



Pulsar B2020+28 – A Brief Inquiry on Mode-Switching Phenomena

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Introduction

PSR B2020+28 is a pulsar exhibiting considerable traits and observable behaviors, as noted by several studies. It demonstrates a mode-switching phenomenon that markedly affects the relative intensity of data. Pulsars that display such characteristic have at least two patterns of mean pulse profiles, which can provide ample information on pulse emission processes, mechanisms, and structural elements. An abnormal mode exists in a more stable state, whereas a normal mode would require a longer duration to stabilize. An article from the Astrophysical Journal interprets this phenomenon as “a change in the inhomogeneous chemical composition and/or structure of the pulsar surface followed by an alteration of the electrostatic conditions in the polar cap regions above the surface, which leads to a different distribution of the particles in the magnetosphere.” According to analyses conducted through the Nanshan 25-m radio telescope, 76 mode-switching phenomena were identified. These observations indicated an unpredictability factor in this phenomenon, meaning that it has no traceable pattern. We’ve compiled data from the B2020+28 pulsar, comparing the mode-switching traits and intensity ratios to other data from a previous study.

Methods and Materials

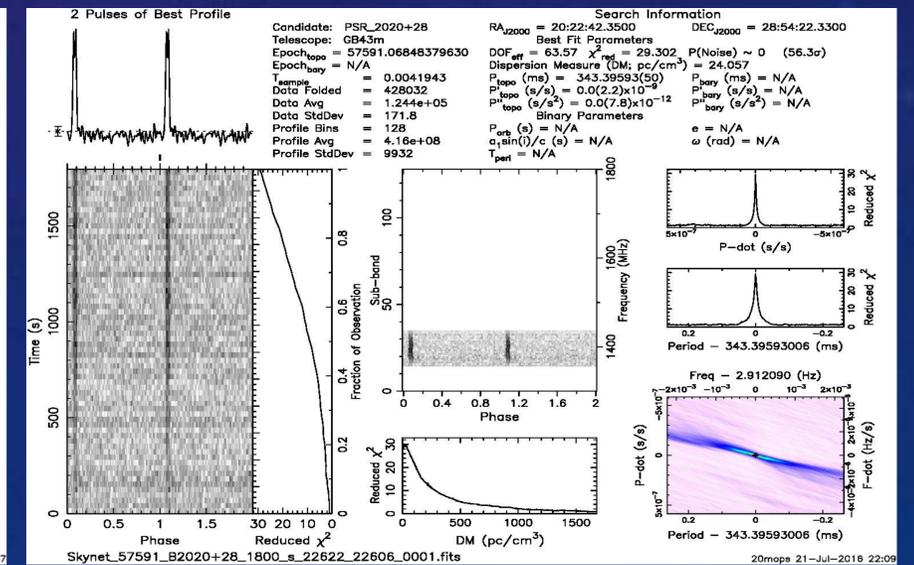
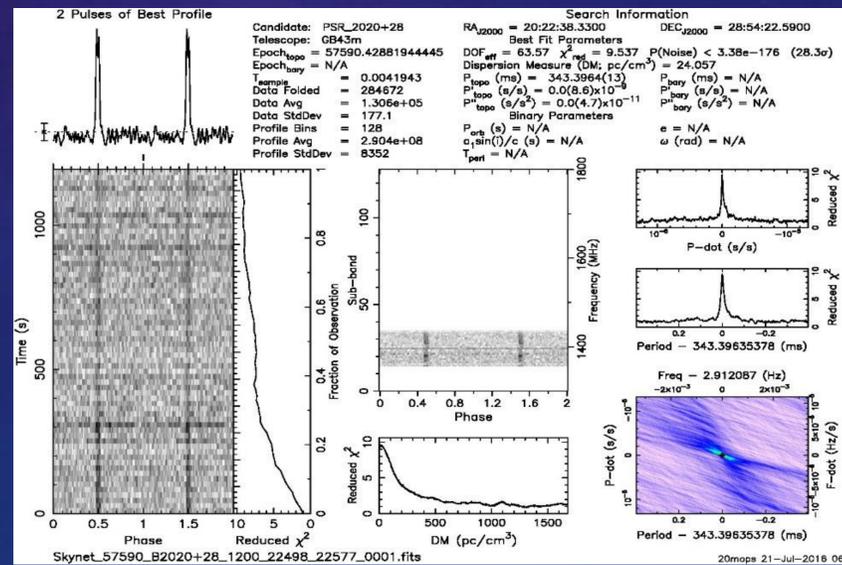
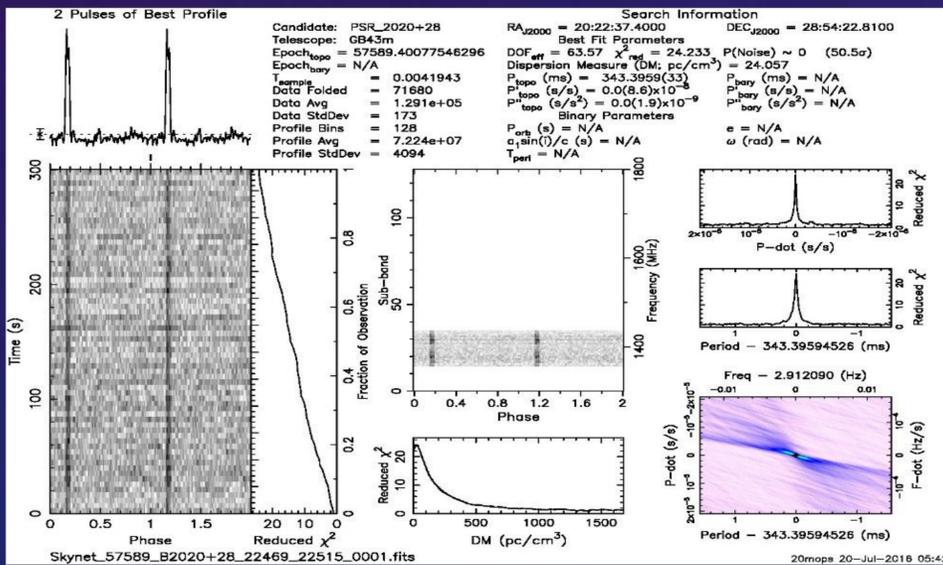
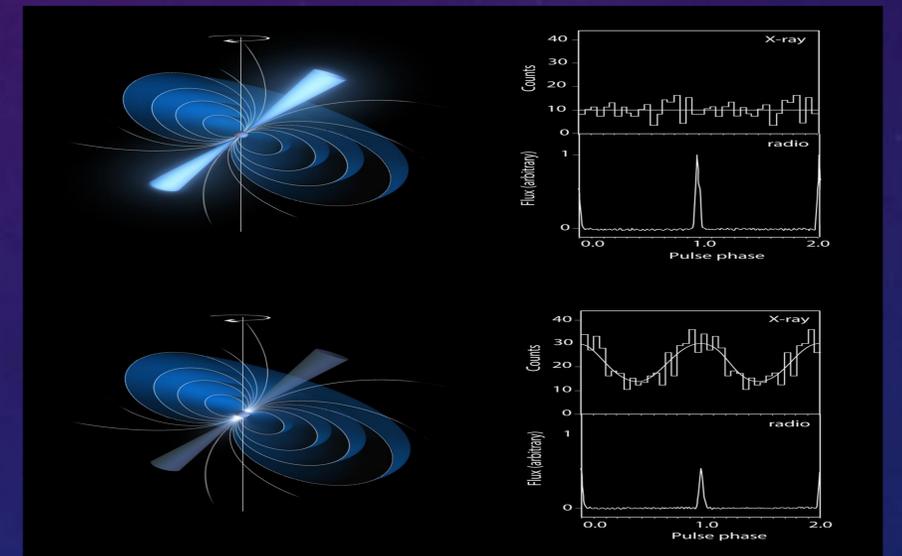
Using the 20 meter radio telescope, we initiated several observations for our designated pulsar, each with varying durations. We’ve assembled data from 300, 1200, and 1800-second observations, each retaining relatively disparate and unique characteristics. Upon receiving the data, we performed several comparisons using analyses from the Nanshan 25 meter radio telescope. Beforehand, however, we interpreted the pulse profiles, time domain plots, sub-band plots, and dispersion measure plots and examined commonalities as well as variations.

Conclusions

Our data compilation suggests that the B2020+28 pulsar resided more frequently in its abnormal state, which, interestingly, consisted of 2 of our 3 observations. However, the Nanshan data indicate that this pulsar occupies such state 11% of received observation, and resides in a normal state 89% of the spanned data collection, which advocated that our data is statistically contradictory and peculiar. A possible explanation for this phenomenon could be that our abnormal data was scrutinized almost exactly a day apart, whereas our 1800-second was viewed within a different time block.

Results

Our results were comparatively indicative of an adequate pulsar observation. The pulse profiles exhibited two well-defined positive peaks as well as a narrow noise bar. The time domain plots, however, revealed two oddly subtle and dim vertical lines, despite its continuous tracking. A curved peak can be indicated in the DM plots with a reading of 24.057 pc/cm³, although it is rather difficult to discern due to the extensive data measure. Conversely, we’ve determined the mode-switching properties of our observation set. Our 300-second examination showed similar traits to a G-type peak intensity ratio, which indicates its abnormal mode state. Likewise, the 1200-second observation exhibited an F-type ratio, which is an abnormal mode indicator. Alternatively, the 1800-second data suggests a normal mode state, exhibiting a C-type ratio, where the leading component is the secondary peak rather than primary.



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References

“The mode switching of PSR B2020+28”
 “The Mode-Switching Phenomenon in Pulsars”