# Equidistribution and microscale results for Coulomb and Riesz gases

Mircea Petrache

Max Planck Institute for Mathematics in Bonn

We consider the statistical mechanics of a classical Coulomb or Riesz gas in general dimension d, appearing in the study of Fekete points in constructive approximation, and in Ginzburg-Landau vortex models for superconductors. We connect the problem to the "renormalized energy" W, a Coulombian or Riesz-type "jellium" type energy for an infinite set of point charges in the plane placed in a unform neutralizing backgound. Jointly with Sylvia Serfaty we studied in a general framework the next order asymptotic expansion of the partition function, obtaining the characterization of the behavior of the system at the microscopic scale: When the temperature tends to zero the system "crystallizes" to a minimizer of W, conjectured to be the "Abrikosov" triangular lattice in 2 dimensions. With Simona Rota-Nodari and in work in progress with Thomas Leble and Simona Rota-Nodari we then prove in general dimension sharp asymptotic microscale discrepancy bounds for Coulomb gases at zero temperature and a precise microscale energy growth behavior at positive temperature for minimizers of the free energy.