Exploration and Analysis of Glitch Sizes and Their Patterns From 112 New Glitches in 30 New Pulsars

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Despite their discovery now dating over 50 years ago, and the great deal of observations we have collected in that time, there is still little we understand about the causes of a pulsar’s greatest phenomenon: glitches. Glitches are a sudden increase in the rotational frequency of a pulsar (a rotating neutron star whose signals contact Earth) that interrupts their typical stable rotation. Studying glitch size properties and their correlations with other parameters of the pulsar can tell us more about some currently unknown causes and conditions. This study completes the first comprehensive exploration and analysis of glitch sizes and their patterns, using a combination of previous data along with almost 4 years worth of new data, which is analyzed for the first time in this work. After initially exploring the population of all detected glitches, the main focus of the study shifted to examining the data of pulsars with robust glitch data as it was realized that this study’s results contradict those of previous literature. A previous hypothesis made by Fuentes et al. (2019) suggested that there are two kinds of glitches - large ones with a correlation between glitch size and the time until the next glitch and small, uncorrelated ones. However, it was found that this hypothesis does not apply to the situations of half of the pulsars in the sample with ~10 or more recorded glitches. This key result indicates that there are multiple, complex explanations as to what causes a pulsar’s glitch breaking point. These explanations may range from starquake events to differences in the initial formation and internal structures of these stars. Exploring these multiple theories would bring us closer than ever to truly understanding the inner mechanisms of these stars.

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