



IDEFIX



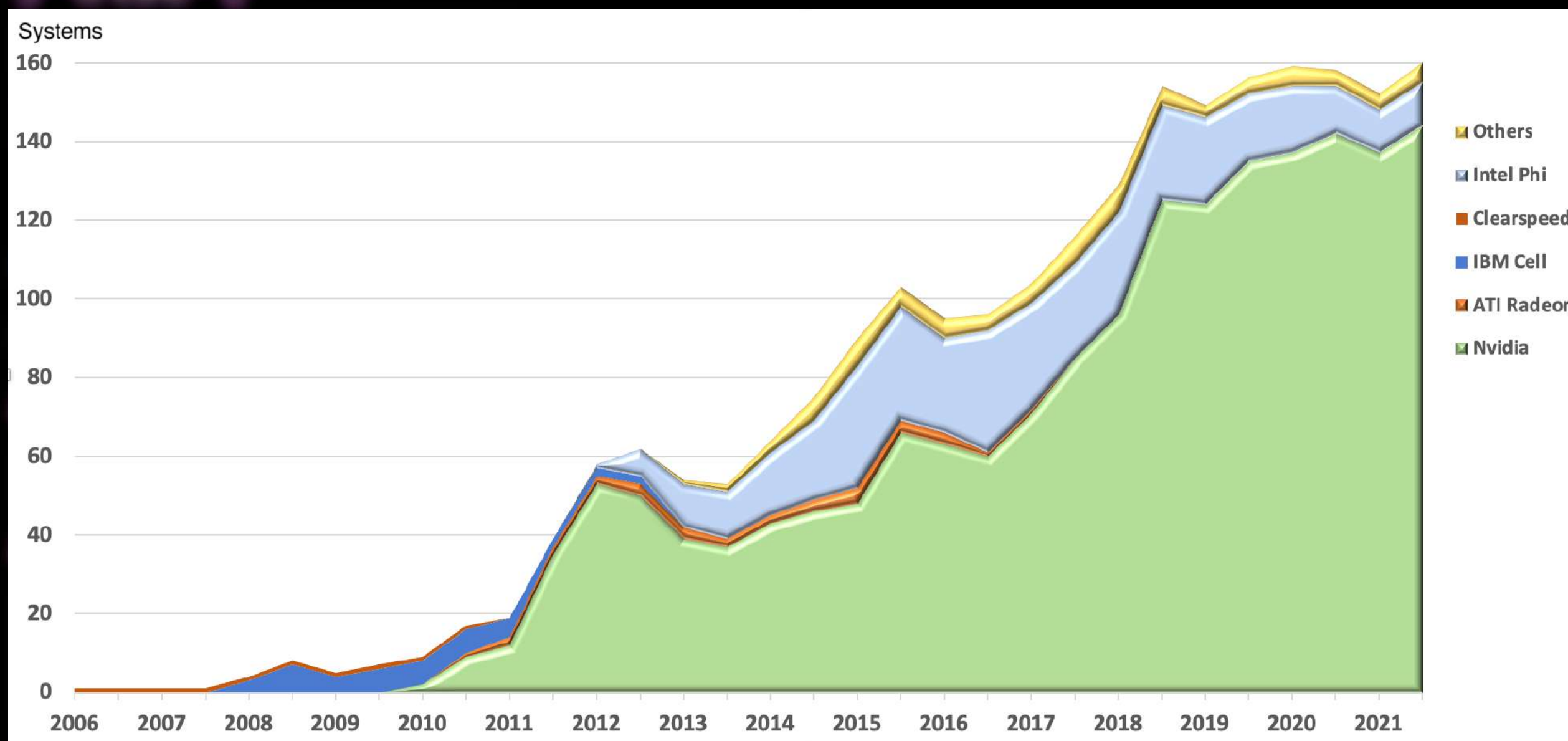
An exascale-ready code for (magneto-) hydrodynamics

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Idefix is a Kokkos¹-based code solving the (M)HD equations in arbitrary geometry written in C++17. Idefix can run both on the latest accelerated supercomputer using GPUs and on your laptop, with no hassle.

The facts

The number of accelerated clusters is rising



systems using GPU accelerators in the TOP500²

The magic

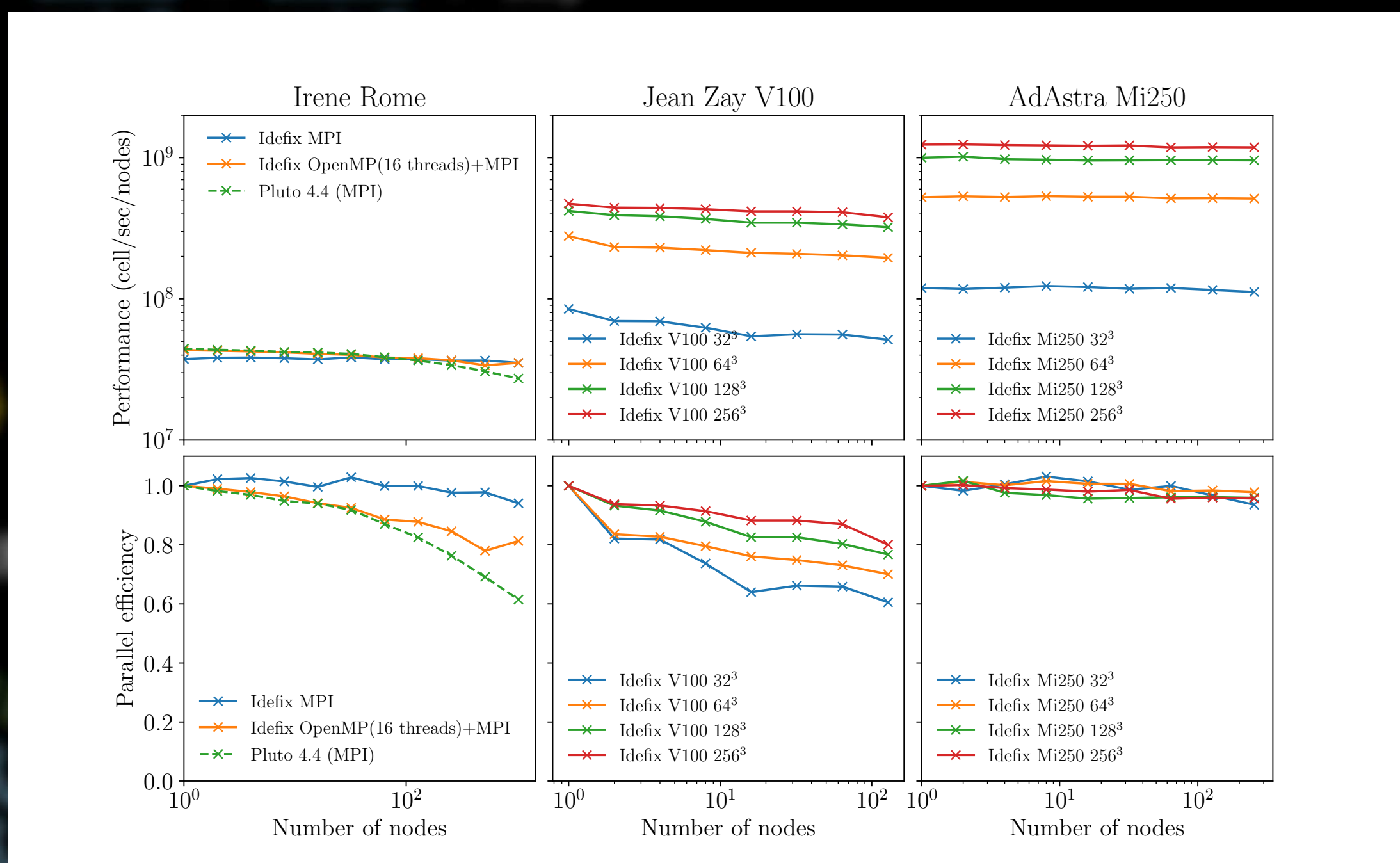
- Replace C arrays by IdefixArray
- Replace for loops by `idefix_for`

That's it* !

```
1 // User-defined gravitational potential. This function is enrolled in the
2 // integration algorithm by the constructor of the Setup class (see below)
3 void Potential(DataBlock& data,
4               const real t,
5               IdefixArray1D<real>& x1,
6               IdefixArray1D<real>& x2,
7               IdefixArray1D<real>& x3,
8               IdefixArray3D<real>& phi) {
9
10    idefix_for("Potential",
11              0, data.np_tot[KDIR],
12              0, data.np_tot[JDIR],
13              0, data.np_tot[IDIR],
14              KOKKOS_LAMBDA (int k, int j, int i) {
15                phi(k,j,i) = -1.0/x1(i);
16              });
17 }
```

* In a few cases, extra steps are required such as when performing reduction operations

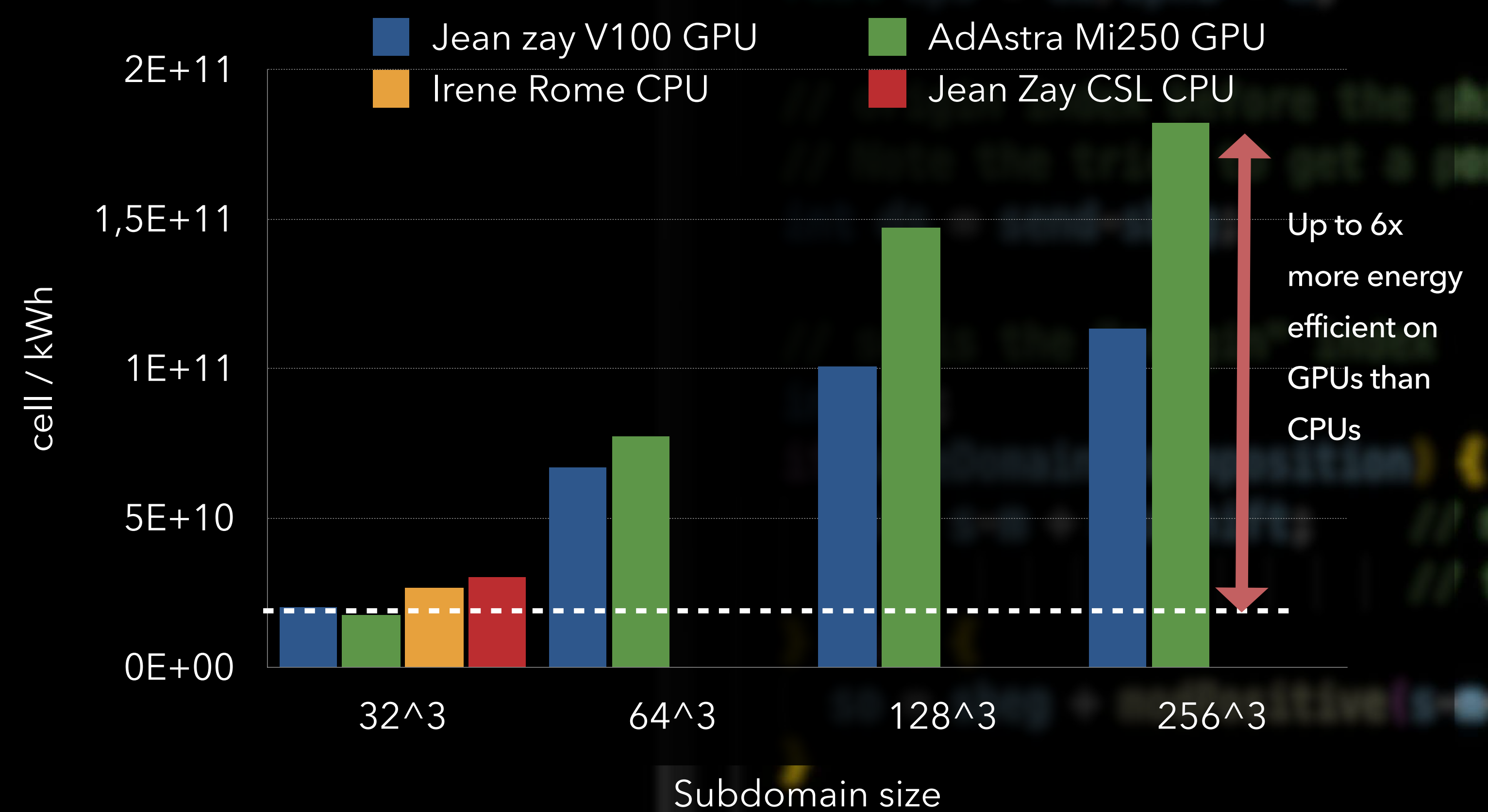
Performance & energy efficiency



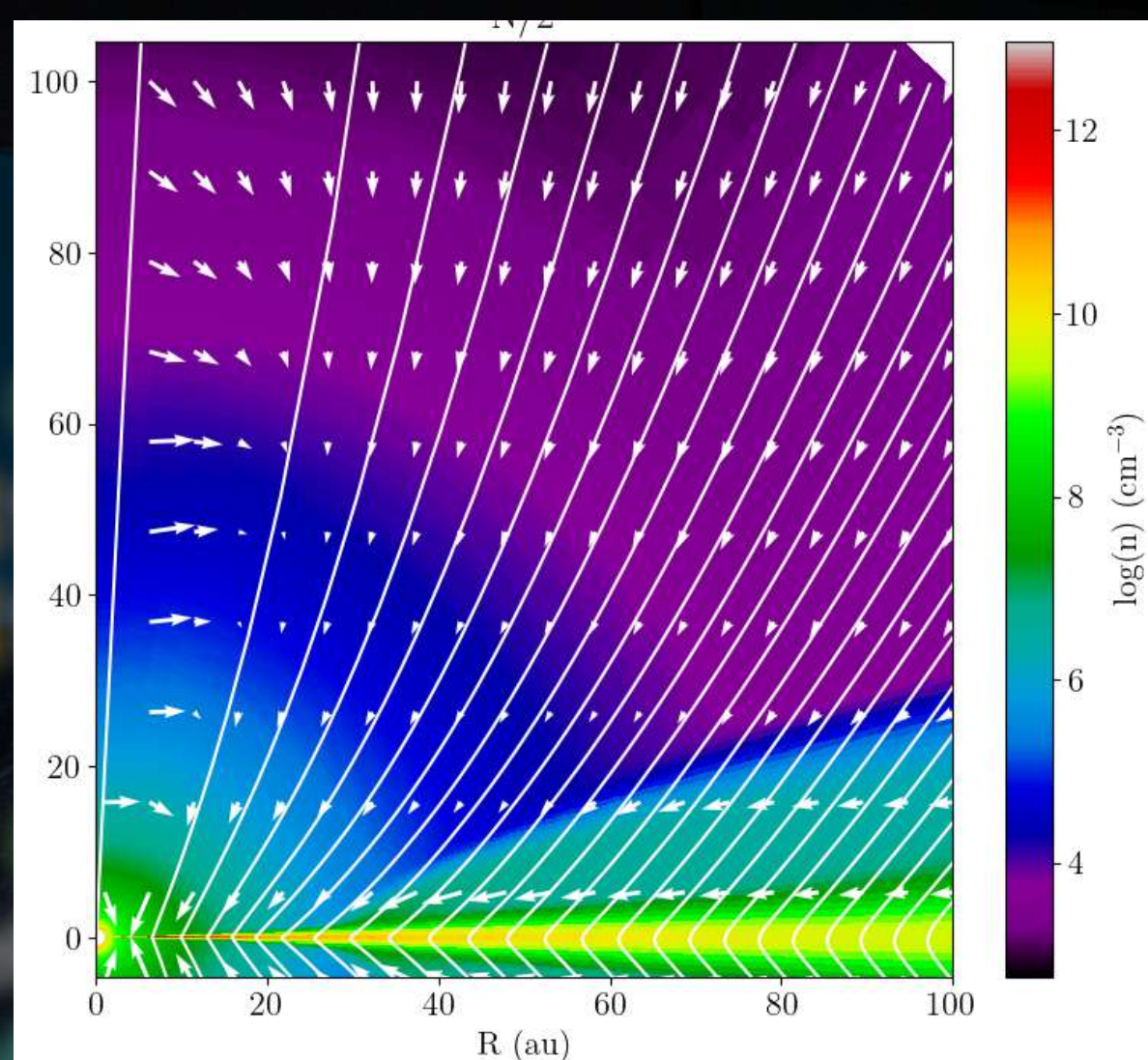
>80% parallel efficiency on up to 131 000 CPU cores and up to 2048 AMD Mi250 GPUs.

Speedup: a single Nvidia V100~120 Intel CSL cores.

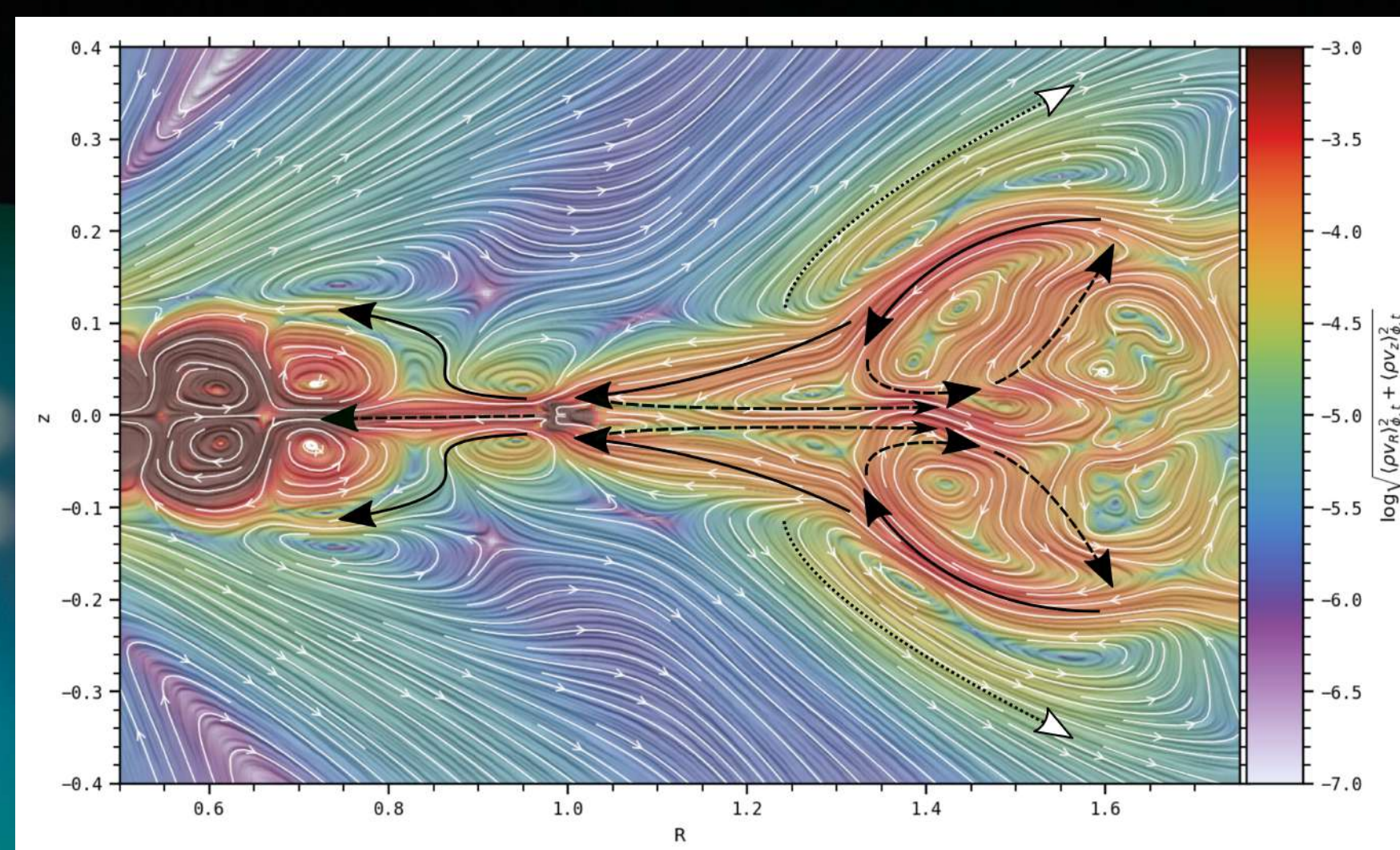
Performances comparable to Pluto 4.3³ on CPUs



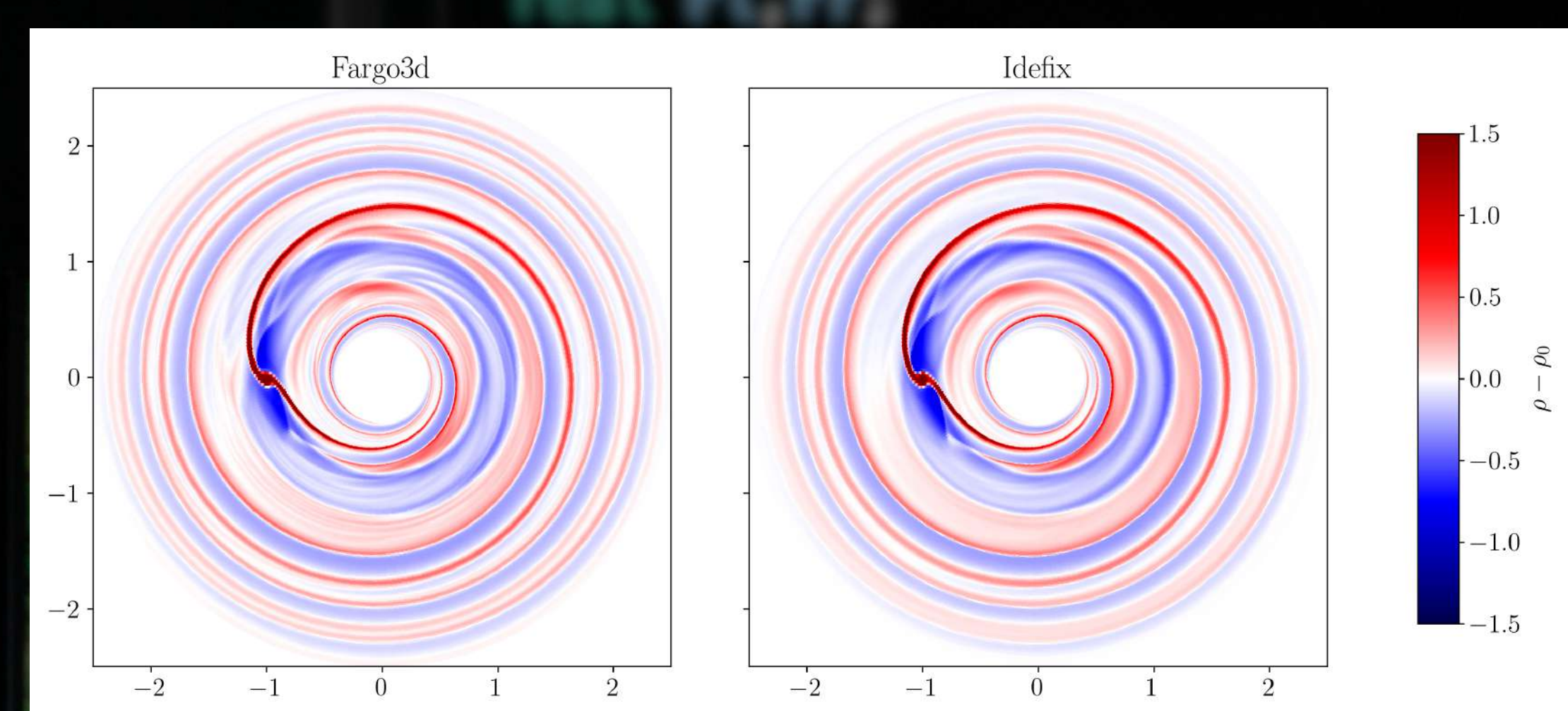
Tests & Applications



NiMHD core collapse simulations
[J. Mauxion]



Planet-disk-MHD wind interaction
[G. Wafflard-Fernandez]



Orbital advection with embedded planets
(comparison with Fargo3D⁴)

References

- 1- Trott, C. R., Lebrun-Grandié, D., Arndt, D., et al. 2022, IEEE Transactions on Parallel and Distributed Systems, 33, 805
- 2- Reed D., Gannon D., Dongarra J., 2022, arXiv, arXiv:2203.02544.
- 3- Mignone, A., Bodo, G., Massaglia, S., et al. 2007, ApJS, 170, 228
- 4- Benítez-Llambay, P. & Masset, F. S. 2016, ApJS, 223, 11



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Revealing the dynamics of planet-forming discs



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