



SPEChpc™ 2021 Small Result

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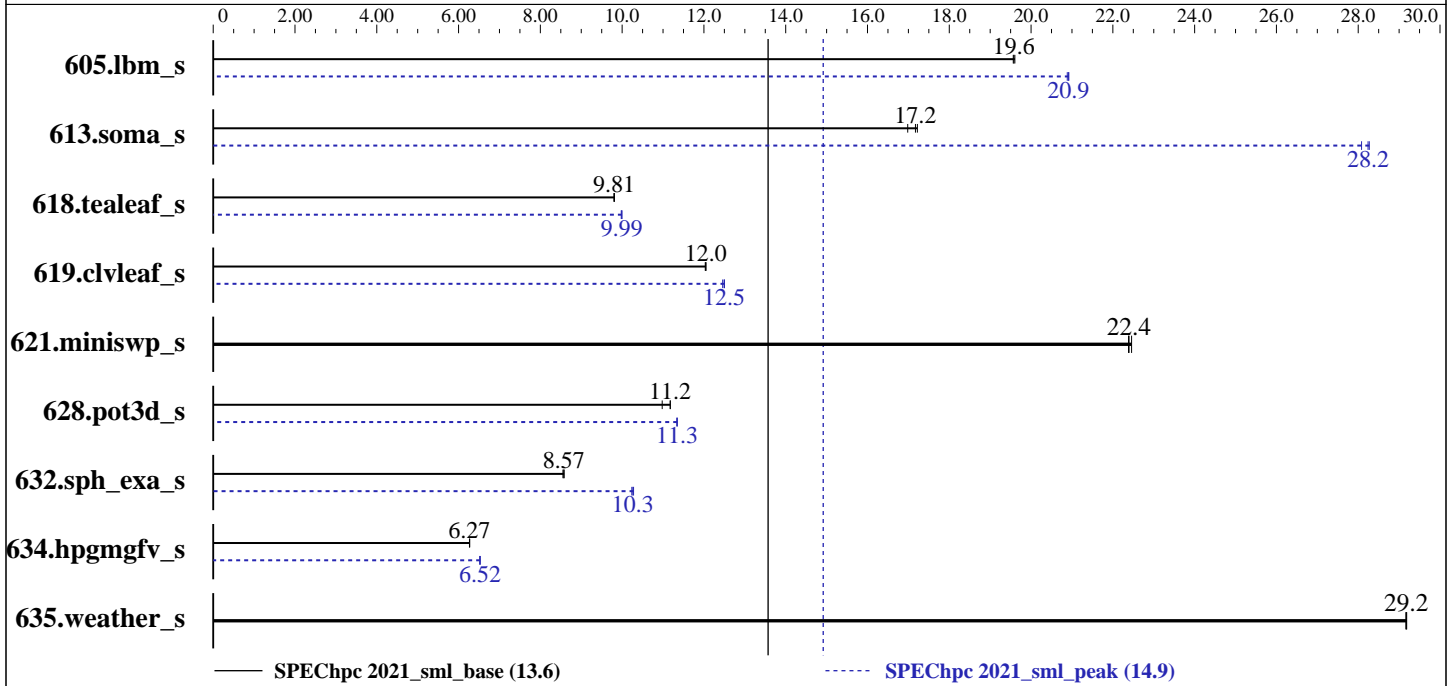
SPEChpc 2021_sml_base = 13.6

SPEChpc 2021_sml_peak = 14.9

NVIDIA DGX A100 System (AMD EPYC 7742 2.25GHz, Tesla A100-SXM-80 GB)

hpc2021 License: 019
Test Sponsor: NVIDIA Corporation
Tested by: NVIDIA Corporation

Test Date: Sep-2022
Hardware Availability: Jul-2020
Software Availability: Mar-2022



Results Table

Benchmark	Base								Peak									
	Model	Ranks	Thrds/Rnk	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio	Model	Ranks	Thrds/Rnk	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio
605.lbm_s	ACC	16	16	79.2	19.6	79.1	19.6	79.2	19.6	ACC	16	16	74.1	20.9	74.2	20.9	74.1	20.9
613.soma_s	ACC	16	16	92.9	17.2	93.2	17.2	94.2	17.0	ACC	8	32	56.6	28.3	56.7	28.2	57.0	28.1
618.tealeaf_s	ACC	16	16	209	9.81	209	9.81	209	9.80	ACC	8	32	205	9.99	205	9.99	205	9.98
619.cvlleaf_s	ACC	16	16	137	12.0	137	12.1	137	12.0	ACC	32	8	132	12.5	132	12.5	132	12.5
621.miniswp_s	ACC	16	16	49.0	22.5	49.1	22.4	49.1	22.4	ACC	16	16	49.0	22.5	49.1	22.4	49.1	22.4
628.pot3d_s	ACC	16	16	153	11.0	150	11.2	150	11.2	ACC	16	16	148	11.3	148	11.3	148	11.3
632.sph_exa_s	ACC	16	16	268	8.57	268	8.58	269	8.55	ACC	32	8	224	10.3	224	10.3	225	10.2
634.hpgmgfv_s	ACC	16	16	155	6.27	156	6.27	155	6.27	ACC	32	8	149	6.52	149	6.53	150	6.52
635.weather_s	ACC	16	16	89.1	29.2	89.1	29.2	89.1	29.2	ACC	16	16	89.1	29.2	89.1	29.2	89.1	29.2

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Results appear in the order in which they were run. Bold underlined text indicates a median measurement.



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Hardware Summary

Type of System: SMP
Compute Node: DGX A100
Compute Nodes Used: 1
Total Chips: 2
Total Cores: 128
Total Threads: 256
Total Memory: 2 TB
Max. Peak Threads: 32

Software Summary

Compiler: C/C++/Fortran: Version 22.3 of NVIDIA HPC SDK for Linux
MPI Library: OpenMPI Version 4.1.2rc4
Other MPI Info: HPC-X Software Toolkit Version 2.10
Other Software: None
Base Parallel Model: ACC
Base Ranks Run: 16
Base Threads Run: 16
Peak Parallel Models: ACC
Minimum Peak Ranks: 8
Maximum Peak Ranks: 32
Max. Peak Threads: 32
Min. Peak Threads: 8

Node Description: DGX A100

Hardware

Number of nodes: 1
Uses of the node: compute
Vendor: NVIDIA Corporation
Model: NVIDIA DGX A100 System
CPU Name: AMD EPYC 7742
CPU(s) orderable: 2 chips
Chips enabled: 2
Cores enabled: 128
Cores per chip: 64
Threads per core: 2
CPU Characteristics: Turbo Boost up to 3400 MHz
CPU MHz: 2250
Primary Cache: 32 KB I + 32 KB D on chip per core
Secondary Cache: 512 KB I+D on chip per core
L3 Cache: 256 MB I+D on chip per chip (16 MB shared / 4 cores)
Other Cache: None
Memory: 2 TB (32 x 64 GB 2Rx8 PC4-3200AA-R)
Disk Subsystem: OS: 2TB U.2 NVMe SSD drive
Internal Storage: 30TB (8x 3.84TB U.2 NVMe SSD drives)
Other Hardware: None
Accel Count: 8
Accel Model: Tesla A100-SXM-80 GB
Accel Vendor: NVIDIA Corporation
Accel Type: GPU
Accel Connection: NVLINK 3.0, NVSWITCH 2.0 600 GB/s
Accel ECC enabled: Yes
Accel Description: See Notes
Adapter: NVIDIA ConnectX-6 MT28908
Number of Adapters: 8
Slot Type: PCIe Gen4

Software

Accelerator Driver: NVIDIA UNIX x86_64 Kernel Module 470.103.01
Adapter: NVIDIA ConnectX-6 MT28908
Adapter Driver: InfiniBand: 5.4-3.4.0.0
Adapter Firmware: InfiniBand: 20.32.1010
Adapter: NVIDIA ConnectX-6 MT28908
Adapter Driver: Ethernet: 5.4-3.4.0.0
Adapter Firmware: Ethernet: 20.32.1010
Operating System: Ubuntu 20.04 5.4.0-121-generic
Local File System: ext4
Shared File System: Lustre
System State: Multi-user, run level 3
Other Software: None

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Node Description: DGX A100

Hardware (Continued)

Data Rate: 200 Gb/s
Ports Used: 1
Interconnect Type: InfiniBand / Communication
Adapter: NVIDIA ConnectX-6 MT28908
Number of Adapters: 2
Slot Type: PCIe Gen4
Data Rate: 200 Gb/s
Ports Used: 2
Interconnect Type: InfiniBand / FileSystem

Compiler Invocation Notes

Binaries built and run within a NVHPC SDK 22.3 CUDA 11.0 Ubuntu 20.04
Container available from NVIDIA GPU Cloud (NGC):
<https://ngc.nvidia.com/catalog/containers/nvidia:nvhpc>
<https://catalog.ngc.nvidia.com/orgs/nvidia/containers/nvhpc/tags>

Submit Notes

The config file option 'submit' was used.

MPI startup command:
srun command was used to start MPI jobs.

Individual Ranks were bound to the NUMA nodes, GPUs and NICs using this "wrapper.GPU" bash-script for the case of 1 rank per GPU

```
ln -s -f libnuma.so.1 /usr/lib/x86_64-linux-gnu/libnuma.so
export LD_LIBRARY_PATH+=:/usr/lib/x86_64-linux-gnu
export LD_RUN_PATH+=:/usr/lib/x86_64-linux-gnu
declare -a NUMA_LIST
declare -a GPU_LIST
declare -a NIC_LIST
NUMA_LIST=( $NUMAS )
GPU_LIST=( $GPUS )
NIC_LIST=( $NICs )
export UCX_NET_DEVICES=${NIC_LIST[$SLURM_LOCALID]}:1
export OMPI_MCA_btl_openib_if_include=${NIC_LIST[$SLURM_LOCALID]}
export CUDA_VISIBLE_DEVICES=${GPU_LIST[$SLURM_LOCALID]}
numactl -l -N ${NUMA_LIST[$SLURM_LOCALID]} $*
```

and this "wrapper.MPS" bash-script for the oversubscribed case.

```
ln -s -f libnuma.so.1 /usr/lib/x86_64-linux-gnu/libnuma.so
export LD_LIBRARY_PATH+=:/usr/lib/x86_64-linux-gnu
```

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Submit Notes (Continued)

```
export LD_RUN_PATH+=:/usr/lib/x86_64-linux-gnu
declare -a NUMA_LIST
declare -a GPU_LIST
declare -a NIC_LIST
NUMA_LIST=( $NUMAS )
GPU_LIST=( $GPUS )
NIC_LIST=( $NICS )
NUM_GPUS=${#GPU_LIST[@]}
RANKS_PER_GPU=$((SLURM_NTASKS_PER_NODE / NUM_GPUS))
GPU_LOCAL_RANK=$((SLURM_LOCALID / RANKS_PER_GPU))
export UCX_NET_DEVICES=${NIC_LIST[$GPU_LOCAL_RANK]}:1
export OMPI_MCA_btl_openib_if_include=${NIC_LIST[$GPU_LOCAL_RANK]}
set +e
nvidia-cuda-mps-control -d 1>&2
set -e
export CUDA_VISIBLE_DEVICES=${GPU_LIST[$GPU_LOCAL_RANK]}
numactl -l -N ${NUMA_LIST[$GPU_LOCAL_RANK]} $*
if [ $SLURM_LOCALID -eq 0 ]
then
echo 'quit' | nvidia-cuda-mps-control 1>&2
fi
```

General Notes

Full system details documented here:

<https://images.nvidia.com/aem-dam/Solutions/Data-Center/gated-resources/nvidia-dgx-superpod-a100.pdf>

Environment variables set by runhpc before the start of the run:

SPEC_NO_RUNDIR_DEL = "on"

Platform Notes

Detailed A100 Information from nvaccelinfo

CUDA Driver Version:	11040
NVRM version:	NVIDIA UNIX x86_64 Kernel Module 470.7.01
Device Number:	0
Device Name:	NVIDIA A100-SXM-80 GB
Device Revision Number:	8.0
Global Memory Size:	85198045184
Number of Multiprocessors:	108
Concurrent Copy and Execution:	Yes
Total Constant Memory:	65536
Total Shared Memory per Block:	49152
Registers per Block:	65536
Warp Size:	32

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Platform Notes (Continued)

Maximum Threads per Block:	1024
Maximum Block Dimensions:	1024, 1024, 64
Maximum Grid Dimensions:	2147483647 x 65535 x 65535
Maximum Memory Pitch:	2147483647B
Texture Alignment:	512B
Clock Rate:	1410 MHz
Execution Timeout:	No
Integrated Device:	No
Can Map Host Memory:	Yes
Compute Mode:	default
Concurrent Kernels:	Yes
ECC Enabled:	Yes
Memory Clock Rate:	1593 MHz
Memory Bus Width:	5120 bits
L2 Cache Size:	41943040 bytes
Max Threads Per SMP:	2048
Async Engines:	3
Unified Addressing:	Yes
Managed Memory:	Yes
Concurrent Managed Memory:	Yes
Preemption Supported:	Yes
Cooperative Launch:	Yes
Multi-Device:	Yes
Default Target:	cc80

Compiler Version Notes

```
=====
CC 605.lbm_s(base, peak) 613.soma_s(base, peak) 618.tealeaf_s(base, peak)
   621.miniswp_s(base, peak) 634.hpgmgfv_s(base, peak)
-----
```

```
nvc 22.3-0 64-bit target on x86-64 Linux -tp zen2-64
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-----
```

```
=====
CXXC 632.sph_exa_s(base, peak)
-----
```

```
nvc++ 22.3-0 64-bit target on x86-64 Linux -tp zen2-64
NVIDIA Compilers and Tools
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-----
```

```
=====
FC 619.clvleaf_s(base, peak) 628.pot3d_s(base, peak) 635.weather_s(base,
-----
```

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Compiler Version Notes (Continued)

peak)

nvfortran 22.3-0 64-bit target on x86-64 Linux -tp zen2-64
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Base Compiler Invocation

C benchmarks:

mpicc

C++ benchmarks:

mpicxx

Fortran benchmarks:

mpif90

Base Portability Flags

605.lbm_s: -DSPEC_OPENACC_NO_SELF
632.sph_exa_s: --c++17

Base Optimization Flags

C benchmarks:

-fast -DSPEC_ACCEL_AWARE_MPI -acc=gpu -gpu=cuda11.0 -gpu=cc80
-Mstack_arrays -Mfprelaxed -Mnouniform -tp=zen2

C++ benchmarks:

-fast -DSPEC_ACCEL_AWARE_MPI -acc=gpu -gpu=cuda11.0 -gpu=cc80
-Mstack_arrays -Mfprelaxed -Mnouniform -tp=zen2

Fortran benchmarks:

-DSPEC_ACCEL_AWARE_MPI -fast -acc=gpu -gpu=cuda11.0 -gpu=cc80
-Mstack_arrays -Mfprelaxed -Mnouniform -tp=zen2



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Base Other Flags

C benchmarks:

-Ispecmpitime -w

C++ benchmarks:

-Ispecmpitime -w

Fortran benchmarks (except as noted below):

-w

619.clvleaf_s: -Ispecmpitime -w

Peak Compiler Invocation

C benchmarks:

mpicc

C++ benchmarks:

mpicxx

Fortran benchmarks:

mpif90

Peak Portability Flags

605.lbm_s: -DSPEC_OPENACC_NO_SELF

632.sph_exa_s: --c++17

Peak Optimization Flags

C benchmarks:

605.lbm_s: -O3 -DSPEC_ACCEL_AWARE_MPI -acc=gpu -gpu=cuda11.0
-gpu=cc80 -gpu=maxregcount:128 -Mstack_arrays -Mfprelaxed
-Mnuniform -tp=zen2 -mp

613.soma_s: -fast -DSPEC_ACCEL_AWARE_MPI -acc=gpu -gpu=cuda11.0
-gpu=cc80 -Mstack_arrays -Mfprelaxed -Mnuniform -tp=zen2

618.tealeaf_s: -O3 -DSPEC_ACCEL_AWARE_MPI -acc=gpu -gpu=cuda11.0
-gpu=cc80 -Mstack_arrays -Mfprelaxed -Mnuniform -tp=zen2

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Peak Optimization Flags (Continued)

618.tealeaf_s (continued):

-mp -Msafeptr

621.miniswp_s: basepeak = yes

634.hpgmgfv_s: -fast -DSPEC_ACCEL_AWARE_MPI -acc=gpu -gpu=cuda11.0
-gpu=cc80 -Mstack_arrays -Mfprelaxed -Mnouniform -tp=zen2
-Msafeptr

C++ benchmarks:

-fast -DSPEC_ACCEL_AWARE_MPI -acc=gpu -gpu=cuda11.0 -gpu=cc80
-Mstack_arrays -Mfprelaxed -Mnouniform -tp=zen2 -Mquad

Fortran benchmarks:

619.clvleaf_s: -DSPEC_ACCEL_AWARE_MPI -fast -acc=gpu -gpu=cuda11.0
-gpu=cc80 -Mstack_arrays -Mfprelaxed -Mnouniform -tp=zen2
-mp

628.pot3d_s: -DSPEC_ACCEL_AWARE_MPI -fast -acc=gpu -gpu=cuda11.0
-gpu=cc80 -Mstack_arrays -Mfprelaxed -Mnouniform -tp=zen2

635.weather_s: basepeak = yes

Peak Other Flags

C benchmarks:

-Ispecmpitime -w

C++ benchmarks:

-Ispecmpitime -w

Fortran benchmarks (except as noted below):

-w

619.clvleaf_s: -Ispecmpitime -w

The flags file that was used to format this result can be browsed at

http://www.spec.org/hpc2021/flags/nv2021_flags_v1.0.3.2022-11-03.html

You can also download the XML flags source by saving the following link:

http://www.spec.org/hpc2021/flags/nv2021_flags_v1.0.3.2022-11-03.xml



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