Pulsars : Problems & Progress
ASP Conference Series, Vol. 105, 1996
S. Johnston, M. A. Walker and M. Bailes, eds.

Expectancy of large pulsar glitches

Altan Baykal

NAS/NRC Resident Research Associate, LHEA NASA/GSFC
Greenbelt, Maryland 20771 USA, and
Physics Dept. Middle East Technical University, Ankara 06531 Turkey

Ali Alpar

Physics Dept. Middle East Technical University, Ankara 06531 Turkey

Abstract. We study the expectancy of large glitches ($\Delta\Omega/\Omega > 10^{-7}$) from a sample of 472 pulsars other than the Vela pulsar. The pulsars in this sample have exhibited 20 large glitches. In the sample the total observation span is larger than 2000 pulsar years. We assume that all pulsars experience such glitches, with rates that depend on the pulsars' rotation rate and spin-down rate, and on the glitch model. The superfluid vortex unpinning model gives good agreement with the observed distribution of glitches and with the parameter values deduced for the Vela pulsar glitches.

Pulsar glitches are sudden frequency changes, $\Delta\dot{\Omega}/\dot{\Omega} \sim 10^{-9} - 10^{-6}$, accompanied by jumps in the spin-down rate, $\Delta\dot{\Omega}/\dot{\Omega} \sim 10^{-3} - 10^{-2}$. Alpar and Ho (1983) and Alpar and Baykal (1994) investigated the expectancy of large glitches by using 267 and 430 pulsars. In the later work the mean glitch parameter $< \delta\Omega/\Omega >$ agrees with that for the Vela pulsar. In this poster, by using the pulsar catalog in anonymous ftp session in pulsar.princeton.edu (Taylor et al., 1993, 1995), we updated the sample to 472 pulsars with time span larger than 2000 years. In Fig. 1 we plot the total pulsar monitoring time versus $\Omega/\dot{\Omega}$ where the asterics denotes the large glitches. As seen from the figure the younger pulsars have larger glitch rates.

In the superfluid vortex unpinning model expectancy of large glitches can be expressed as

$$< n >= \frac{1}{< \delta\Omega/\Omega >} \sum t_i \dot{\Omega}_i / \Omega_i \qquad (1)$$

where $< n >$ is the total large glitches in the sample, t_i is the observed time span of each pulsar, $< \delta\Omega/\Omega > \sim < \delta N/N >$, N is the total number of vortices in the star and δN is the number of vortices unpinning in the glitch. Using the pulsar rotation rate Ω and spin-down rate $\dot{\Omega}$ and setting the $< n >$ equal to the observed number of large glitches, 20, the critical glitch parameter $< \delta\Omega/\Omega > \sim 10^{-4}$ is found. This value is very close to Vela glitch parameter (Alpar et al., 1993). The number of unpinned vortices during large glitches seems to be similar in all pulsars, and the interglitch time scale increases with pulsar age

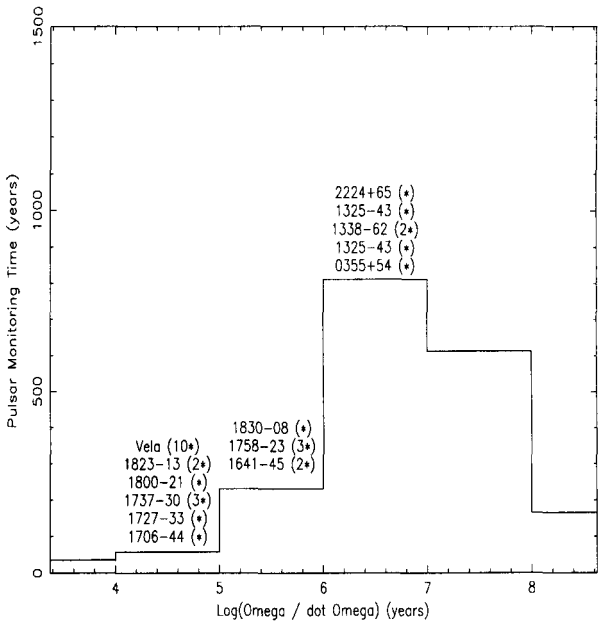

Figure 1. Pulsar Monitoring Time (years) versus Log($\Omega/\dot{\Omega}$) (years), asterics denote the large pulsar glitches

$t_g =< \delta\Omega/\Omega > \Omega/\dot{\Omega}$. Hence the observed large glitches are less frequent in older ages (see Fig. 1).

References

Alpar M.A et al., 1993, ApJ, 409, 345
Alpar M.A and Ho., 1983, MNRAS, 204, 655
Alpar M.A and Baykal A., 1994 MNRAS, 269, 849
Taylor et al., 1993 ApJS, 88, 529
Taylor et al., 1995 Unpublished work

https://doi.org/10.1017/S0252921100041154 Published online by Cambridge University Press