



CEA - Saclay 91191 Gif-sur-yvette Cedex
Service de Physique de l'Etat Condensé - UMR 3680

SÉMINAIRE

Mercredi 1^{er} mars 2017 à 11h15

Orme des Merisiers SPEC, Salle Itzykson, Bât.774

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Instabilities in Electromagnetically-driven flows

The conversion of electromagnetic energy into kinetic energy by an electrically conducting fluid is a ubiquitous phenomenon that can be found in several natural systems as well as industrial applications. In nature, the magnetic reconnection in the solar corona is a typical example in which a tremendous amount of kinetic energy is produced from strong magnetic fields. Similarly, many industrial systems involve a liquid metal subject to electrical currents or external magnetic fields, among which we can cite electromagnetic driving of liquid sodium or production of aluminum by electrolysis.

Despite the importance of these applications, several aspects of the dynamics of electromagnetically driven (EMD) flows still remain poorly understood. One major problem is to identify the mechanisms that limit the maximum efficiency of magnetic to kinetic energy transformation in the presence of turbulence. Interestingly, this bound on the efficiency almost always results from unexpected flow instabilities occurring as soon as the size of the system or the magnitude of the driving becomes large enough. The origin itself of such flow instabilities is not fully understood.

During this seminar, I will discuss both theoretical and experimental aspects of such EMD flows. In a first part, I will present direct numerical simulations of an annular electromagnetic pump (EMP) similar to the ones used in some secondary cooling system of fast breeder nuclear reactors. For some parameters, a large scale instability is observed in the fluid and leads to a dramatic drop of the flow rate developed by the pump, a phenomenon related to flux expulsion within the fluid. In a second part, I will present a laboratory experiment in which the flow of a liquid metal (Galinstan) is driven in an annular channel by two propagating sinusoidal magnetic fields traveling in the azimuthal direction, generating a driving close to the one used in electromagnetic pumps. Preliminary results indicate a driving of the fluid in good agreement with theoretical predictions. For some parameters, it is possible to observe unstable regimes, characterized by some intermittency of the flow.

A coffee break will be served at 11h00. The seminar will be given in English.
