

Parallel computing: application.

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Hierarchy of computational units

1. Processor core
2. Node (~20-100 cores): MPI and OpenMP (multicore CPU), CUDA (GPU)
3. Server (~10k cores): MPI
4. Cluster (up to 1M cores): MPI

CUDA - Compute Unified Device Architecture

CPU - Central processing unit

MPI - Message Passing Interface

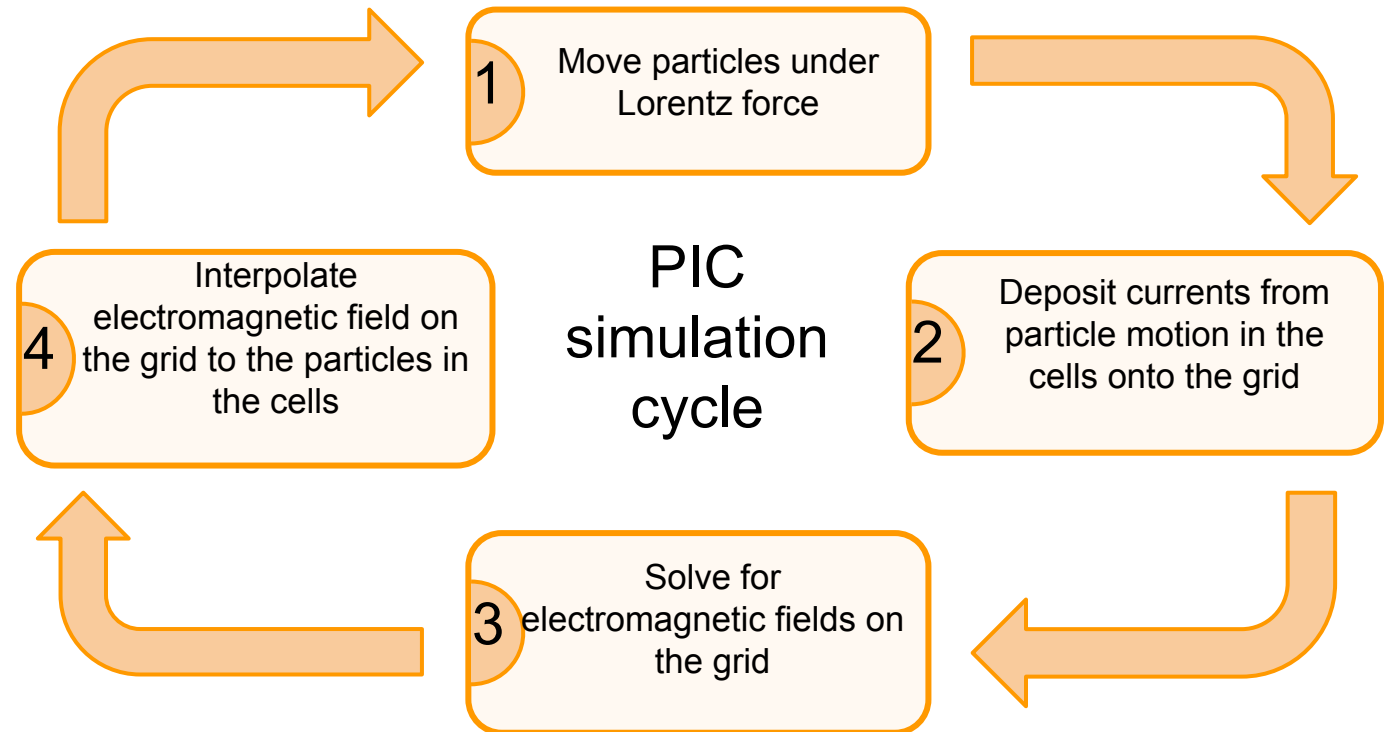
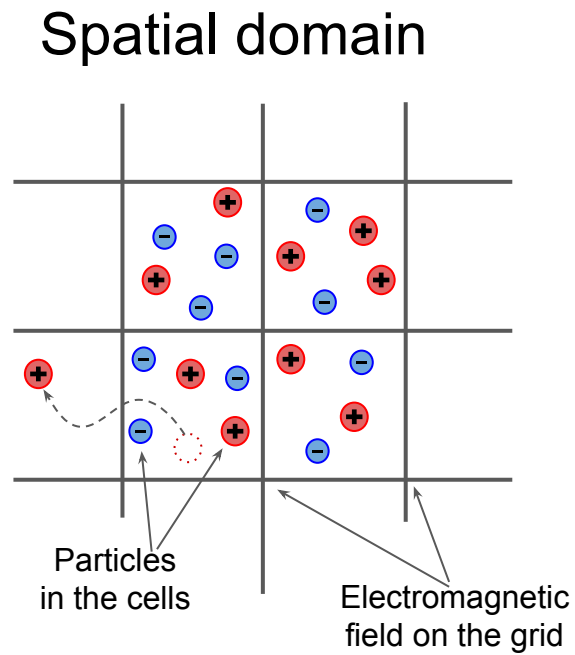
OpenMP - Open Multi-Processing

GPU - Graphics processing unit

Types of parallel computing

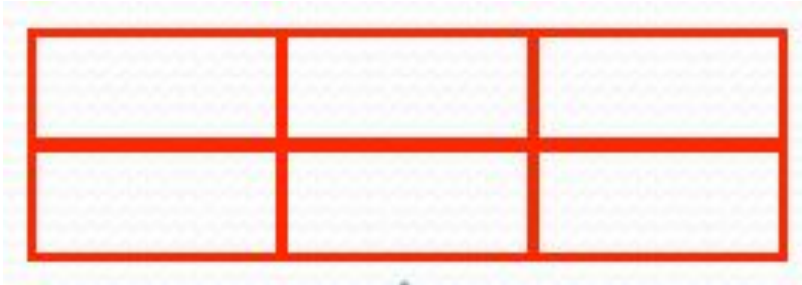
1. Without communications (Monte Carlo: considers independent events)
2. With communication (plasma simulations: splits simulations box in to smaller regions)
3. Mixture

Particle-in-cell (PIC) codes

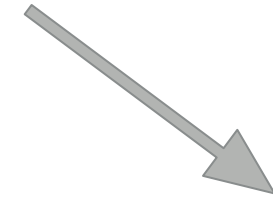
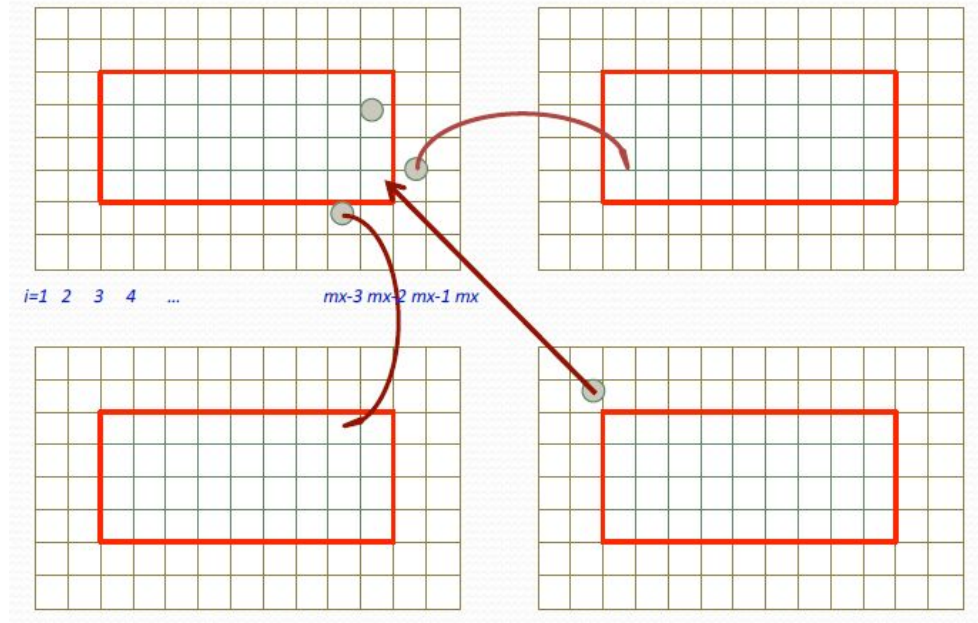


Parallelization of PIC codes

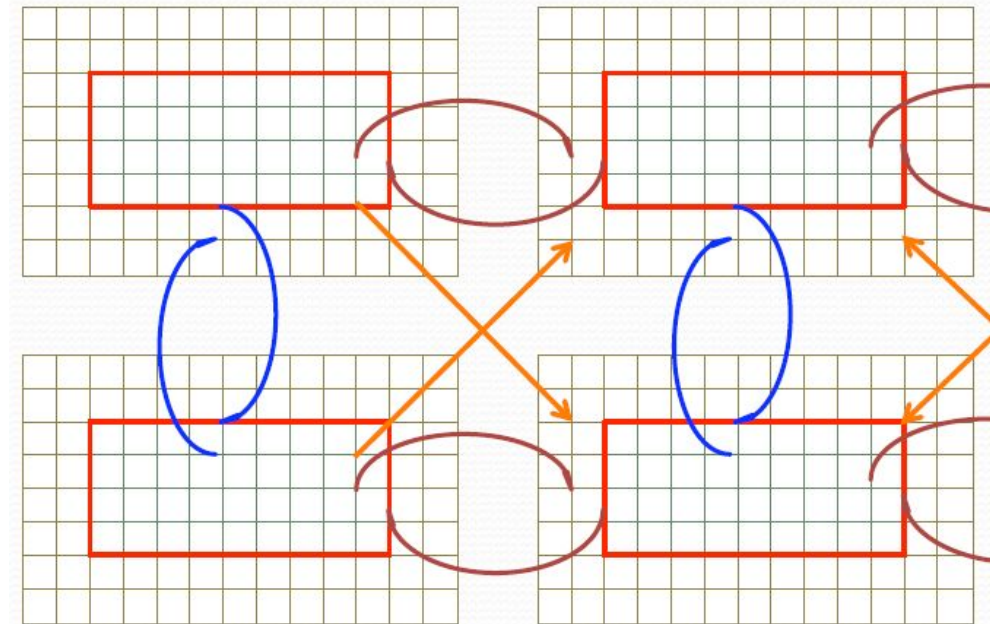
Simulation box



Particles



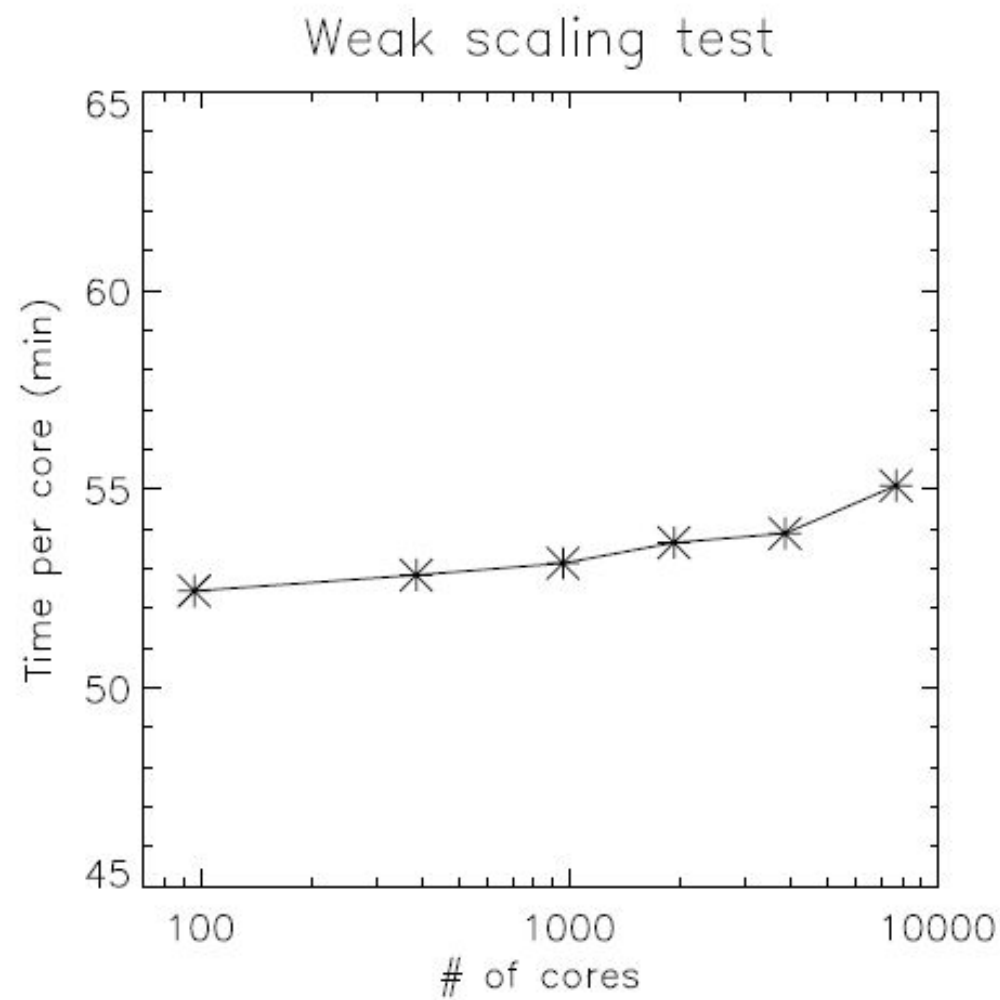
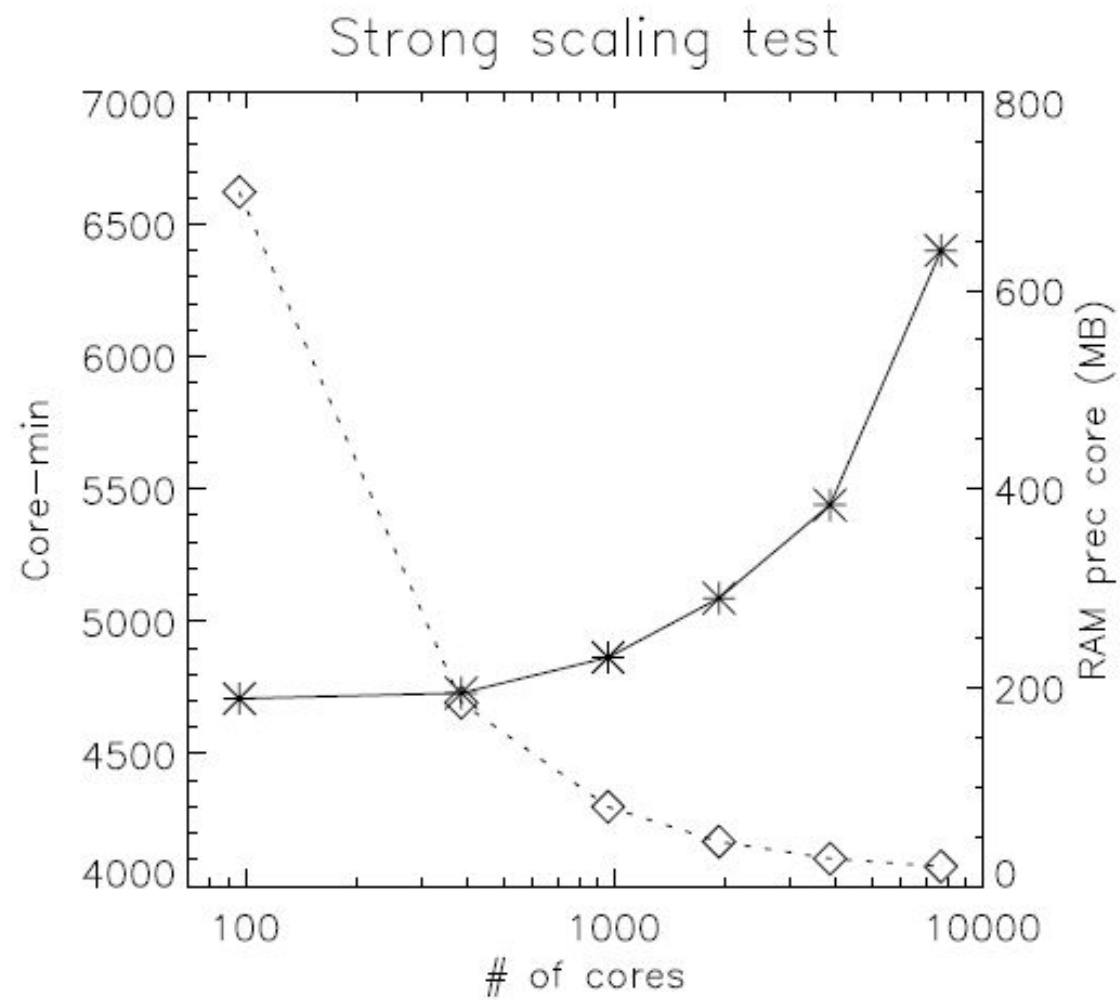
Fields



Types of parallelizations:

1. MPI
2. MPI-CUDA
3. MPI-OpenMP

PIC code scaling



Computational clusters

HLRN (Germany)

- 8.9 PFlop/s (TOP 47, Nov 2020)
- Intel Xeon Platinum 9242 48C 2.3GHz
- 120,296 cores
- Access via annual applications, deadline -is the end of October (free of charge for university users)



Prometheus (Poland)

- 2.4 PFlop/s (TOP 326, Nov 2020)
- Intel Xeon E5-2680v3
- 53,568 cores
- Access via collaboration with polish scientists

11/2020: #326
06/2020: #289
11/2019: #241
06/2019: #174
11/2018: #131
06/2018: #103
11/2017: #77
06/2017: #71
11/2016: #59
06/2016: #48
11/2015: #38
06/2015: #48



Thank you

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