Invited Talk-07

Understanding of Chaos and Hyper Chaos in Fluid Dynamics Through the Use of Lyapunov Exponents

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ABSTRACT

Weakly non-linear analysis of Rayleigh-Benard convection in ferromagnetic fluids (known as ferroconvection) will be considered as a representative problem for studying the influence of different modes on the onset of two-dimensional ferroconvection (regular convection) and also chaotic-ferroconvection. The concept of a minimal Fourier system (Magnetic-Lorenz model) for studying ferroconvection shall be introduced. Discussion shall be made on whether this minimal system covers all aspects predicted by the full system. Modes shall be added to the minimal system to see if the additional modes present dynamics that is qualitatively different from that of the minimal system. Numerical experimentation through systematic addition of vertical, horizontal and mixed modes shall be elaborated upon to get a clear picture of various aspects of two-dimensional ferroconvection. The role of Lyapunov exponents in understanding chaotic dynamical systems shall be discussed. Since the extended Lorenz systems are fourth order and higher, the possibility of hyper-chaos showing up exists and this aspect shall be addressed through illustrative examples of ferroconvection.

Keywords: Ferroconvection, Hyper chaos, Magnetic-Lorenz model, Lyapunov exponents.

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