Karlstad Applied Analysis Seminar (2021)

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Coupled finite-volume/Monte-Carlo methods for plasma edge simulation in fusion reactors

Abstract

Nuclear fusion reactor design crucially depends on numerical simulation. The plasma can usually be modeled using fluid equations (for mass, momentum and energy). However, the reactor also contains neutral (non-charged) particles (which are important in its operation), of which both the position and velocity distribution is important. This leads to a Boltzmann-type transport equation that needs to be discretised with a Monte Carlo method. One then obtains a coupled finite-volume/Monte-Carlo simulation, of which the results possess both a bias and a variance. In this talk, I introduce the problems associated with the simulation of the plasma edge region in a fusion reactor. I discuss how to couple a finite volume discretisation of the plasma equations with a Monte Carlo simulation of the neutral particles, and show how the Monte Carlo errors affect convergence of steady state computations and reliability of gradient computations (necessary during optimization).