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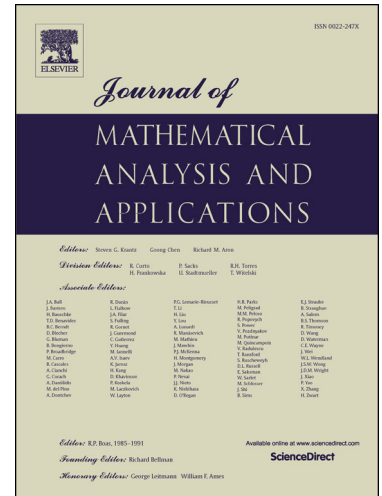
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# A regularity criterion for the 3D incompressible Magneto-hydrodynamics equations \*

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**Abstract.** The paper is dedicated to study of the regularity criterion for weak solutions to the 3D incompressible MHD equations. Employing the Littlewood-Paley decomposition, we show that if  $\tilde{\nabla}\tilde{u} = (\partial_1\tilde{u}, \partial_2\tilde{u}) \in L^{s_1}([0, T]; \dot{B}_{r_1, \frac{2r_1}{3}}^0(\mathbb{R}^3))$ ,  $\frac{2}{s_1} + \frac{3}{r_1} = 2$ ,  $\frac{3}{2} < r_1 \leq \infty$  and  $\tilde{\nabla}\tilde{b} = (\partial_1\tilde{b}, \partial_2\tilde{b}) \in L^{s_2}([0, T]; \dot{B}_{r_2, \frac{2r_2}{3}}^0(\mathbb{R}^3))$ ,  $\frac{2}{s_2} + \frac{3}{r_2} = 2$ ,  $\frac{3}{2} < r_2 \leq \infty$ , then the solutions to the MHD actually is smooth on  $(0, T)$ .

**Key words.** MHD equations, Regularity criterion, Littlewood-Paley decomposition

**AMS subject classifications.** 76W05 35B65

## 1 Introduction

We consider the 3D incompressible magneto-hydrodynamics (MHD) equations

$$(MHD) \begin{cases} \frac{\partial u}{\partial t} - \nu \Delta u + u \cdot \nabla u = -\nabla p - \frac{1}{2} \nabla |b|^2 + b \cdot \nabla b, \\ \frac{\partial b}{\partial t} - \eta \Delta b + u \cdot \nabla b = b \cdot \nabla u, \\ \nabla \cdot u = \nabla \cdot b = 0, \\ u(0, x) = u_0(x), \quad b(0, x) = b_0(x). \end{cases} \quad (1.1)$$

Here  $u$ ,  $b$  describe the flow velocity vector and the magnetic field vector respectively,  $p$  is a scalar pressure,  $\nu > 0$  is the kinematic viscosity and  $\eta > 0$  is the magnetic diffusivity, while  $u_0$  and  $b_0$  are the given initial velocity and initial magnetic field respectively, with  $\nabla \cdot u_0 = \nabla \cdot b_0 = 0$ . If  $\nu = \eta = 0$ , (1.1) is called the ideal MHD equations. Using the standard energy method, it can be easily proved that for given initial data  $(u_0, b_0) \in H^s(\mathbb{R}^3)$  with  $s > \frac{1}{2}$ , there exists a

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