Scaling Cellular Automata beyond 100,000 cores: *Fortran coarrays, MPI, OpenMP, do concurrent*

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**MPI beats coarrays - optimisation?**

ARCHER, Cray XC30, 2x12-core CPUs per node

Separate halo coarrays  □
Whole model coarrays  ○
ideal  ▲

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**Any amount of threading is bad - ideal load balance?**

ARCHER, Cray XC30, 100 nodes, 2 NUMA regions / node

Coarrays triple loop
Coarrays do concurrent
Coarrays
MPI triple loop
MPI do concurrent
MPI
OpenMP

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Separate halo coarrays are best - why?

CA iterations
(1) MPI IO, (2) NetCDF, (3) HDF5, etc.
(1) Ising magnetisation
(2) Solidification
(3) Fracture
+ many other kernels

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CASUP - modular CA library for HPC