Online LTP Seminar
May 11, 2021

Modeling transport in instabilities in magnetized low temperature plasma sources

Gerjan Hagelaar

Laboratoire Plasma et Conversion d'Energie (LAPLACE), Toulouse, France

Magnetized low-temperature plasma (LTP) sources such as Hall thrusters, magnetrons or ion sources for fusion involve complex transport phenomena which play a key role in their operation but are still not well understood, posing great challenges to the modeling as well as the further development of these sources. One of the main problems is the presence of various types of plasma instabilities, breaking the symmetry of the plasma and leading to "anomalous" electron transport across the magnetic field, or to the formation of large self-organized plasma structures.

In this lecture, we discuss the capabilities and limitations of fluid models to describe the operation of these magnetized LTP sources, in comparison with kinetic particle-in-cell simulations. We discuss some important general principles of magnetized plasma transport and illustrate how they work out in different basic source configurations. We show that even standard fluid LTP models, when solved properly in the 2D plane perpendicular to the magnetic field lines, intrinsically produce certain plasma instabilities and anomalous transport, which may be realistic in some cases but not in others. The lecture will accessible to non-specialists wishing to get a general idea of the topic.

Short Bio

Gerjan Hagelaar is a senior scientist with the French National Center for Scientific Research (CNRS), working at the LAPLACE laboratory in Toulouse. He obtained his MSc and PhD degrees at the Eindhoven University of Technology (The Netherlands) in 1996 and 2000, respectively, and holds a habilitation degree from the University of Toulouse since 2008. His work is focused on modeling of different types of non-thermal LTPs (dielectric barrier discharges, inductive discharges, magnetized plasmas, microwave plasmas, …) for different applications (plasma displays, space propulsion, neutral beam injection for fusion, surface treatment, …). He is also the author of the widely-used electron Boltzmann equation solver BOLSIG+ and one of the co-initiators of the LXCat database. One of his main research topics is the development of self-consistent models of magnetized LTPs.