UniTs - University of Trieste

Long-term statistics of pulsar glitches

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github.com/Spina02/pulsar

Purpose of the Study

This project aims to reproduce the results of the study [1] on the long-term statistics of pulsar glitches.

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1 Introduction

In this work, we will explore a model able tu simulate the glitches of a pulsar.

Radio pulsar glitches appear to follow an avalanche-like pattern[2], where the star's superfluid core transfers angular momentum to its solid crust through a series of connected, threshold-triggered events. This process maintains the system in a self-organized critical state. Analysis of the time intervals between glitches shows an exponential distribution pattern in seven out of nine well-observed pulsars, after accounting for observational constraints on minimum waiting times. This distribution aligns with what we would expect from a constant-rate Poisson process.

A recent study [1] proposed a microphysics-agnostic meta-model where internal stress accumulates as a Brownian process between glitches, with glitches triggered when a critical threshold is reached. This model makes specific predictions about glitch statistics, including a Spearman correlation coefficient > 0.25 between glitch size and waiting time. The model's predictions were tested against six pulsars with extensive glitch records, with varying degrees of consistency.

2
Conclusions

Bibliography

[1] J B Carlin et al. “Long-term statistics of pulsar glitches triggered by a Brownian stress accumulation process”. In: *Monthly Notices of the Royal Astronomical Society* 494.3 (Apr. 2020), pp. 3383–3391. ISSN: 0035-8711. DOI: 10.1093/mnras/staa935. eprint: https://academic.oup.com/mnras/article-pdf/494/3/3383/33138210/staa935.pdf. URL: https://doi.org/10.1093/mnras/staa935.

[2] A. Melatos et al. “Avalanche Dynamics of Radio Pulsar Glitches”. In: *The Astrophysical Journal* 672.2 (Jan. 2008), pp. 1103–1118. ISSN: 1538-4357. DOI: 10.1086/523349. URL: http://dx.doi.org/10.1086/523349.