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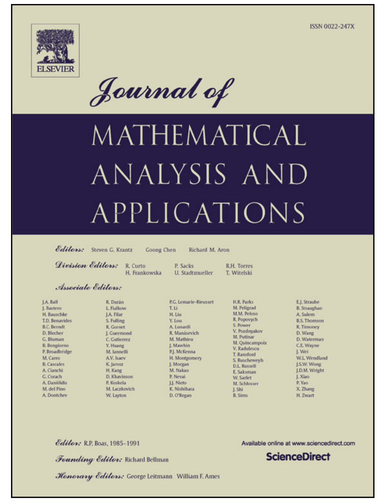

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STABILITY OF STEADY-STATE SOLUTIONS TO NAVIER-STOKES-POISSON SYSTEMS

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Abstract. This paper is concerned with a stability problem for compressible Navier-Stokes-Poisson systems. It arises in the modeling of semiconductors with a viscosity term in momentum equations. We prove that smooth solutions exist globally in time near the steady-state solution, and converge to the steady state for large time. In this stability result, we don't give any special assumptions on the given doping profile. The proof is based on the techniques of anti-symmetric matrix and an induction argument on the order of the space derivatives of solutions in energy estimates.

Keywords: Navier-Stokes-Poisson system, steady-state, global smooth solution, energy estimate

AMS Subject Classification (2000) : 35Q35, 76N10

1. Introduction and main results

1.1. **Introduction.** We consider smooth solutions of compressible Navier-Stokes-Poisson systems on $\mathbb{R}^3$. This system describes the dynamic of electrons in semiconductors with a viscosity term in momentum equations. The symbols $n, p, u = (u_1, u_2, u_3)^T$ and ϕ stand for the density, pressure, the velocity and the electric potential of the electrons. The scaled system is written as (see [1, 13, 17]) :

$$\begin{cases} \partial_t n + \nabla \cdot (nu) = 0, \\ \partial_t (nu) + \nabla \cdot (nu \otimes u) + \nabla p(n) = n \nabla \phi + \Delta u, \\ -\Delta \phi = b(x) - n, \quad \lim_{|x| \to \infty} \phi = 0, \end{cases} \tag{1.1}$$

for $t > 0$ and $x \in \mathbb{R}^3$, where $b(x)$ is the doping profile for semiconductors. We assume b is sufficiently smooth and satisfies $b \geq$ const. > 0 on $\mathbb{R}^3$, and pressure p is smooth and strictly increasing on $(0, +\infty)$. The system is supplemented by the following initial condition

$$t = 0 : \ (n, u) = (n_0, u_0), \quad x \in \mathbb{R}^3. \tag{1.2}$$

For smooth solutions in any non-vacuum field, the momentum equations in (1.1) can be written as

$$\partial_t u + (u \cdot \nabla) u + \nabla h(n) = \nabla \phi + \frac{\Delta u}{n},$$

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