

# Timing results for Lindgren and Triolith

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## 1 Code and test case

For all tests, the PENCIL CODE was used. It is publicly available on <http://pencil-code.googlecode.com/>, where also detailed documentation is available. The code uses explicit sixth order finite differences. The time step is third-order. In this sample, we run isothermal magnetohydrodynamics in a periodic domain<sup>1</sup>. Power spectra are computed during the run, but our current parallelization of the Fourier transform requires that the meshpoint number is an integer multiple of the product of processor numbers in the  $y$  and  $z$  directions and the product of processor numbers in the  $x$  and  $y$  directions. In addition, the number of processors in one direction should not be so large that the number of mesh points per processor becomes comparable to or less than the number of ghost zones (which is 6).

## 2 Running the code

To run the code, get one of the sample run directories, e.g., [http://norl51.nordita.org/~brandenb/pencil-code/timings/bforced/512\\_4x16x32](http://norl51.nordita.org/~brandenb/pencil-code/timings/bforced/512_4x16x32). The relevant file to be changed is `src/cparam.local`

```
ncpus=2048,nprocx=4,nprocy=16,nprocz=ncpus/(nprocx*nprocy)
nxgrid=512,nygrid=nxgrid,nzgrid=nxgrid
```

in particular the values of `ncpus`, `nprocx`, `nprocy`, and `nxgrid`. Once they are chosen, say `make`, and `submit start_run.csh`.

## 3 Triolith

On Triolith, strong scaling tests have been performed for three mesh sizes. The time per time step and mesh point is given for different processor numbers and layouts. Generally, it is advantageous

<sup>1</sup>Run directories are available on <http://norl51.nordita.org/~brandenb/pencil-code/timings/bforced/>

to keep the number of processors in the  $x$  direction small.

*Comments.* Although on Triolith the number of processors per node is 16, resolutions with one or two powers of 3 (such as 576) still work well. Furthermore, the number of processors above which the scaling becomes poor increases quadratically with the number of mesh points. This implies that the RAM per processor increases linearly with the problem size per direction. However, this will not be a limitation, because even for  $2304^3$  meshes, the required RAM is still below 100 MB.

## 4 Lindgren

On Lindgren, we have performed weak scaling tests and compare with weak scaling results for Triolith. Triolith is about twice as fast as Lindgren.

\$Header: /var/cvs/brandenb/tex/pencil-code/performance/notes.tex,v 1.6 2021/10/31 04:29:15 brandenb Exp \$

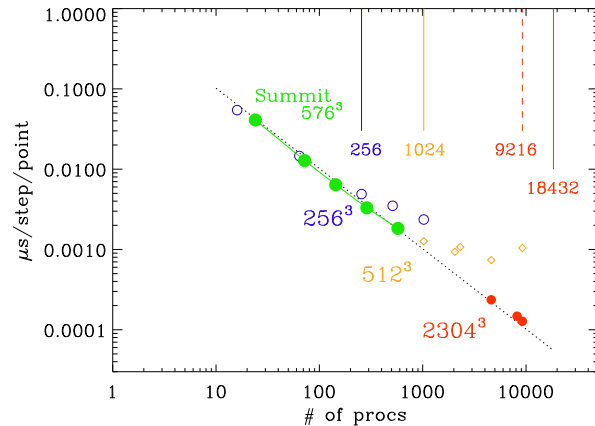


Figure 1: Strong scaling on Triolith. Comparison with Summit in Boulder (2017).

Table 1: Triolith timings

proc	$\frac{\mu s}{pt \ step}$	resol.	layout
16	0.075	$128^3$	2x2x4
16	0.065	$128^3$	1x4x4
16	0.0544	$256^3$	1x4x4
64	0.0146	$256^3$	1x8x8
64	0.0164	$256^3$	2x4x8
256	0.0049	$256^3$	1x16x16
512	0.0035	$256^3$	2x16x16
1024	0.00236	$256^3$	2x16x32
1024	0.00127	$512^3$	2x16x32
1024	0.00129	$512^3$	4x16x16
2048	$9.34 \times 10^{-4}$	$512^3$	4x16x32
2304	0.00107	$576^3$	4x18x32
4096	$3.6 \times 10^{-4}$	$1024^3$	4x32x32
4096	$3.8 \times 10^{-4}$	$1024^3$	8x16x32
4096	$4.2 \times 10^{-4}$	$1024^3$	4x16x64
4608	$7.38 \times 10^{-4}$	$576^3$	8x18x32
4608	$2.66 \times 10^{-4}$	$1152^3$	4x32x36
4608	$3.03 \times 10^{-4}$	$1152^3$	4x36x32
4608	$3.12 \times 10^{-4}$	$1152^3$	4x18x64
4608	$2.36 \times 10^{-4}$	$2304^3$	2x32x72
8192	$1.475 \times 10^{-4}$	$2048^3$	4x32x64
9216	0.00104	$576^3$	16x18x32
9216	$1.276 \times 10^{-4}$	$2304^3$	4x36x64
9216	$1.30 \times 10^{-4}$	$2304^3$	4x32x72

Table 2: Lindgren timings

proc	$\frac{\mu s}{pt \ step}$	resol.	layout
1536	0.00171	$512^2 \times 384$	2x32x24
2048	0.00129	$512^2 \times 1024$	1x32x64
2048	0.00129	$1024^2 \times 2048$	1x32x64
4096	$4.6 \times 10^{-4}$	$2048^3$	4x16x64
9216	$2.36 \times 10^{-4}$	$2304^3$	4x48x48

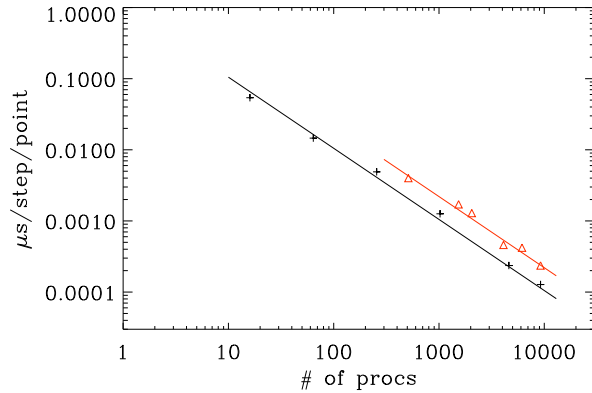


Figure 2: Comparison Triolith (black, plus signs) and Lindgren (red, triangles). Weak scaling.