

DRF: Thesis SL-DRF-19-0599

## RESEARCH FIELD

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Mathematics - Numerical analysis - Simulation / Engineering science

## TITLE

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Numerical schemes for modelling the interplay between edge and core turbulent transport in tokamak plasmas

## ABSTRACT

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Predicting the performance of fusion plasmas in terms of amplification factor, namely the ratio of the fusion power over the injected power, is among the key challenges in fusion plasma physics. In this perspective, turbulence and heat transport need being modeled within the most accurate theoretical framework. The gyrokinetic equation for each species (ions & electrons), coupled to Maxwell's equations is an appropriate self-consistent description of this problem. The field of core transport modelling in tokamak plasmas has now reached maturity with several first-principle-based codes in the world available to address this issue. However, despite their numerous successes to date, their predictive capabilities are still constrained with respect to the energy content, in particular in optimized discharges. Challenging this gap requires pushing gyrokinetic modelling towards the edge region of the container vessel, and as far as possible addressing edge and core transport on an equal footing.

The long term aim for the non-linear petascale gyrokinetic code GYSELA developed at IRFM/CEA is to perform such edge-core turbulent plasma simulations with kinetic electrons for the international ITER tokamak under construction at Cadarache (France). We already know that it will require exascale HPC capabilities. The objective of the PhD thesis is to develop innovative scalable numerical schemes to tackle the problem of large magnitude fluctuations and temperature variations (by 1 to 2 orders of magnitude) in realistic X-point magnetic configurations. For this purpose, the semi-Lagrangian scheme used in the GYSELA code will be revisited in the framework of multi-resolution grids. The PhD student will work in a dynamic scientific environment in strong interaction with mathematicians, physicists and computer scientists.

## LOCATION

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Institut de recherche sur la fusion par confinement magnétique

Service Chauffage et Confinement du Plasma

Transport Turbulence et MagnétohydroDynamique

Place: Cadarache

Start date of the thesis: 01/10/2019

## CONTACT PERSON

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## UNIVERSITY / GRADUATE SCHOOL

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