Contribution ID: **75** Type: **Talk**

The magnetic field profile in strongly magnetized neutron stars

Thursday 11 May 2017 10:40 (20 minutes)

We report a realistic calculation of the magnetic field profile for the equation of state inside strongly magnetized neutron stars. Unlike previous estimates, which are widely used in the literature, we find that magnetic fields increase relatively slowly with increasing baryon chemical potential (or baryon density) of magnetized matter. More precisely, the increase is polynomial instead of exponential, as previously assumed. Through the analysis of several different realistic models for the microscopic description of matter in the star (including hadronic, hybrid and quark models) combined with general relativistic solutions endowed with a poloidal magnetic field obtained by solving Einstein-Maxwell's field equations in a self-consistent way, we generate a phenomenological fit for the magnetic field distribution in the stellar polar direction to be used as input in microscopic calculations.

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Track Classification: SMFNS2017