Highlights of Astronomy, Volume 15
XXVIIth IAU General Assembly, August 2009
Ian F Corbett, ed.

doi:10.1017/S1743921310009701

Dynamo action in rotating convection

Gustavo Guerrero[1,2] and Elisabete M. de Gouveia Dal Pino[2]

[1]Nordita, AlbaNova University Center,
Roslagstullsbacken 23 SE-10691, Stockholm, Sweden
email: guerrero@nodita.org

[2]Instituto de Astronomia, Geofísica e Ciências Atmosféricas (IAG), Universidade de São Paulo,
São Paulo, Brazil
email: dalpino@astro.iag.usp.br

Abstract. We present MHD numerical simulations of a rotating turbulent convection system in a 3D domain (we have used the finite volume, Goudunov type MHD code PLUTO (Mignone *et al.* 2007)). Rotating convection is the natural scenario for the study of the dynamo action which is able to generate a large scale magnetic field, like the observed in the sun. Though we have neglected in the present approach the Ω effect, due to a large scale shear, our model is appropriate to test the controversial existence of the so called α effect that arises from helical turbulence (e.g. Cattaneo & Hughes 2006, Käpylä *et al.* 2009). We start with a two-layer piecewise polytropic region in hydrostatic equilibrium (e.g. Ziegler 2002), considering one stable overshoot layer at the bottom and a convectively unstable layer at the top of the computational domain. We have allowed this hydrodynamic system to evolve up to the steady state, i.e., after about 10 turnover times (τ). Then, we introduced a seed magnetic field and let the system evolve for more $\sim 40\tau$. Our preliminary results are summarized below in Figure 2.

References

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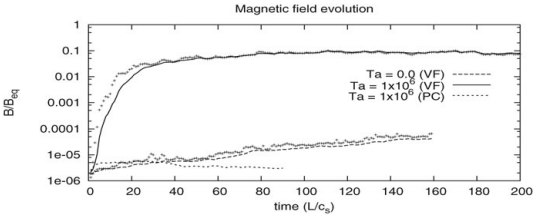

Figure 1. We show the time evolution of the mean magnetic field for models with two different rotation rates: Ta=0 and Ta=10^6. These simulations consider a vertical field (VF) boundary condition for the magnetic field (e.g., Käpylä *et al.* 2009). The case for Ta=10^6 with perfect conductor (PC) boundary conditions is also presented in this figure. Two significant results are evident: first, the presence of rotation allows the exponential amplification of a large scale magnetic field, which suggests the existence of a turbulent α effect operating in the convection zone, in agreement with Käpylä *et al.* (2009). Second, this result is very sensitive to the boundary conditions: for VF boundary conditions, or open boundaries, there is a growing of the large scale magnetic fields to values around 10 % of the equipartition value with the kinetic energy, while in the case with PC boundary conditions the saturation of the magnetic field occurs at the early stages of the time evolution resulting in a much smaller amplification of its strength. The evolution of the fluctuating components of the magnetic field are also shown with + symbols, for comparison.