Modelling and analysis for multicomponent incompressible fluids

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In this talk, we consider fluids consisting N chemical substances at small compressibility. Starting from a thermodynamically consistent constitutive model for the free energy, we analyze the incompressible limit, where the molar volume becomes independent of pressure. We show that, as a consequence of thermodynamic consistency, the molar volume must be independent on temperature as well, and moreover that it is given as a linear constitutive function of the composition variable (concentration fractions). Compared to our knowledge of thermal expansion in incompressible fluids, and to well-known nonlinear volume effects during the mixing of substances, these two properties seem surprising. We will discuss the two problems, in particular putting them into the light of the low Mach-number limit in PDEs describing the dynamics of multicomponent fluids in non–equilibrium. If time allows, we shall also discuss recent well–posedness issues concerning the PDEs for multicomponent incompressible fluids. The talk relies on joined works with D. Bothe (TU Darmstadt) and W. Dreyer (WIAS Berlin).