



南昌大学

NANCHANG UNIVERSITY

数智论坛 (第十六期)

ON MAGNETIC INHIBITION THEORY IN 3D NON-RESISTIVE MAGNETOHYDRODYNAMIC FLUIDS: GLOBAL EXISTENCE OF LARGE SOLUTIONS

ABSTRACT:

This talk is mainly concerned with the global existence and asymptotic behaviour of classical solutions to the three-dimensional (3D) incompressible non-resistive viscous magnetohydrodynamic (MHD) equations with large initial perturbations in a 3D periodic domain (in Lagrangian coordinates). Motivated by the approximate theory of the ideal MHD equations in [C. Bardos, C. Sulem, P. Sulem, TAMS, 1988], the Diophantine condition imposed in [J.J. Chen, T.Y. Hou, CMP, 2021] and the magnetic inhibition mechanism in the version of Lagrangian coordinates analyzed in [F. Jiang, S. Jiang, ARMA, 2019], we prove the global existence of a unique classical solution with some class of large initial perturbations, where the intensity of impressed magnetic fields depends increasingly on the $H^{1,7} \times H^{2,1}$ -norm of the initial velocity and magnetic field perturbations. Our result not only mathematically verifies that a strong impressed magnetic field can prevent the singularity formation of classical solutions with large initial data in the viscous MHD case, but also provides a starting point for the existence theory of large perturbation solutions to the 3D non-resistive viscous MHD equations. In addition, we also show that for large time or sufficiently strong impressed magnetic fields, the MHD equations converge to the corresponding linearized pressureless equations in the algebraic convergence-rates with respect to both time and field intensity. (This is a joint-work with Prof. Fei Jiang from Fuzhou University)

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江松，应用数学与计算数学专家，中国科学院院士、北京应用物理与计算数学研究所研究员，研究领域为流体力学的数学理论、数值方法和应用研究等。江松院士在可压缩NAVIER-STOKES方程与磁流体力学方程的数学理论、武器物理计算方法和重大武器型号软件平台研制等方面取得了突出成绩；曾获国家自然科学二等奖、军队科技进步一等奖，入选国家“百千万人才工程”，1998年获第六届中国青年科技奖，2002年获得国家杰出青年科学基金，2003年获中国科协“求是杰出青年奖”，2014年评选为中国工程物理研究院杰出专家，2015年当选中国科学院院士，2019年获何梁何利基金科学与技术进步奖。

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