The quasi-neutral limit for the ionic Vlasov-Poisson system with rough data

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Vlasov-Poisson type systems are well known as kinetic models for plasma. The version of the equation describing ions includes an additional exponential nonlinearity in the equation for the electrostatic potential compared to the electron case, which creates several new mathematical difficulties.

The quasineutral limit refers to the limit of vanishing Debye length, a length scale governing electrostatic interactions and typically very small in physical plasmas. In the case of the ionic model, the formal limit is the kinetic isothermal Euler system; however, this limit is highly non-trivial to justify rigorously and known to be false in general without very strong regularity conditions and/or structural conditions.

I will present a recent work, joint with Mikaela Iacobelli, in which we prove the quasi-neutral limit for the ionic Vlasov-Poisson system for a class of rough (L^\infty) data: that is, data that may be expressed as perturbations of an analytic function, vanishing like a single exponential of a power of the inverse Debye length, in the sense of Wasserstein/Monge-Kantorovich distances from optimal transport. The condition we obtain is much less restrictive than previous results, and the single exponential form is essentially optimal.