www.phoronix-test-suite.com

OpenCL CUDA NVIDIA GPGPU Linux Tests

Running pts/shoc-1.0.0, pts/askap-1.0.0, pts/cuda-mini-nbody-1.0.0, pts/juliagpu-1.3.0, pts/mandelbulbgpu-1.3.0 via the Phoronix Test Suite.

Automated Executive Summary

GeForce GTX Titan Xp Oct-Swappiness 100 had the most wins, coming in first place for 44% of the tests.

Based on the geometric mean of all complete results, the fastest (GeForce GTX Titan Xp Oct-Off) was 5.886x the speed of the slowest (GeForce GTX 750).

The results with the greatest spread from best to worst included:

SHOC Scalable HeterOgeneous Computing (Target: CUDA - Benchmark: MD5 Hash) at 14.824x
SHOC Scalable HeterOgeneous Computing (Target: OpenCL - Benchmark: MD5 Hash) at 14.776x
CUDA Mini-Nbody (Test: Flush Denormals To Zero) at 9.087x
CUDA Mini-Nbody (Test: SOA Data Layout) at 8.978x
CUDA Mini-Nbody (Test: Original) at 8.935x
CUDA Mini-Nbody (Test: Cache Blocking) at 8.636x
CUDA Mini-Nbody (Test: Loop Unrolling) at 7.508x
SHOC Scalable HeterOgeneous Computing (Target: OpenCL - Benchmark: Texture Read Bandwidth) at 5.199x
SHOC Scalable HeterOgeneous Computing (Target: OpenCL - Benchmark: FFT SP) at 5.125x

ASKAP tConvolveCuda (Processing: Degridding) at 4.88x.

Test Systems:

GeForce GTX 950

Processor: Intel Core i5-6600K @ 3.50GHz (4 Cores), Motherboard: MSI Z170A GAMING PRO (MS-7984) v1.0, Chipset: Intel Device 191f, Memory: 16384MB, Disk: 256GB TS256GSSD370S, Graphics: eVGA NVIDIA GeForce GTX 950 2048MB (135/405MHz), Audio: Intel Device a170, Network: Intel Device 15b8

OS: Ubuntu 14.04, Kernel: 3.19.0-33-generic (x86_64), Desktop: Unity 7.2.5, Display Server: X Server 1.17.1, Display Driver: NVIDIA 352.39, OpenGL: 4.3.0, Compiler: GCC 4.8.4 + Clang 3.4-1ubuntu3 + CUDA 7.5, File-System: ext4, Screen Resolution: 3840x2160

Compiler Notes: --build=x86_64-linux-gnu --disable-browser-plugin --disable-libmudflap --disable-werror --enable-checking=release --enable-clocale=gnu --enable-gnu-unique-object --enable-gtk-cairo --enable-java-awt=gtk --enable-java-home --enable-languages=c,c++,java,go,d,fortran,objc,obj-c++ --enable-libstdcxx-debug --enable-libstdcxx-time=yes --enable-multiarch --enable-nls --enable-objc-gc --enable-plugin --enable-shared --enable-threads=posix --host=x86_64-linux-gnu --target=x86_64-linux-gnu --with-abi=m64 --with-arch-32=i686 --with-arch-directory=amd64 --with-multilib-list=m32,m64,mx32 --with-tune=generic -v
Processor Notes: Scaling Governor: acpi-cpufreq performance
OpenCL Notes: GPU Compute Cores: 768
System Notes: GPU Compute Cores: 768.

GeForce GTX 980 Ti

Processor: Intel Core i5-6600K @ 3.50GHz (4 Cores), Motherboard: MSI Z170A GAMING PRO (MS-7984) v1.0, Chipset: Intel Device 191f, Memory: 16384MB, Disk: 256GB TS256GSSD370S, Graphics: NVIDIA GeForce GTX 980 Ti 6144MB (999/3505MHz), Audio: Intel Device a170, Network: Intel Device 15b8

OS: Ubuntu 14.04, Kernel: 3.19.0-33-generic (x86_64), Desktop: Unity 7.2.5, Display Server: X Server 1.17.1, Display Driver: NVIDIA 352.39, OpenGL: 4.3.0, Compiler: GCC 4.8.4 + Clang 3.4-1ubuntu3 + CUDA 7.5, File-System: ext4, Screen Resolution: 3840x2160

Compiler Notes: --build=x86_64-linux-gnu --disable-browser-plugin --disable-libmudflap --disable-werror --enable-checking=release --enable-clocale=gnu --enable-gnu-unique-object --enable-gtk-cairo --enable-java-awt=gtk --enable-java-home --enable-languages=c,c++,java,go,d,fortran,objc,obj-c++ --enable-libstdcxx-debug --enable-libstdcxx-time=yes --enable-multiarch --enable-nls --enable-objc-gc --enable-plugin --enable-shared --enable-threads=posix --host=x86_64-linux-gnu --target=x86_64-linux-gnu --with-abi=m64 --with-arch-32=i686 --with-arch-directory=amd64 --with-multilib-list=m32,m64,mx32 --with-tune=generic -v
Processor Notes: Scaling Governor: acpi-cpufreq performance
OpenCL Notes: GPU Compute Cores: 2816
System Notes: GPU Compute Cores: 2816.

GeForce GTX 970

Processor: Intel Core i5-6600K @ 3.50GHz (4 Cores), Motherboard: MSI Z170A GAMING PRO (MS-7984) v1.0, Chipset: Intel Device 191f, Memory: 16384MB, Disk: 256GB TS256GSSD370S, Graphics: eVGA NVIDIA GeForce GTX 970 4096MB (1163/3505MHz), Audio: Intel Device a170, Network: Intel Device 15b8

OS: Ubuntu 14.04, Kernel: 3.19.0-33-generic (x86_64), Desktop: Unity 7.2.5, Display Server: X Server 1.17.1, Display Driver: NVIDIA 352.39, OpenGL: 4.3.0, Compiler: GCC 4.8.4 + Clang 3.4-1ubuntu3 + CUDA 7.5, File-System: ext4, Screen Resolution: 3840x2160

Compiler Notes: --build=x86_64-linux-gnu --disable-browser-plugin --disable-libmudflap --disable-werror --enable-checking=release --enable-clocale=gnu --enable-gnu-unique-object --enable-gtk-cairo --enable-java-awt=gtk --enable-java-home --enable-languages=c,c++,java,go,d,fortran,objc,obj-c++ --enable-libstdcxx-debug

--enable-libstdcxx-time=yes --enable-multiarch --enable-nls --enable-objc-gc --enable-plugin --enable-shared --enable-threads=posix --host=x86_64-linux-gnu --target=x86_64-linux-gnu --with-abi=m64 --with-arch-32=i686 --with-arch-directory=amd64 --with-multilib-list=m32,m64,mx32 --with-tune=generic -v
Processor Notes: Scaling Governor: acpi-cpufreq performance
OpenCL Notes: GPU Compute Cores: 1664
System Notes: GPU Compute Cores: 1664.

GeForce GTX 980

Processor: Intel Core i5-6600K @ 3.50GHz (4 Cores), Motherboard: MSI Z170A GAMING PRO (MS-7984) v1.0, Chipset: Intel Device 191f, Memory: 16384MB, Disk: 256GB TS256GSSD370S, Graphics: NVIDIA GeForce GTX 980 4096MB (1126/3505MHz), Audio: Intel Device a170, Network: Intel Device 15b8

OS: Ubuntu 14.04, Kernel: 3.19.0-33-generic (x86_64), Desktop: Unity 7.2.5, Display Server: X Server 1.17.1, Display Driver: NVIDIA 352.39, OpenGL: 4.3.0, Compiler: GCC 4.8.4 + Clang 3.4-1ubuntu3 + CUDA 7.5, File-System: ext4, Screen Resolution: 3840x2160

Compiler Notes: --build=x86_64-linux-gnu --disable-browser-plugin --disable-libmudflap --disable-werror --enable-checking=release --enable-clocale=gnu --enable-gnu-unique-object --enable-gtk-cairo --enable-java-awt=gtk --enable-java-home --enable-languages=c,c++,java,go,d,fortran,objc,obj-c++ --enable-libstdcxx-debug --enable-libstdcxx-time=yes --enable-multiarch --enable-nls --enable-objc-gc --enable-plugin --enable-shared --enable-threads=posix --host=x86_64-linux-gnu --target=x86_64-linux-gnu --with-abi=m64 --with-arch-32=i686 --with-arch-directory=amd64 --with-multilib-list=m32,m64,mx32 --with-tune=generic -v
Processor Notes: Scaling Governor: acpi-cpufreq performance
OpenCL Notes: GPU Compute Cores: 2048
System Notes: GPU Compute Cores: 2048.

GeForce GTX 960

Processor: Intel Core i5-6600K @ 3.50GHz (4 Cores), Motherboard: MSI Z170A GAMING PRO (MS-7984) v1.0, Chipset: Intel Device 191f, Memory: 16384MB, Disk: 256GB TS256GSSD370S, Graphics: eVGA NVIDIA GeForce GTX 960 2048MB (1277/3505MHz), Audio: Intel Device a170, Network: Intel Device 15b8

OS: Ubuntu 14.04, Kernel: 3.19.0-33-generic (x86_64), Desktop: Unity 7.2.5, Display Server: X Server 1.17.1, Display Driver: NVIDIA 352.39, OpenGL: 4.3.0, Compiler: GCC 4.8.4 + Clang 3.4-1ubuntu3 + CUDA 7.5, File-System: ext4, Screen Resolution: 3840x2160

Compiler Notes: --build=x86_64-linux-gnu --disable-browser-plugin --disable-libmudflap --disable-werror --enable-checking=release --enable-clocale=gnu --enable-gnu-unique-object --enable-gtk-cairo --enable-java-awt=gtk --enable-java-home --enable-languages=c,c++,java,go,d,fortran,objc,obj-c++ --enable-libstdcxx-debug --enable-libstdcxx-time=yes --enable-multiarch --enable-nls --enable-objc-gc --enable-plugin --enable-shared --enable-threads=posix --host=x86_64-linux-gnu --target=x86_64-linux-gnu --with-abi=m64 --with-arch-32=i686 --with-arch-directory=amd64 --with-multilib-list=m32,m64,mx32 --with-tune=generic -v
Processor Notes: Scaling Governor: acpi-cpufreq performance
OpenCL Notes: GPU Compute Cores: 1024
System Notes: GPU Compute Cores: 1024.

GeForce GTX TITAN X

Processor: Intel Core i5-6600K @ 3.50GHz (4 Cores), Motherboard: MSI Z170A GAMING PRO (MS-7984) v1.0, Chipset: Intel Device 191f, Memory: 16384MB, Disk: 256GB TS256GSSD370S, Graphics: NVIDIA GeForce GTX TITAN X 12288MB (1001/3505MHz), Audio: Intel Device a170, Network: Intel Device 15b8

OS: Ubuntu 14.04, Kernel: 3.19.0-33-generic (x86_64), Desktop: Unity 7.2.5, Display Server: X Server 1.17.1, Display Driver: NVIDIA 352.39, OpenGL: 4.3.0, Compiler: GCC 4.8.4 + Clang 3.4-1ubuntu3 + CUDA 7.5, File-System: ext4, Screen Resolution: 3840x2160

Compiler Notes: --build=x86_64-linux-gnu --disable-browser-plugin --disable-libmudflap --disable-werror --enable-checking=release --enable-clocale=gnu --enable-gnu-unique-object --enable-gtk-cairo --enable-java-awt=gtk --enable-java-home --enable-languages=c,c++,java,go,d,fortran,objc,obj-c++ --enable-libstdcxx-debug --enable-libstdcxx-time=yes --enable-multiarch --enable-nls --enable-objc-gc --enable-plugin --enable-shared --enable-threads=posix --host=x86_64-linux-gnu --target=x86_64-linux-gnu --with-abi=m64 --with-arch-32=i686 --with-arch-directory=amd64 --with-multilib-list=m32,m64,mx32 --with-tune=generic -v
Processor Notes: Scaling Governor: acpi-cpufreq performance
OpenCL Notes: GPU Compute Cores: 3072
System Notes: GPU Compute Cores: 3072.

GeForce GTX 780 Ti

Processor: Intel Core i5-6600K @ 3.50GHz (4 Cores), Motherboard: MSI Z170A GAMING PRO (MS-7984) v1.0, Chipset: Intel Device 191f, Memory: 16384MB, Disk: 256GB TS256GSSD370S, Graphics: NVIDIA GeForce GTX 780 Ti 3072MB (875/3500MHz), Audio: Intel Device a170, Network: Intel Device 15b8

OS: Ubuntu 14.04, Kernel: 3.19.0-33-generic (x86_64), Desktop: Unity 7.2.5, Display Server: X Server 1.17.1, Display Driver: NVIDIA 352.39, OpenGL: 4.3.0, Compiler: GCC 4.8.4 + Clang 3.4-1ubuntu3 + CUDA 7.5, File-System: ext4, Screen Resolution: 3840x2160

Compiler Notes: --build=x86_64-linux-gnu --disable-browser-plugin --disable-libmudflap --disable-werror --enable-checking=release --enable-clocale=gnu --enable-gnu-unique-object --enable-gtk-cairo --enable-java-awt=gtk --enable-java-home --enable-languages=c,c++,java,go,d,fortran,objc,obj-c++ --enable-libstdcxx-debug --enable-libstdcxx-time=yes --enable-multiarch --enable-nls --enable-objc-gc --enable-plugin --enable-shared --enable-threads=posix --host=x86_64-linux-gnu --target=x86_64-linux-gnu --with-abi=m64 --with-arch-32=i686 --with-arch-directory=amd64 --with-multilib-list=m32,m64,mx32 --with-tune=generic -v
Processor Notes: Scaling Governor: acpi-cpufreq performance
OpenCL Notes: GPU Compute Cores: 2880
System Notes: GPU Compute Cores: 2880.

GeForce GTX 680

Processor: Intel Core i5-6600K @ 3.50GHz (4 Cores), Motherboard: MSI Z170A GAMING PRO (MS-7984) v1.0, Chipset: Intel Device 191f, Memory: 16384MB, Disk: 256GB TS256GSSD370S, Graphics: NVIDIA GeForce GTX 680 2048MB (1006/3004MHz), Audio: Intel Device a170, Network: Intel Device 15b8

OS: Ubuntu 14.04, Kernel: 3.19.0-33-generic (x86_64), Desktop: Unity 7.2.5, Display Server: X Server 1.17.1, Display Driver: NVIDIA 352.39, OpenGL: 4.3.0, Compiler: GCC 4.8.4 + Clang 3.4-1ubuntu3 + CUDA 7.5, File-System: ext4, Screen Resolution: 3840x2160

Compiler Notes: --build=x86_64-linux-gnu --disable-browser-plugin --disable-libmudflap --disable-werror --enable-checking=release --enable-clocale=gnu --enable-gnu-unique-object --enable-gtk-cairo --enable-java-awt=gtk --enable-java-home --enable-languages=c,c++,java,go,d,fortran,objc,obj-c++ --enable-libstdcxx-debug --enable-libstdcxx-time=yes --enable-multiarch --enable-nls --enable-objc-gc --enable-plugin --enable-shared --enable-threads=posix --host=x86_64-linux-gnu --target=x86_64-linux-gnu --with-abi=m64 --with-arch-32=i686 --with-arch-directory=amd64 --with-multilib-list=m32,m64,mx32 --with-tune=generic -v
Processor Notes: Scaling Governor: acpi-cpufreq performance
OpenCL Notes: GPU Compute Cores: 1536
System Notes: GPU Compute Cores: 1536.

GeForce GTX 750

Processor: Intel Core i5-6600K @ 3.50GHz (4 Cores), Motherboard: MSI Z170A GAMING PRO (MS-7984) v1.0, Chipset: Intel Device 191f, Memory: 16384MB, Disk: 256GB TS256GSSD370S, Graphics: eVGA NVIDIA GeForce GTX 750 1024MB (1019/2505MHz), Audio: Intel Device a170, Network: Intel Device 15b8

OS: Ubuntu 14.04, Kernel: 3.19.0-33-generic (x86_64), Desktop: Unity 7.2.5, Display Server: X Server 1.17.1, Display Driver: NVIDIA 352.39, OpenGL: 4.3.0, Compiler: GCC 4.8.4 + Clang 3.4-1ubuntu3 + CUDA 7.5, File-System: ext4, Screen Resolution: 3840x2160

Compiler Notes: --build=x86_64-linux-gnu --disable-browser-plugin --disable-libmudflap --disable-werror --enable-checking=release --enable-clocale=gnu --enable-gnu-unique-object --enable-gtk-cairo --enable-java-awt=gtk --enable-java-home --enable-languages=c,c++,java,go,d,fortran,objc,obj-c++ --enable-libstdcxx-debug --enable-libstdcxx-time=yes --enable-multiarch --enable-nls --enable-objc-gc --enable-plugin --enable-shared --enable-threads=posix --host=x86_64-linux-gnu --target=x86_64-linux-gnu --with-abi=m64 --with-arch-32=i686 --with-arch-directory=amd64 --with-multilib-list=m32,m64,mx32 --with-tune=generic -v
Processor Notes: Scaling Governor: acpi-cpufreq performance
OpenCL Notes: GPU Compute Cores: 512
System Notes: GPU Compute Cores: 512.

GeForce GTX 760

Processor: Intel Core i5-6600K @ 3.50GHz (4 Cores), Motherboard: MSI Z170A GAMING PRO (MS-7984) v1.0, Chipset: Intel Device 191f, Memory: 16384MB, Disk: 256GB TS256GSSD370S, Graphics: NVIDIA GeForce GTX 760 2048MB (980/3004MHz), Audio: Intel Device a170, Network: Intel Device 15b8

OS: Ubuntu 14.04, Kernel: 3.19.0-33-generic (x86_64), Desktop: Unity 7.2.5, Display Server: X Server 1.17.1, Display Driver: NVIDIA 352.39, OpenGL: 4.3.0, Compiler: GCC 4.8.4 + Clang 3.4-1ubuntu3 + CUDA 7.5, File-System: ext4, Screen Resolution: 3840x2160

Compiler Notes: --build=x86_64-linux-gnu --disable-browser-plugin --disable-libmudflap --disable-werror --enable-checking=release --enable-clocale=gnu --enable-gnu-unique-object --enable-gtk-cairo --enable-java-awt=gtk --enable-java-home --enable-languages=c,c++,java,go,d,fortran,objc,obj-c++ --enable-libstdcxx-debug --enable-libstdcxx-time=yes --enable-multiarch --enable-nls --enable-objc-gc --enable-plugin --enable-shared --enable-threads=posix --host=x86_64-linux-gnu --target=x86_64-linux-gnu --with-abi=m64 --with-arch-32=i686 --with-arch-directory=amd64 --with-multilib-list=m32,m64,mx32 --with-tune=generic -v
Processor Notes: Scaling Governor: acpi-cpufreq performance
OpenCL Notes: GPU Compute Cores: 1152
System Notes: GPU Compute Cores: 1152.

GeForce GTX Titan Xp Oct-Off

Processor: Intel Core i9-7920X @ 4.40GHz (24 Cores), Motherboard: ASUS WS X299 SAGE, Chipset: Intel Sky Lake-E DMI3 Registers, Memory: 64512MB, Disk: 10001GB Western Digital WD101KRYZ-01, Graphics: TITAN Xp 12288MB (139/405MHz), Audio: Realtek ALC1220, Network: Intel Connection

OS: Ubuntu 18.04, Kernel: 4.15.0-42-generic (x86_64), Desktop: GNOME Shell 3.28.3, Display Driver: NVIDIA 410.48, OpenGL: 4.6.0, Compiler: CUDA 9.1, File-System: ext4, Screen Resolution: 1920x1080

Compiler Notes: --build=x86_64-linux-gnu --disable-vtable-verify --disable-werror --enable-checking=release --enable-clocale=gnu --enable-default-pie --enable-gnu-unique-object --enable-languages=c,ada,c++,go,brig,d,fortran,objc,obj-c++ --enable-libmpx --enable-libstdcxx-debug --enable-libstdcxx-time=yes --enable-multiarch --enable-multilib --enable-nls --enable-objc-gc=auto --enable-offload-targets=nvptx-none --enable-plugin --enable-shared --enable-threads=posix --host=x86_64-linux-gnu --program-prefix=x86_64-linux-gnu- --target=x86_64-linux-gnu --with-abi=m64 --with-arch-32=i686 --with-default-libstdcxx-abi=new --with-gcc-major-version-only --with-multilib-list=m32,m64,mx32 --with-target-system-zlib --with-tune=generic --without-cuda-driver -v
Processor Notes: Scaling Governor: intel_pstate powersave
OpenCL Notes: GPU Compute Cores: 3840
System Notes: GPU Compute Cores: 3840.

GeForce GTX Titan Xp Oct-Swappiness 100

Processor: Intel Core i9-7920X @ 4.40GHz (24 Cores), Motherboard: ASUS WS X299 SAGE, Chipset: Intel Sky Lake-E DMI3 Registers, Memory: 64512MB, Disk: 10001GB Western Digital WD101KRYZ-01, Graphics: TITAN Xp 12288MB (1468/5702MHz), Audio: Realtek ALC1220, Network: Intel Connection

OS: Ubuntu 18.04, Kernel: 4.15.0-42-generic (x86_64), Desktop: GNOME Shell 3.28.3, Display Driver: NVIDIA 410.48, OpenGL: 4.6.0, Compiler: CUDA 9.1, File-System: ext4, Screen Resolution: 1920x1080

Compiler Notes: --build=x86_64-linux-gnu --disable-vtable-verify --disable-werror --enable-checking=release --enable-clocale=gnu --enable-default-pie --enable-gnu-unique-object --enable-languages=c,ada,c++,go,brig,d,fortran,objc,obj-c++ --enable-libmpx --enable-libstdcxx-debug --enable-libstdcxx-time=yes --enable-multiarch --enable-multilib --enable-nls --enable-objc-gc=auto --enable-offload-targets=nvptx-none --enable-plugin --enable-shared --enable-threads=posix --host=x86_64-linux-gnu --program-prefix=x86_64-linux-gnu- --target=x86_64-linux-gnu --with-abi=m64 --with-arch-32=i686 --with-default-libstdcxx-abi=new --with-gcc-major-version-only --with-multilib-list=m32,m64,mx32 --with-target-system-zlib --with-tune=generic --without-cuda-driver -v
Processor Notes: Scaling Governor: intel_pstate powersave
OpenCL Notes: GPU Compute Cores: 3840
System Notes: GPU Compute Cores: 3840.

OpenCL CUDA NVIDIA GPGPU Linux Tests

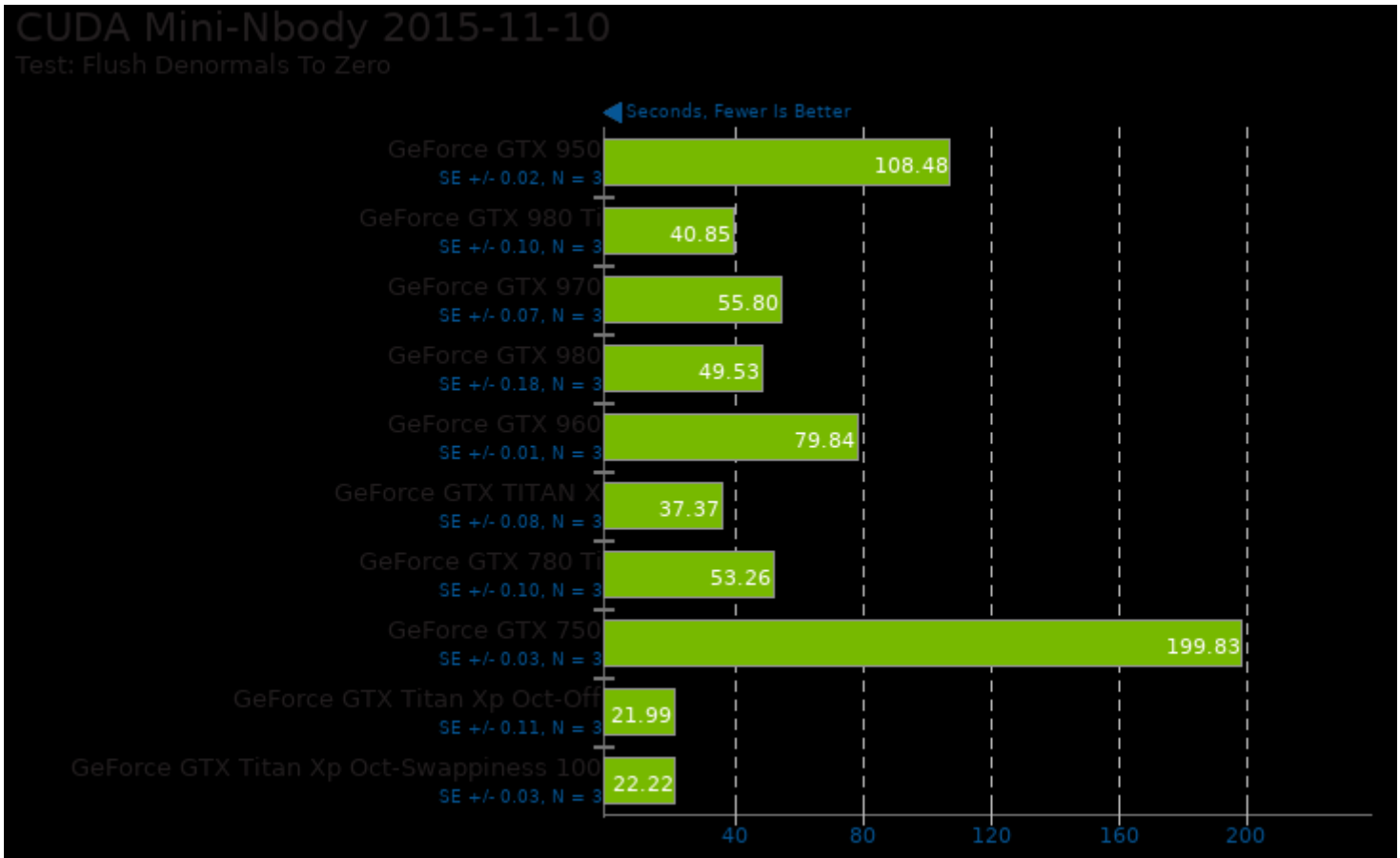
	GeForce GTX 950	GeForce GTX 980 Ti	GeForce GTX 970	GeForce GTX 980	GeForce GTX 960	GeForce GTX TITAN X	GeForce GTX 780 Ti	GeForce GTX 680	GeForce GTX 750	GeForce GTX 760	GeForce GTX Titan Xp Oct-Off	GeForce GTX Titan Xp Oct-Swappines
CUDA Mini-Nbody -	108.48	40.85	55.80	49.53	79.84	37.37	53.26		**199.83**		**21.99**	22.22
Normalized	20.27%	53.83%	39.41%	44.4%	27.54%	58.84%	41.29%		11%		100%	98.96%
Standard Deviation	0%	0.4%	0.2%	0.6%	0%	0.4%	0.3%		0%		0.9%	0.2%
CUDA Mini-Nbody - SOA Data Layout	108.50	40.94	55.87	50.15	79.97	37.43	54.39		**199.95**		22.34	**22.27**
Normalized	20.53%	54.4%	39.86%	44.41%	27.85%	59.5%	40.95%		11.14%		99.69%	100%
Standard Deviation	0%	0.5%	0.2%	0.7%	0.2%	0.9%	0.5%		0%		0.7%	0.4%
CUDA Mini-Nbody -	105.30	34.58	54.32	45.38	82.01	32.37	61.03		**180.66**		20.40	**20.22**
Normalized	19.2%	58.47%	37.22%	44.56%	24.66%	62.47%	33.13%		11.19%		99.12%	100%
Standard Deviation	0.4%	2.8%	0.4%	0.4%	0.9%	1.9%	1.4%		0%		1%	0.9%
CUDA Mini-Nbody - Cache Blocking	49.89	19.77	28.53	25.13	37.08	18.65	29.99		**98.19**		11.49	**11.37**
Normalized	22.79%	57.51%	39.85%	45.24%	30.66%	60.97%	37.91%		11.58%		98.96%	100%
Standard Deviation	0.1%	1.8%	0%	0.4%	0.1%	0.9%	1.6%		0%		0.5%	0.3%
CUDA Mini-Nbody - Loop Unrolling	47.54	18.46	26.42	23.88	35.35	17.59	27.05		**89.34**		12.02	**11.90**
Normalized	25.03%	64.46%	45.04%	49.83%	33.66%	67.65%	43.99%		13.32%		99%	100%
Standard Deviation	0.1%	1.4%	0.1%	1.5%	0.2%	2.5%	0.3%		0.1%		1.5%	0.4%
SHOC Scalable HeterOgeneous Computing - OpenCL - T.R.B (GB/s)	239.19	345.55	283.36	332.60	269.98	354.09	286.62	242.16	**121.14**	170.26	626.12	**629.83**
Normalized	37.98%	54.86%	44.99%	52.81%	42.87%	56.22%	45.51%	38.45%	19.23%	27.03%	99.41%	100%
Standard Deviation	0.5%	0.1%	0%	0.1%	0.4%	0.8%	0%	0.7%	0.3%	0.3%	0.4%	0.2%
SHOC Scalable HeterOgeneous Computing - OpenCL - FFT SP (GFLOPS)	63.22	170.36	117.23	140.12	62.78	173.89	126.71	74.97	**54.69**	78.44	**280.29**	279.72
Normalized	22.56%	60.78%	41.82%	49.99%	22.4%	62.04%	45.21%	26.75%	19.51%	27.99%	100%	99.8%
Standard Deviation	0.2%	0.7%	0.8%	1.6%	3.3%	0.2%	0.3%	2%	0.3%	0.7%	1.1%	1.1%

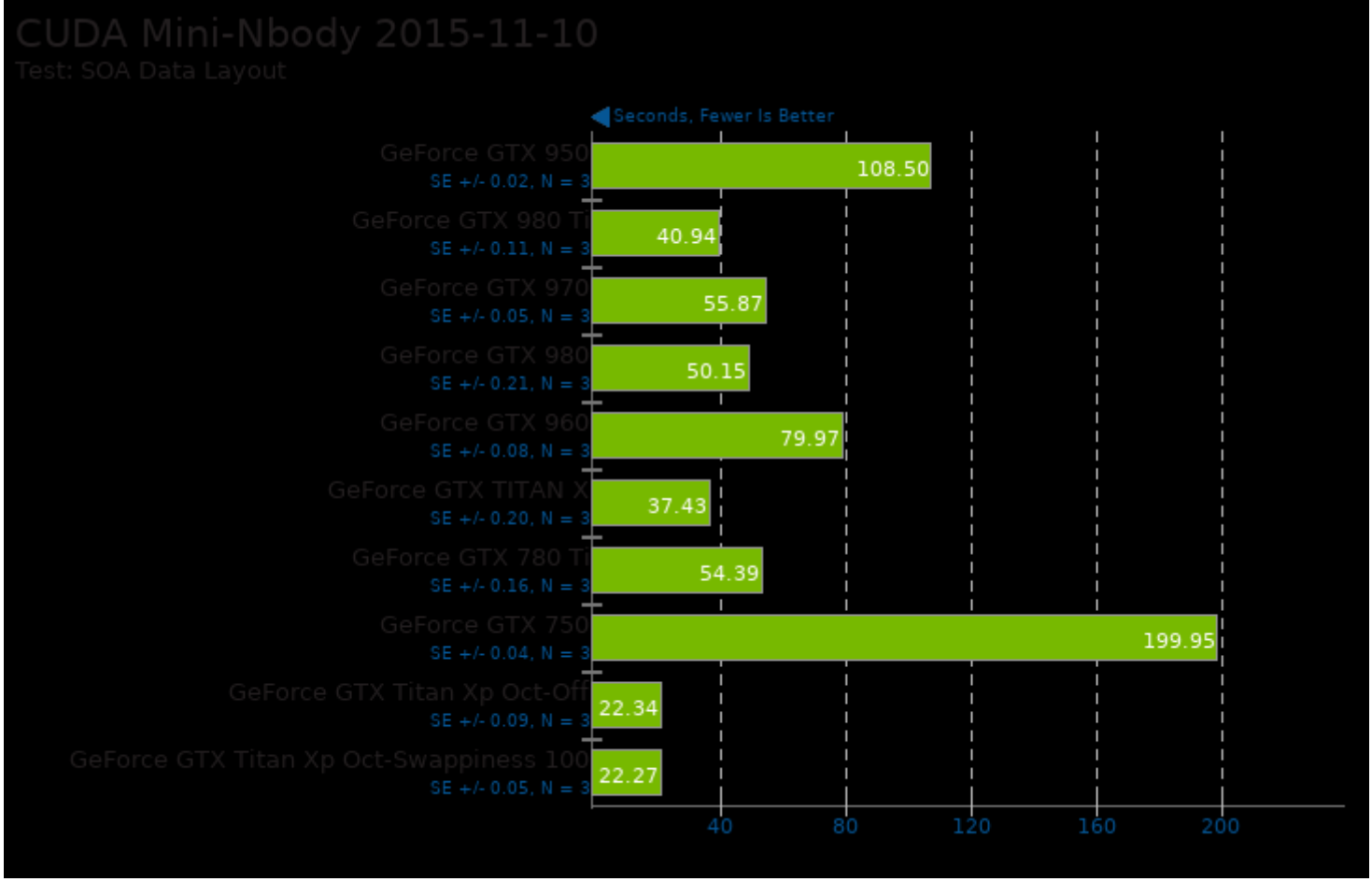
OpenCL CUDA NVIDIA GPGPU Linux Tests

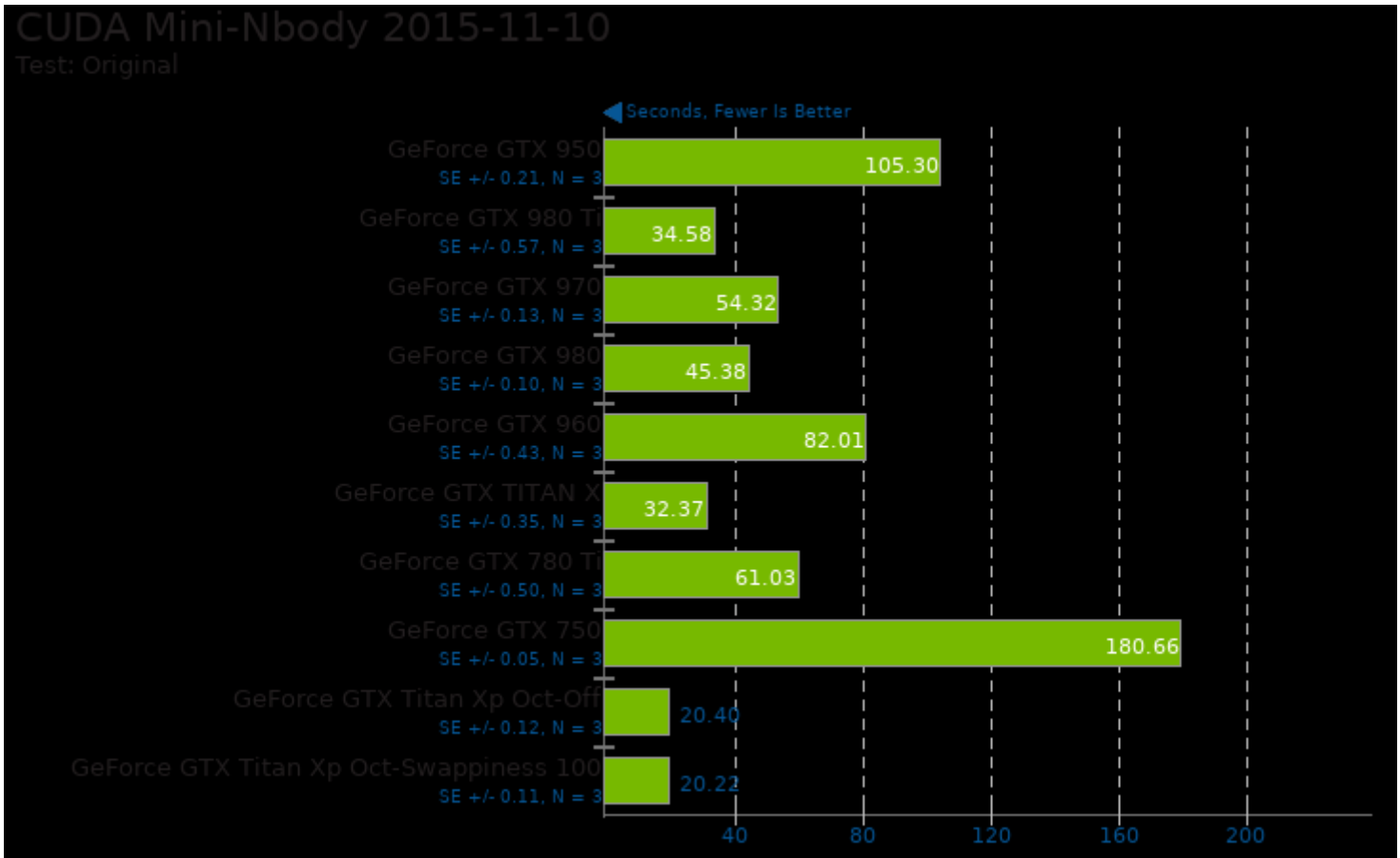
ASKAP tConvolveCuda - Degridding (Million Grid Points/sec)	5706	17381	9509	11094	**5290**	17381					**25819**	25012
Normalized	22.1%	67.32%	36.83%	42.97%	20.49%	67.32%					100%	96.87%
Standard Deviation	1.2%	3.7%	0%	0%	1.1%	3.7%					5.4%	5.6%
MandelbulbGPU - GPU (Samples/sec)	371560 71	716567 09	588113 17	636165 59	449533 99	756147 74	474000 02	316365 13	**200602 76**	253921 39	**877136 32**	869212 86
Normalized	42.36%	81.69%	67.05%	72.53%	51.25%	86.21%	54.04%	36.07%	22.87%	28.95%	100%	99.1%
Standard Deviation	0.1%	0.4%	0.3%	0.4%	0.3%	0.4%	0.2%	0.2%	0.1%	0.2%	0.4%	1.9%
ASKAP tConvolveCuda - Gridding (Million Grid Points/sec)	3399	8321	5325	6051	**3145**	8459					13465	**13546**
Normalized	25.09%	61.42%	39.31%	44.67%	23.22%	62.44%					99.4%	100%
Standard Deviation	0.7%	0%	0%	0%	0.7%	3.1%					6.1%	3%
JuliaGPU - GPU (Samples/sec)	649136 83	127978 050	104144 917	113830 604	800420 42	136037 921	788397 70	480747 89	**361368 74**	383106 51	149218 673	**149335 524**
Normalized	43.47%	85.7%	69.74%	76.22%	53.6%	91.1%	52.79%	32.19%	24.2%	25.65%	99.92%	100%
Standard Deviation	0.2%	0.6%	0.1%	0.3%	0.3%	0.4%	0.6%	0.2%	0.1%	0.1%	0.4%	0.6%
LuxMark - GPU - Hotel (Score)	769	1855	1346	1492	897	**1906**	992	577		**463**		
Normalized	40.35%	97.32%	70.62%	78.28%	47.06%	100%	52.05%	30.27%		24.29%		
Standard Deviation	0%	0%	0%	0.1%	0.1%	0%	0%	0.6%		0.1%		
SHOC Scalable HeterOgeneous Computing - CUDA - FFT SP (GFLOPS)	172.28	311.46	263.14	289.63	212.43	324.09			**113.64**		**458.71**	450.23
Normalized	37.56%	67.9%	57.37%	63.14%	46.31%	70.65%			24.77%		100%	98.15%
Standard Deviation	0.5%	0.2%	1.6%	1.8%	1.2%	0.6%			1.1%		0.4%	1.5%
LuxMark - GPU - Luxball HDR (Score)	5313	13802	9737	10713	5474	**14081**	9639	4554	**3491**	4253		
Normalized	37.73%	98.02%	69.15%	76.08%	38.88%	100%	68.45%	32.34%	24.79%	30.2%		
Standard Deviation	0.5%	0.6%	0.4%	0%	0%	0.1%	0.6%	0.5%	0.6%	0.1%		
SHOC Scalable HeterOgeneous Computing - CUDA - T.R.B (GB/s)	326.23	348.92	325.16	336.48	351.31	356.52			**158.42**		623.58	**635.35**
Normalized	51.35%	54.92%	51.18%	52.96%	55.29%	56.11%			24.93%		98.15%	100%
Standard Deviation	0.4%	0.6%	0.1%	0.6%	0.1%	0.1%			0.5%		3.2%	0.6%
LuxMark - GPU - Microphone (Score)	2423	6268	4458	4776	2460	**6360**	4302	2127		**1941**		
Normalized	38.1%	98.55%	70.09%	75.09%	38.68%	100%	67.64%	33.44%		30.52%		
Standard Deviation	0.3%	0.5%	0.3%	0%	0.1%	0.1%	0.5%	0.2%		0.1%		

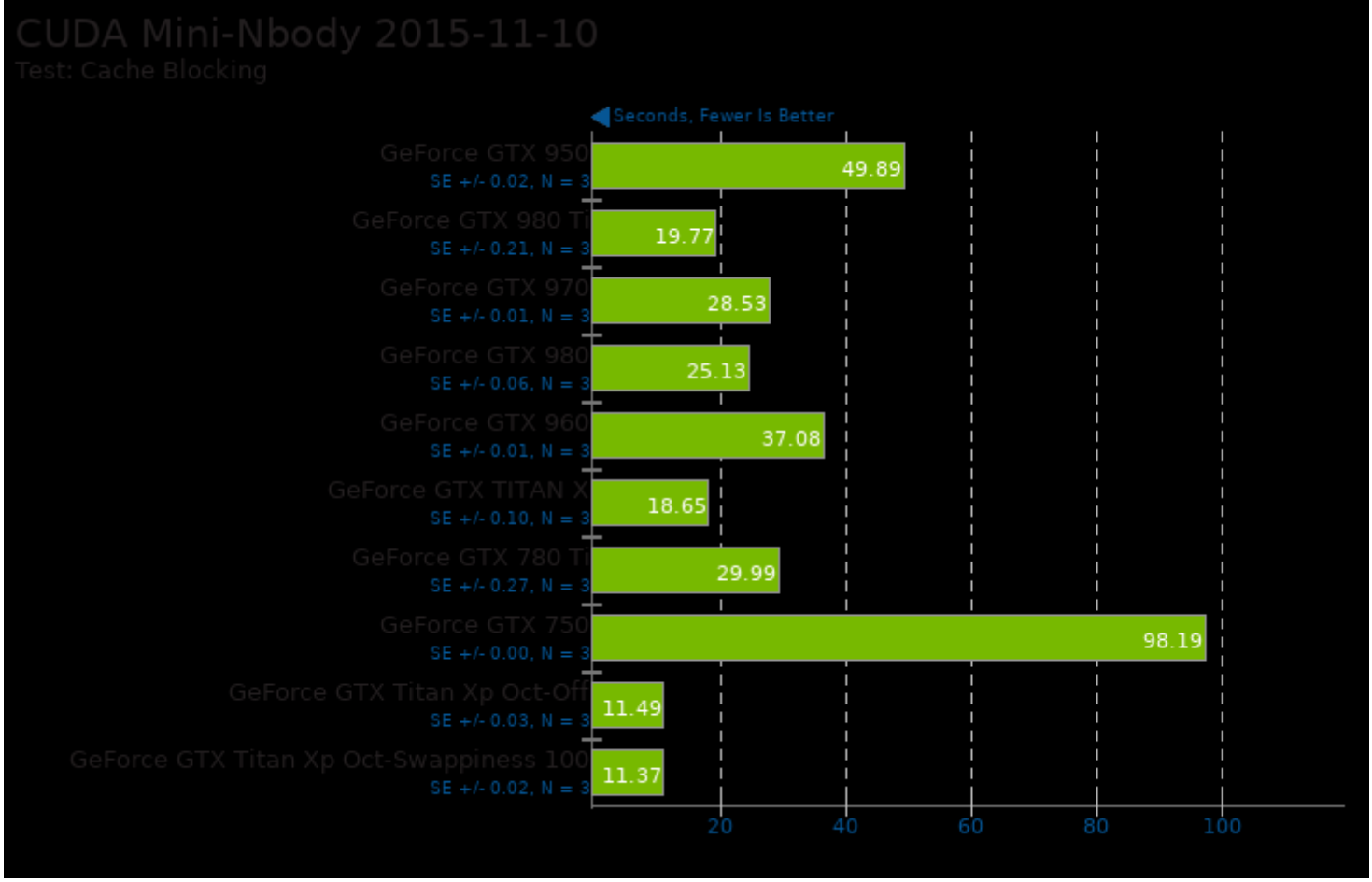
OpenCL CUDA NVIDIA GPGPU Linux Tests

SHOC Scalable HeterOgeneous Computing - CUDA - MD5 Hash (GHash/s)	2.36	6.81	4.79	5.70	3.38	7.42			**1.08**		**16.01**	**16.01**
Normalized	14.74%	42.54%	29.92%	35.6%	21.11%	46.35%			6.75%		100%	100%
Standard Deviation	0.2%	0%	0.1%	0%	0.1%	0%			0%		0%	0%
SHOC Scalable HeterOgeneous Computing - OpenCL - MD5 Hash (GHash/s)	2.34	6.79	4.77	5.68	3.36	7.41	3.78	1.91	**1.07**	1.40	**15.81**	**15.81**
Normalized	14.8%	42.95%	30.17%	35.93%	21.25%	46.87%	23.91%	12.08%	6.77%	8.86%	100%	100%
Standard Deviation	0.1%	0.1%	0%	0%	0.1%	0.1%	0.1%	0.1%	0%	0%	0.1%	0.1%

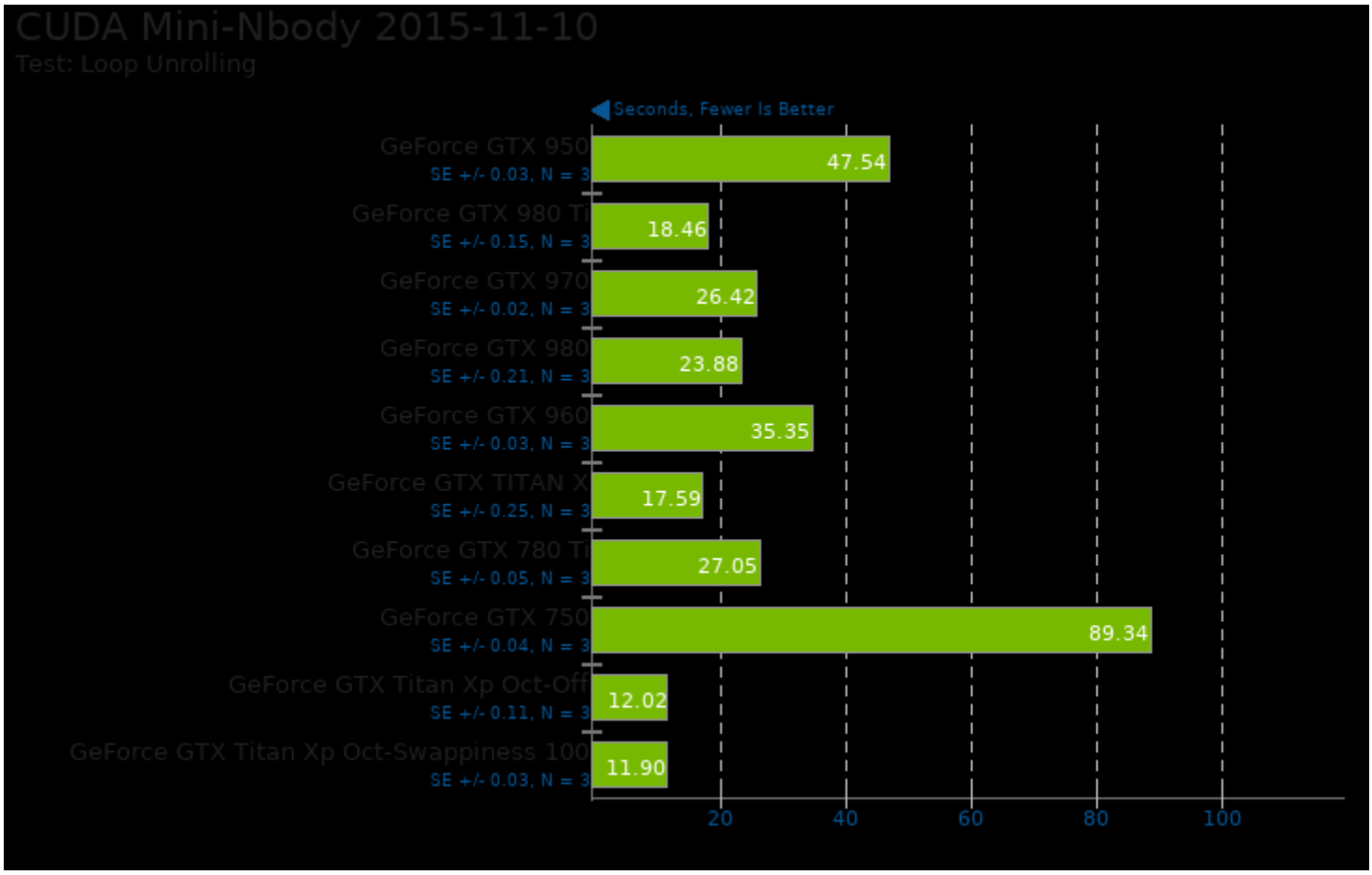

CUDA Mini-Nbody 2015-11-10
Test: Flush Denormals To Zero
Seconds, Fewer Is Better
GeForce GTX 950
SE +/- 0.02, N = 3
108.48
GeForce GTX 980 Ti
SE +/- 0.10, N = 3
40.85
GeForce GTX 970
SE +/- 0.07, N = 3
55.80
GeForce GTX 980
SE +/- 0.18, N = 3
49.53
GeForce GTX 960
SE +/- 0.01, N = 3
79.84
GeForce GTX TITAN X
SE +/- 0.08, N = 3
37.37
GeForce GTX 780 Ti
SE +/- 0.10, N = 3
53.26
GeForce GTX 750
SE +/- 0.03, N = 3
199.83
GeForce GTX Titan Xp Oct-Off
SE +/- 0.11, N = 3
21.99
GeForce GTX Titan Xp Oct-Swappiness 100
SE +/- 0.03, N = 3
22.22
40
80
120
160
200

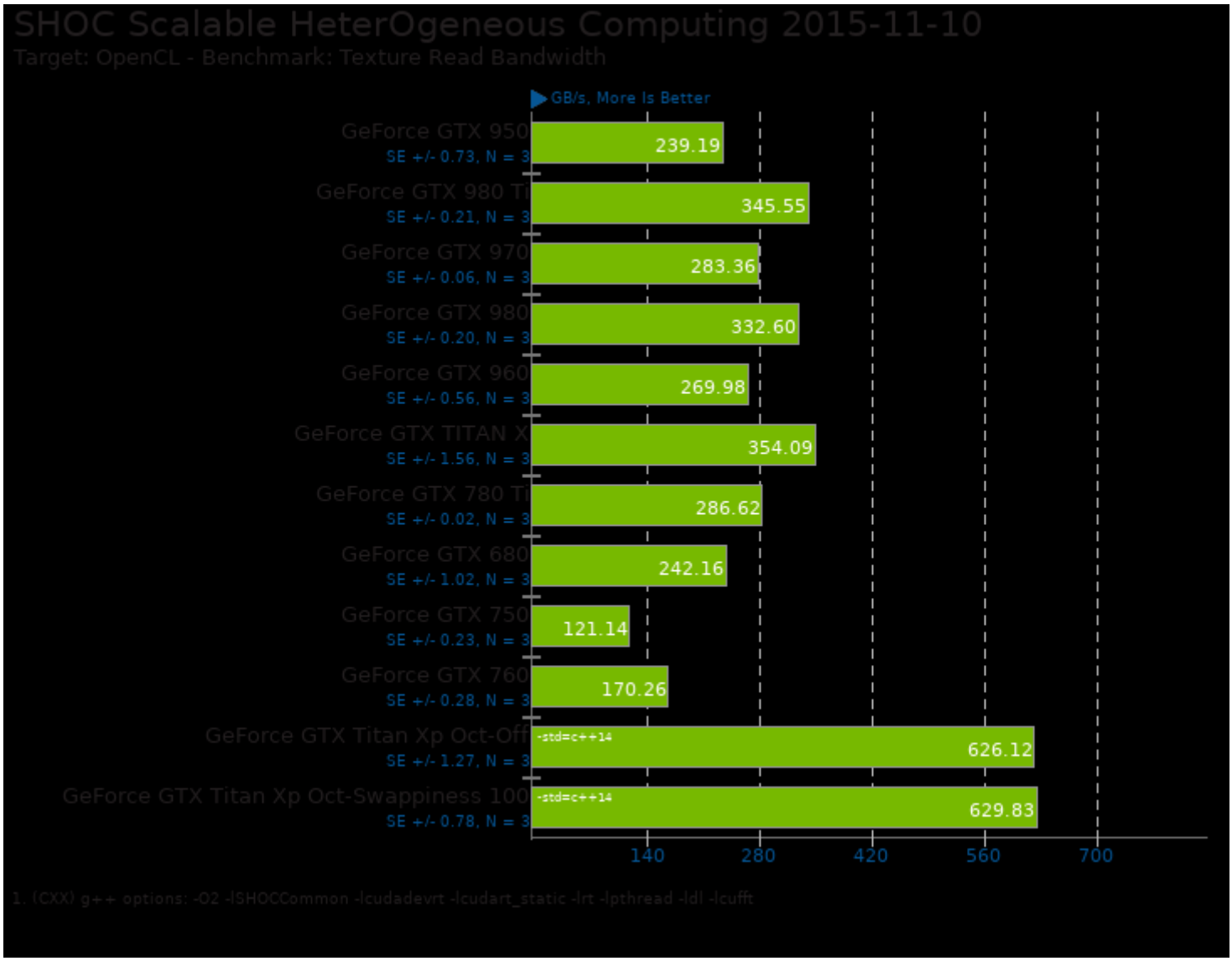

CUDA Mini-Nbody 2015-11-10
Test: SOA Data Layout
Seconds, Fewer Is Better
GeForce GTX 950
SE +/- 0.02, N = 3
108.50
GeForce GTX 980 Ti
SE +/- 0.11, N = 3
40.94
GeForce GTX 970
SE +/- 0.05, N = 3
55.87
GeForce GTX 980
SE +/- 0.21, N = 3
50.15
GeForce GTX 960
SE +/- 0.08, N = 3
79.97
GeForce GTX TITAN X
SE +/- 0.20, N = 3
37.43
GeForce GTX 780 Ti
SE +/- 0.16, N = 3
54.39
GeForce GTX 750
SE +/- 0.04, N = 3
199.95
GeForce GTX Titan Xp Oct-Off
SE +/- 0.09, N = 3
22.34
GeForce GTX Titan Xp Oct-Swappiness 100
SE +/- 0.05, N = 3
22.27
40
80
120
160
200

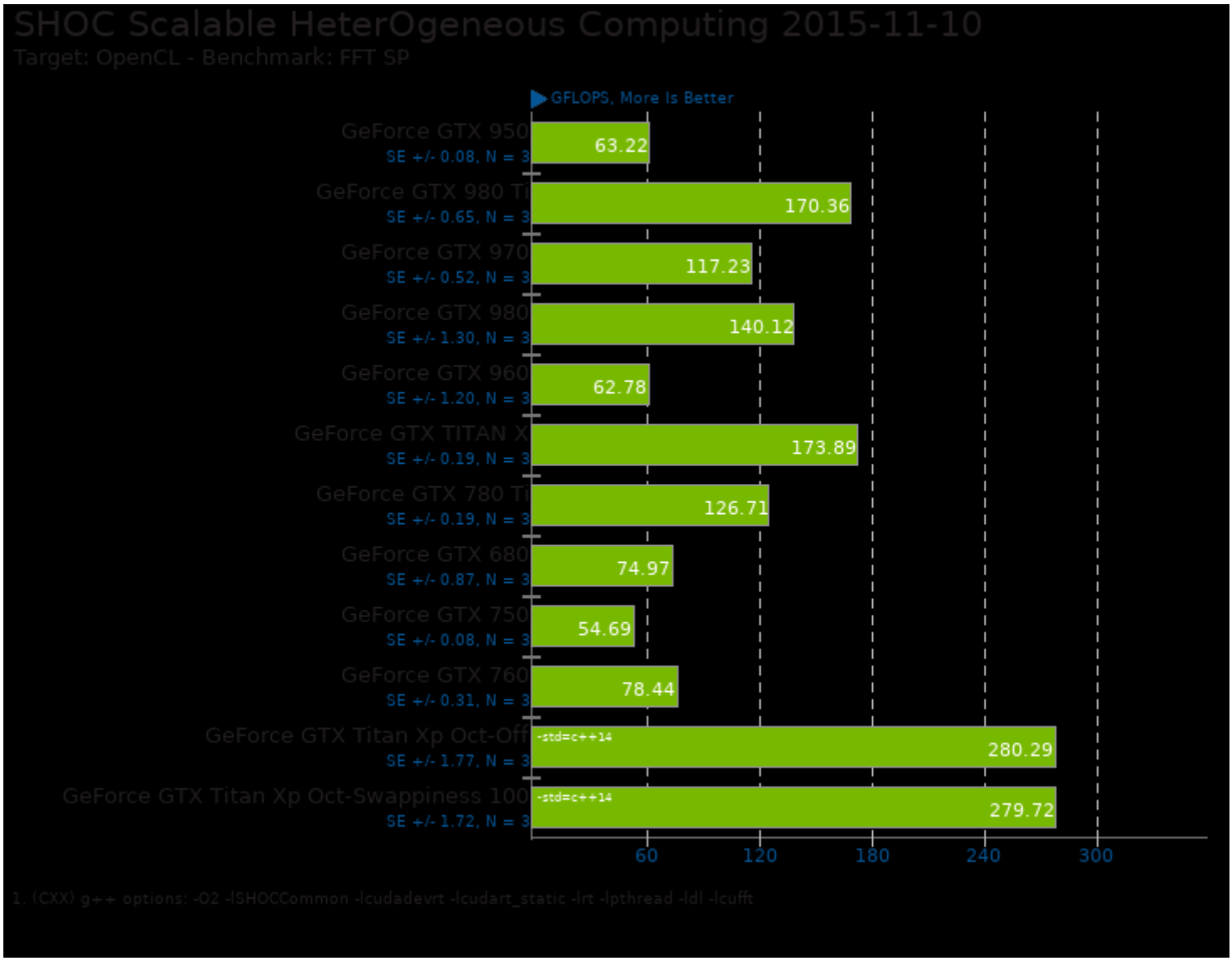

CUDA Mini-Nbody 2015-11-10
Test: Original
Seconds, Fewer Is Better
GeForce GTX 950
SE +/- 0.21, N = 3
105.30
GeForce GTX 980 Ti
SE +/- 0.57, N = 3
34.58
GeForce GTX 970
SE +/- 0.13, N = 3
54.32
GeForce GTX 980
SE +/- 0.10, N = 3
45.38
GeForce GTX 960
SE +/- 0.43, N = 3
82.01
GeForce GTX TITAN X
SE +/- 0.35, N = 3
32.37
GeForce GTX 780 Ti
SE +/- 0.50, N = 3
61.03
GeForce GTX 750
SE +/- 0.05, N = 3
180.66
GeForce GTX Titan Xp Oct-Off
SE +/- 0.12, N = 3
20.40
GeForce GTX Titan Xp Oct-Swappiness 100
SE +/- 0.11, N = 3
20.22
40
80
120
160
200


CUDA Mini-Nbody 2015-11-10
Test: Cache Blocking
Seconds, Fewer Is Better
GeForce GTX 950
SE +/- 0.02, N = 3
49.89
GeForce GTX 980 Ti
SE +/- 0.21, N = 3
19.77
GeForce GTX 970
SE +/- 0.01, N = 3
28.53
GeForce GTX 980
SE +/- 0.06, N = 3
25.13
GeForce GTX 960
SE +/- 0.01, N = 3
37.08
GeForce GTX TITAN X
SE +/- 0.10, N = 3
18.65
GeForce GTX 780 Ti
SE +/- 0.27, N = 3
29.99
GeForce GTX 750
SE +/- 0.00, N = 3
98.19
GeForce GTX Titan Xp Oct-Off
SE +/- 0.03, N = 3
11.49
GeForce GTX Titan Xp Oct-Swappiness 100
SE +/- 0.02, N = 3
11.37
20
40
60
80
100

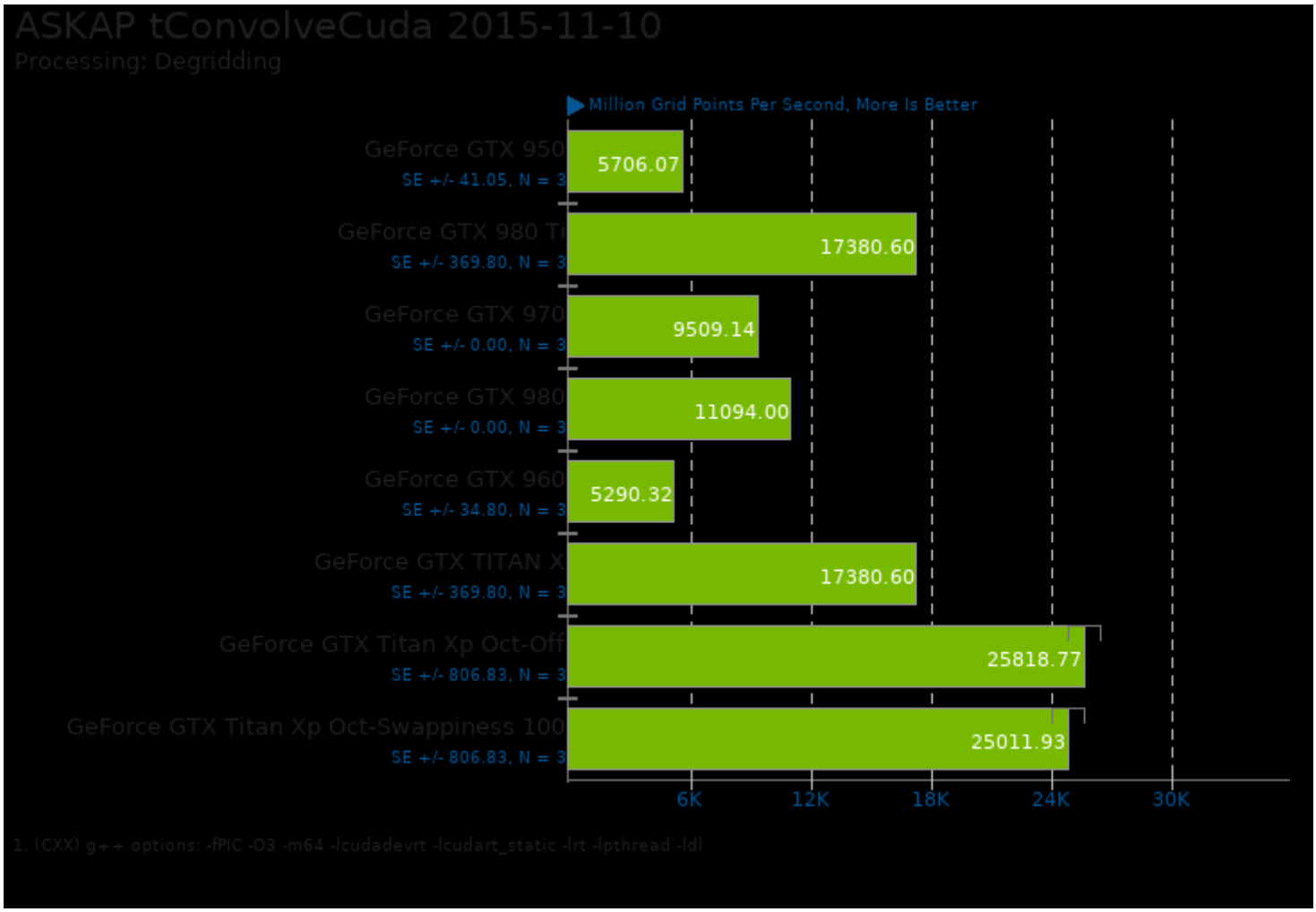
OpenCL CUDA NVIDIA GPGPU Linux Tests

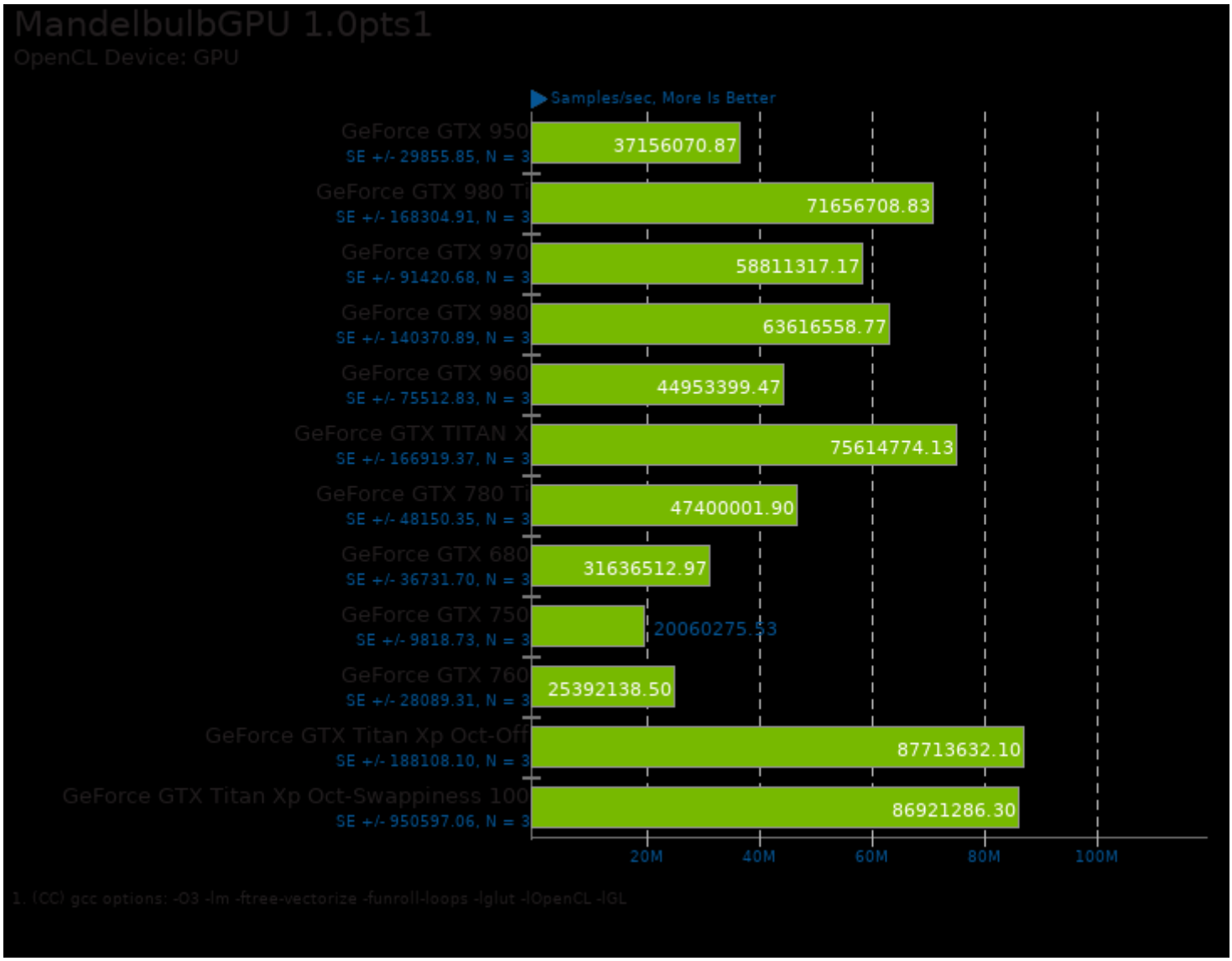



SHOC Scalable HeterOgeneous Computing 2015-11-10
Target: OpenCL - Benchmark: Texture Read Bandwidth
GB/s, More Is Better
GeForce GTX 950
SE +/- 0.73, N = 3
239.19
GeForce GTX 980 Ti
SE +/- 0.21, N = 3
345.55
GeForce GTX 970
SE +/- 0.06, N = 3
283.36
GeForce GTX 980
SE +/- 0.20, N = 3
332.60
GeForce GTX 960
SE +/- 0.56, N = 3
269.98
GeForce GTX TITAN X
SE +/- 1.56, N = 3
354.09
GeForce GTX 780 Ti
SE +/- 0.02, N = 3
286.62
GeForce GTX 680
SE +/- 1.02, N = 3
242.16
GeForce GTX 750
SE +/- 0.23, N = 3
121.14
GeForce GTX 760
SE +/- 0.28, N = 3
170.26
GeForce GTX Titan Xp Oct-Off
-std=c++14
SE +/- 1.27, N = 3
626.12
GeForce GTX Titan Xp Oct-Swappiness 100
-std=c++14
SE +/- 0.78, N = 3
629.83
140
280
420
560
700
1. (CXX) g++ options: -O2 -lSHOCCommon -lcudadevrt -lcudart_static -lrt -lpthread -ldl -lcufft

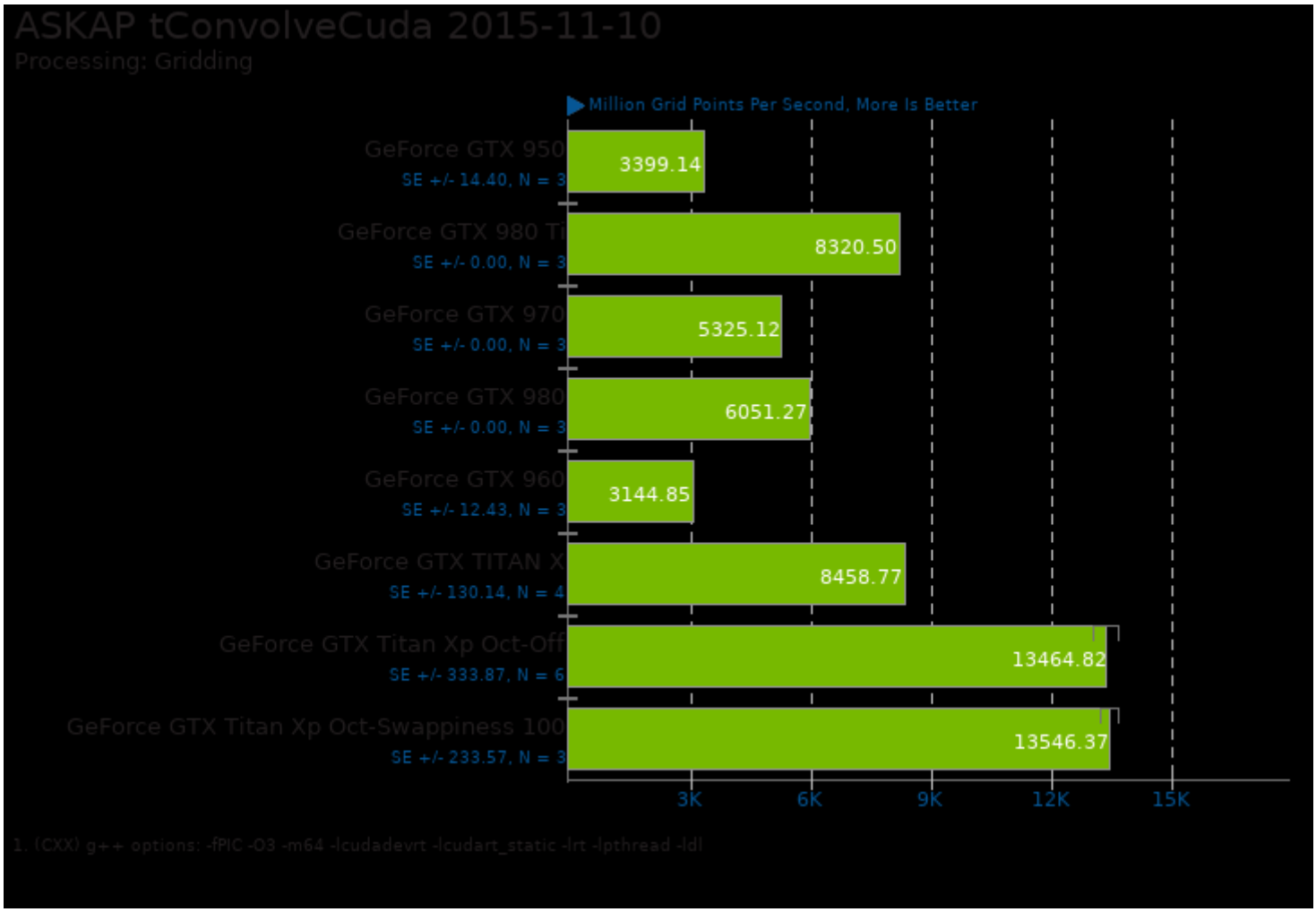

SHOC Scalable HeterOgeneous Computing 2015-11-10
Target: OpenCL - Benchmark: FFT SP
GFLOPS, More Is Better
GeForce GTX 950
SE +/- 0.08, N = 3
63.22
GeForce GTX 980 Ti
SE +/- 0.65, N = 3
170.36
GeForce GTX 970
SE +/- 0.52, N = 3
117.23
GeForce GTX 980
SE +/- 1.30, N = 3
140.12
GeForce GTX 960
SE +/- 1.20, N = 3
62.78
GeForce GTX TITAN X
SE +/- 0.19, N = 3
173.89
GeForce GTX 780 Ti
SE +/- 0.19, N = 3
126.71
GeForce GTX 680
SE +/- 0.87, N = 3
74.97
GeForce GTX 750
SE +/- 0.08, N = 3
54.69
GeForce GTX 760
SE +/- 0.31, N = 3
78.44
GeForce GTX Titan Xp Oct-Off
SE +/- 1.77, N = 3
-std=c++14
280.29
GeForce GTX Titan Xp Oct-Swappiness 100
SE +/- 1.72, N = 3
-std=c++14
279.72
60
120
180
240
300
1. (CXX) g++ options: -O2 -lSHOCCommon -lcudadevrt -lcudart_static -lrt -lpthread -ldl -lcufft

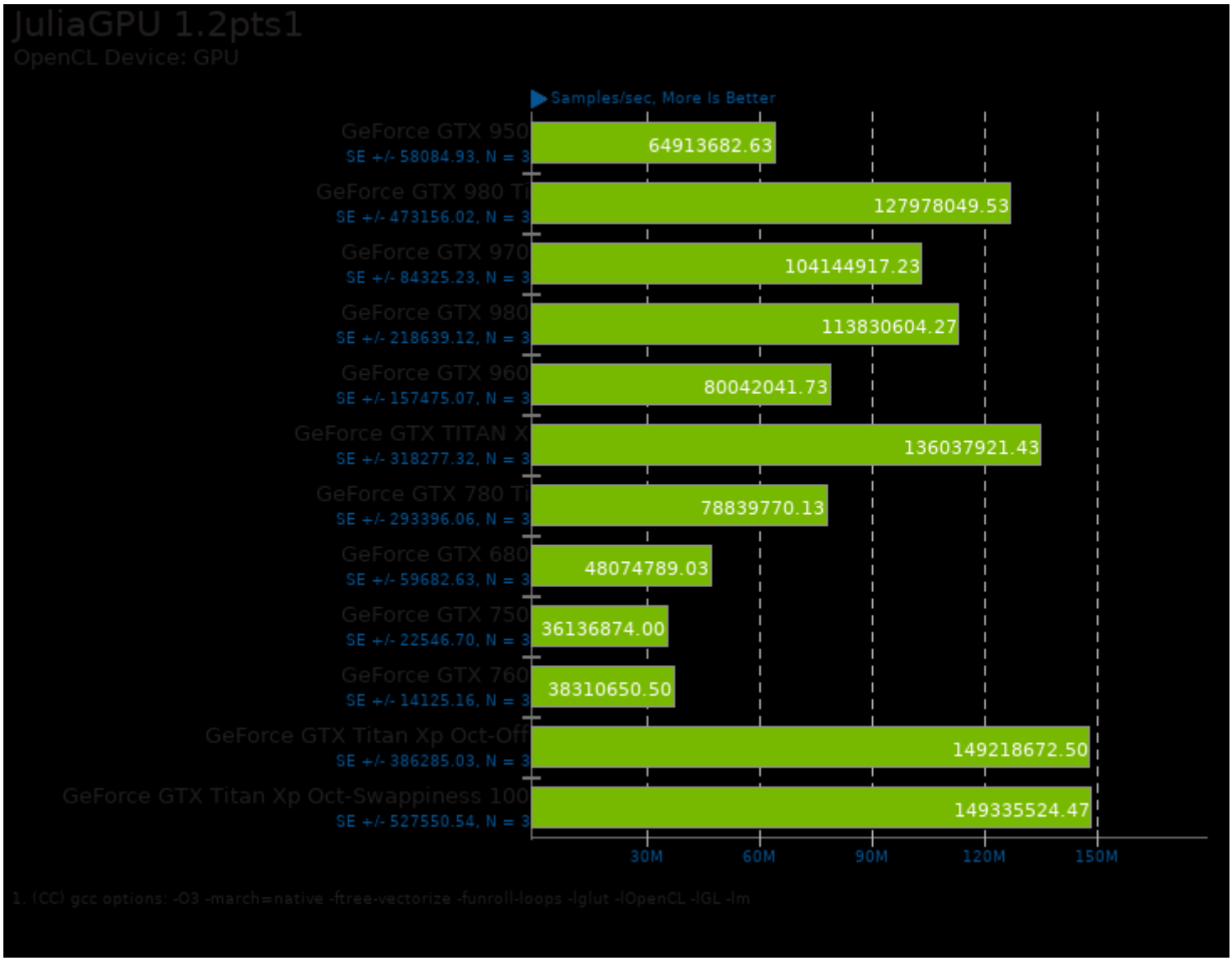
OpenCL CUDA NVIDIA GPGPU Linux Tests



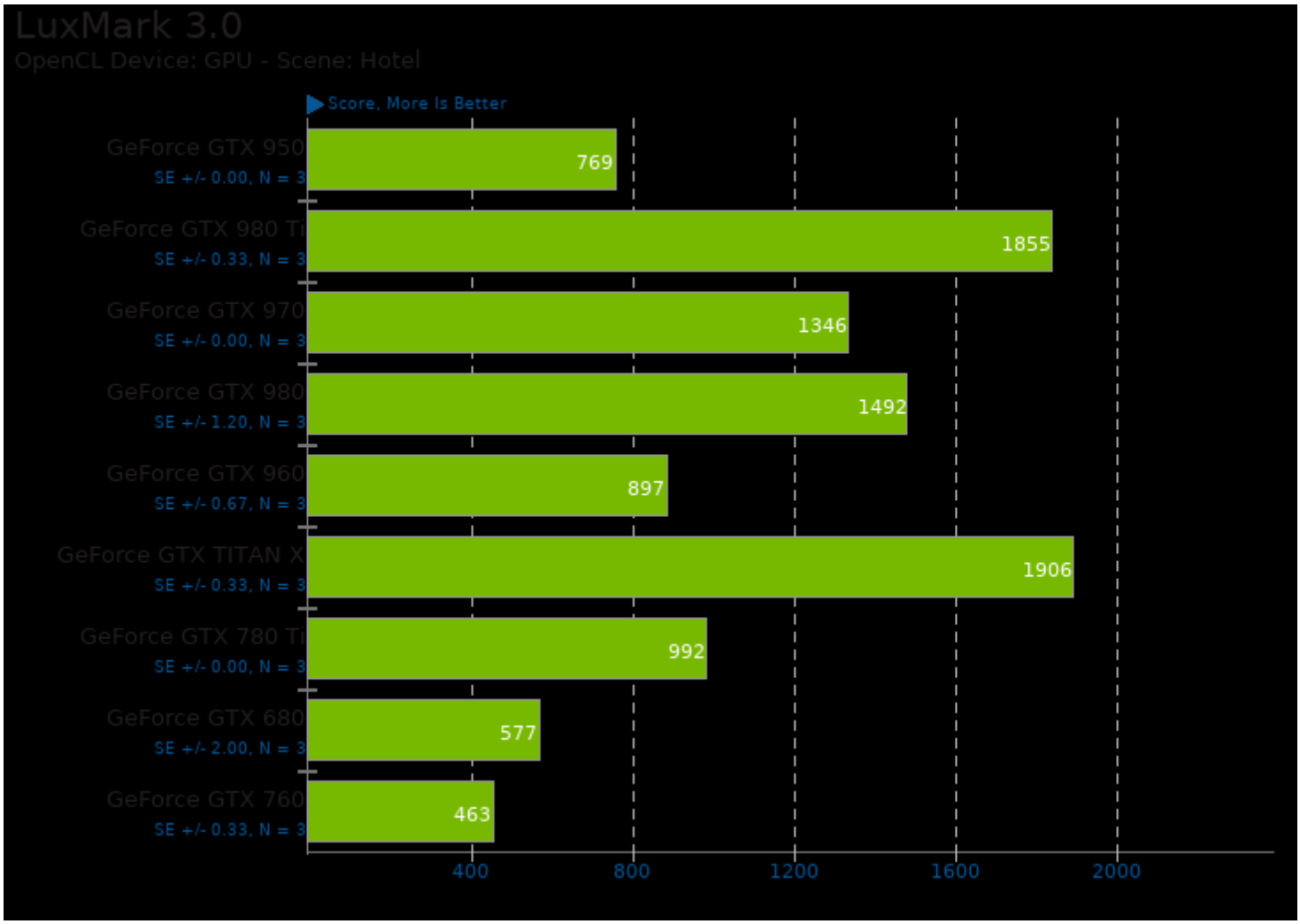

MandelbulbGPU 1.0pts1
OpenCL Device: GPU
Samples/sec, More Is Better
GeForce GTX 950
SE +/- 29855.85, N = 3
37156070.87
GeForce GTX 980 Ti
SE +/- 168304.91, N = 3
71656708.83
GeForce GTX 970
SE +/- 91420.68, N = 3
58811317.17
GeForce GTX 980
SE +/- 140370.89, N = 3
63616558.77
GeForce GTX 960
SE +/- 75512.83, N = 3
44953399.47
GeForce GTX TITAN X
SE +/- 166919.37, N = 3
75614774.13
GeForce GTX 780 Ti
SE +/- 48150.35, N = 3
47400001.90
GeForce GTX 680
SE +/- 36731.70, N = 3
31636512.97
GeForce GTX 750
SE +/- 9818.73, N = 3
20060275.53
GeForce GTX 760
SE +/- 28089.31, N = 3
25392138.50
GeForce GTX Titan Xp Oct-Off
SE +/- 188108.10, N = 3
87713632.10
GeForce GTX Titan Xp Oct-Swappiness 100
SE +/- 950597.06, N = 3
86921286.30
20M
40M
60M
80M
100M
1. (CC) gcc options: -O3 -lm -ftree-vectorize -funroll-loops -lglut -lOpenCL -lGL

OpenCL CUDA NVIDIA GPGPU Linux Tests

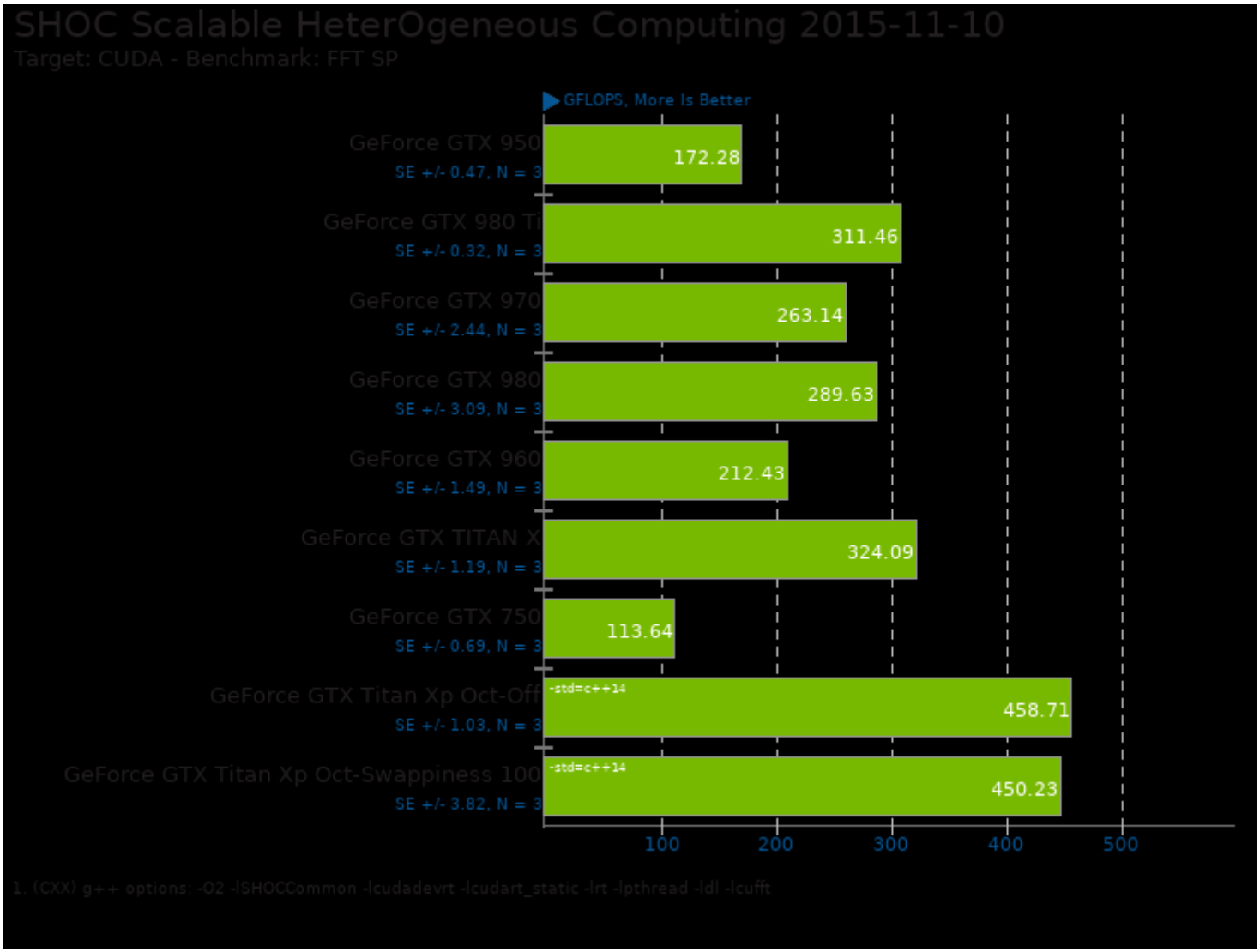



JuliaGPU 1.2pts1
OpenCL Device: GPU
Samples/sec, More Is Better
GeForce GTX 950
SE +/- 58084.93, N = 3
64913682.63
GeForce GTX 980 Ti
SE +/- 473156.02, N = 3
127978049.53
GeForce GTX 970
SE +/- 84325.23, N = 3
104144917.23
GeForce GTX 980
SE +/- 218639.12, N = 3
113830604.27
GeForce GTX 960
SE +/- 157475.07, N = 3
80042041.73
GeForce GTX TITAN X
SE +/- 318277.32, N = 3
136037921.43
GeForce GTX 780 Ti
SE +/- 293396.06, N = 3
78839770.13
GeForce GTX 680
SE +/- 59682.63, N = 3
48074789.03
GeForce GTX 750
SE +/- 22546.70, N = 3
36136874.00
GeForce GTX 760
SE +/- 14125.16, N = 3
38310650.50
GeForce GTX Titan Xp Oct-Off
SE +/- 386285.03, N = 3
149218672.50
GeForce GTX Titan Xp Oct-Swappiness 100
SE +/- 527550.54, N = 3
149335524.47
30M
60M
90M
120M
150M
1. (CC) gcc options: -O3 -march=native -ftree-vectorize -funroll-loops -lglut -lOpenCL -lGL -lm

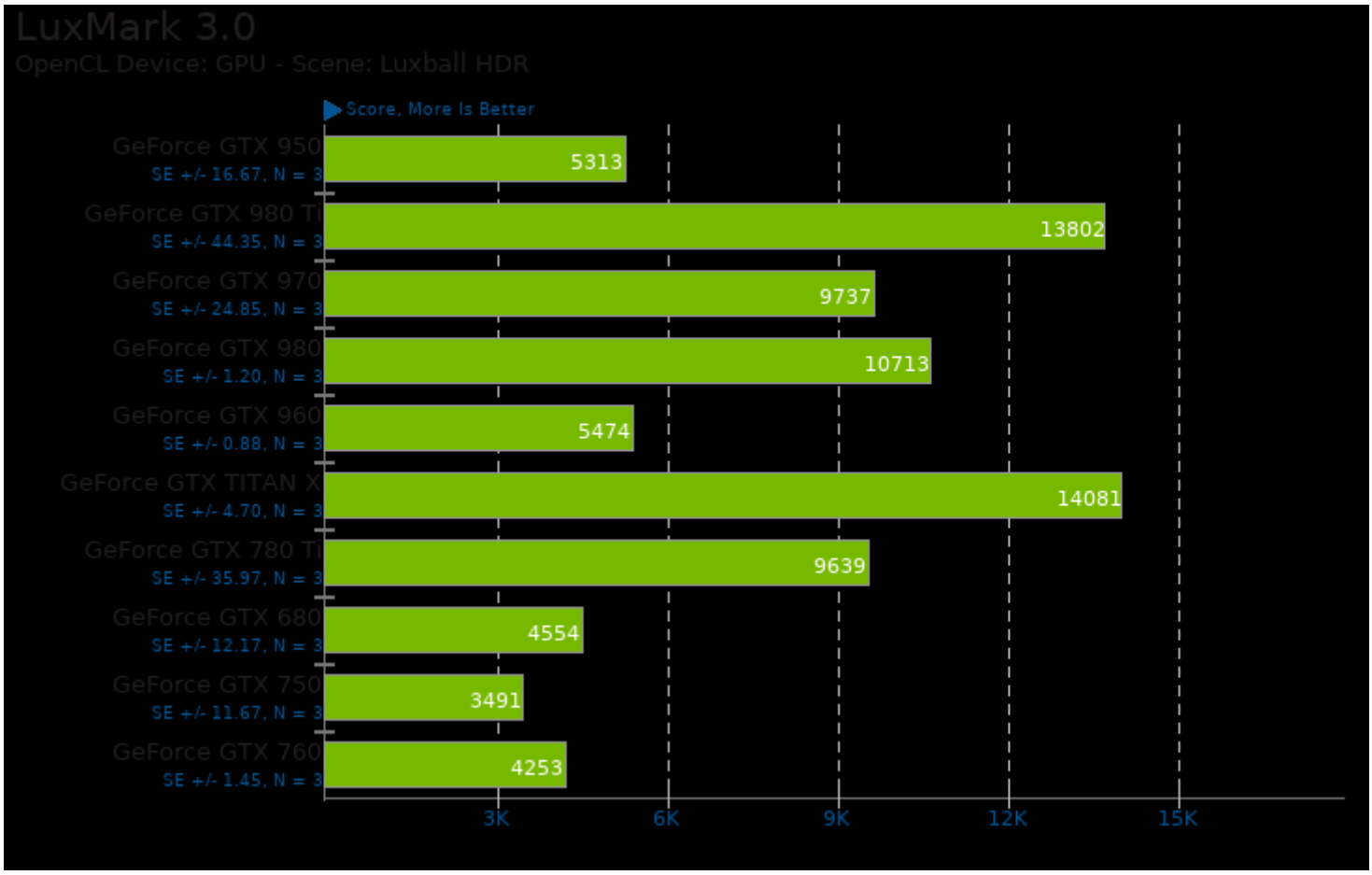
OpenCL CUDA NVIDIA GPGPU Linux Tests

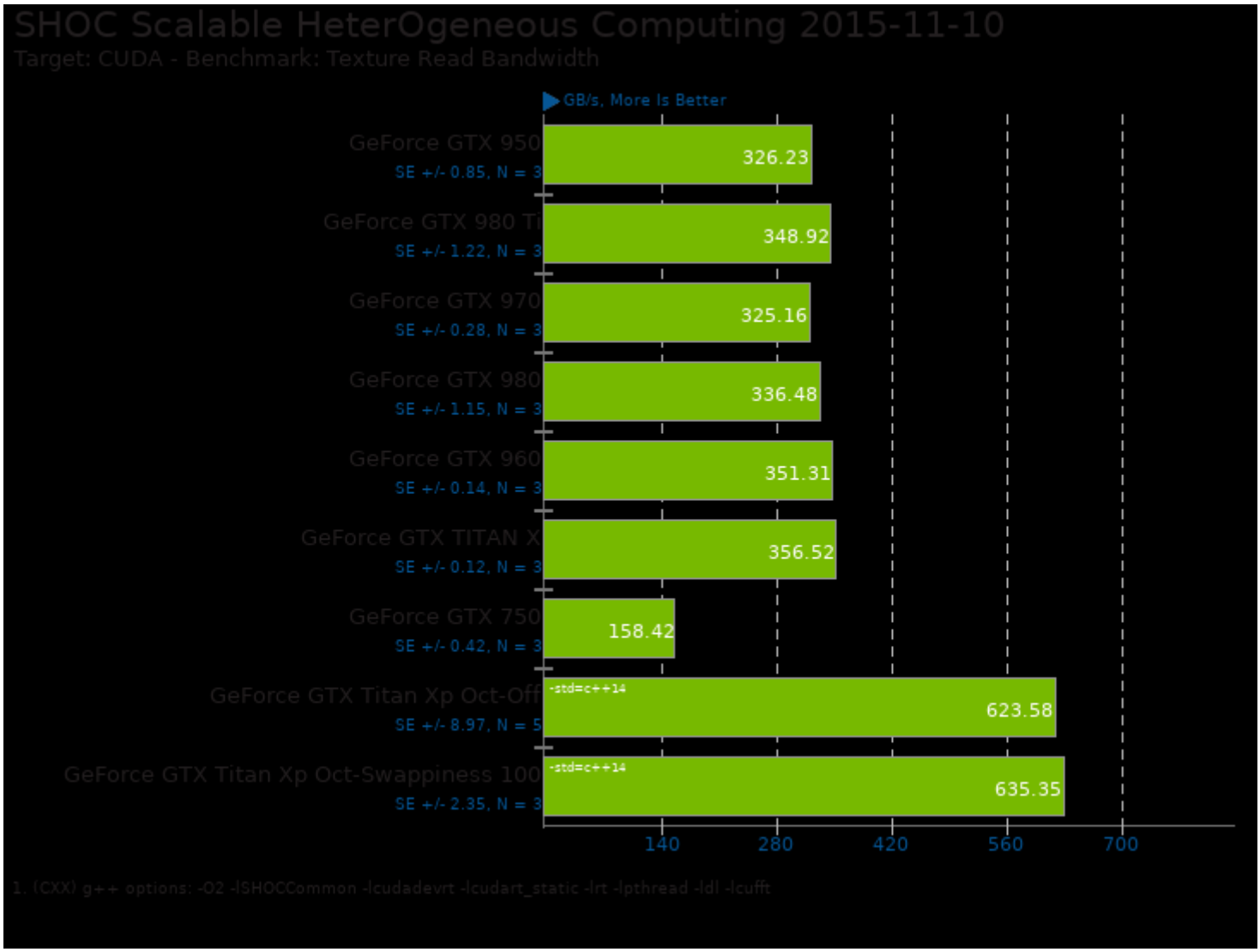


OpenCL CUDA NVIDIA GPGPU Linux Tests

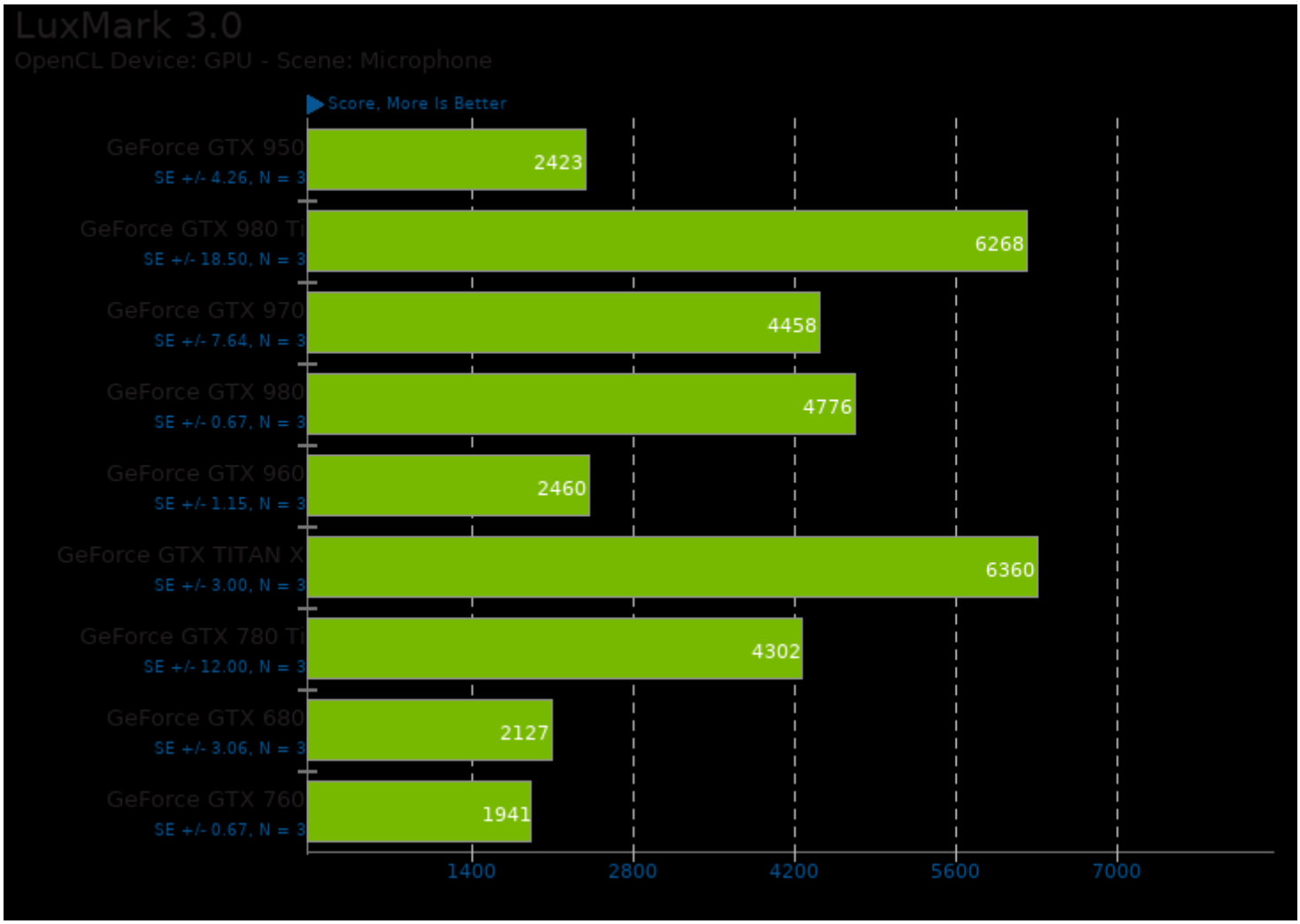


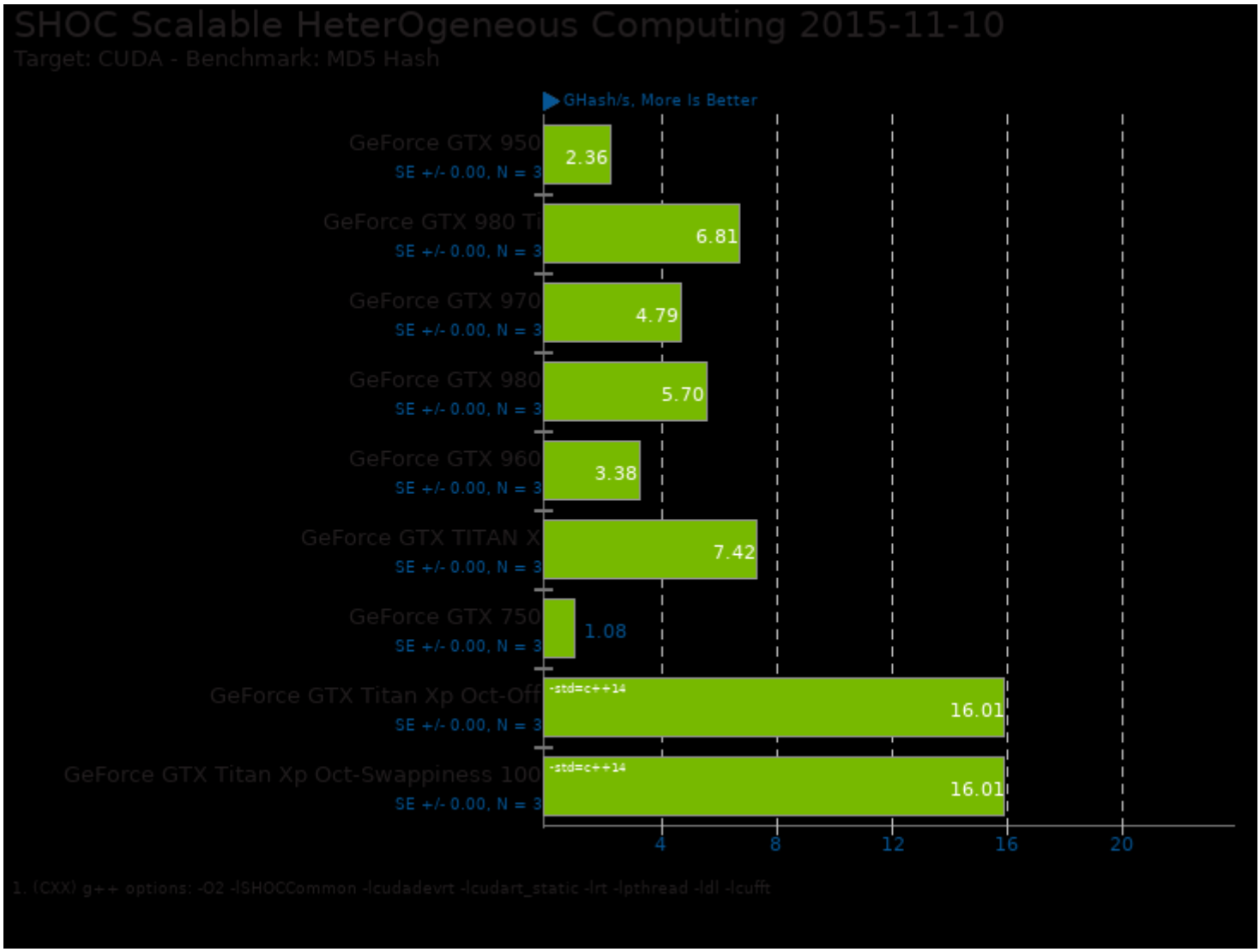
OpenCL CUDA NVIDIA GPGPU Linux Tests

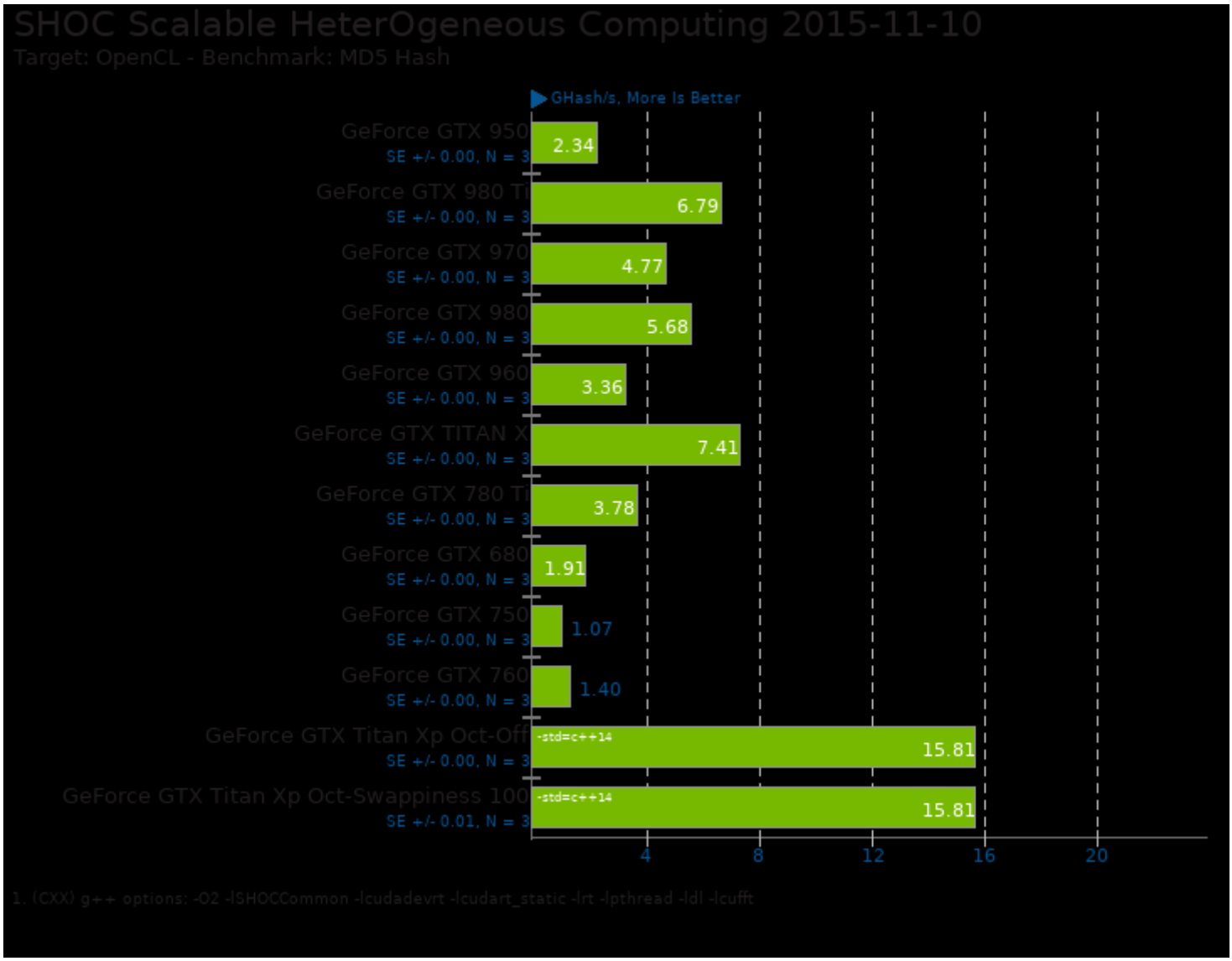



SHOC Scalable HeterOgeneous Computing 2015-11-10
Target: CUDA - Benchmark: Texture Read Bandwidth
GB/s, More Is Better
GeForce GTX 950
SE +/- 0.85, N = 3
326.23
GeForce GTX 980 Ti
SE +/- 1.22, N = 3
348.92
GeForce GTX 970
SE +/- 0.28, N = 3
325.16
GeForce GTX 980
SE +/- 1.15, N = 3
336.48
GeForce GTX 960
SE +/- 0.14, N = 3
351.31
GeForce GTX TITAN X
SE +/- 0.12, N = 3
356.52
GeForce GTX 750
SE +/- 0.42, N = 3
158.42
GeForce GTX Titan Xp Oct-Off
SE +/- 8.97, N = 5
-std=c++14
623.58
GeForce GTX Titan Xp Oct-Swappiness 100
SE +/- 2.35, N = 3
-std=c++14
635.35
140
280
420
560
700
1. (CXX) g++ options: -O2 -lSHOCCommon -lcudadevrt -lcudart_static -lrt -lpthread -ldl -lcufft

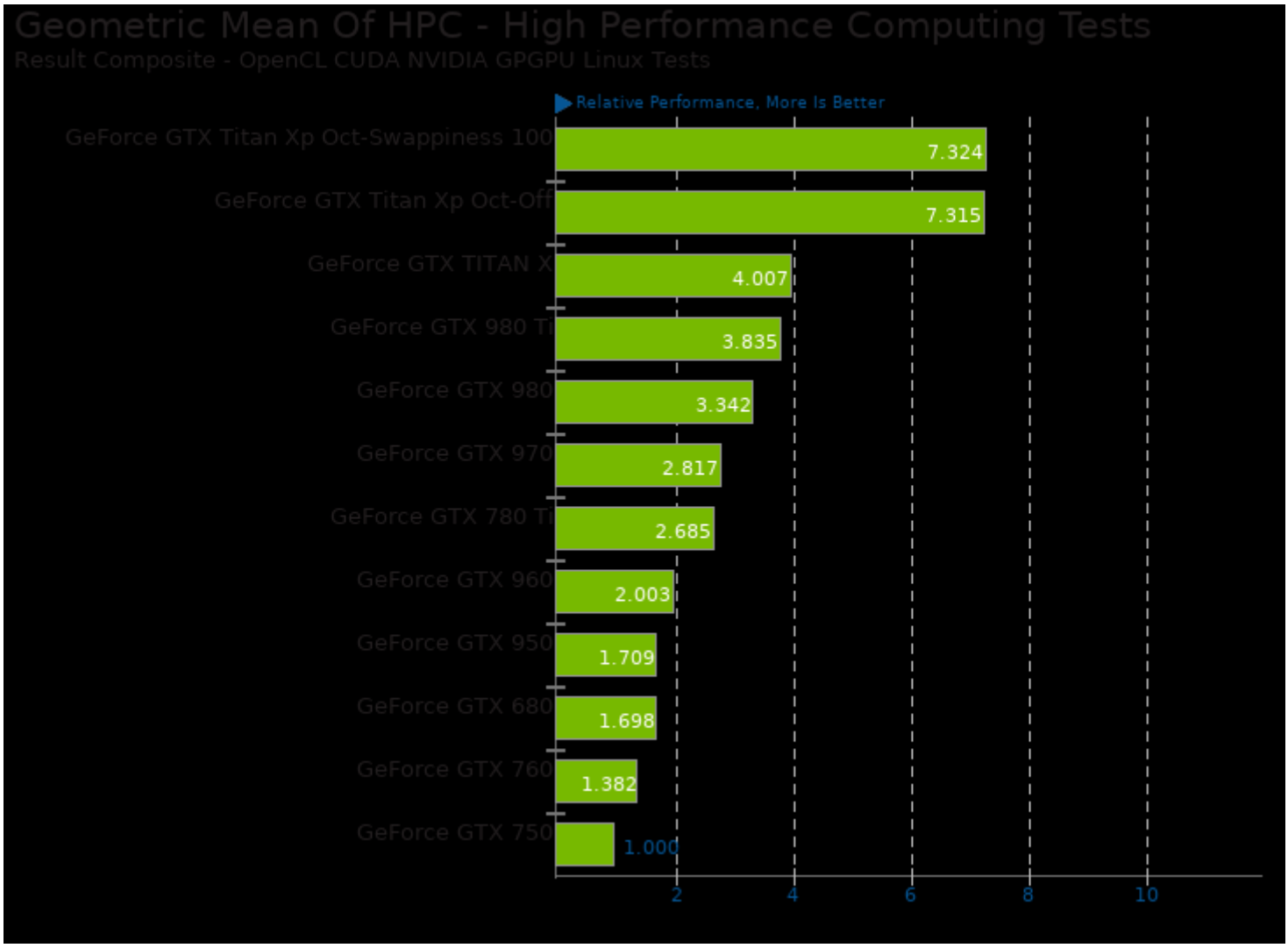
OpenCL CUDA NVIDIA GPGPU Linux Tests



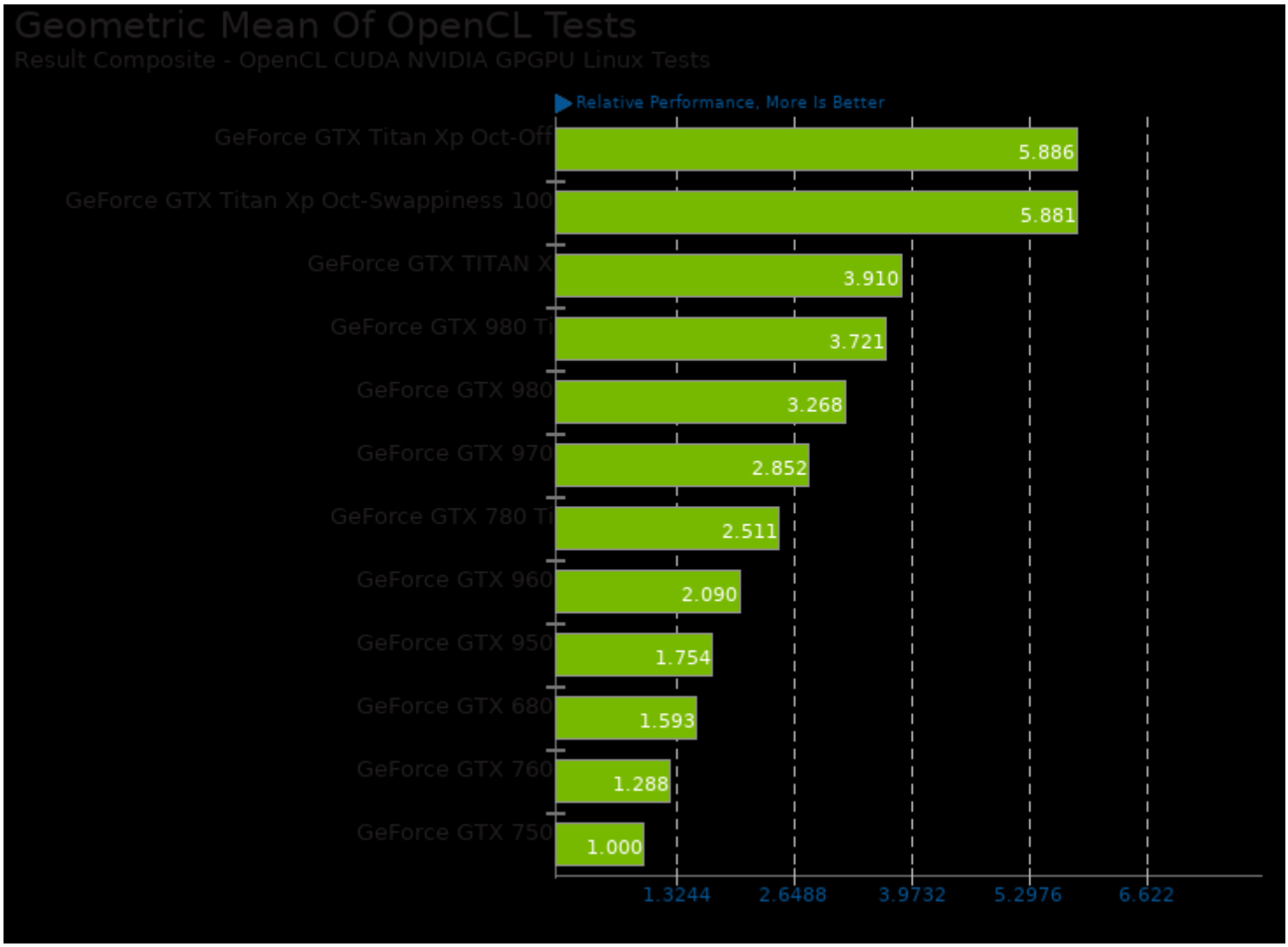

SHOC Scalable HeterOgeneous Computing 2015-11-10
Target: CUDA - Benchmark: MD5 Hash
GHash/s, More Is Better
GeForce GTX 950
SE +/- 0.00, N = 3
2.36
GeForce GTX 980 Ti
SE +/- 0.00, N = 3
6.81
GeForce GTX 970
SE +/- 0.00, N = 3
4.79
GeForce GTX 980
SE +/- 0.00, N = 3
5.70
GeForce GTX 960
SE +/- 0.00, N = 3
3.38
GeForce GTX TITAN X
SE +/- 0.00, N = 3
7.42
GeForce GTX 750
SE +/- 0.00, N = 3
1.08
GeForce GTX Titan Xp Oct-Off
SE +/- 0.00, N = 3
-std=c++14
16.01
GeForce GTX Titan Xp Oct-Swappiness 100
SE +/- 0.00, N = 3
-std=c++14
16.01
4
8
12
16
20
1. (CXX) g++ options: -O2 -lSHOCCommon -lcudadevrt -lcudart_static -lrt -lpthread -ldl -lcufft


SHOC Scalable HeterOgeneous Computing 2015-11-10
Target: OpenCL - Benchmark: MD5 Hash
GHash/s, More Is Better
GeForce GTX 950
SE +/- 0.00, N = 3
2.34
GeForce GTX 980 Ti
SE +/- 0.00, N = 3
6.79
GeForce GTX 970
SE +/- 0.00, N = 3
4.77
GeForce GTX 980
SE +/- 0.00, N = 3
5.68
GeForce GTX 960
SE +/- 0.00, N = 3
3.36
GeForce GTX TITAN X
SE +/- 0.00, N = 3
7.41
GeForce GTX 780 Ti
SE +/- 0.00, N = 3
3.78
GeForce GTX 680
SE +/- 0.00, N = 3
1.91
GeForce GTX 750
SE +/- 0.00, N = 3
1.07
GeForce GTX 760
SE +/- 0.00, N = 3
1.40
GeForce GTX Titan Xp Oct-Off
SE +/- 0.00, N = 3
-std=c++14
15.81
GeForce GTX Titan Xp Oct-Swappiness 100
SE +/- 0.01, N = 3
-std=c++14
15.81
4
8
12
16
20
1. (CXX) g++ options: -O2 -lSHOCCommon -lcudadevrt -lcudart_static -lrt -lpthread -ldl -lcufft

These geometric means are based upon test groupings / test suites for this result file.



Geometric mean based upon tests: pts/askap and pts/shoc



Geometric mean based upon tests: pts/juliagpu, pts/mandelbulbgpu, pts/luxmark and pts/shoc

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