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Magneto-Optical Traps (MOT) are experimental devices used to trap cold atoms.
The mathematical modeling of such devices involves the Vlasov-Poisson(-Fokker-Planck) system with an external potential. We can identify physically relevant regimes which allow us to replace this equation by a model of macroscopic nature. The analysis relies on the derivation of the Incompressible Euler system from the Vlasov equation in the quasi-neutral regime by Y. Brenier and N. Masmoudi. However, by contrast to these cases studied on the torus or with infinite charge, here, the strong external field governs the shape of the domain on which the limit equation is posed.
The discussion of these phenomena has unexpected connections with the analysis of the obstacle problem.
This is a joint work with J. Barré (Univ. Orléans), D. Chiron (Univ. Côte d'Azur) and N. Masmoudi (CIMS-NYU).