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Stochastic and secular anomalies in measurements of pulsar braking indices

Stochastic (i.e. the achromatic component of timing noise unrelated to interstellar propagation) and secular variations in the spin frequency ν of a rotation-powered pulsar complicate the interpretation of the measured second derivative of the spin frequency $\ddot{\nu}$, and hence the braking index, n, in terms of a power-law spin-down torque $\propto \nu^{n_{\rm pl}}$. Both categories of variation can lead to measurements of $\ddot{\nu}$ which yield anomalous braking indices, i.e. $|n| = |\nu\ddot{\nu}/\dot{\nu}^2| \gg 1$, where the overdot symbolizes a derivative with respect to time. In this talk, I will discuss the following three key results. First, the combined effect of stochastic and secular deviations from pure power-law spin down on measurements of $\ddot{\nu}$ and its implications in observationally constraining n. Second, how the variance of $\ddot{\nu}$ (or equivalently n) satisfies a falsifiable, analytical result derived from first principles. We quantify said variance through analytic calculations, Monte Carlo simulations involving synthetic data from a phenomenological model, and modern Bayesian techniques. Third, how the variance of $\ddot{\nu}$ may be applied to real astronomical situations to predict or interpret the measured braking index n.

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