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Collisions of signed Coulomb particles

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By Coulomb particles I mean electrically charged particles ($+1$ or -1) in 2D. They move by a first-order ‘velocity = electric force’ law. Since the electric force scales by one over the distance between the particle, it becomes singular at collisions. Hence, at collisions the standard well-posedness theory breaks down. This makes it interesting to study existence and uniqueness of solutions that contain collisions, and to figure out what kind of (possibly multi-particle) collisions can occur. I will do this both for the absence and presence of noise.

My presentation will cover parts of several papers. [1] treats the 1D deterministic case, [2] treats part of the 2D stochastic case, [3] completes the 2D stochastic case, and ongoing work addresses the 2D deterministic case.

Keywords: Coulomb interactions, ODE, SDE

MSC2020: 65C35, 35K55

References

- [1] P. van Meurs, M. A. Peletier, and N. Požár. Discrete-to-continuum convergence of charged particles in 1D with annihilation. *Archive for Rational Mechanics and Analysis*, 246(1):241–297, 2022.
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- [3] P. van Meurs and Y. Tardy. Well-posedness for the SDE of a Coulomb gas with mixed signs. *Preprint (Hopefully on ArXiv by now)*, 2026.