The EPFL Advanced Computing Hub

Paolo Ricci (Scientific Director)
Gilles Fourestey (Director of Operations)

EUROfusion

EPFL

A campus-wide EPFL team led by the SPC

■ Swiss Plasma Center (~ 150 people, theory group: ~ 30 people)

INFORMATIQUE SCIENTIFIQUE & SUPPORT APPLICATIF
SCITAS
SCIENTIFIC IT AND APPLICATION SUPPORT

Support center for HPC applications and provider of advanced computing platforms (~15 people)

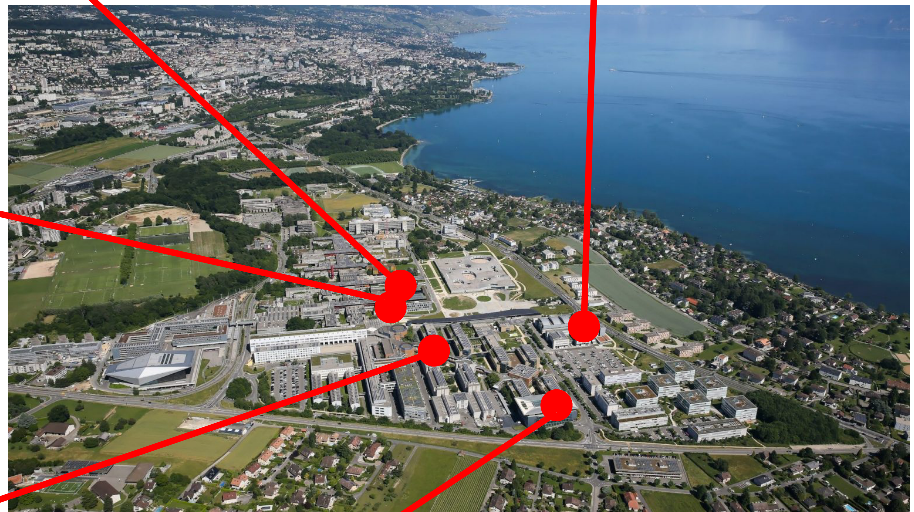
Experimental Museology +

Virtual, augmented, mixed reality, through advanced computer science and state-of-the-art visualization facilities (~10 people)

MATHICSE

Computational Science and Engineering Mathematics group (~70 people)

Swiss Data Science Center, national institute for artificial intelligence and machine learning techniques (~50 people)



A comprehensive support, from HPC code design to visualization

We will act as competence center for

- methods, providing support to specific needs
- applications, developing and maintaining EUROfusion software

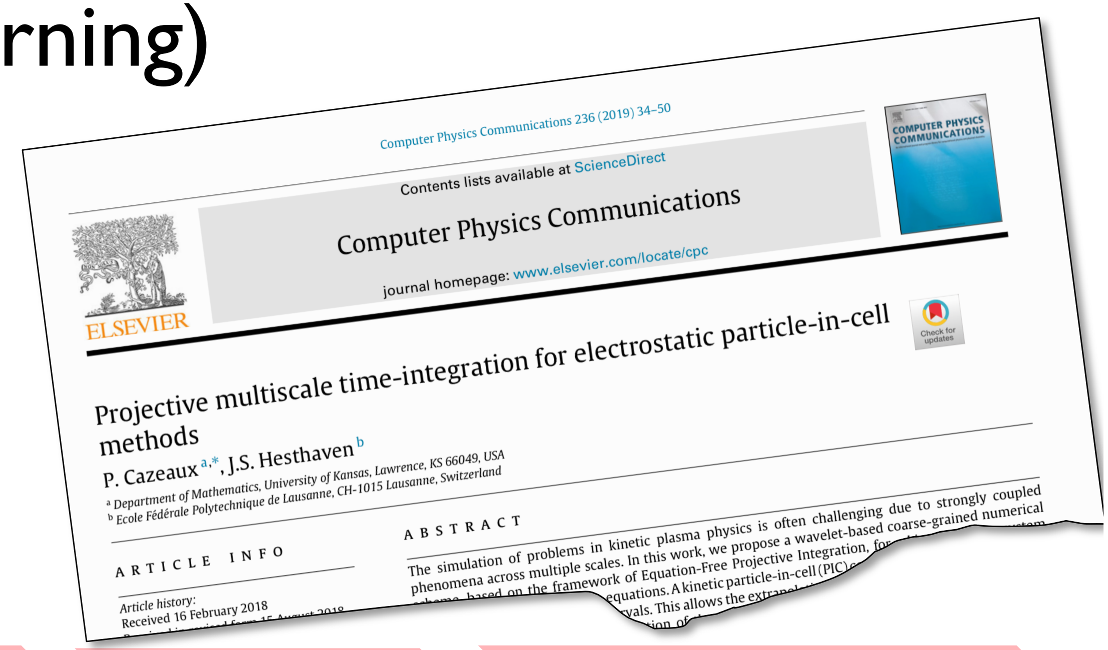
Proximity of developers, users, experimentalists fostered culture of tight development loops, key to meet EUROfusion needs

DESIGN → IMPLEMENTATION → TESTING → VISUALIZATION

Code design with state-of-the-art algorithms

- Solution of large scale linear systems
- Methods for multiscale models
- Error estimation and control
- Tuning parameters in algorithmic optimization (e.g. using machine learning)
- Complex geometries

~ 1.5 person, starting 2022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ELSEVIER

Check for updates

Projective multiscale time-integration for electrostatic particle-in-cell methods

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ABSTRACT

The simulation of problems in kinetic plasma physics is often challenging due to strongly coupled phenomena across multiple scales. In this work, we propose a wavelet-based coarse-grained numerical scheme based on the framework of Equation-Free Projective Integration ... equations. A kinetic particle-in-cell (PIC) ... intervals. This allows the extrapolation ...

DESIGN | IMPLEMENTATION | TESTING | VISUALIZATION

Support to code implementation

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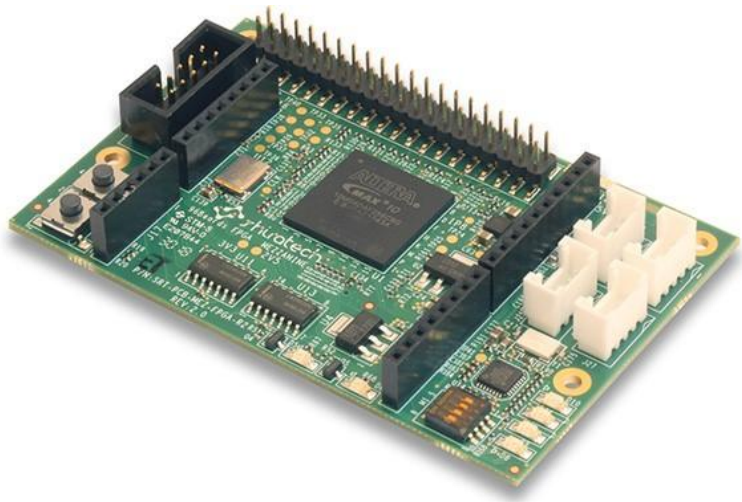
- Code optimization
- Hybrid architectures (GPU, FPGA, …)



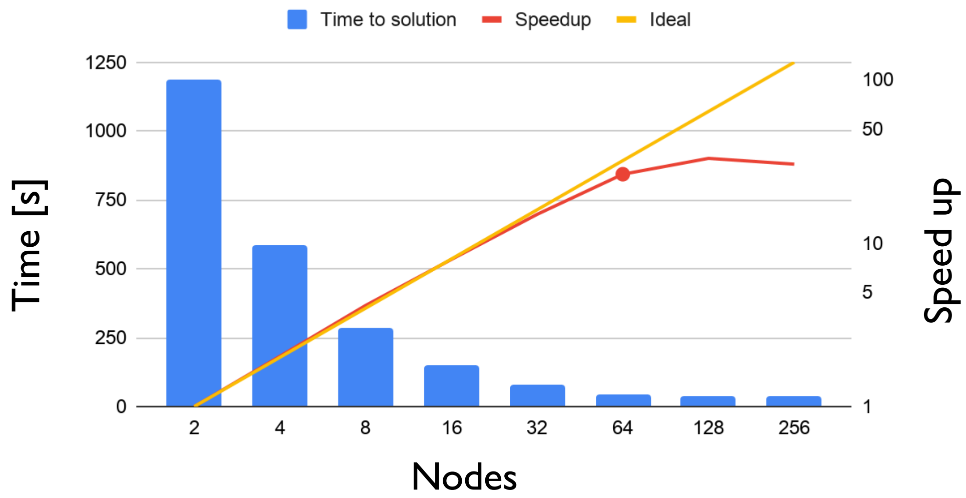
~ 3 people, starting on 2021

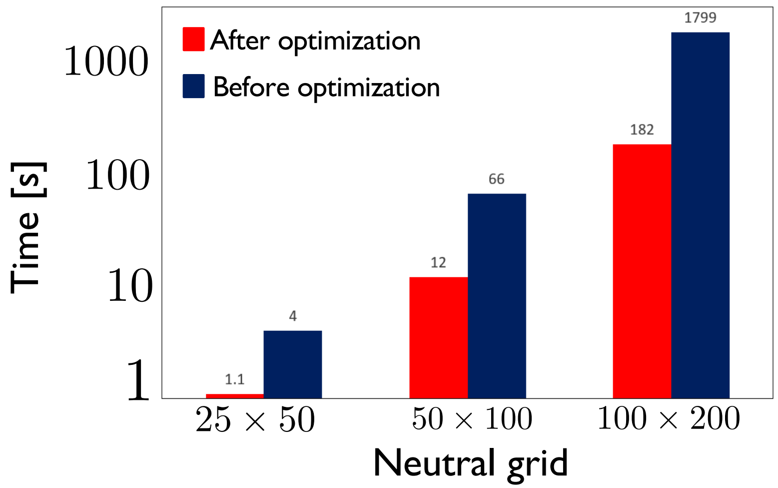
DESIGN → IMPLEMENTATION → TESTING → VISUALIZATION

Significant progress in TSVV-3 during pilot phase (turbulent fluid simulation of the boundary)

$$\nabla \cdot (n \nabla \phi) = \omega$$

Scaling up to ~ 6'000 cores





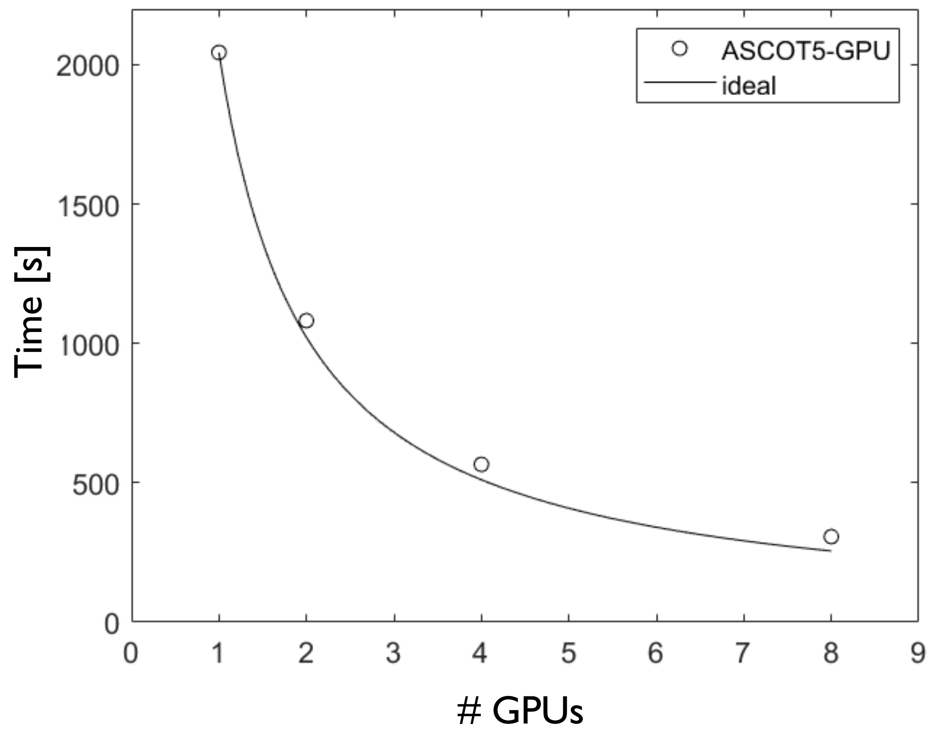
$$\frac{\partial f_n}{\partial t} + \mathbf{v} \cdot \frac{\partial f_n}{\partial \mathbf{x}} = -\nu_{\mathrm{iz}} f_n - \nu_{\mathrm{cx}} \left(f_n - \frac{n_n}{n_i} \right) + \nu_{\mathrm{rec}} f_i$$

10 times faster at TCV scale

DESIGN | IMPLEMENTATION | TESTING | VISUALIZATION

Porting ASCOT5 to GPU

Port to GPU using new OpenMP offload (4.5+)



DESIGN | IMPLEMENTATION | TESTING | VISUALIZATION

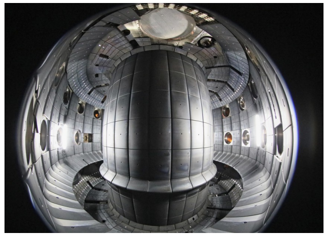
Support EUROFusion V&V efforts

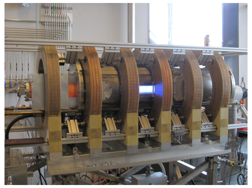
- Verification and validation methodologies, including UQ procedures
- Synthetic diagnostics
- Provision of experimental results for validation

~1 person, starting 2023

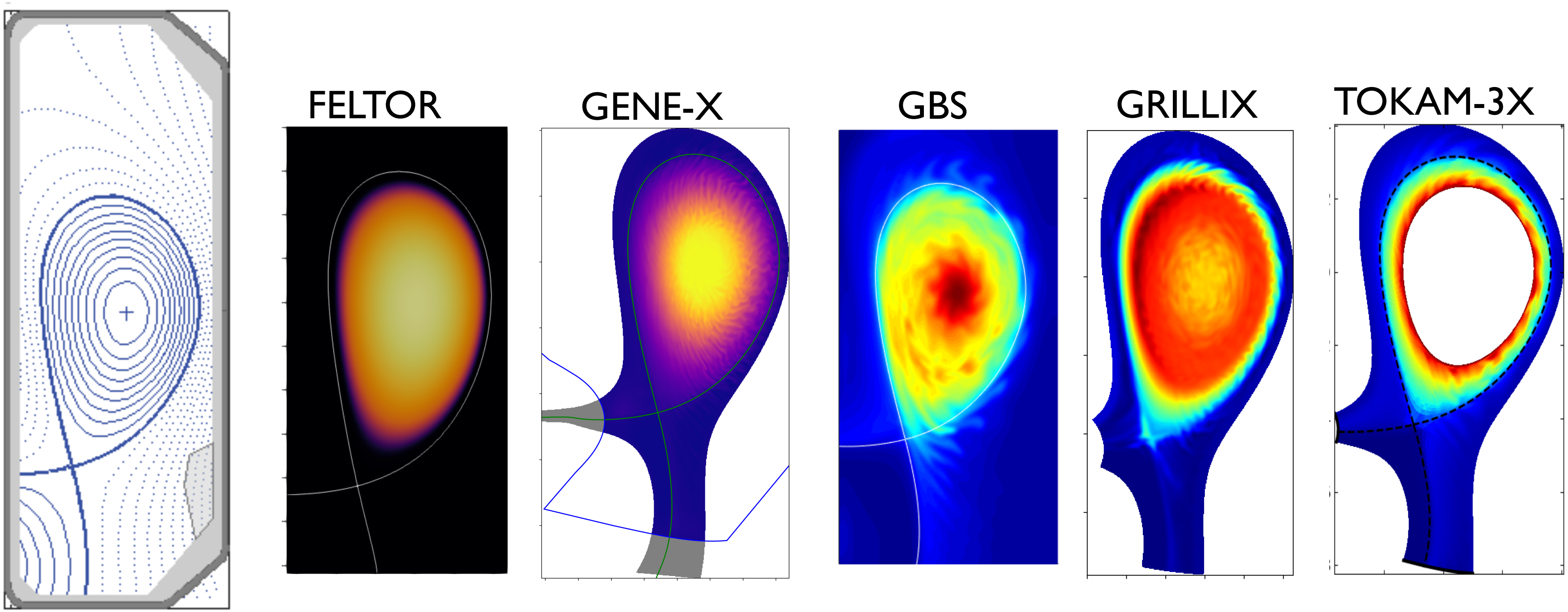
DESIGN | IMPLEMENTATION | **TESTING** | VISUALIZA...

Ideally placed to provide experimental results for validation





Example: a fully-diagnosed TCV discharge with parameters ideal for validation



Courtesy of: T. Body, F. Jenko, D. Galassi, E. Laribi, D. Michels, A. Stegmeir, P. Tamain, C. Theiler, P. Ulbl, M. Wiesenberger

DESIGN → IMPLEMENTATION → **TESTING** → VISUALIZATION

Advanced visualization

Experimental Museology +

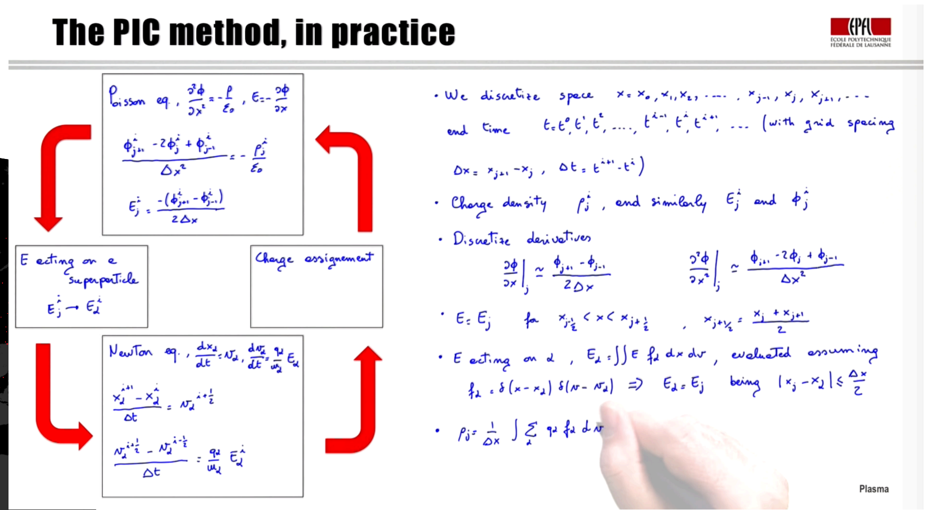
- Provision of powerful visualization tools
- Visualization software development (many levels of complexity, integrated modelling, experimental data…)
- Delocalization of immersive visualization

~ 1 person, starting 2022

DESIGN → IMPLEMENTATION → TESTING → **VISUALIZATION**

EPFL, ideal location for training courses, modelling campaigns,…

- Large experience in organizing European training courses (Fusenet)
- Host of MST campaigns
- Infrastructures to create MOOCs



The EPFL ACH received a significant cut and will be operated with important financial contribution from EPFL

Severe overbooking denotes large need of our expertise

Most of EPFL hub personnel has already been hired at EPFL and available to start

We are ready to discuss an enhancement of our contributions, if there is interest for EUROfusion, now and in the future

The EPFL ACH steering committee

Prof. Ambrogio Fasoli

Prof. Laurent Villard, Head

Prof. Sarah Kenderdine

Prof. Annalisa Buffa

Prof. Jan Hesthaven

Dr. Christian Schlatter, Finance