



CENTRE OF EXCELLENCE FOR HPC
ASTROPHYSICAL APPLICATIONS

RAMSES on the road to exascale

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EuroHPC
Joint Undertaking

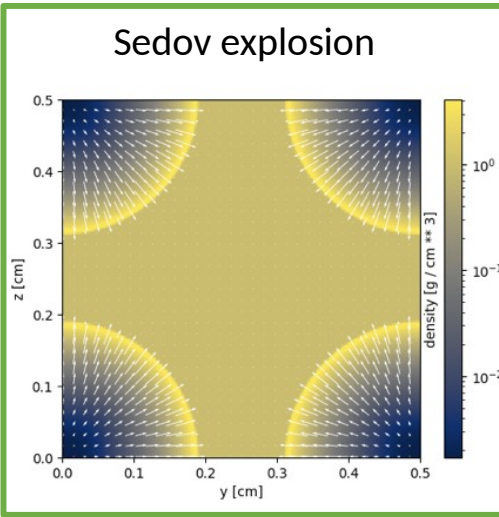
EuroHPC systems (CPU partitions)



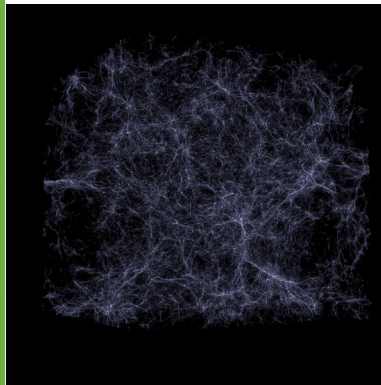
system (country)	#nodes	RAM/node [GB]	processor (cores)	chosen compiler
Discoverer (Bulgaria)	1128	256, 1024	2 x AMD EPYC 7H12 (2x64)	GNU + OpenMPI
Karolina (Czech rep.)	720	256	2 x AMD EPYC 7H12 (2x64)	GNU + OpenMPI
Vega (Slovenia)	960	256, 1024	2 x AMD EPYC 7H12 (2x64)	GNU + OpenMPI
MeluXina (Luxembourg)	573	512, 4096	2 x AMD EPYC 7H12 (2x64)	GNU + OpenMPI
Lumi (Finland)	2048	256, 512, 1024	2 x AMD EPYC 7763 (2x64)	GNU + MPICH (Cray)
Leonardo (Italy)	1536	512	2 x Intel Xeon Platinum 8480+ (2x56)	Intel + Intel MPI
Mare Nostrum (Spain)	6192	256, 1024	2 x Intel Xeon Platinum 8480+ (2x56)	Intel + Intel MPI
Deucalion (Portugal)	-	-	-	-

Selected representative use cases:

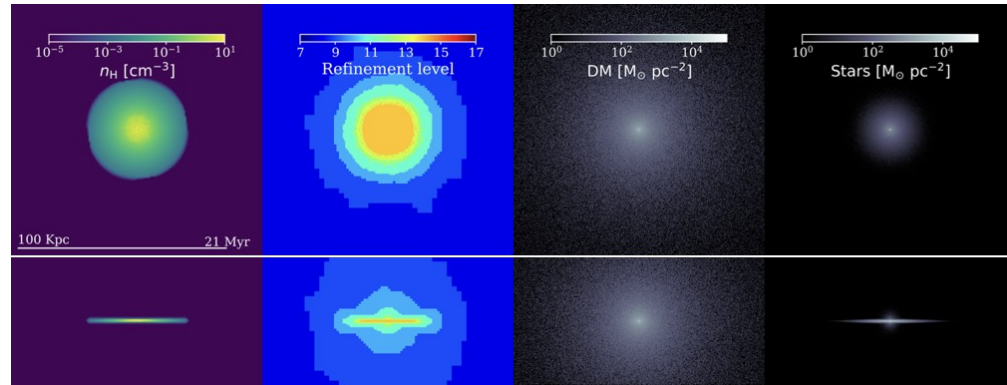
Sedov explosion



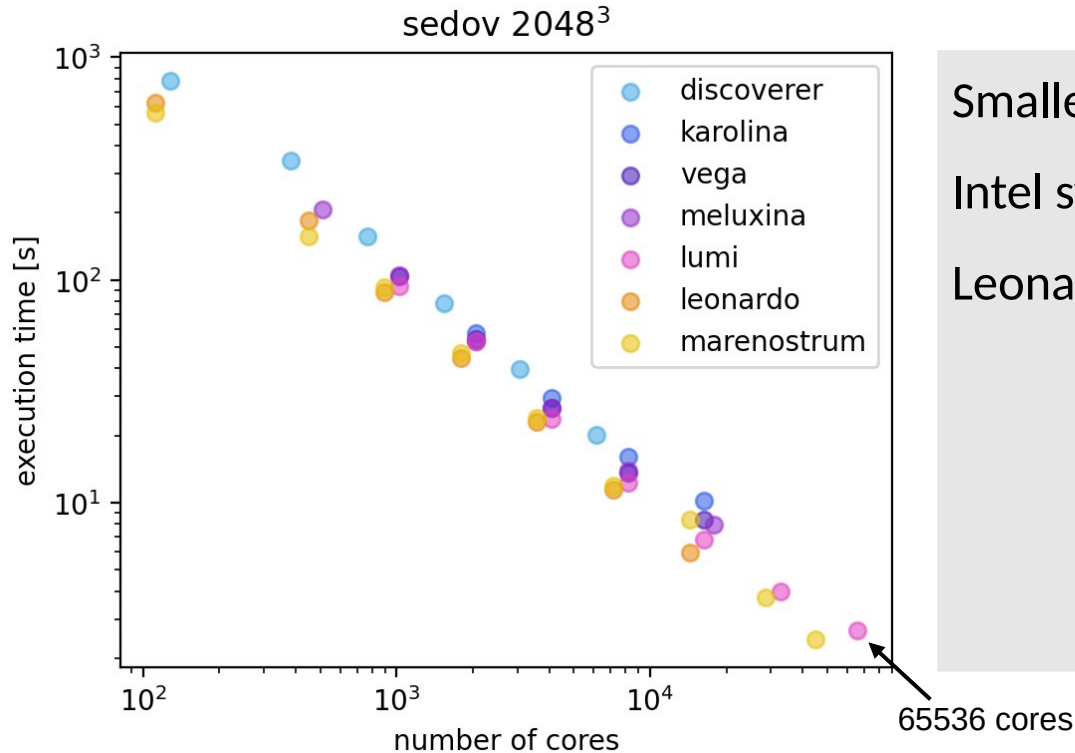
Cosmological box



Isolated galaxy



Performance on EuroHPC systems



Smaller AMD systems similar

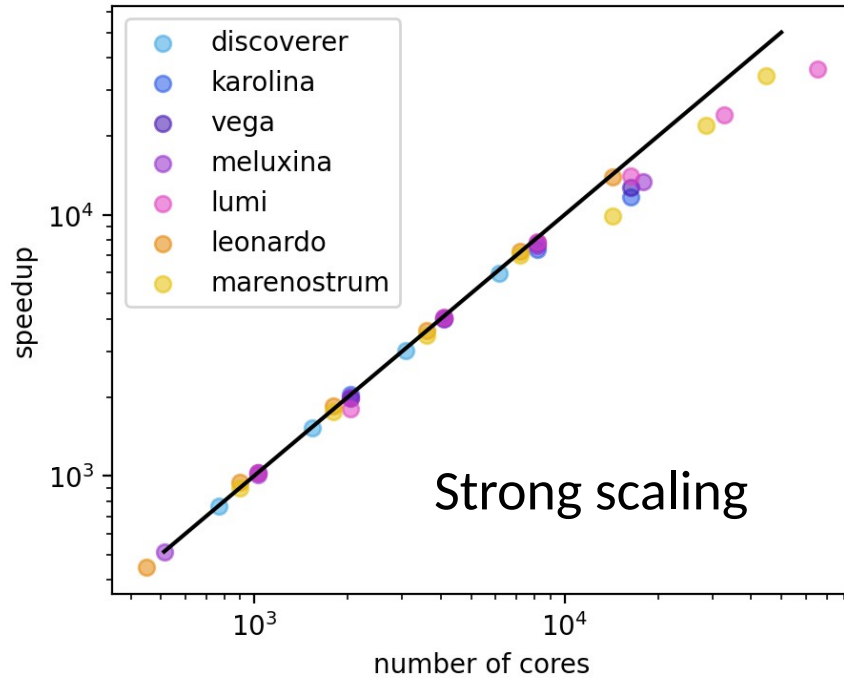
Intel systems typically slightly faster

Leonardo best timings (but unstable)

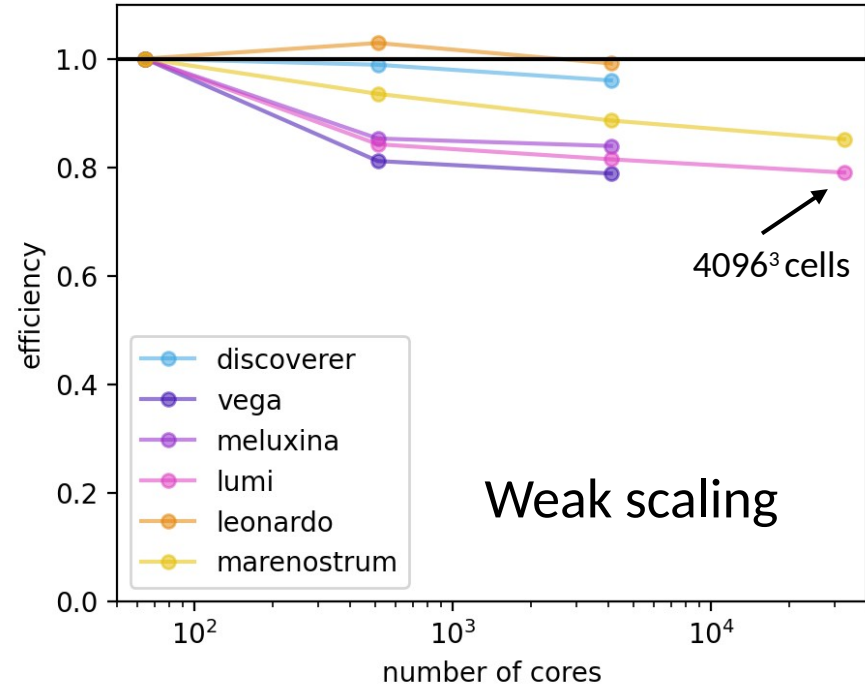
Scaling on EuroHPC systems



sedov 2048³



sedov 128³/core



MPI + OpenMP implementation

Shared memory parallelism with OpenMP inside nodes

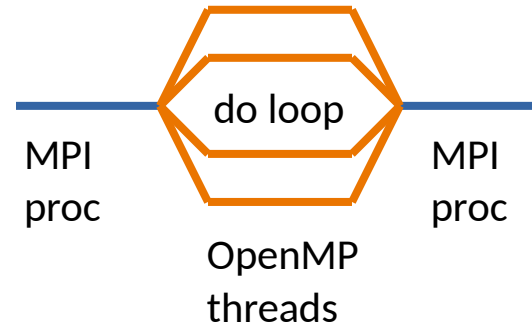
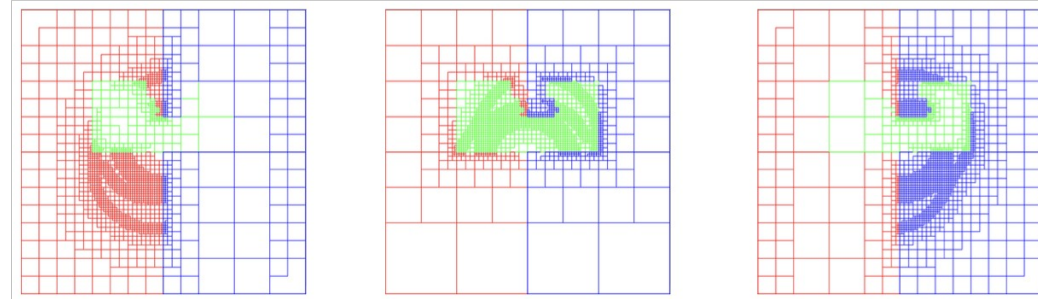
=> reduce number of MPI domain

=> decrease communication & reduced memory imprint ghost zones

=> less time spent communicating

=> **improved scalability**

Starting from RAMSES-yOMP

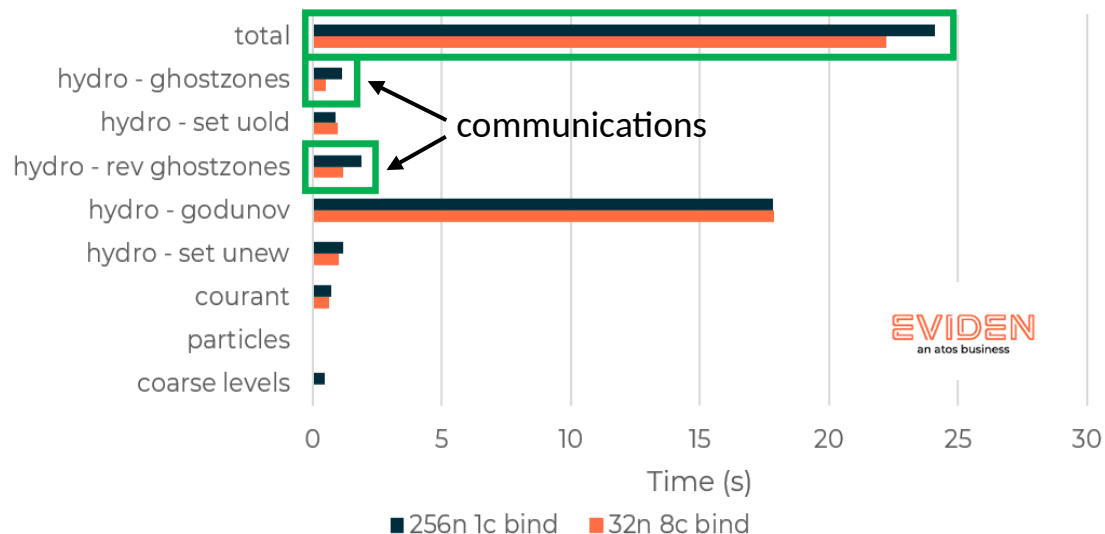


Results for unigrid: sedov test



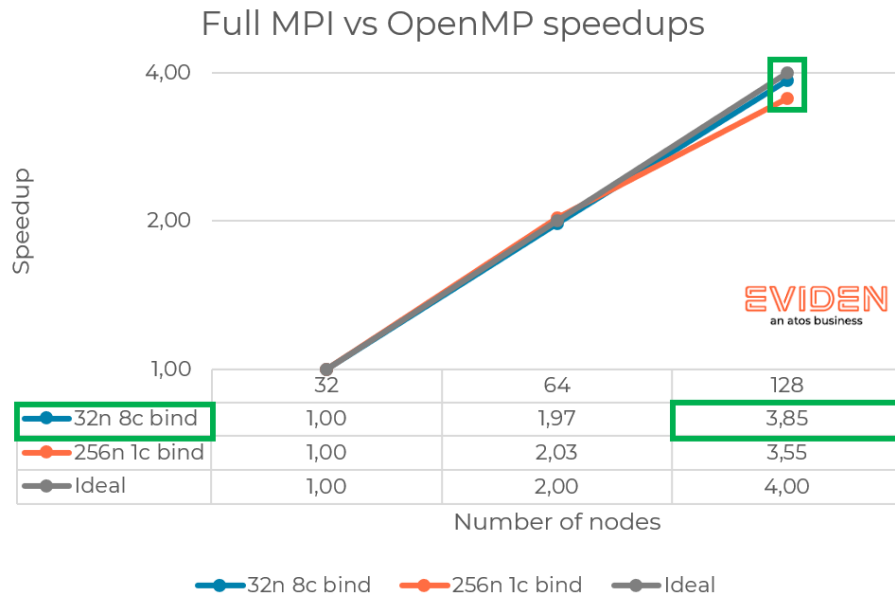
Parallelization of hydro main loop (godunov fine)

Full MPI vs MPI + OpenMP (32 MPI / 8 threads), 32 nodes

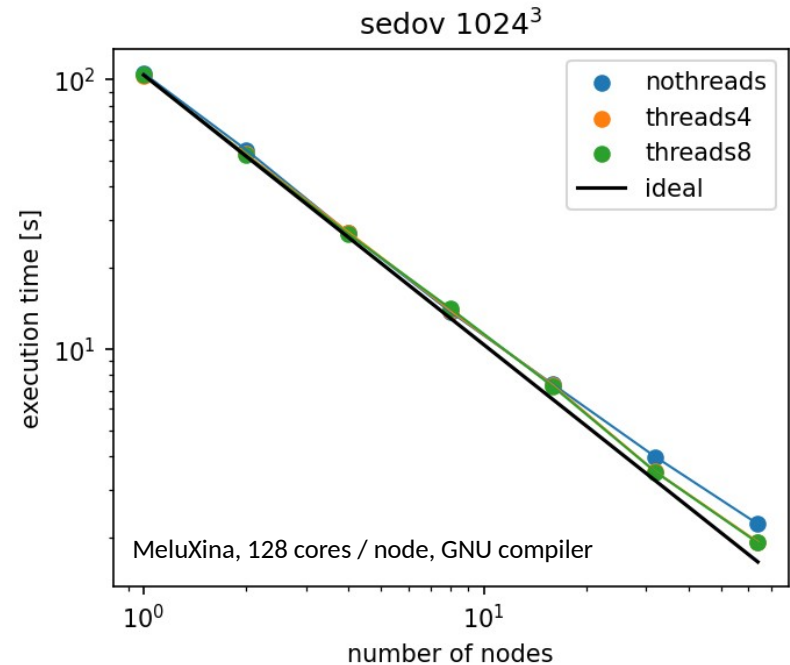


AMD Milan architecture, 128 cores (256 threads) / node, AOCC compiler

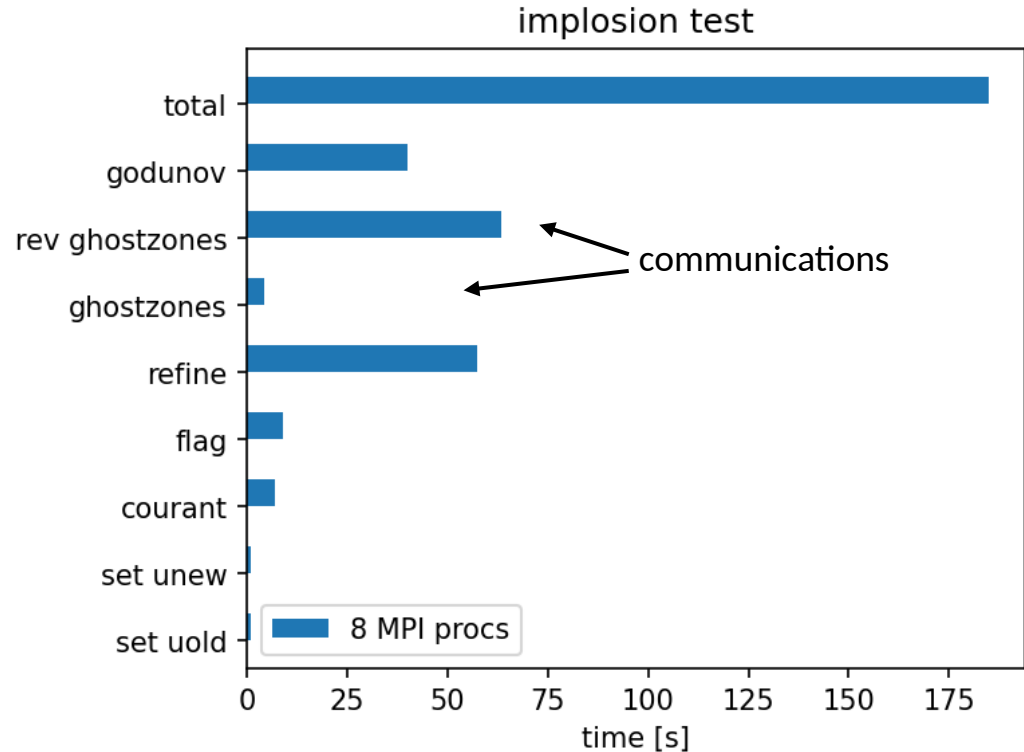
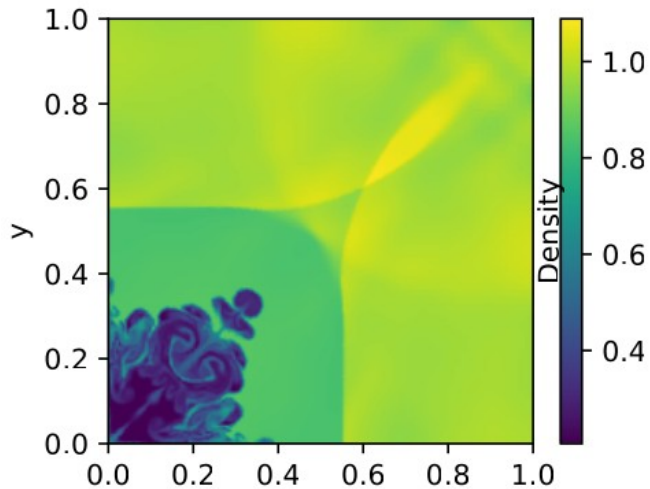
Results for unigrid: sedov test



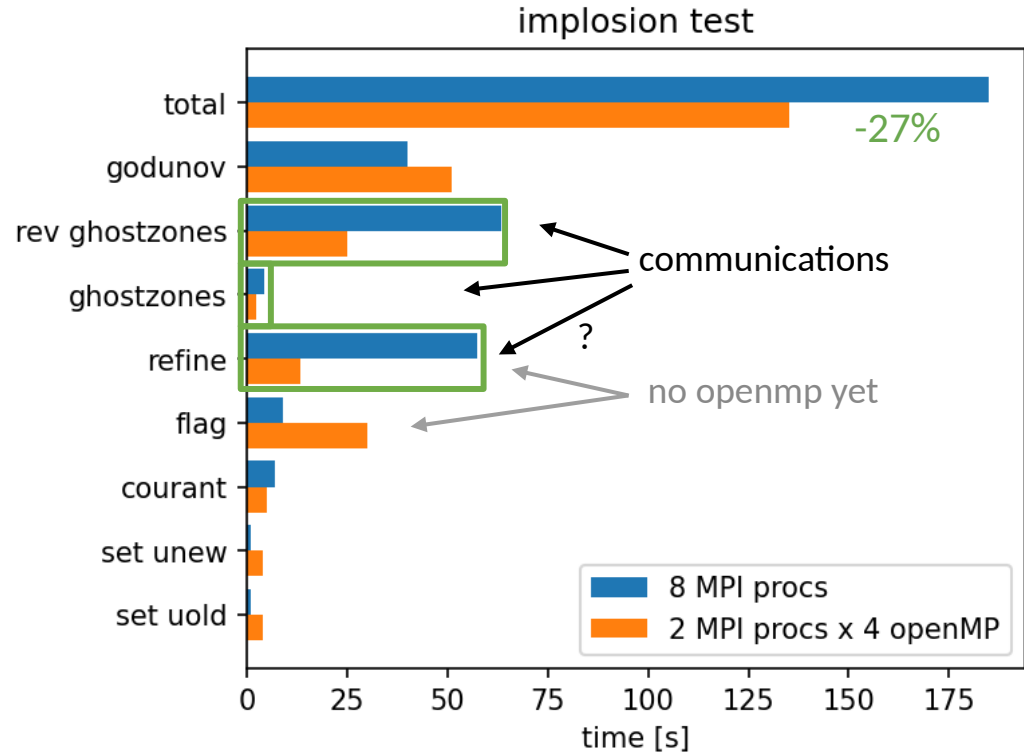
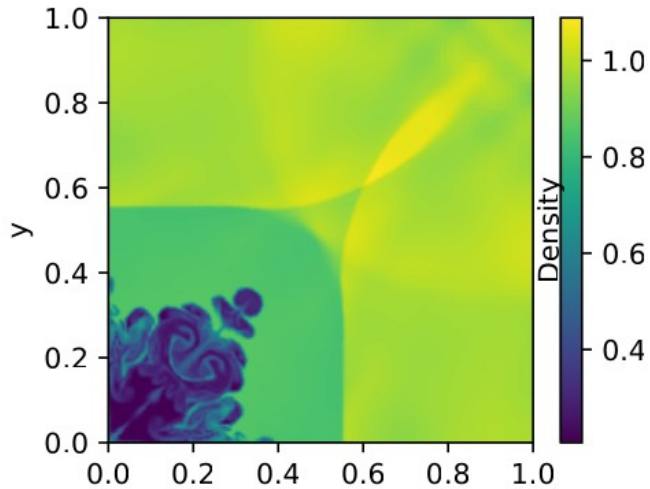
AMD Milan architecture, 128 cores (256 threads) / node, AOCC compiler



WIP: implosion test with AMR



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Starting OpenMP working group

Goal: Full openMP version of RAMSES

Tasks:

- Add openMP to main RAMSES, based on RAMSES-yOMP
- parallelize parts not present in yOMP
- code review
- testing on different machines

WG meetings:

- discuss technical details
- review changes and results

To join: email me at
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Acknowledgement & Disclaimer



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