

# GROUP OF LASERS AND PLASMAS

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## VIP Seminar

Friday, 14 October 2022, 11:00, chat & coffee+ from 10:30

Anfiteatro Abreu Faro, complexo I, Instituto Superior Técnico

Av. Rovisco Pais, 1049-001 Lisboa, Portugal

Host: Hugo Terças

## Foundations of Quantum Magnetohydrodynamics

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### Abstract

The suitable density and temperature ranges where quantum effects are relevant for plasmas are reviewed. Typically such quantum plasmas are characterized by large densities and low temperatures, with a significant overlap of the wave packets of the charge carriers. In this case the wave nature of electrons, which have in general a much smaller mass than ions, becomes unavoidable deserving a quantum description. Examples arise in compact stars such as white dwarfs and neutron stars, in ultra-small electronic devices and in intense laser-solid density plasma interaction experiments. Starting from quantum kinetic theory, we discuss the foundations and the need of quantum hydrodynamic models for the nonlinear treatment of quantum plasmas. In this context the basic quantum magnetohydrodynamic model is derived. The role of spin-statistics and relativistic effects is discussed. A detailed comparison between the kinetic theory and hydrodynamic models of the exchange interaction is provided in the case of quantum ion-acoustic waves. The validity conditions of quantum hydrodynamics are analyzed. Finally we consider some recent developments in the area.

