Abstract for "Simulations of stably stratified regions with MagIC: modelling of the Tayler-Spruit dynamo"

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MagIC is a pseudo-spectral and parallel code which solves the MHD equations in a 3D spherical geometry. This code is particularly adapted to investigate dynamo problems in spherical astrophysical objects, such as geo-, stellar, and proto-neutron star dynamos. While dynamos driven by convection have been extensively studied, dynamos driven by MHD instabilities in stably stratified shear flows are much less known. I will focus on the modelling of the Tayler instability-driven dynamo, the so-called Tayler-Spruit. This mechanism is of particular interest for astrophysics, especially to explain angular momentum transport in stellar interiors and the formation of very magnetized neutron stars called magnetars. Due to its subcritical nature, this dynamo has remained elusive in numerical simulations until the recent studies of *Petitdemange et al.* and *Barrère et al.* I will present the recent results arising from a large numerical study of the Tayler-Spruit dynamo, in which we used MagIC. Our results demonstrate the existence of different subcritical branches showing distinct magnetic field geometries and dynamical behaviours, which were not predicted by previous analytical studies. This rich dynamics can be grasped using tools of the non-linear dynamical system theory. On the astrophysical aspect, the strongest branch harbours magnetic fields which are consistent with the observation of magnetars with low magnetic dipoles and in global agreement with analytical prescriptions for angular momentum transport in stellar radiative zones. Thus, beyond capturing an unexpected rich dynamics of the Tayler-Spruit dynamo, our work provides a better understanding of the formation of magnetars and the physics in stellar interiors.