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Diffusion in multicomponent systems: from Maxwell-Stefan to compressible fluid models

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ABSTRACT

Fluid mixtures appear in many applications like heliox for asthma patients, ion transport in biological membranes, and lithium-ion batteries. Their dynamics should be described by thermodynamically consistent fluid models. In this talk, some models with various complexity are presented. The starting point are Maxwell-Stefan systems which consist of cross-diffusion equations with an entropy structure. These systems can be complemented by equations for the velocity, temperature, or electric potential and coupled to the compressible Navier-Stokes equations. The mathematical challenges are the thermodynamically consistent modeling (which gives energy and entropy estimates) and the degeneracy of the Maxwell-Stefan diffusion matrix. The existence of solutions to Maxwell-Stefan systems and stationary coupled Maxwell-Stefan-Navier-Stokes systems is presented. For the latter model, we combine entropy methods and techniques from Lions and Feireisl. The compactness for the total mass density follows from an improved integrability estimate for the density, the effective viscous flux identity, and uniform bounds related to Feireisl's oscillations defect measure.

This is joint work with M. Bulicek, M. Pokorny, and N. Zamponi (Prague).

Time integration of randomly perturbed Schrödinger-type equations

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ABSTRACT

The first part of the presentation deals with the numerical integration in time of the nonlinear Schrödinger equation with power law nonlinearity and random dispersion. We will then present preliminary results on the time discretisation of a coupled system of stochastic Schrödinger equations.