Evidence of cyclic evolution of radio pulsars periods on the hundreds years.

A. Biryukov (1,2), G. Beskin (1), S. Karpov(1)

(1) Special Astrophysical Observatory of RAS, (2) Moscow State University (contact: eman@sai.msu.ru, beskin@sao.ru)

The statistical properties of subset of all "normal" radio pulsars with measured second frequency derivative are studied. It is shown that a significant correlation (with r ˜ 0.9) between first and second frequency derivatives exists for pulsars with both positive and negative second derivative. We argue in favor of evolutionary nature of such correlation. Due to the absence of any correlation of the second frequency derivative sign with any other pulsar parameters such a picture undoubtedly means some sort of cyclic evolution of pulsar rotational frequency with repeated changes of second derivative sign on a time scale much shorter than the life time of the pulsar while longer than the time span of observations. Such behaviour explains the extraordinary high and negative values of observed braking indices of pulsars. We propose the simple model of harmonic oscillations superimposed with usual power-law secular frequency evolution which describes observational data rather well. The derived braking index of secular slow-down is roughly equal to 5, which, while deviates from the "usual" magneto-dipole value of 3, is rather convenient, and may argue in favor of a quadrupole nature of rotational energy loss.