CHAOS 2009
2nd Chaotic Modeling and Simulation International Conference
June 1 - 5, 2009 Chania Crete Greece www.chaos2009.net

Turbulent effects in Flux-dominated Solar dynamo models

G. Guerrero, E. M. de Gouveia Dal Pino & M. Dikpati
IAG-USP, Sao Paolo, Brazil
guerrero@astro.iag.usp.br

The Babcock-Leighton Solar dynamo models have shown to be relatively successful in reproducing the main features of the solar cycle. In this class of models, the source of the poloidal field is the emergence of bipolar magnetic regions (BMR's) and their further diffusive decay. Meridional flow plays also an important role because it transports the low latitude dipolar field towards the poles, and then to the inner layers in order to close the dynamo loop. This mechanism to produce poloidal field differs from the turbulent α effect, which it is believed to be quenched, under some conditions, in the presence of strong toroidal fields. However there are another turbulent effects operating in the interior of the convective zone that could have important consequences in the dynamo process. In this work we explore the introduction of the turbulent magnetic pumping and the η-quenching in a Babcock-Leighton dynamo model. We find that the former is important in the transport or the toroidal fields, being in some cases more important than the meridional flow in setting the correct period of the cycle. It could also help to produce solutions with the observed dipolar parity, suggesting that the parity problem is related to the quadrupolar imprint of the meridional flow on the poloidal component of the magnetic field. The turbulent pumping positively contributes to wash out this imprint. For the quenching effect, we solve an algebraic function for η by which it is strongly suppressed when the magnetic field is large, we find the formation of long-lived small an intense toroidal magnetic structures. Since the period of the cycle increases when the efficiency of the quenching is larger, we explore whether it is possible to have large values of the magnetic diffusivity in the convection zone and still keep the dynamo in the flux-transport regime, however we observe that for values of η above 2e11 cm^2 / s, the model drifts to the diffusion regime.