14th World Congress on Computational Mechanics (WCCM XIV)
8th European Congress on Computational Methods in Applied Science and Engineering (ECCOMAS 2020)
July 19–24, 2019, Paris, France

NUMERICAL METHODS FOR THE SIMULATION OF MAGNETICALLY CONFINED PLASMAS IN FUSION TRACK NUMBER 600

GIORGIO GIORGIANI*, **ERIC SERRE***

* Aix-Marseille Univ., CNRS, Centrale Marseille, M2P2,
38 Rue Frédéric Joliot Curie, 13451 Marseille
giorgio.giorgiani@univ-amu.fr

Key words: Magnetic confinement fusion, computational plasma physics, ITER

ABSTRACT

Electric power production by magnetic fusion remains an ambitious scientific and technological challenge that requires a long and sustained research effort. Research in magnetic confinement fusion plasmas explores the possibility of producing carbon-free electric power by using fusion in deuterium-tritium plasmas heated to temperatures of up to 10^7-10^8K, and confined by strong magnetic field in machines of toroidal shape known as tokamaks.

The success of fusion experiments in ITER will be conditioned by our capability to both ensure the quality of plasma confinement in the core, and to control the heat and particle fluxes on the wall. The difficulty to generate a global description of the plasma based on experimental measurements in tokamaks requires performing complementary numerical simulations that requires an important modelling effort.

Due to the wide different scales involved, tokamak plasma modelling requires to perform both particle and fluid simulations of fine-scale turbulence and large-scale dynamics. Recently, thanks to the increasing power of the computational machines, the interest in coupling different models is also growing, in order to achieve a multi-physics capability of the codes and with the final goal of obtaining predictive simulations. Thus, fusion-plasma numerical simulation involves a hierarchy of complementary models based on fluids and MHD conservation equations to kinetic ones.

This MS aims at bringing together researchers with a large range of expertise in applied mathematics, computational mechanics and physics, as well as in computing science, to share recent advances on the areas of high-performance computing in plasma modeling. The MS will be more particularly concerned with new discretization techniques in plasma simulations, numerical methods for multi-physics coupling (fluid/kinetic, MHD/turbulence, ...), codes design and new algorithms for HPC.