ASYMMETRIC NEUTRINO EMISSIONS IN STRONGLY MAGNETIZED MATTER IN RELATIVIS- TIC QUANTUM APPROACH

T. Maruyama[1], T. Kajino[2], M.K. Cheoun[3] and G.J. Mathews[4],
[1]College of Bioresource Sciences, Nihon University, Fujisawa 252-8510, Japan
[2]National Astronomical Observatory of Japan, Mitaka, Tokyo 181-8588, Japan
[3]Department of Physics, Soongsil University, Seoul, 156-743, Korea
[4]Center of Astrophysics, Univ. of Notre Dame, Notre Dame, IN 46556, USA

We have been studying neutrino reactions in strongly magnetized neutron-star matters in the relativistic mean field theory. In that work we found the asymmetry of neutrino emissions from the magnetized proto-neutron-stars (PNSs), and showed that this asymmetry largely contributes to the pulsar-kick [1] and the spin-deceleration of the PNSs [2]. In the above calculations, however, we considered only spin currents in a perturbative way.

Recently, we have introduced Landau levels in our framework and have calculated pion productions though proton synchrotron radiation [3]. The results exhibit that quantum calculations give quite different momentum-distribution of the pions from those in semi-classical calculations.

Then, we apply our new theoretical approach to neutrino reactions. In this work we consider $\nu - \bar{\nu}$ pair production from electron and proton synchrotron radiations, which occur only under the strong magnetic field. In addition, produced neutrinos are emitted into the direction nearly perpendicular to a magnetic field [5], and the neutrinos can transfer from deep inside of the star.

Recently, it was suggested that a toroidal component of the magnetic field, which is larger than a poloidal component, exists inside the magnetars [6]. By studying their momentum distribution, thus, we can know the distribution of the magnetic field and demonstrate the toroidal component.

The neutrino emissions also play important roles in the cooling and the spin-deceleration of magnetars These works must give significant information to know their structures.