Abstract:
"Existence of the thermodynamic limit" is the claim that the macroscopic physical world can be derived from the microscopic laws of motion on the atomic scale. Put somewhat more modestly it states the extensivity of physical quantities, i.e., that quantities such as energy per volume or density (mass per volume) are meaningful in the limit of an infinite number of particles. It is remarkable, that contrary to most advances of modern physics, this fundamental result was, even in its original form, derived as a mathematically rigorous theorem. The pioneers were Dyson, Lebowitz, Lenard, Lieb, and Thirring. Of course existence of the thermodynamic limit relies on a perfect balance between electric forces, but this alone does not explain it. The Pauli exclusion principle plays an important role in the balance. I will in this talk describe the mathematics behind the existence of the thermodynamic limit and in particular explain the solution to a conjecture of Dyson that in the absence of the Pauli principle matter would form a superfluid state causing instability of macroscopic matter.