

Pulsar kick velocity induced by natal neutrino chirality flip: lower bound for the neutrino magnetic moment[†]

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- The pulsar kick velocity can be rewritten in the following form

$$v = -803.925 \frac{\text{km}}{\text{s}} \left(\frac{1.4 M_{\odot}}{M_{NS}} \right) \left(\frac{R}{10 \text{ km}} \right)^3 \left(\frac{I}{\text{MeV fm}^{-3}} \right),$$

where

$$I = \int_{T_i}^{T_f} \chi_e(B, T, \mu_i) C_v(B, T, \mu_i) dT, \quad i = e, u, d, s.$$

- Taking into account neutrino quirkality flip as a factor in the the electron spin polarization χ , we obtained the velocity showed in Fig. 1.

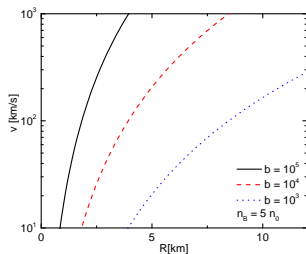


Figure: Kick velocities as a function of the NS radius for a NS with 1.4 solar masses.

Conclusions

- 1 We have shown that neutrino quirkality flip during the birth of a SQM NS is an efficient mechanism to allow the produced neutrinos to escape from the NS core provided the neutrino magnetic moment is not smaller than $4.7 \times 10^{-15} \mu_B$.
- 2 The results of this work set a range for the neutrino magnetic moment given by $4.7 \times 10^{-15} \leq \mu_\nu / \mu_B \leq (0.1 - 0.4) \times 10^{-11}$.
- 3 The obtained kick velocities for natal NS conditions are consistent with the observed ones and span the correct range of radii for typical magnetic field intensities.