

Krein space related perturbation theory for MHD α^2 -dynamos and resonant unfolding of diabolical points

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The spectrum of the spherically symmetric α^2 -dynamo is studied in the case of idealized boundary conditions. Starting from the exact analytical solutions of models with constant α -profiles a perturbation theory and a Galerkin technique are developed in a Krein-space approach. With the help of these tools a very pronounced α -resonance pattern is found in the deformations of the spectral mesh as well as in the unfolding of the diabolical points located at the nodes of this mesh. Non-oscillatory as well as oscillatory dynamo regimes are obtained. A Fourier component based estimation technique is developed for obtaining the critical α -profiles at which the eigenvalues enter the right spectral half-plane with non-vanishing imaginary components (at which overcritical oscillatory dynamo regimes form). Finally, Fréchet derivative (gradient) based methods are developed, suitable for further numerical investigations of Krein-space related setups like MHD α^2 -dynamos or models of PT -symmetric quantum mechanics.

- [1] F. Krause and K.-H. Rädler, *Mean-field magnetohydrodynamics and dynamo theory*, (Akademie-Verlag, Berlin and Pergamon Press, Oxford, 1980).
- [2] H. Langer and C. Tretter, Czech. J. Phys. **54**, (2004), 1113-1120.
- [3] F. Stefani and G. Gerbeth, Phys. Rev. Lett. **94**, (2005), 184506; physics/0411050.
- [4] F. Stefani, G. Gerbeth, U. Günther, and M. Xu, *Why dynamos are prone to reversals*, Earth Planet. Sci. Lett. (2006), to appear, physics/0509118.
- [5] O. N. Kirillov, A. A. Mailybaev and A. P. Seyranian, J. Phys. A: Math. Gen. **38**(24), (2005), 5531-5546, math-ph/0411006.