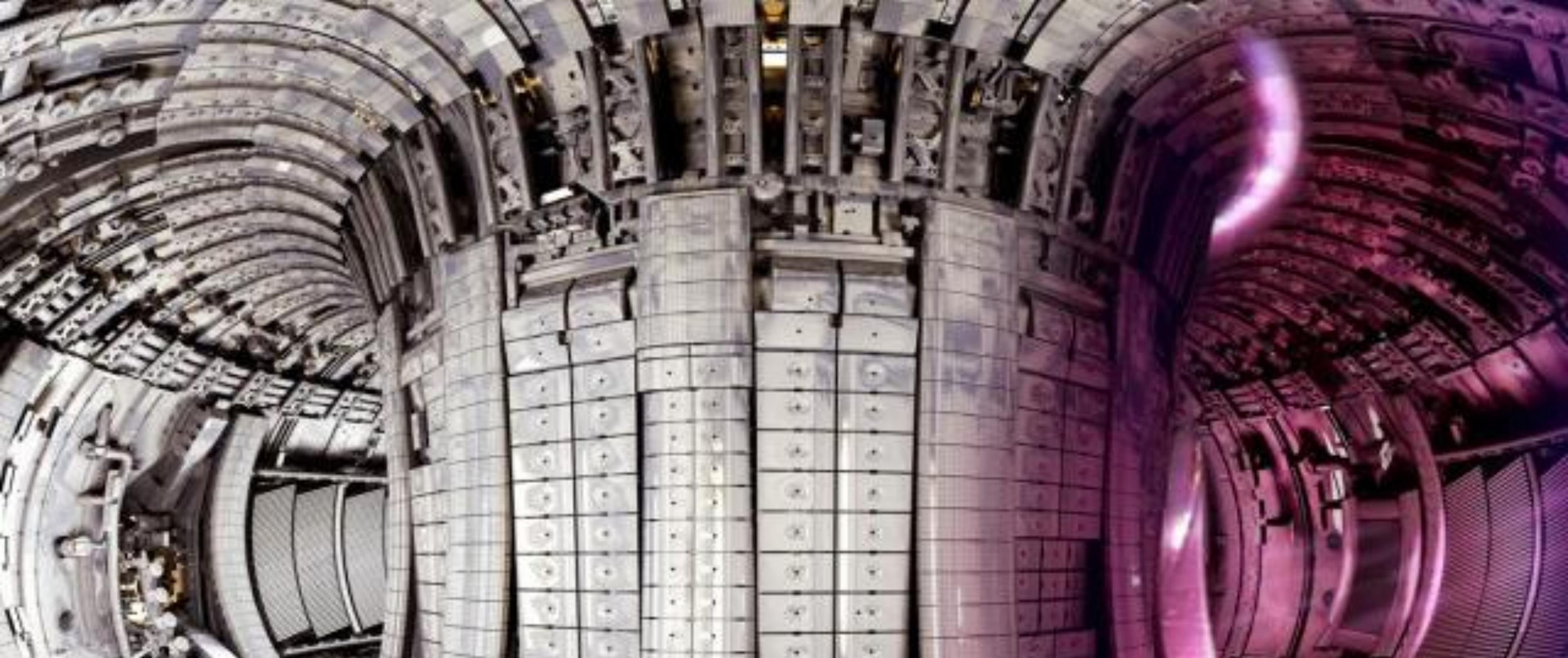

PICLS – Developing a particle-in-cell code for the outer region of a nuclear fusion device

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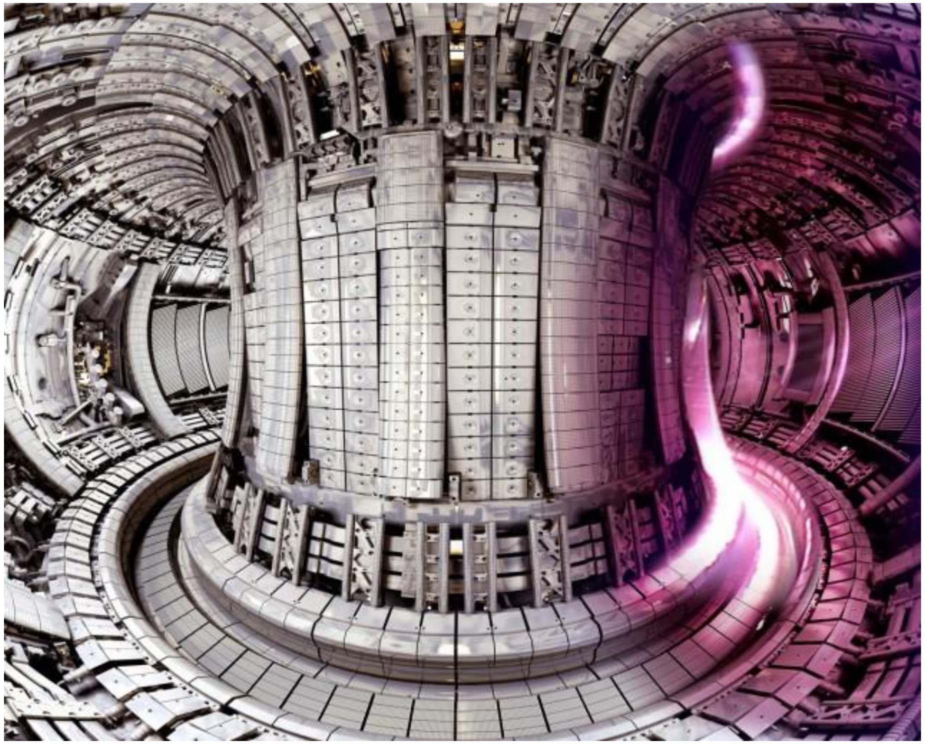
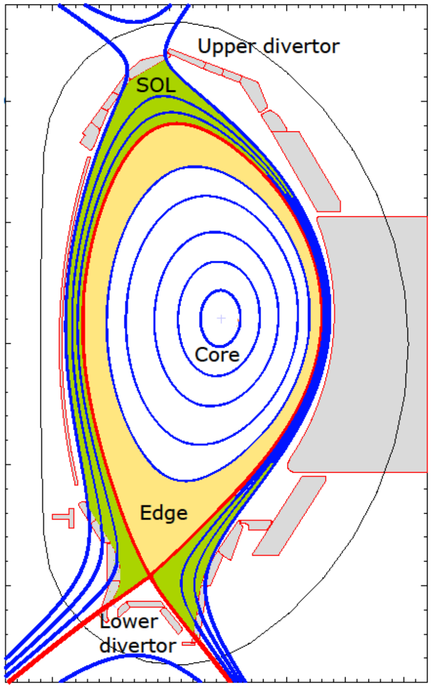
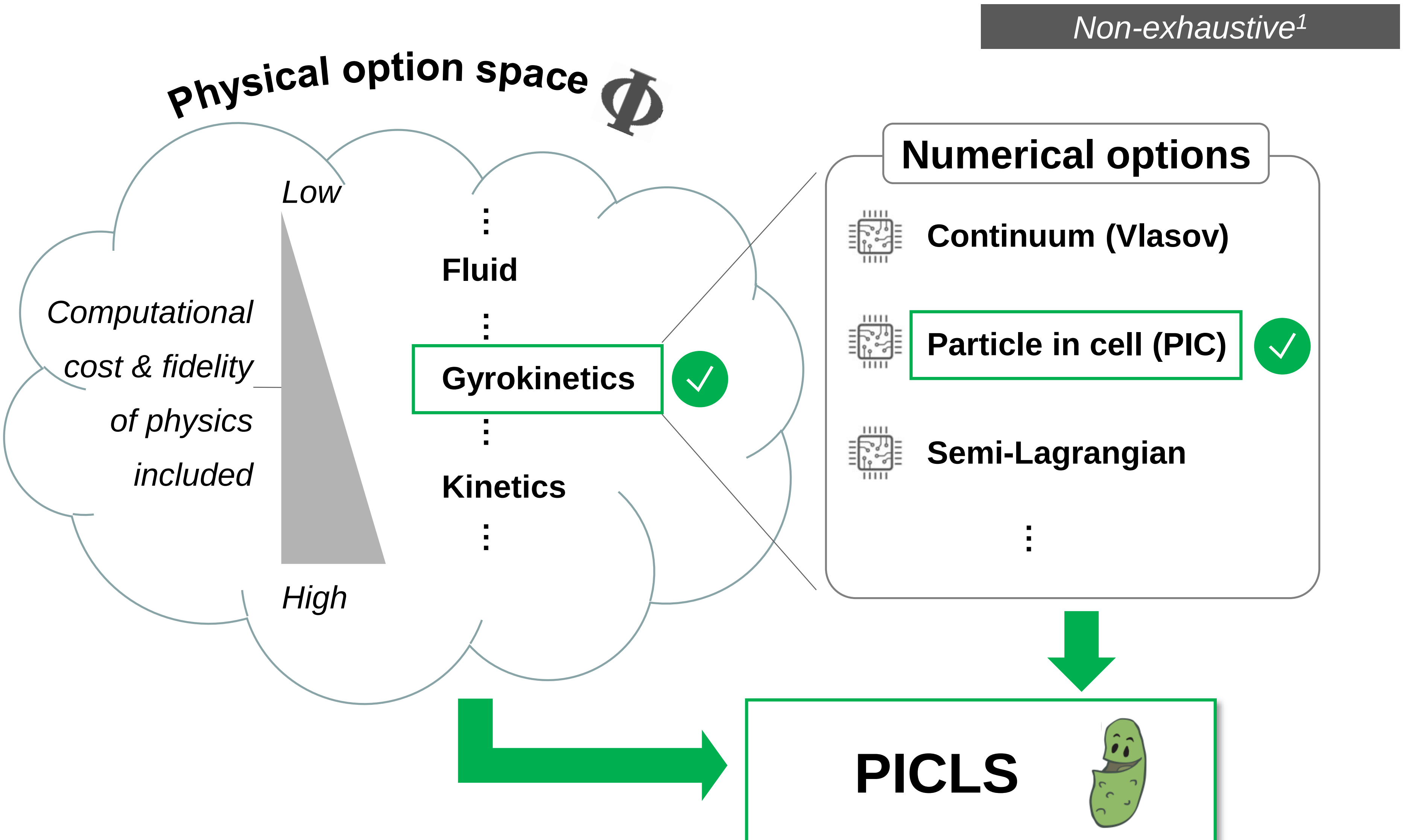
To make fusion work, simulations in the outer plasma region are key





- Construction of fusion devices very costly – risk mitigation via simulation
- Goal of "virtual Tokamak" requires realistic edge/SOL models
- Complex outer plasma region significantly influences plasma confinement

PICLS code framework thoroughly chosen in wide option space



1. Options only subset of most well-known approaches

Gyrokinetics and PIC for dummies

Schematic explanation

Physics: Gyrokinetic model Φ

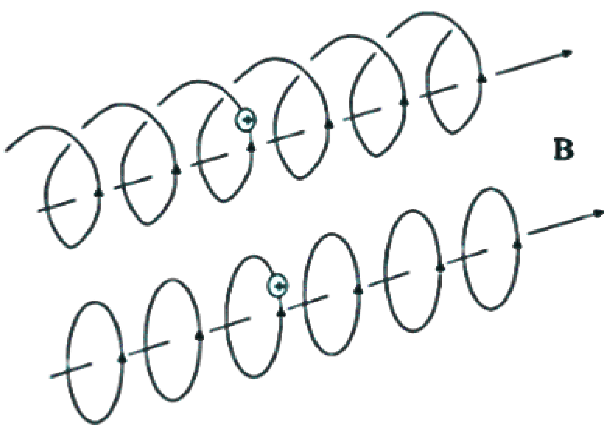
By de-coupling fast gyro motion, significant speed up can be gained

- Larger time steps possible
- Reduction from 6D ($\boldsymbol{x},\boldsymbol{v}$) to 5D($\boldsymbol{x},v_{||},\mu$)

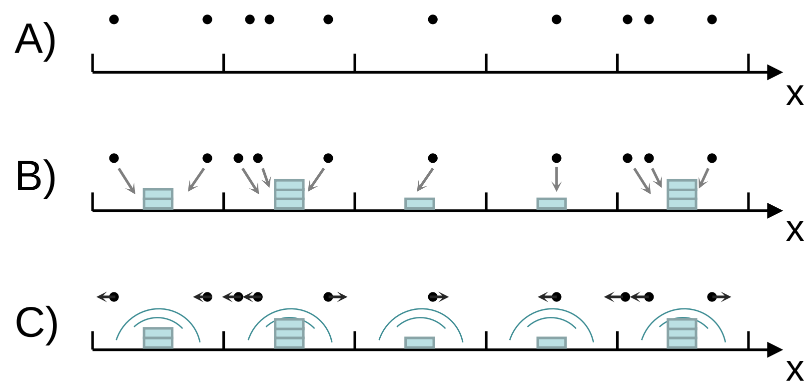
6D:

↓

5D:



Numerics: Particle-in-cell (PIC)

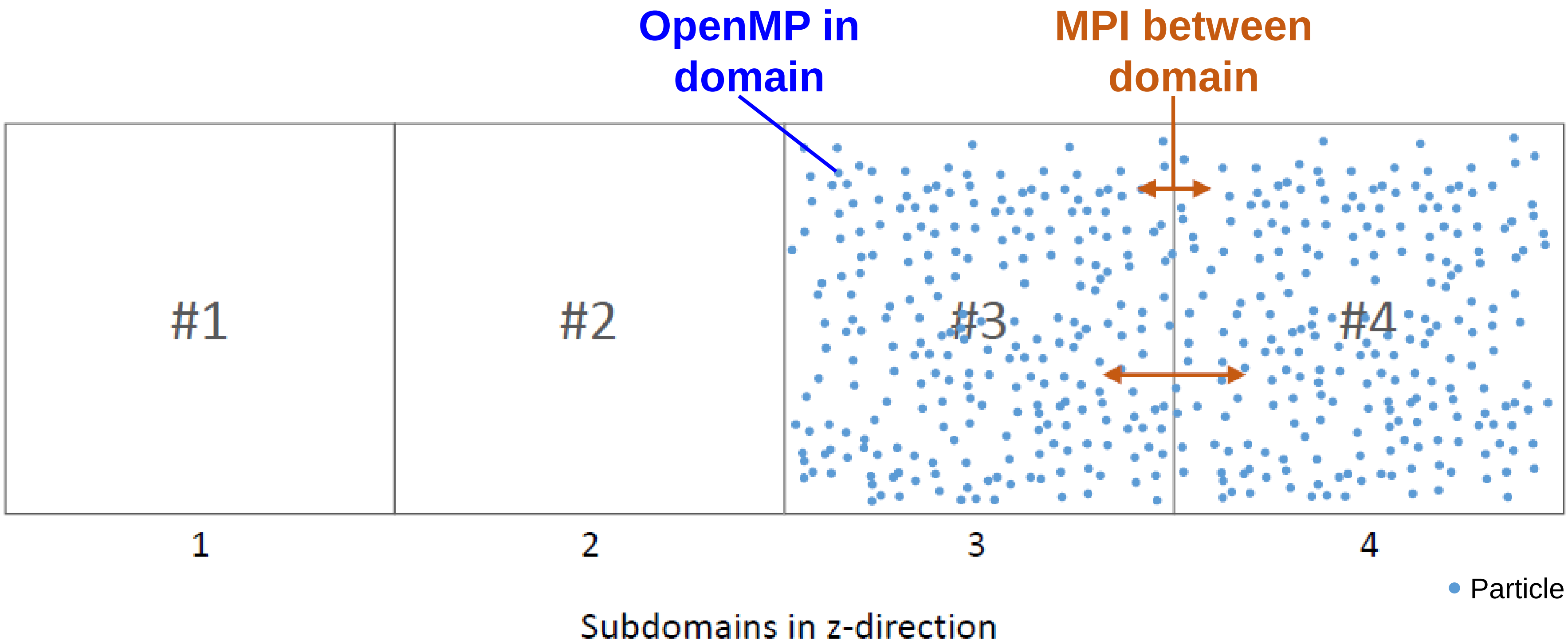


Main principle of PIC:

- A) Calculate particle[1] position
- B) Deposit charges on grid
- C) Let fields act on "particle" motions

1. Only simplistic view; in reality one randomly pulls from the distribution function f via a Monte Carlo method

We use a hybrid OpenMP/MPI parallelization



- Suggestions for optimization of parallelization scheme?
- What about porting to GPUs (effort, performances, etc.)?

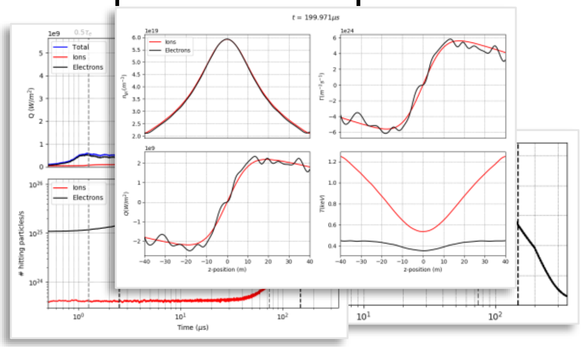
What's the status and what's next?

Current status: 3D implementation

0. Code development ✓ | **1. 1D1V simulations** ✓ | **2. 3D2V simulations**

- Derive and implement physical model (linearized field equations)
- Develop basic numerical code features
- Check validity

- Proof of principle: apply concept on simplified 1D1V problem*



- Benchmark with results from other codes (GENE, Gkeyll)

- Implement collision operator (Lenard-Bernstein)
- Conduct 3D2V simulations (code already mostly 3D capable) in Slab geometry
- …

* Will be published soon