

Stable magnetic equilibria in upper-main-sequence and degenerate stars

Andreas Reisenegger

Pontificia Universidad Catolica de Chile

Massive stars on or just beyond the main sequence, as well as white dwarfs and neutron stars, possess long-lived magnetic fields that are organized on a large scale, with a strong dipole component. Dynamically, these fields are unimportant, as the Lorentz force is at least a million times weaker than pressure and gravity forces. Thus, it is likely that these configurations are hydro-magnetic equilibria, in which a small perturbation to the latter forces balances the Lorentz force. In the radiative envelope of the massive stars, as well as in the whole interior of the degenerate remnants, matter is stably stratified, and therefore the pressure and gravity forces are determined by two independent variables (e.g., pressure and density perturbations) that allow to balance a wide range of magnetic field structures. The latter are discussed for the particular case of axial symmetry, in which poloidal and toroidal field components are likely to stabilize each other, as found numerically by Braithwaite and collaborators. In strongly magnetized neutron stars, the equilibrium is likely to be eroded on time scales short enough to explain the “magnetar” phenomenon. In all other cases, the magnetic field is likely to survive over the observable lifetime of the stars. (Reference: Reisenegger 2008, A&A, submitted, arXiv:0809.0361v1 [astro-ph])