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Neutron Star Cooling on Strong Magnetic Field : Neutrino -Antineutrino Pair Emission and Direct Urca Processes

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We study cooling neutron-stars with strong magnetic fields through neutrino emissions from neutrino and antineutrino pair emission [1] and the Direct urca (DU) processes. We perform exact relativistic quantum calculations by introducing the Landau levels and anomalous magnetic moments [2]. Strong magnetic fields supply energy and momentum and make these processes even in the conditions where these processes do not occur in no magnetic field.

Then, we find that when the strength of the magnetic field is $B = 10^{14}$ - 10^{16} G, these contributions are much larger than the modified Urca process.

[1] T.Maruyama et al., Phys Lett. B 805, 135413 (2020).

[2] T. Maruyama et al., Phys. Rev. D 91, 123007 (2015); Phys. Lett. B 757, 125 (2016); Phys. Lett. B 779, 160 (2018).

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