THE RELATION BETWEEN RADIO LUMINOSITY AND MAGNETIC FIELD IN ROTATION-POWERED PULSARS

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ABSTRACT. The relationship between radio luminosity L and magnetic field B is re-investigated under the assumption that the new spindown mechanism proposed by Huang et al. (1982) becomes dominant at large periods ($\dot{P} \propto P^2$). Magnetic dipole braking is still assumed to provide the main torque at short periods ($\dot{P} \propto P^{-1}$). Both spindown torques depend on B^2 (assuming proportionality between internal and external fields) so that the resultant magnetic field in this hybrid model is given by (note the difference with the standard expression):

$$B^2 = 1.0 \times 10^{39}\ \dot{P}\ P \ /\ (1 + \gamma\ P^3)\ \text{Gauss.}$$

A value of 3.6 is used for γ (Pineault 1986). For the radio luminosity we use the values tabulated by Manchester and Taylor (1981).

The results of the correlation analysis give log L = 0.80 log B + constant, with a correlation coefficient of 0.29, a highly significant result for the sample of 291 objects used (nominally < 0.0001%). For comparison, in the standard model, the correlation coefficient is only 0.04 (this differs from the results of Lyne et al. (1985) because of a different luminosity definition). The implications of this analysis on the distribution of pulsar properties in models with luminosity evolution (Gunn and Ostriker 1970, Lyne et al. 1985) and on the apparent correlation between transverse velocity and magnetic field (Cordes 1987) are currently under study.

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