

CORSIKA 8 PROFILING

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Profiling – Setup

- **Architecture** : Intel Xeon Gold, avx512 support

```
faure@phone10:~$ lscpu
Architecture : x86_64
Mode(s) opératoire(s) des processeurs : 32-bit, 64-bit
Boutisme : Little Endian
Address sizes: 46 bits physical, 48 bits virtual
Processeur(s) : 96
Liste de processeur(s) en ligne : 0-95
Thread(s) par cœur : 2
Cœur(s) par socket : 24
Socket(s) : 2
Nœud(s) NUMA : 2
Identifiant constructeur : GenuineIntel
Famille de processeur : 6
Modèle : 85
Nom de modèle : Intel(R) Xeon(R) Gold 5220R CPU @ 2.20GHz
Révision : 7
Vitesse du processeur en MHz : 1000.004
Vitesse maximale du processeur en MHz : 4000.0000
Vitesse minimale du processeur en MHz : 1000.0000
BogoMIPS : 4400.00
Virtualisation : VT-x
Cache L1d : 1.5 MiB
Cache L1i : 1.5 MiB
Cache L2 : 48 MiB
Cache L3 : 71.5 MiB
Nœud NUMA 0 de processeur(s) : 0-23,48-71
Nœud NUMA 1 de processeur(s) : 24-47,72-95
Vulnerability Itlb multihit: KVM: Mitigation: Split huge pages
Vulnerability L1tf: Not affected
Vulnerability Mds: Not affected
Vulnerability Meltdown: Not affected
Vulnerability Mmio stale data: Mitigation; Clear CPU buffers; SMT vulnerable
Vulnerability Retbleed: Mitigation; Enhanced IBRS
Vulnerability Spec store bypass: Mitigation; Speculative Store Bypass disabled via prctl and seccomp
Vulnerability Spectre v1: Mitigation; usercopy/swapgs barriers and __user pointer sanitization
Vulnerability Spectre v2: Mitigation; Enhanced IBRS, IBPB conditional, RSB filling, PBRSE-eIBRS SW sequence
Vulnerability Srbds: Not affected
Vulnerability Tsx async abort: Mitigation; TSX disabled
Drapaux : fpu vme de pse tsc msr pae mce cx8 apic sep mtrr pge mca cmov pat pse36 clflush dts acpi mmx fxsr sse sse2 ss ht tm pbe syscall nx pdpe1gb rdtscp lm constant_tsc art arch_
perfmon pebs bts rep_good nopl xtopology nonstop_tsc cpuid aperfmperf pni pclmulqdq dtes64 monitor ds_cpl vmx smx est tm2 ssse3 sdbg fma cx16 xtpr pdcm pcid dca sse4_1 sse
4_2 x2apic movbe popcnt tsc_deadline_timer aes xsave avx f16c rdrand lahf_lm abm 3dnowprefetch cpuid_fault epb cat_l3 cdp_l3 invpcid_single intel_ppin ssbd mba ibrs ibpb s
tbp ibrs_enhanced tpr_shadow vnmi flexpriority ept vpid ept_ad fsgsbase tsc_adjust bmi1 avx2 smep bmi2 erms invpcid cqm mpx rdt_a avx512f avx512dq rdseed adx smap clflush
opt clwb intel_pt avx512cd avx512bw avx512vl xsaveopt xsavec xgetbv1 xsaves cqm_llc cqm_occup_llc cqm_mbm_total cqm_mbm_local dtherm ida arat pln pts hwp hwp_act_window hw
p_pkg_req pku ospke avx512_vnni md_clear flush_l1d arch_capabilities
```

Profiling – Setup

- **Compilation flags** : -O3 -g -mavx2 -mavx512f -march=native -mtune=native -mprefer-vector-width=512...
- **Compiler** : gcc 9.4.0
- **Profiler** : perf

Profiling – Use case

1) A 1 TeV hadronic cascade with 30° inclination, N_showers = 100

```
./c8_air_shower --pdg 2212 -E 1e3 -z 30 -N 100  
-f hadron_100n_1e3_30z > std.out
```

Profiling – General stats

```
faure@phone10:~/CORSIKA/corsika-build-1902/bin$ perf stat -d ./c8_air_shower --pdg 2212 -E 1e3 -z 30 -N 100 -f hadron_100n_1e3_30z_2 > std.out
```

```
Performance counter stats for './c8_air_shower --pdg 2212 -E 1e3 -z 30 -N 100 -f hadron_100n_1e3_30z_2':
```

1085087.53	msec	task-clock	#	1.000	CPUs utilized	
4240		context-switches	#	0.004	K/sec	
1		cpu-migrations	#	0.000	K/sec	
32329		page-faults	#	0.030	K/sec	
4087281976902		cycles	#	3.767	GHz	(50.00%)
5889524973459		instructions	#	1.44	insn per cycle	(62.50%)
918958820344		branches	#	846.898	M/sec	(62.50%)
3951816222		branch-misses	#	0.43%	of all branches	(62.50%)
1445494866764		L1-dcache-loads	#	1332.146	M/sec	(62.50%)
71353821108		L1-dcache-load-misses	#	4.94%	of all L1-dcache hits	(62.50%)
407211634		LLC-loads	#	0.375	M/sec	(50.00%)
7610502		LLC-load-misses	#	1.87%	of all LL-cache hits	(50.00%)

```
1085.194466747 seconds time elapsed
```

```
1084.949367000 seconds user
```

```
0.139987000 seconds sys
```

Profiling – Vectorization

```
Faure@phone10:~/CORSIKA/corsika-build-1902/bin$ perf stat -M FLOPc ./c8_air_shower --pdg 2212 -E 1e3 -z 30 -N 100 -f hadron_100n_1e3_30z_3 > std.out
Performance counter stats for './c8_air_shower --pdg 2212 -E 1e3 -z 30 -N 100 -f hadron_100n_1e3_30z_3':

   791246538      fp_arith_inst_retired.scalar_single #          0.3 FLOPc          (44.44%)
   872720729238   fp_arith_inst_retired.scalar_double          (44.44%)
   98405709357    fp_arith_inst_retired.128b_packed_double    (44.44%)
           0      fp_arith_inst_retired.128b_packed_single    (44.44%)
   15734          fp_arith_inst_retired.256b_packed_double    (44.44%)
           0      fp_arith_inst_retired.256b_packed_single    (44.44%)
  2250798594     fp_arith_inst_retired.512b_packed_double    (44.44%)
           0      fp_arith_inst_retired.512b_packed_single    (44.44%)
  4129153948555   cycles                                       (44.44%)

1096.037830973 seconds time elapsed

1095.752017000 seconds user
   0.151988000 seconds sys
```

Profiling – FlameGraph

- Generated with `perf record --call-graph dwarf`
- In the Firefox Profiler : <https://share.firefox.dev/3T7o5qB>
- 95% of the call stacks were traced back to the main.

THANK YOU !