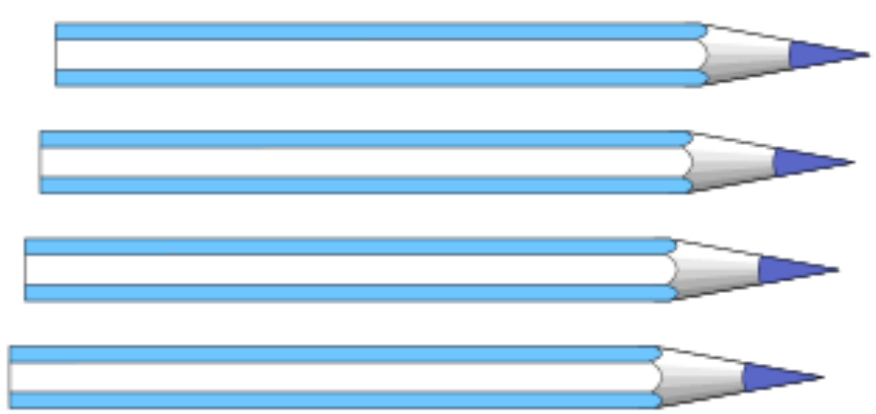
# Profiling



**PRACE project:**
**"INTERDYNS**
**Interplay of large- and small-scale dynamos in rotating stellar convection zones"**
**on SUPERMUC-NG@LRZ**

**Setup:**
**Global (spherical wedge) convective dynamo simulation**
**512x1024x512 gridpoints**
**8x16x16 cores**
**Solve for aa, uu, ss, lnrho**

**Use the program:**
**Intel Amplifier and Performance Snapshopts (APS):**
**https://www.lrz.de/services/software/programmierung/intel_amplifier/**

```
| Summary information
|--------------------------------------------------------------------
Application              : run.x
Report creation date     : 2020-06-18 21:48:17
Number of ranks          : 2048
Ranks per node           : min: 47, max: 48
HW Platform              : Intel(R) Xeon(R) Processor co
Frequency                : 2.69 GHz
Logical core count per node: 96
Collector type           : Driverless Perf system-wide co
Used statistics          : aps_result_20200618/
|
| Your application is MPI bound.
| This may be caused by high busy wait time inside th
|
Elapsed time:            7284.70 sec
SP GFLOPS:                 0.09
DP GFLOPS:                86.63
Average CPU Frequency:      2.29 GHz
CPI Rate:                 1.32
| The CPI value may be too high.
| This could be caused by such issues as memory stall
| branch misprediction, or long latency instructions.
| Use Intel(R) VTune(TM) Amplifier General Explorat
| particular reasons of high CPI.
MPI Time:                3480.55 sec          47.78%
| Your application is MPI bound. This may be caused b
| inside the library (imbalance), non-optimal commun
| library settings. Explore the MPI Imbalance metric
| MPI profiling tools like Intel(R) Trace Analyzer and
| possible performance bottlenecks.
  MPI Imbalance:  N/A*
| * No information about MPI Imbalance time is availa
| value to 2 or greater or set APS_IMBALANCE_TYPE
  Top 5 MPI functions (avg time):
    Barrier                1614.43 sec  (22.16 %)
    Allreduce               1439.02 sec  (19.75 %)
    Bcast                  305.71 sec  ( 4.20 %)
    Isend                   57.81 sec  ( 0.79 %)
    Wait                   52.10 sec  ( 0.72 %)
Memory Stalls:                          50.60% of pipeline slo
| The metric value can indicate that a significant frac
| pipeline slots could be stalled due to demand memor
| second level metrics to define if the application is ca
| the NUMA efficiency. Use Intel(R) VTune(TM) Ampl
| to review a detailed metric breakdown by memory h
| information, and correlation by memory objects.
  Cache Stalls:                         8.20% of cycles
  DRAM Stalls:                          13.80% of cycles
  DRAM Bandwidth
    Peak:              201.47  GB/sec
    Average:             54.76  GB/sec
    Bound:               15.80 %
  NUMA: % of Remote Accesses:             0.20%
Vectorization:                          97.50%
  Instruction Mix:
    SP FLOPs:                           0.00% of uOps
    DP FLOPs:                           23.40% of uOps
      Packed:                           97.50% from DP FP
        128-bit:                        0.00%
        256-bit:                        97.50%
| A significant fraction of floating point arithmetic vec
| executed with partial vector load. A possible reason
| legacy instruction set. Check the compiler options. A
| compiler code generation specifics. Use Intel(R) Adv
        512-bit:                        0.00%
      Scalar:                           2.50% from DP FP
    Non-FP:                             76.60% of uOps
  FP Arith/Mem Rd Instr. Ratio:           0.65
  FP Arith/Mem Wr Instr. Ratio:           1.73
Disk I/O Bound:          0.00 sec ( 0.00 %)
    Data read:          7.4 GB
    Data written:       125.9 GB
Memory Footprint:
Resident:
    Per node:
      Peak resident set size   :      19420.88 MB (nod
      Average resident set size :      10502.70 MB
    Per rank:
      Peak resident set size   :       408.44 MB (rank
      Average resident set size :       220.52 MB
Virtual:
    Per node:
      Peak memory consumption   :     243434.26 MB (node i07r08c05s07.sng.lrz.de)
      Average memory consumption :     239991.07 MB
    Per rank:
      Peak memory consumption   :      5093.62 MB (rank 483)
      Average memory consumption :      5038.87 MB
```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|----------
Application : run.x
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Number of ranks : 2048
Ranks per node : min: 47, max: 48
HW Platform : Intel(R) Xeon(R) Processor code named Skylake

MPI Imbalance: N/A*
| * No information about MPI Imbalance time is available. Set the MPS_STAT_LEVEL
| value to 2 or greater or set APS_IMBALANCE_TYPE to 1 or 2 to collect it.
Top 5 MPI functions (avg time):
Barrier 1614.43 sec (22.16 %)
Allreduce 1439.02 sec (19.75 %)
Bcast 305.71 sec ( 4.20 %)
Isend 57.81 sec ( 0.79 %)
Wait 52.10 sec ( 0.72 %)
Memory Stalls: 50.60% of pipeline slots
| The metric value can indicate that a significant fraction of execution
| pipeline slots could be stalled due to demand memory load and stores. See the
| second level metrics to define if the application is cache- or DRAM-bound and
| the NUMA efficiency. Use Intel(R) VTune(TM) Amplifier Memory Access analysis
| to review a detailed metric breakdown by memory hierarchy, memory bandwidth
| information, and correlation by memory objects.


Graphical representation of this data is available in the HTML report: /dss/dsshome1/0E/di68qin2/pencil-code/joern/convection/spherical/PRACE/PartI/profiling/A2_ref/aps_report_20200619_135609.html

# Two problem/issue identified:

1. **SupermucNG uses 48 cores per node**
   **Using "-m plane=48“ in your (sbatch) jobscript**

2. **Global operations: (mass conservation + angular momentum conservation)**
   **Using „it_rmv=1 ,  2, etc.“ in your run.in**

All have run tmax=7200 s = 2 hours

| | | | Wall clock time/timestep/meshpoint | | MPI functions [sec] | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Runs | nt | t | [microsec] | factor | Barrier | Allreduce | Bcast | Isend | Wait |
| A2_ref | 16881 | 5.17705445720646 | 1.589E-03 | 1 | 1614.43 (22.16%) | 1439.02 (19.75%) | 305.71 ( 4.20%) | 57.81 ( 0.79%) | 52.10 ( 0.72%) |
| A2_xsky | 16796 | 5.15089825272330 | 1.597E-03 | 1 | 1584.84 (21.68%) | 1496.67 (20.47%) | 283.00 ( 3.87%) | 62.76 ( 0.86%) | 53.53 ( 0.73%) |
| A2_xsky512 | 16600 | 5.09058861852746 | 1.616E-03 | 1 | 1601.98 (22.01%) | 1373.11 (18.87%) | 354.22 ( 4.87%) | 57.36 ( 0.79%) | 56.03 ( 0.77%) |
| A2_mplane | 27783 | 8.50052592936429 | 9.654E-04 | 1.64 | 458.72 ( 6.30%) | 873.47 (11.99%) | 107.04 ( 1.47%) | 115.89 ( 1.59%) | 44.32 ( 0.61%) |
| (-m plane=48 is on for all below) | | | | | | | | | |
| A2_nio | 27929 | 8.54400050403610 | 9.604E-04 | 1.65 | 495.56 ( 6.81%) | 961.08 (13.21%) | 60.61 ( 0.83%) | 116.91 ( 1.61%) | 44.97 ( 0.62%) |
| A2_noglobal | 33069 | 10.0691585576811 | 8.111E-04 | 1.95 | 568.12 ( 7.77%) | 125.62 ( 1.72%) | 104.64 ( 1.43%) | 74.26 ( 1.02%) | 474.81 ( 6.50%) |
| A2_noglobal_512 | 31757 | 9.67868241338961 | 8.446E-04 | 1.87 | 572.22 ( 7.86%) | 109.20 ( 1.50%) | 107.15 ( 1.47%) | 72.67 ( 1.00%) | 344.57 ( 4.73%) |
| A2_global_it1 | 29514 | 9.02149605185795 | 9.088E-04 | 1.74 | 605.85 ( 8.32%) | 392.29 ( 5.39%) | 122.21 ( 1.68%) | 85.09 ( 1.17%) | 272.67 ( 3.75%) |
| A2_global_it2 | 31500 | 9.609 | 8.375E-04 (crashed) | 1.90 | 509.01 ( 7.03%) | 235.12 ( 3.25%) | 69.44 ( 0.96%) | 82.72 ( 1.14%) | 330.71 ( 4.57%) |
| A2_global_it5 | 32081 | 9.67999268304746 | 8.268E-04 (crashed) | 1.92 | 516.21 ( 7.76%) | 107.64 ( 1.62%) | 100.33 ( 1.51%) | 67.70 ( 1.02%) | 304.06 ( 4.57%) |
| A2_global_it10 | 31980 | 9.75320257240328 | 8.387E-04 | 1.89 | 430.50 ( 6.47%) | 107.28 ( 1.61%) | 188.71 ( 2.84%) | 67.57 ( 1.02%) | 311.22 ( 4.68%) |
| A2_global_it20 | 28901 | 8.78596798653852 | 8.308E-04 (crashed) | 1.91 | 807.24 (11.50%) | 125.16 ( 1.78%) | 150.30 ( 2.14%) | 67.43 ( 0.96%) | 371.47 ( 5.29%) |
| A2_global_it50 | 31883 | 9.72940614143547 | 8.413E-04 | 1.88 | 629.17 ( 8.65%) | 124.57 ( 1.71%) | 90.01 ( 1.24%) | 73.36 ( 1.01%) | 354.98 ( 4.88%) |