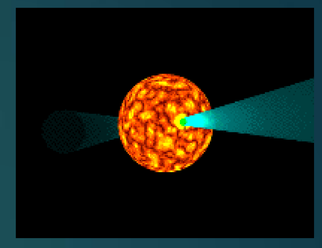
Names / % Found	N	Z	M
RFI	71%	66%	74%
Noise	29%	34%	26%

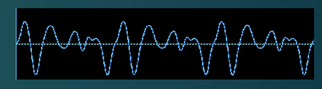
RFI vs. Noise in Pulsar Datasets





N Z M





Noise

Noise is the natural scattering and lack of signal in radio astronomy; it is the equivalent of static on a television when there is no cable. This natural behavior is the intrinsic noise to the functions of one's instrument. A random dispersion of dots in single pulse plots are a common indicator of the presence of noise. Noise can be identified in the pre-fold plot by the noise bar; the greater the size of this barrier, the greater the odds are of noise being present. In the time domain plot, noise is visible by static-looking lines on a gray color scheme. When noise is present, the image becomes very hazy, and it is difficult to distinguish distinct pulses in the data plots.

Analyzation:

The research we conducted through the Pulsar Search Collaboratory furthered our knowledge and awareness of the universe's cosmology, particularly from a radio astronomical view. Although no pulsars were observed, the data we collected as contributed to the pulsar search. The clear presence of extrinsic properties in our data plots opened our minds to crucial factors that contribute to finding a pulsar. Our attention shifted to an analytical standpoint, where we focused on what causes this absence of pulsars in the datasets. We plan to further our research on the potential Fast Radio Burst we encountered while still searching for new pulsars and pulsar systems and hopefully, contributing to the advancement of the radio astronomical field of science.

Acknowledgements

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5. Mark Leadingham
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7. Duncan Lorimer
8. Cecilia McGough
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