

Exascale Port of a 3D Sparse PIC Simulation Code for Plasma Modeling

GENERALE INFORMATIONS

Reference: CDD, Exascale Port of a 3D Sparse PIC Simulation Code for Plasma Modeling

Workplace: MAISON DE LA SIMULATION, CEA-Saclay, Gif-sur-Yvette

Type of contract: Scientific fixed-term contract

Contract duration: 24 months

Expecting date of employment: May 05, 2025

Working hours: Full time

Salary: Between €2800 and €3000 gross per month

Level of education required: Engineering degree or PhD

MISSIONS

The person recruited will be involved in the ANR project called MATURATION (<https://www.math.univ-toulouse.fr/~narski/MATURATION/>) based on the use of sparse grids coupled with the Particle-In-Cell (PIC) approach to study plasma physics. The aim will be to port to exascale architectures an initial 3D simulation code developed as part of previous work [1]. This work will initially focus on scaling up (distributed memory), optimizing CPU algorithms (vectorization) and further GPU porting. The exploration of C++ programming models for performance portability, such as Kokkos or StarPU, will form a second part. A comparative study will evaluate the different implementations in terms of both performance and portability. Performance studies will be carried out on various CPU and GPU technologies, using local resources and access to national supercomputers. The person recruited will also be involved in setting up and sharing best practices in software engineering. This work will be carried out in close interaction with the other MATURATION project partners.

[1] - Guillet, C. (2023). Approche sur grilles parcimonieuses pour accélérer la méthode PIC (PhD, Toulouse 3).

ACTIVITEES

- Participate in the Exascale porting of 3D sparse-PIC code, including distributed parallelism, vectorization, and GPU porting.
- Investigate new programming models to achieve performance portability.
- Analyze code performance on various recent CPU and GPU architectures.
- Enhance software engineering practices related to the code.
- Publish the results of the study.
- Hand over the code handling to the supervisory team.

SKILLS

- Engineering degree / PhD computer science or physics with high-performance computing
- Experience in Fortran, C or C++ programming
- Experience in high-performance computing and parallel programming, in particular GPU
- Experience in plasma PIC simulation would be highly appreciated.
- A good knowledge of English is required, as well as the ability to work in a team.

WORK CONTEXT

The Maison de la Simulation is a joint laboratory between CEA, CNRS, Université Paris-Saclay and Université Versailles Saint-Quentin. It specializes in high-performance computing and numerical simulations in close connection with physical applications, parallel software engineering, programming models, visualization techniques, artificial intelligence, and quantum computing.

INFORMATIONS COMPLEMENTAIRES

To apply for this position, please submit the following documents through the CNRS portal:

- a description of your qualifications, experience, and motivations related to the post
- a complete curriculum vitae (CV) including details of your training, publications, research experience, etc.,
- contact information of two referees and letters of recommendation.