## Magnetic field structures inside magnetars with strong toroidal field.

Kotaro Fujisawa<sup>\*1</sup>

<sup>1</sup>University of Tokyo (UT) – Department of Earth Science and Astronomy, Graduate School of Arts and Sciences, University of Tokyo, 3-8-1 Komaba, Meguro-ku, Tokyo 153-8902, Japan, Japan

## Abstract

AXPs and SGRs are considered as special types of magnetized neutron stars, magnetars. Typical magnetars have very strong dipole magnetic field. Recent observations, however, reported low field SGRs whose global dipole fields are much lower than typical magnetars' (Rea et al. 2010, 2012). Their magnetar-like activities would be driven by the magnetic energy stored in the internal toroidal magnetic field. Therefore, such low-field magnetars must have very strong toroidal magnetic fields inside them. On the other hand, many theoretical studies (Ciolfi et al. 2009, Lander & Jones 2009, Fujisawa et al. 2012, etc.) failed to obtain the magnetized star equilibria with very strong toroidal magnetic field. Since all of their solutions does not satisfy the stability criteria (Braithwaite 2009), these magnetic field configurations would be unstable ones.

Very recently, we have analysed the previous studies and revealed the condition that the magnetized star can sustain the strong toroidal magnetic field inside them (Fujisawa & Eriguchi 2013). In the study, we have showed the importance of the coexistence of oppositely toroidal currents density for magnetized stars to sustain strong toroidal magnetic fields within them. In other words, the strong toroidal magnetic fields can be supported by the negative current in the crust region of the magnetar. This result implies that the crust cracking results in the injection of toroidal magnetic field energy. In this presentation, I will talk about the details of the magnetic field configurations of the magnetized equilibrium states with strong toroidal magnetic field.

<sup>\*</sup>Speaker