Two entropic finite volume schemes for a Nernst-Planck-Poisson system with ion volume constraints

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In this talk, I'll consider a drift-diffusion system with cross-coupling through the chemical potentials comprising a model for the motion of finite size ions in liquid electrolytes that can be thought of a a simplified version of [2]. The drift term is due to the self-consistent electric field maintained by the ions and described by a Poisson equation.
I'll present two finite volume schemes based on different formulations of the fluxes. Following [1], I will provide a stability analysis of these schemes based on the preservation of physical properties : the conservation of mass, the second principle of thermodynamic, and the non-negativity of concentrations. Form these properties stems an existence result for the corresponding discrete solutions. A convergence result is also proposed for non-degenerate solutions. Numerical experiments show the behavior of these schemes.

[1] C. Cancès, C. Chainais-Hillairet, J. Fuhrmann, B. Gaudeul. *A numerical-analysis-focused comparison of several finite volume schemes for a unipolar degenerate drift-diffusion model.* IMA Journal of Numerical Analysis, **41(1)**, 271–314, 2021.

[2] W. Dreyer, C. Guhlke, R. Müller. *Overcoming the shortcomings of the nernst–planck model.* Physical Chemistry Chemical Physics, **15(19)**, 7075–7086, 2013.

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