Characterizing the radio frequency timing stability of fast and millisecond pulsars

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1 Abstract

We propose measuring the average profile stabilization rate in millisecond pulsars. We consider the correlations between a pulsar's global average profile and subaverage profiles constructed using increasing numbers of pulses, thereby quantifying the number of pulses required to build a stable average profile. We adopt the methodology developed by Helfand *et al.* [1] and later employed by Rathnasree & Rankin [2] to calculate the stabilization rates of a sample of both normal and millisecond pulsars. A correlation coefficient, X_n, is obtained by averaging the correlation coefficients of the global average profile with each subaverage profile of n pulses. By plotting how X_n increases with n, one can observe how the star's profile stabilizes as the number of pulses used to construct it increases. We look for values of n for which the correlation coefficient X_n is statistically significant and interpret this value as the number of pulses required to compute a stable average profile of a given star. We expect n to be smaller for millisecond pulsars, as they typically exhibit very few intrinsic variations. This work considers the stars studied by Rathnasree & Rankin, as well as millisecond pulsars that are of interest to the pulsar timing community and in particular the NANOGrav[1] initiative.

References

[1] Helfand, D.J., Manchester, R.N., & Taylor, J.H. 1975, *Ap.J.*, 198, 661.

[2] Rathnasree, N., Rankin, J.M., 1995, *Ap.J.*, 452, 814.

[1] North American Nanohertz Observatory for Gravitational Waves : www.NANOGrav.org