Development of a Spatial Domain Decomposition Scheme for Monte Carlo Neutron Transport

M. García[1], D. Ferraro[1], L. Mercatali[1], V. Sanchez[1], J. Leppänen[2], V. Valtavirta[2]

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[1]Karlsruhe Institute of Technology (KIT),

[2]Technical Research Centre of Finland (VTT)

Motivation

- McSAFE project:
  - Full-core pin-by-pin LWR analysis based on the Monte Carlo method.
  - Steady-state, depletion and transient problems.
  - High performance Monte Carlo neutron transport (Serpent2).
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  - Massive parallelization with MPI-OpenMP (speedup optimization).
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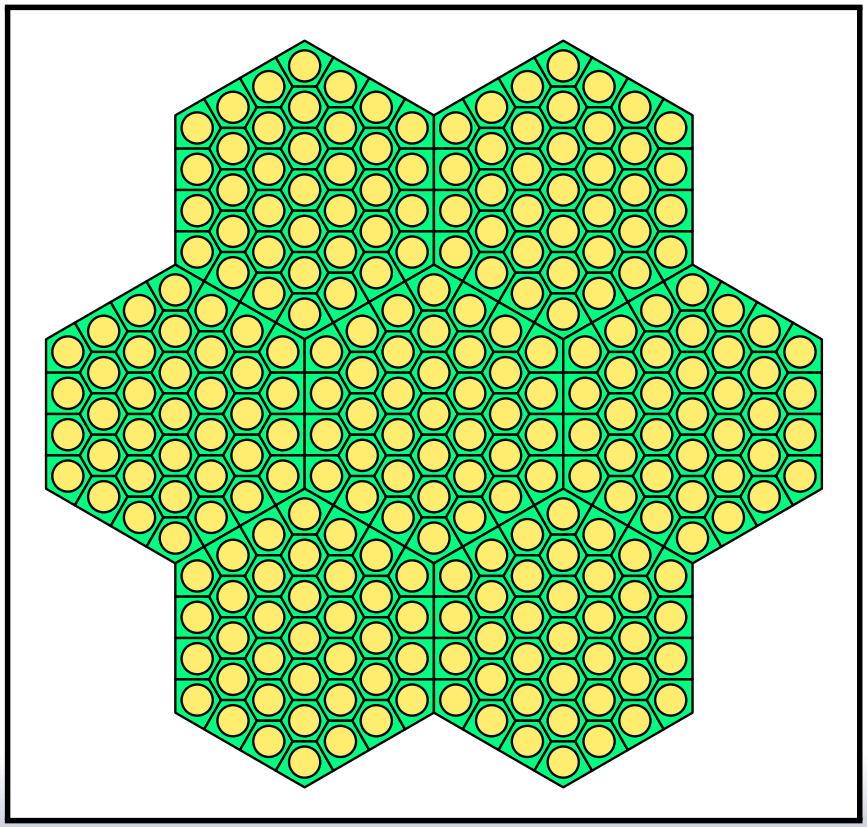

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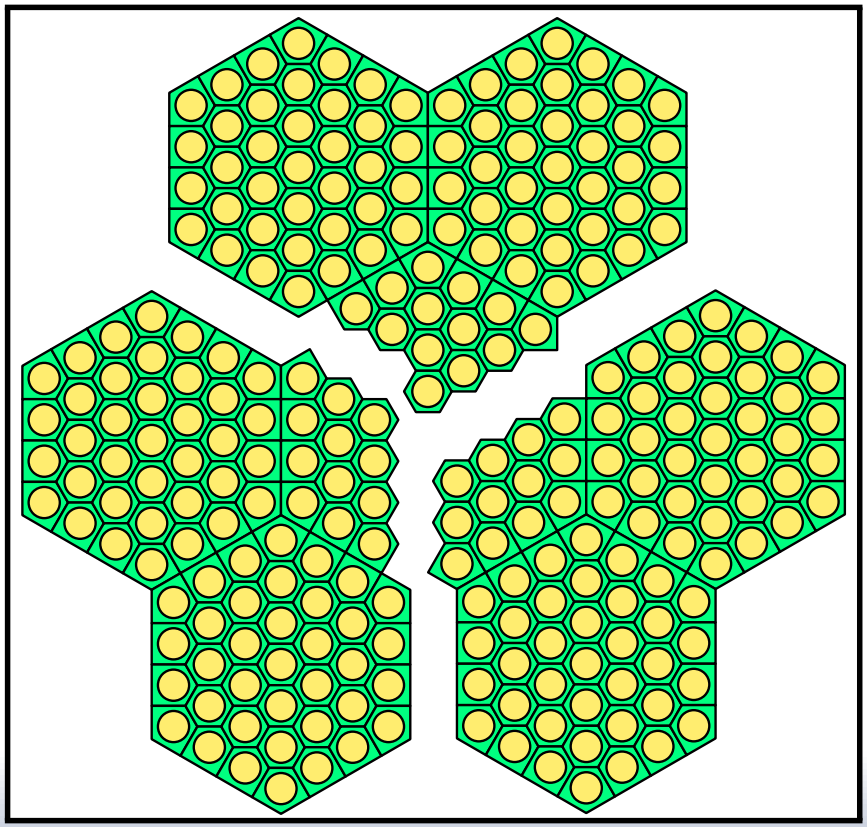

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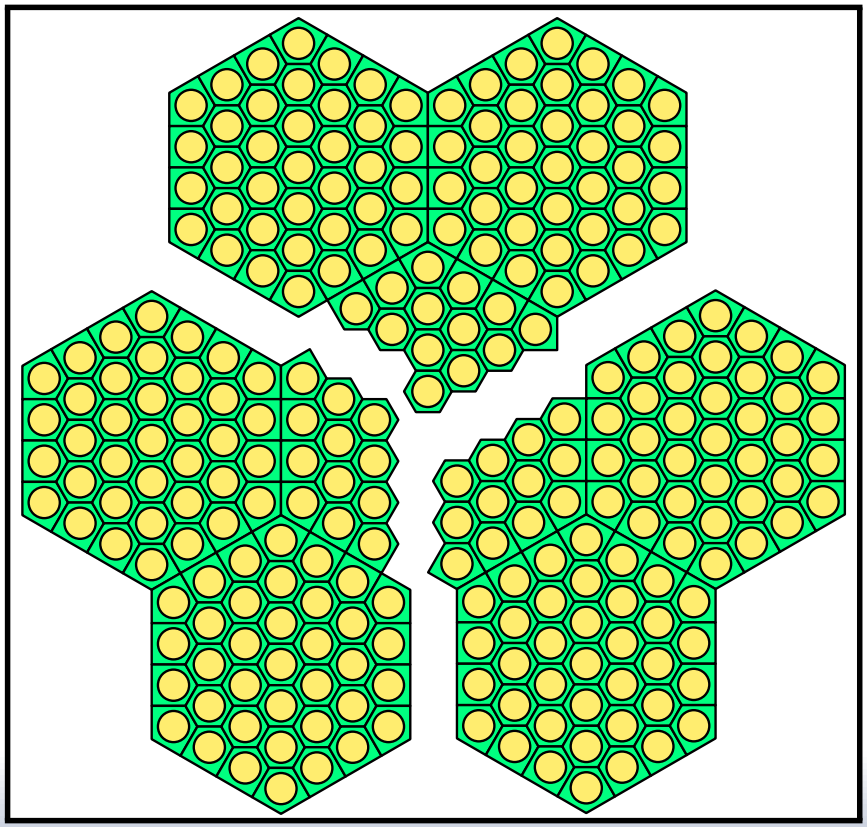

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  - Geometry partition.
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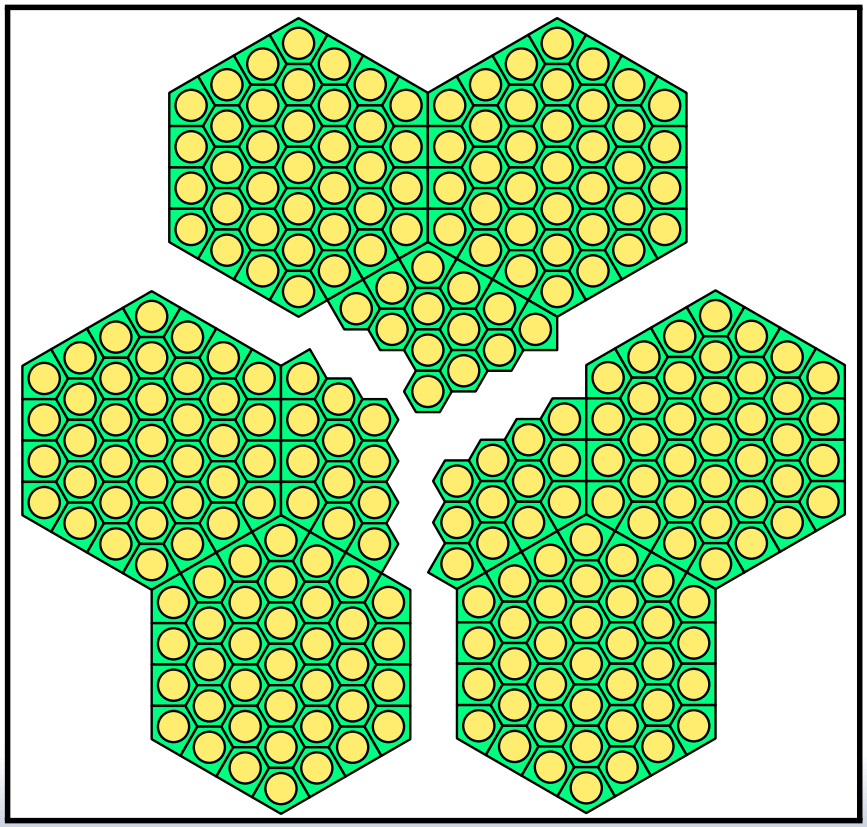

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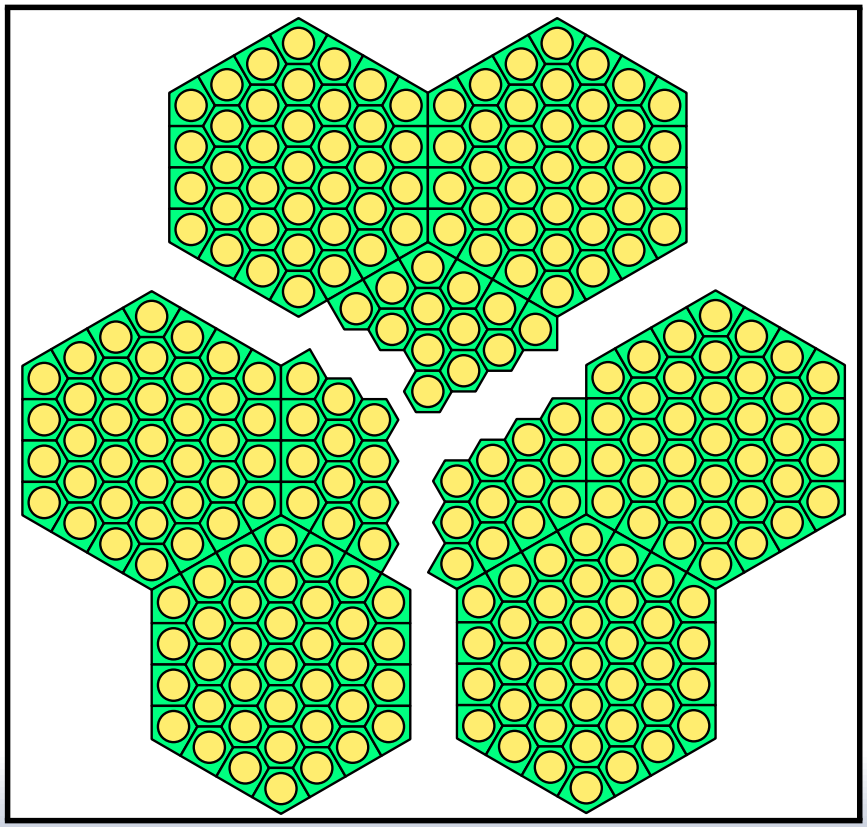

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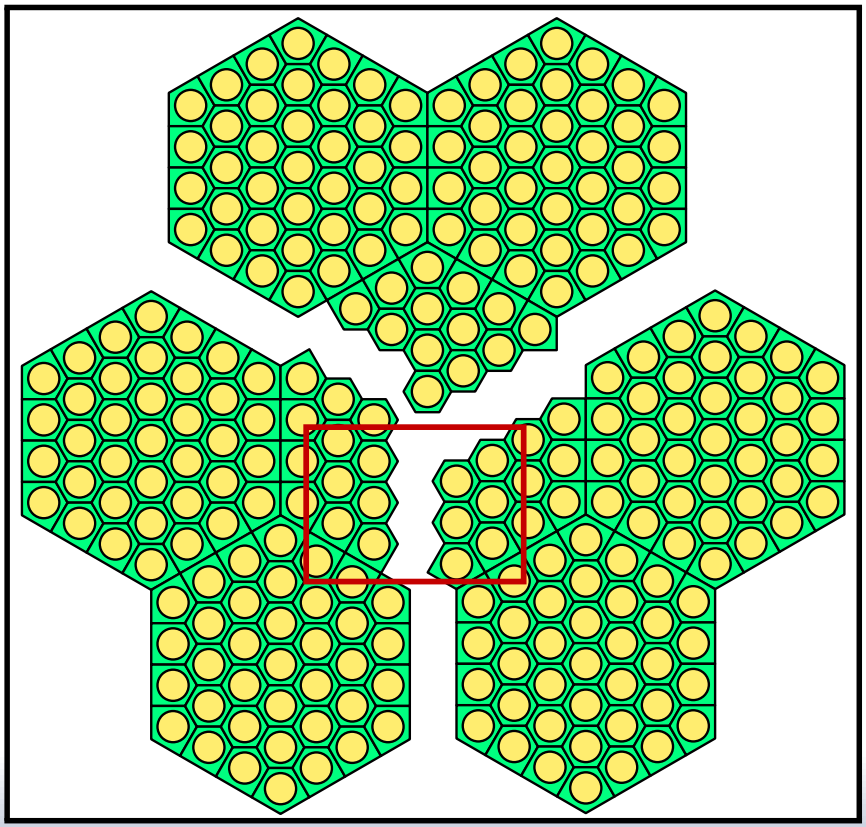

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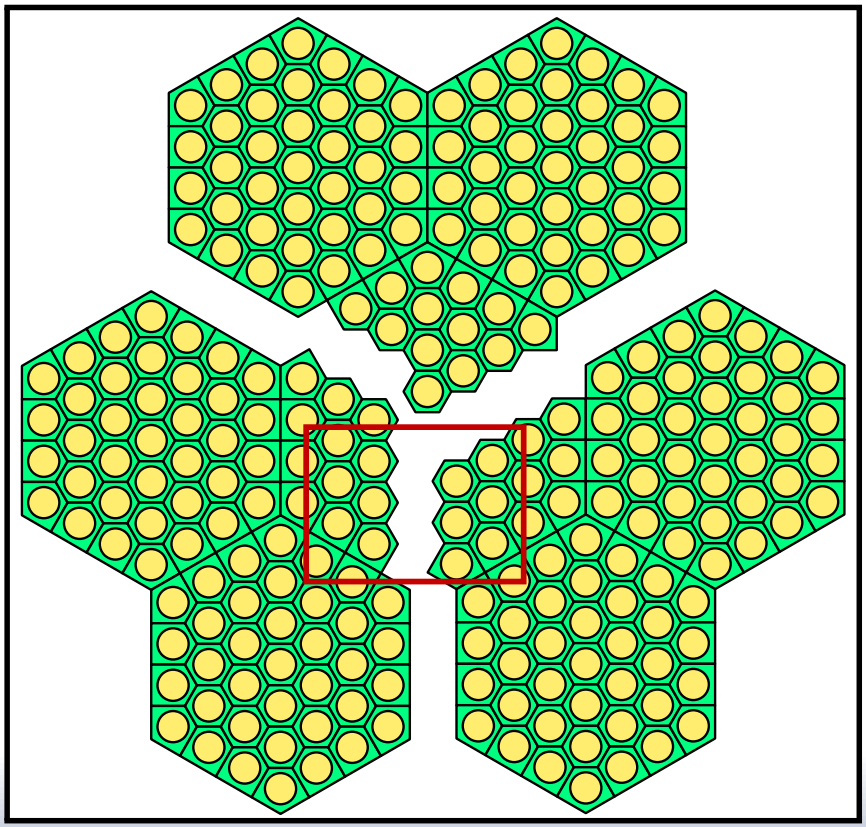

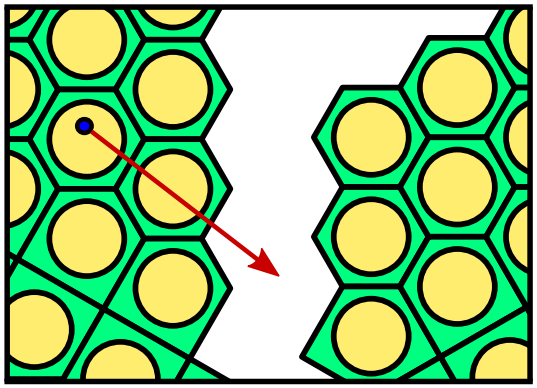

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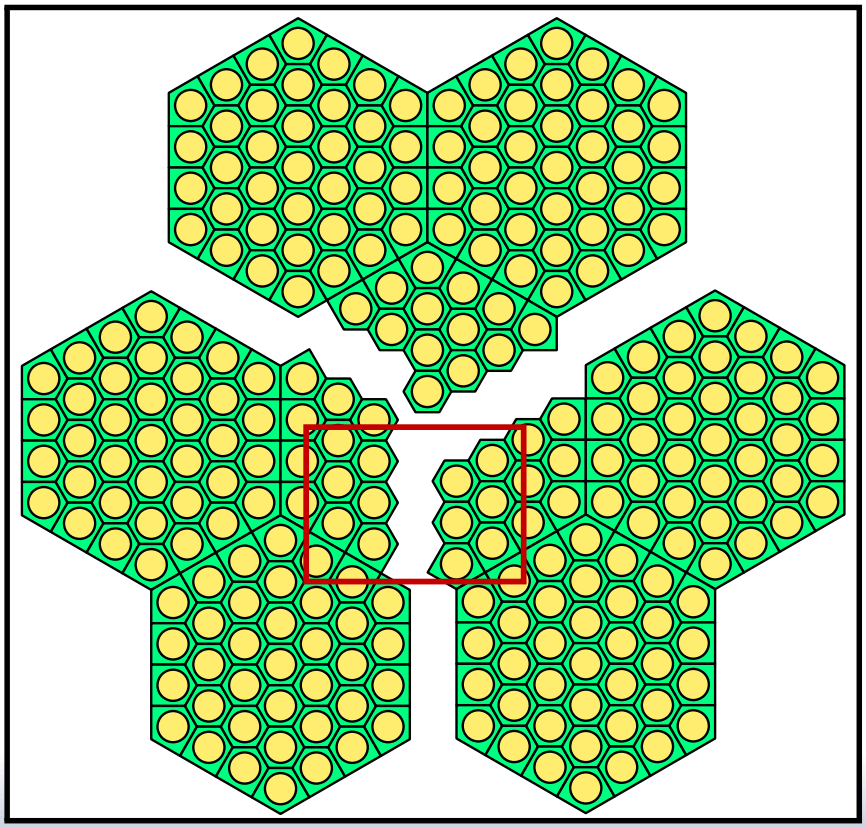

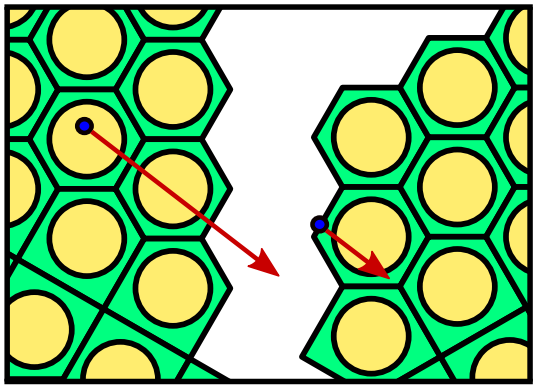

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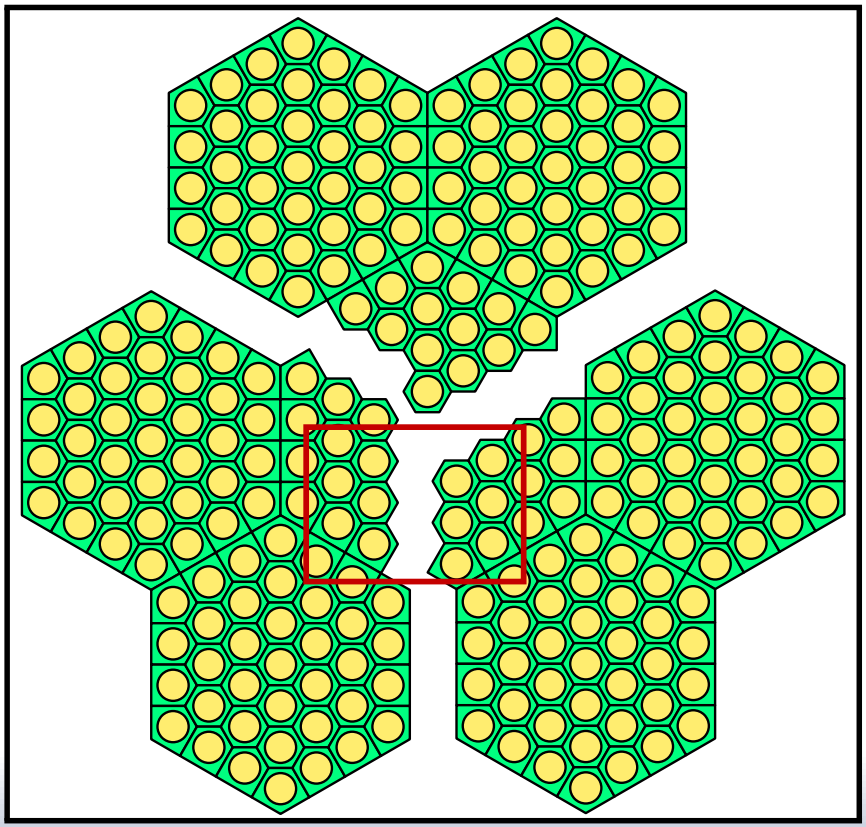

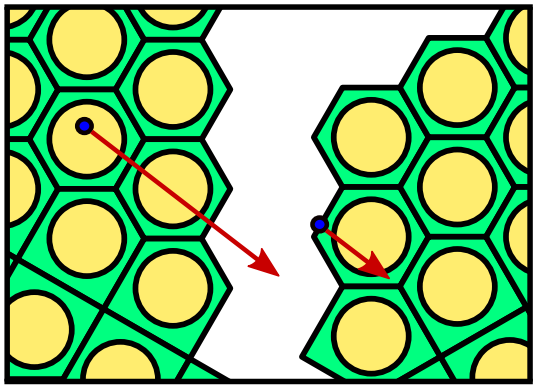

- Particle transfers:
  - Data: $\vec{r}$, $\vec{\Omega}$, E, t, w, etc.
  - Asynchronous (`MPI_ISend()`, `MPI_IRecv()`).
  - Buffered.

Tracking termination

- Termination condition:
  - All local histories have to be completed.
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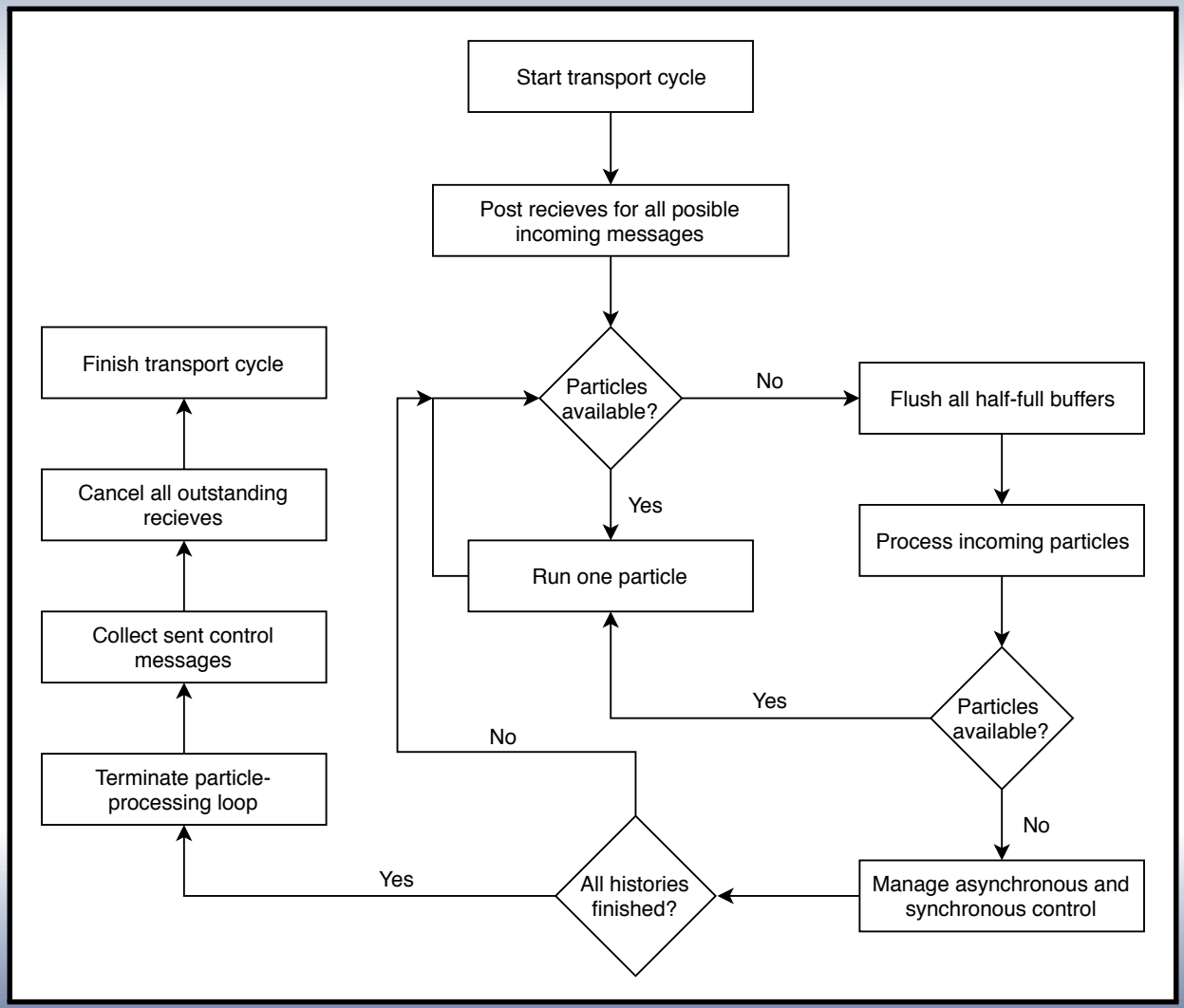
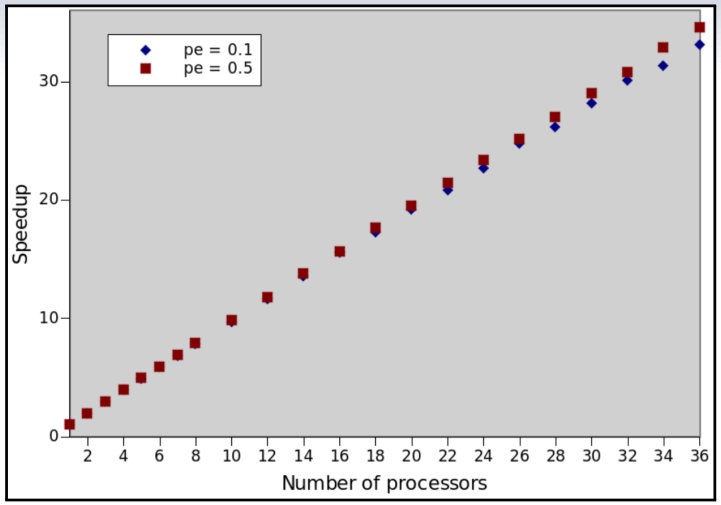
- Asynchronous estimation:
  - The particle balance can be estimated without synchronization.
  - Synchronization can be requested when this estimation matches.

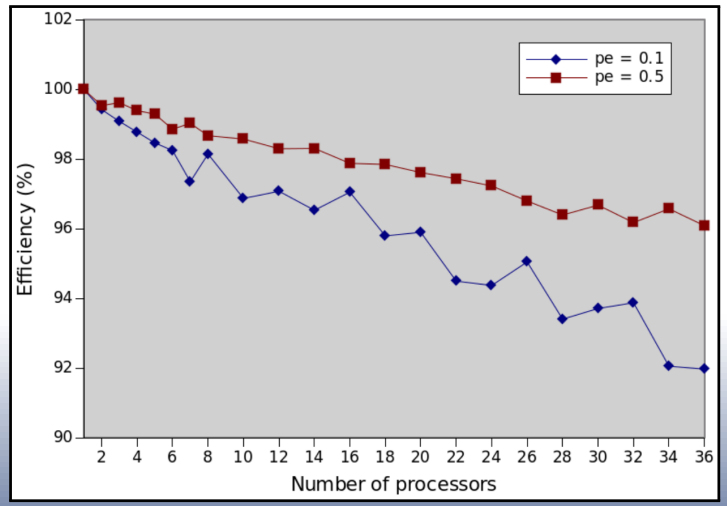
Particle tracking loop



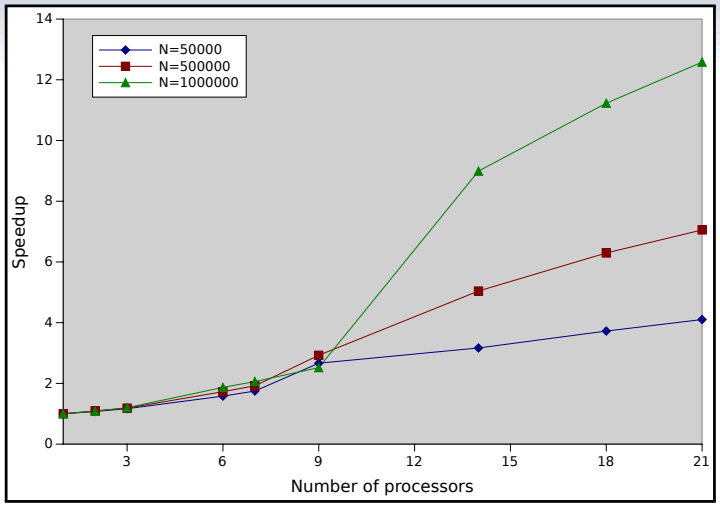
Test program

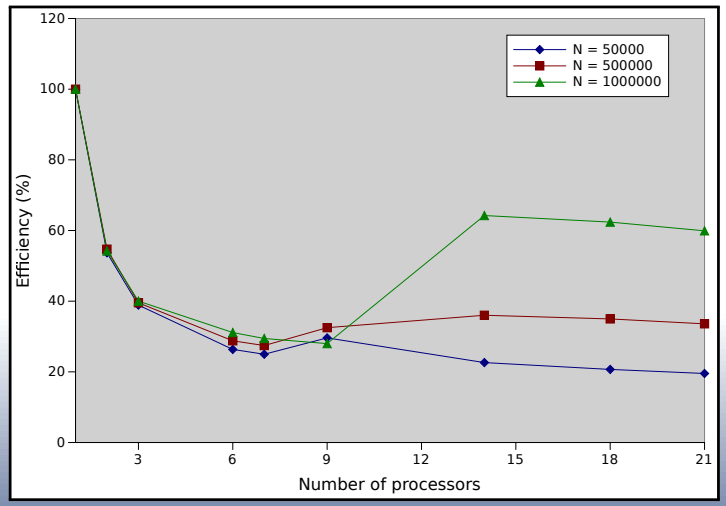
- No transport.
- Neutrons born in a domain escape with probability p_e.
- Uniform source.
- Average tracking time taken from Serpent2.



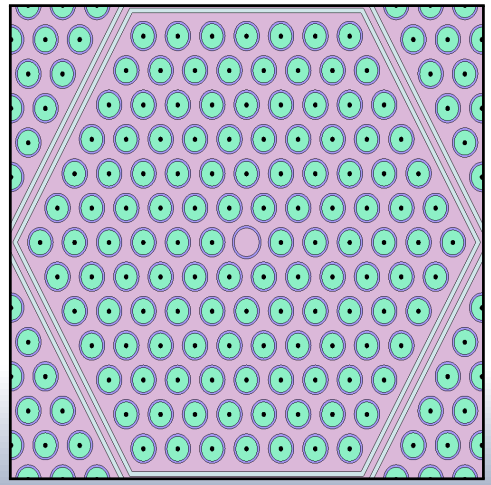


Serpent2





- VVER-440 pin-by-pin fuel assembly.
- Pure MPI (no OpenMP).
- Simplified algorithm.



Current status and future work

- Current status:
  - SDD communications scheme implemented, tested and optimized.
  - Implementation in Serpent2 underway.
  - Geometry partition being developed.
- Future work:
  - Development of an MPI-OpenMP optimized algorithm.
  - Further optimization and verification.
- McSAFE project:
  - Potential capabilities for pin-by-pin full-core simulation.
  - Optimization of parallel multiphysics schemes.

Questions?


THANK
YOU
GRACIAS
ARIGATO
SHUKURIA
BOLZÏN
MERCI
BÏYAN
SHUKRIA
DANKSCHEEN
TASHAKKUR ATU
SUKSAMA
EKHMET
MEHRBANI
GRAZIE
MAAKE
KOMAPSUMNIDA
JUSPAXAR
GOZAIMASHITA
EFCHARISTO
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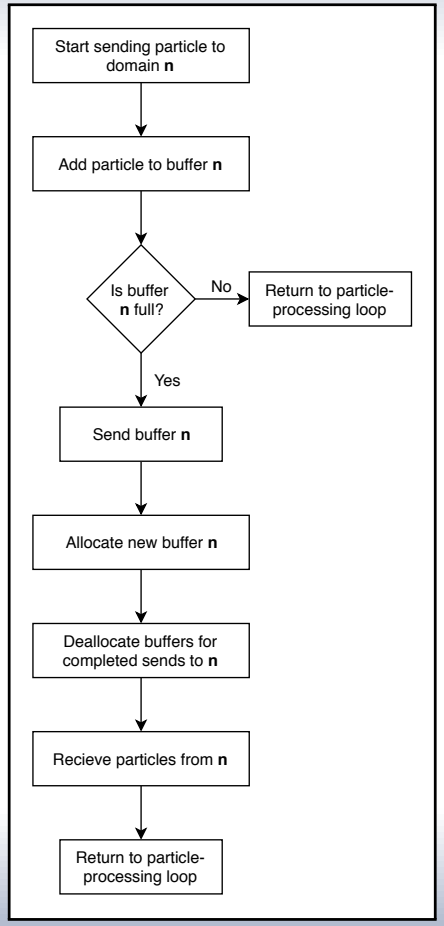
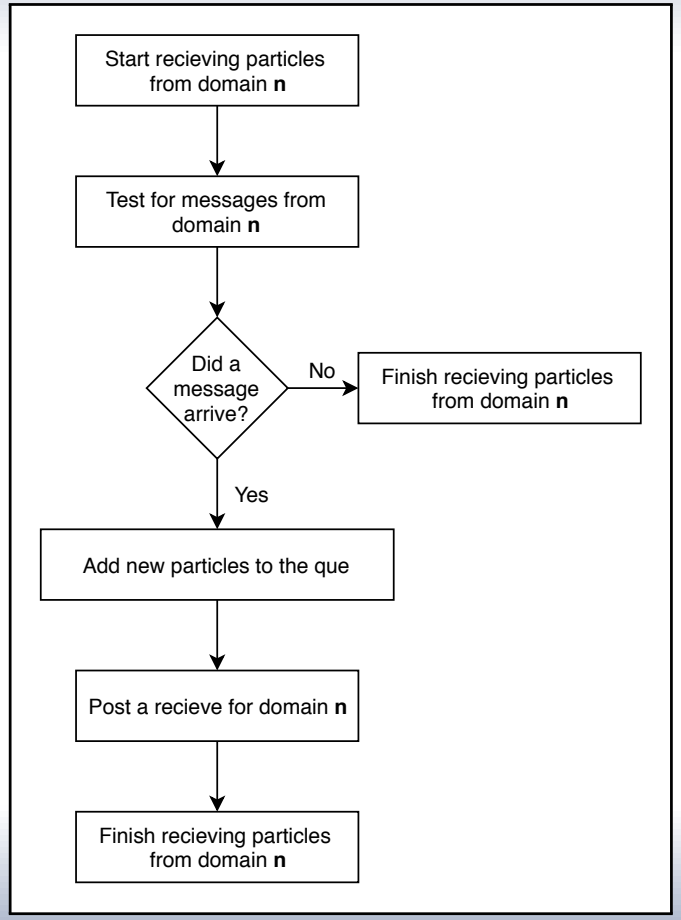
Appendices

Particle communications





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