Quantum fluid models for nanoelectronics

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Quantum fluid equations, which are known since 1926, have recently aroused a renewed interest for their possible applications to the mathematical modeling of nanoscale semiconductor devices. Indeed, they represent an ideal tool for describing the quantum-mechanical behavior of carriers with the advantage of using the "classical" language of fluid-dynamics.

In this talk we present a survey of recent developments in the derivation of quantum fluid equations from an underlying kinetic description. We shall illustrate how the *quantum maximum entropy principle* can be exploited to obtain quantum-fluid models of various kinds and how such models can be semiclassically approximated, which typically leads to equations of Euler or drift-diffusion type with quantum corrections. In particular, we shall focus on systems with spin-like degrees of freedom (KP-model, Rashba spin-orbit, graphene) and systems with indistinguishable-particles statistics (Fermi and Bose fluids). Systems of this kind are expected to play an important role in the future technology.

Perspectives and open problems will be eventually discussed.