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A new simple dynamo model for solar activity cycle

Nobumitsu Yokoi (1) and Dieter Schmitt (2)

(1) University of Tokyo, Institute of Industrial Science, Tokyo, Japan (nobyokoi@iis.u-tokyo.ac.jp), (2) Max-Planck Institut für Sonnensystemforschung (MPS), Göttingen, Germany

The solar magnetic activity cycle has been investigated in an elaborated manner with several types of dynamo models [1]. In most of the current mean-field approaches, the inhomogeneity of the large-scale flow is treated as an essential ingredient in the mean magnetic field equation whereas it is completely neglected in the turbulence equation. In this work, a new simple model for the solar activity cycle is proposed. The present model differs from the previous ones mainly in two points. First, in addition to the helicity coefficient α, we consider a term related to the cross helicity, which represents the effect of the inhomogeneous mean flow, in the turbulent electromotive force [2, 3]. Second, this transport coefficient (γ) is not treated as an adjustable parameter, but the evolution equation for γ is simultaneously solved. The basic scenario for the solar activity cycle in this approach is as follows: The toroidal field is induced by the toroidal rotation in mediation by the turbulent cross helicity. Then due to the α or helicity effect, the poloidal field is generated from the toroidal field. The poloidal field induced by the α effect produces a turbulent cross helicity whose sign is opposite to the original one (negative cross-helicity production). The cross helicity with this opposite sign induces a reversed toroidal field. Results of the eigenvalue analysis of the model equations are shown, which confirm the above scenario.

References

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