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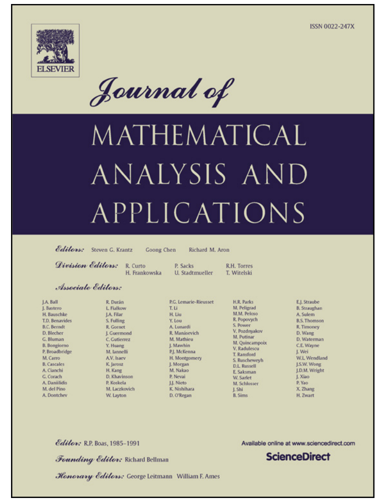

Global existence of smooth solutions for three-dimensional magnetic Bénard system with mixed partial dissipation, magnetic diffusion and thermal diffusivity

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ACCEPTED MANUSCRIPT

GLOBAL EXISTENCE OF SMOOTH SOLUTIONS FOR THREE-DIMENSIONAL MAGNETIC BÉNARD SYSTEM WITH MIXED PARTIAL DISSIPATION, MAGNETIC DIFFUSION AND THERMAL DIFFUSIVITY

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ABSTRACT. This paper deals with the Cauchy problem to the 3D system of incompressible magnetic Bénard fluids. We prove that as the initial data satisfy $\|u_0\|^2_{H^1(\mathbb{R}^3)} + \|b_0\|^2_{H^1(\mathbb{R}^3)} + \|\theta_0\|^2_{H^1(\mathbb{R}^3)} \leq \varepsilon$, where ε is a suitably small positive number, then the 3D magnetic Bénard system with mixed partial dissipation, magnetic diffusion and thermal diffusivity admit global smooth solutions.

2010 Mathematics Subject Classification: 35A01; 35B65; 35Q30; 76D03.
Key words: Magnetic Bénard system; Partial dissipation; Magnetic diffusion; Thermal diffusivity; Smooth solution.

1. Introduction

This paper studies the global existence of smooth solutions to the initial value problem of the three-dimensional (3D) incompressible magnetic Bénard system with mixed partial dissipation, magnetic diffusion and thermal diffusivity. The 3D magnetic Bénard system reads

$$\begin{cases} \partial_t u + (u\cdot\nabla)u + \nabla\pi = \mu_1\partial_{xx}u + \mu_2\partial_{yy}u + \mu_3\partial_{zz}u + (b\cdot\nabla)b + \theta e_3, \\ \partial_t b + (u\cdot\nabla)b = \nu_1\partial_{xx}b + \nu_2\partial_{yy}b + \nu_3\partial_{zz}b + (b\cdot\nabla)u, \\ \partial_t\theta + (u\cdot\nabla)\theta = \kappa_1\partial_{xx}\theta + \kappa_2\partial_{yy}\theta + \kappa_3\partial_{zz}\theta + u\cdot e_3, \\ \nabla\cdot u = 0,\ \nabla\cdot b = 0, \end{cases} \tag{1.1}$$

where $(x, y, z) \in \mathbb{R}^3$, $t \geq 0$, $\mu_i \geq 0 (i = 1, 2, 3)$ are the fluid viscosity, $\nu_i \geq 0(i = 1, 2, 3)$ the magnetic diffusion, and $\kappa_i \geq 0(i = 1, 2, 3)$ the thermal diffusivity; $u = u(x, y, z, t) = (u_1(x, y, z, t), u_2(x, y, z, t), u_3(x, y, z, t))$ denotes the velocity, $b = b(x, y, z, t) = (b_1(x, y, z, t), b_2(x, y, z, t), b_3(x, y, z, t))$ the magnetic, $\pi = \pi(x, y, z, t)$ the pressure, $\theta = \theta(x, y, z, t)$ a scalar function which may for instance represents the temperature variation in the content of thermal convection, $e_3 = (0, 0, 1)^T$ the unit vector in the vertical direction. We

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