

# AliRoot & Root6

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06/11/2013

# Root6

- Ongoing effort (2012-...)
- Main changes (my “ALICE-centric” opinion):
  - CLING/CLANG/llvm instead of CINT
  - C++11 support
  - possibility for parallelization
  - many improvements/redesign/refactoring
- Release plans
  - First test release (tag): end of November’2013
  - Production release: May’2014
- Weekly coordination meeting with the LHC experiments
  - [Very good collaboration with the Root team!](#)

# AliRoot changes for Root6

- Summer 2013 – dev branch, running reconstruction and simulation
  - Some CMake prototyping
- October 2013 – Root6-enabled version in the trunk
  - Thanks to Christian for the enthusiastic work and to the detector experts for the fast feedback!
  - Tested with Root5 in the analysis tags, no regression
  - Local performance tests

# Running with Root6: user point of view

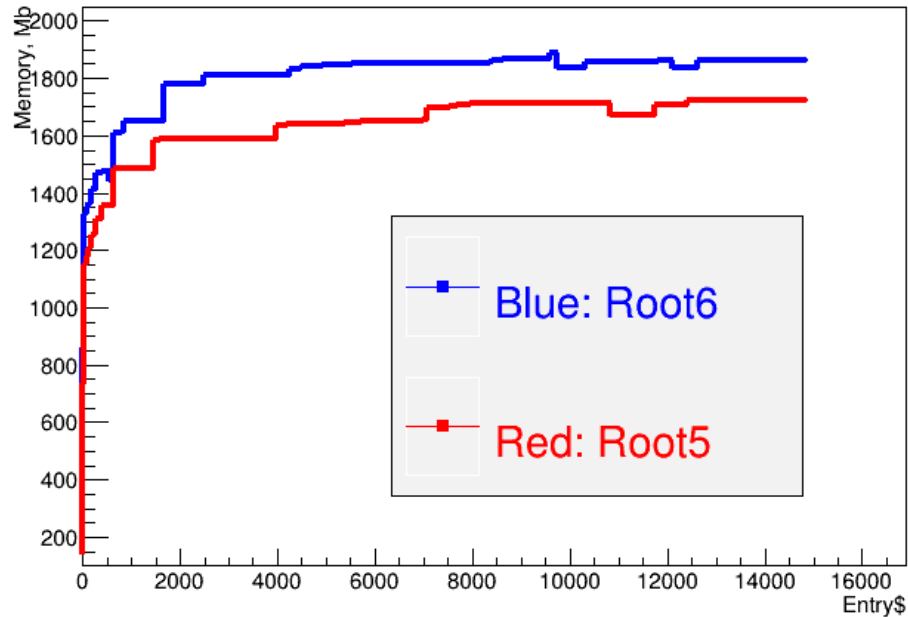
- Main difference: we cannot load the library and create an object from it in the same C++ macro
  - Instead of mymacro.C  
gSystem->Load("MyLib.so");  
MyObj \* obj = new MyObj;
  - Use two macros:  
load.C containing gSystem->Load("MyLib.so");  
mymacro.C containing MyObj \* obj = new MyObj;
  - In batch you can have run.C that contains two lines  
gROOT->Macro("load.C");  
gROOT->Macro("mymacro.C");
- You also cannot unload libraries, exit the Root session
- Both issues will be fixed in the May'2014 release of Root

# Some performance comparisons

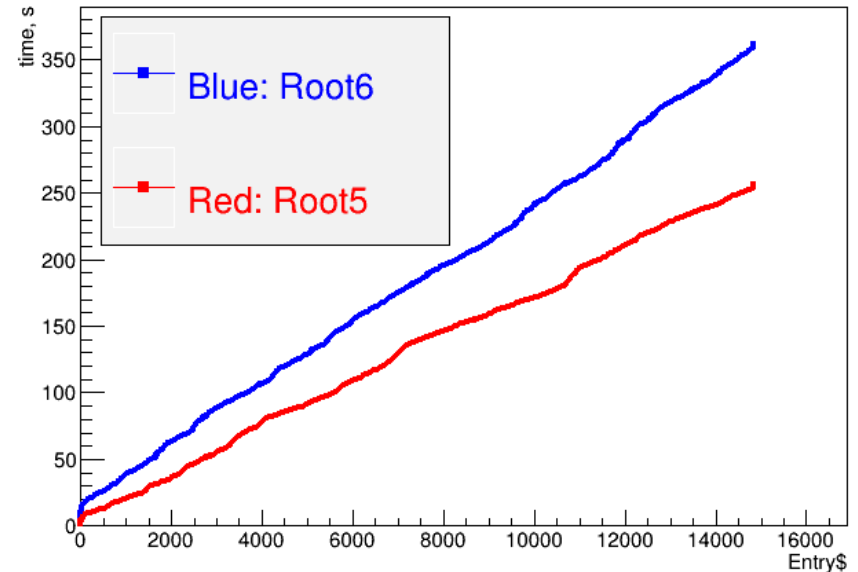
- Simulation of 200 min bias pp. events (Root6 faster)
  - Root6: 11949 s
  - Root5: 12388 s
- Reconstruction of the same events (Root6 slower)
  - Root6: 545 s
  - Root5: 455 s

# Reconstruction: memory and user CPU

Reconstruction of 200 pp ev.: resident memory

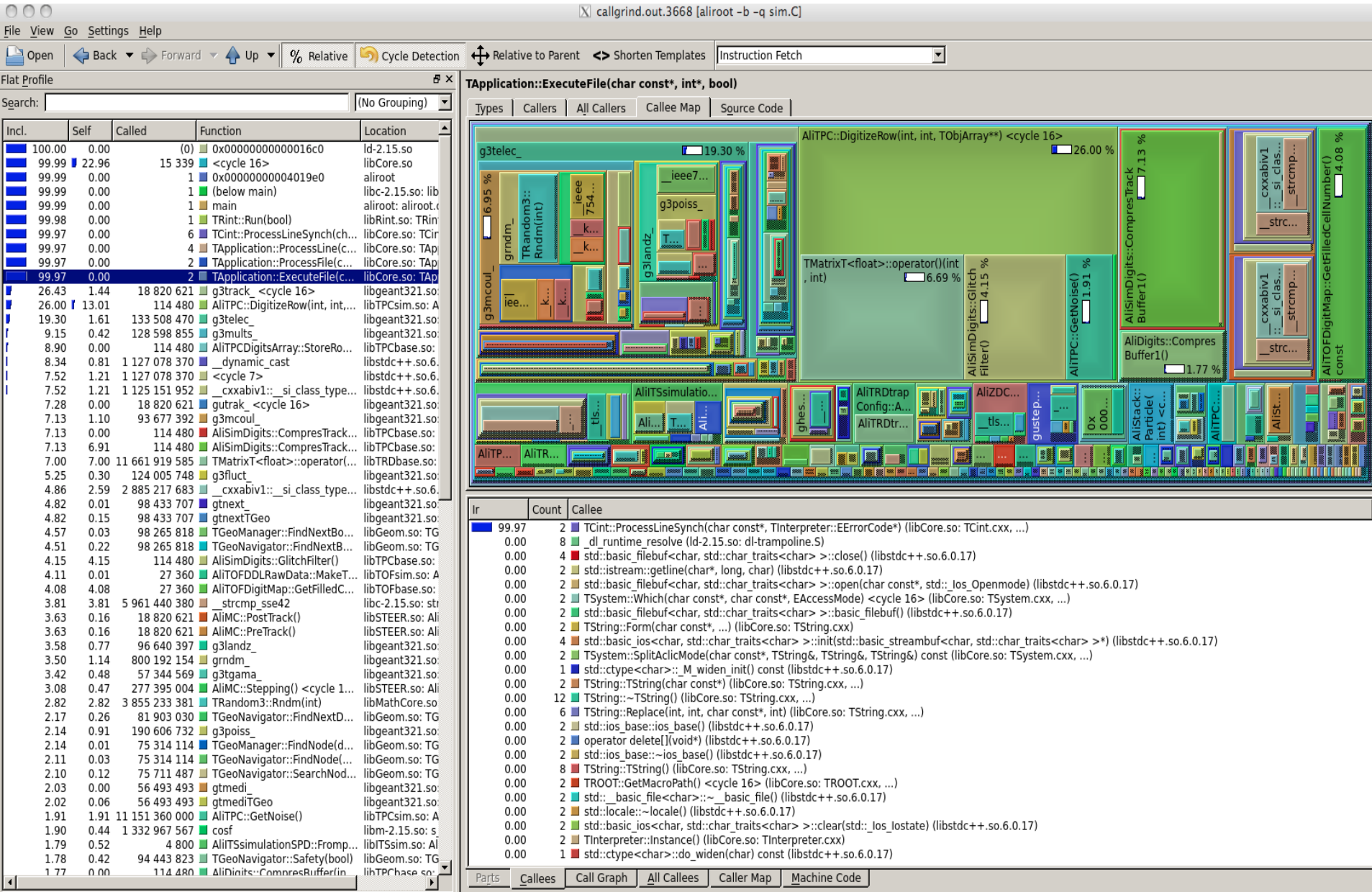


Reconstruction of 200 pp ev.: integrated CPU time, s

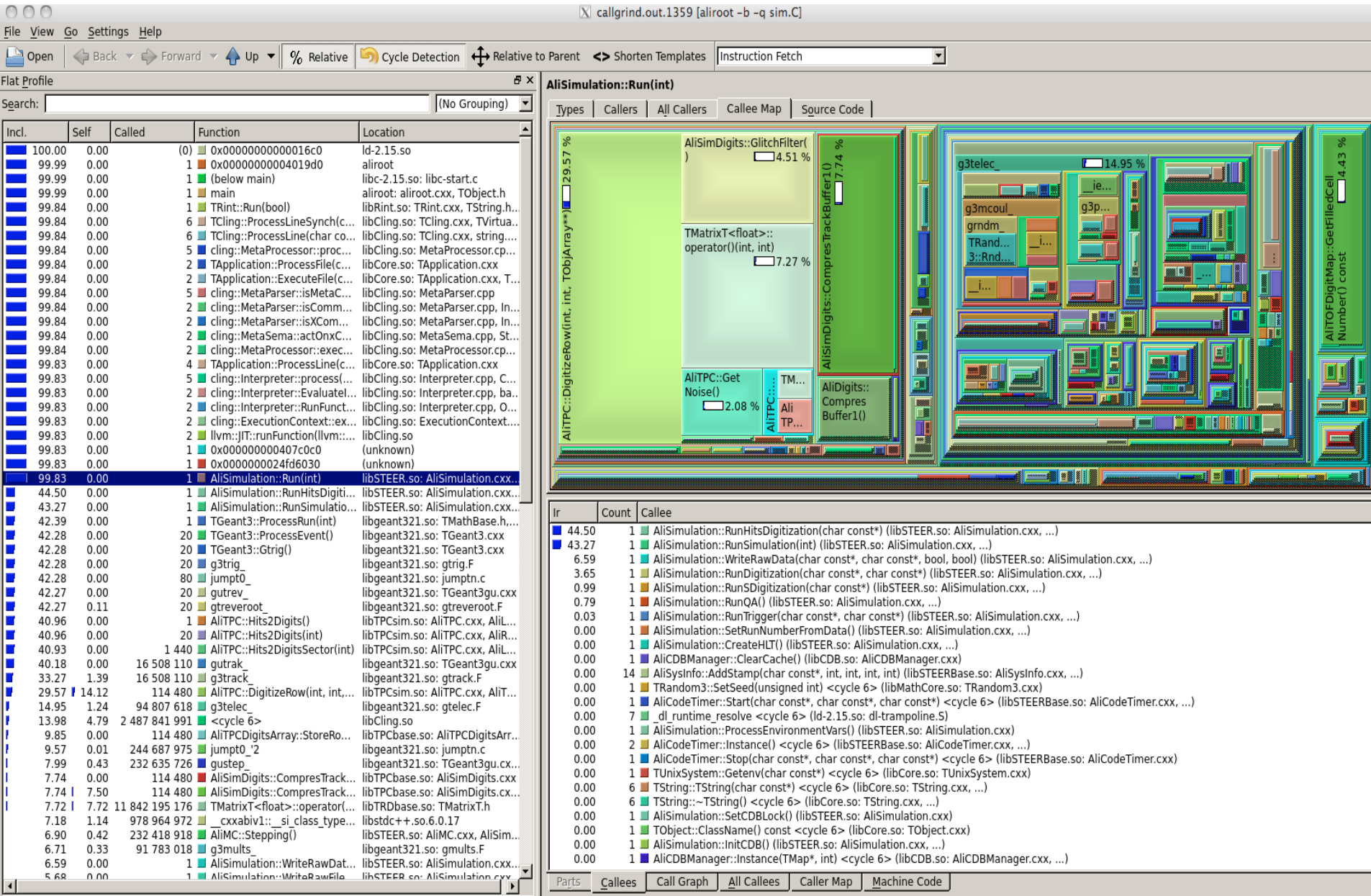


Inconsistency? It looks like we do not integrate all the CPU time.

# Simulation: Root5 (20pp ev.)



# Simulation: Root6 (20pp ev.)





# Reconstruction: Root5 (20pp ev.)

callgrind.out.9769 [alroot -b -q rec.]

File View Go Settings Help

Open Back Forward Up % Relative Cycle Detection Relative to Parent Shorten Templates Instruction Fetch

Flat Profile (No Grouping)

Incl	Self	Called	Function	Location
100.00	0.00	(0)	0x00000000000016c0	ld-2.15.so
99.60	19.26	15 990	<cycle 15>	libCore.so
99.40	0.00	1	0x000000000004019e0	alroot
99.40	0.00	1	(below main)	libc-2.15.so: libc-st
99.40	0.00	1	main	alroot: alroot.cxx,
99.29	0.00	1	TRint::Run(bool)	libRint.so: TRint.cx
99.04	0.00	6	TCint::ProcessLineSynch(ch...	libCore.so: TCint.co
99.04	0.00	4	TApplication::ProcessLineC...	libCore.so: TApplic
99.03	0.00	2	TApplication::ProcessFileC...	libCore.so: TApplic
99.03	0.00	2	TApplication::ExecuteFile(C...	libCore.so: TApplic
10.29	0.00	41 803	R_unzip	libCore.so: ZInflate
10.26	0.44	41 799	inflate	libz.so.1.2.7
7.86	0.06	158 606	AliTrackerBase::MeanMater...	libESD.so: AliTrack
7.20	0.00	527 116	TGeoManager::FindNextBo...	libGeom.so: TGeoM
7.19	0.05	527 116	TGeoNavigator::FindNextB...	libGeom.so: TGeoN
6.73	0.00	40 780	0x00000000000007840	libz.so.1.2.7
6.10	0.97	535 867	AliTPCClusterParam::QtotC...	libTPCrec.so: AliTP
5.98	0.00	702	AliMUONDigitMaker::Trigge...	libMUONbase.so: A
5.93	0.00	6 912	AliMUONLogger::Log(char c...	libMUONcore.so: A
5.31	0.01	45 081	TBasket::ReadBasketBuffer...	libTree.so: TBasket
5.14	2.10	33 759 621	AliTPCClusterParam::Gauss...	libTPCrec.so: AliTP
4.96	0.08	527 111	TGeoNavigator::FindNextD...	libGeom.so: TGeoN
4.70	0.00	3 973	TKey::ReadObj() <cycle 15>	libRIO.so: TKey.cxx
4.36	0.47	45 227 477	operator new(unsigned long)	libstdc++.so.6.0.1
4.18	0.00	15 947	R_zipMultipleAlgorithm	libCore.so: Bits.h
4.09	0.07	564 493	TGeoShapeAssembly::DistF...	libGeom.so: TGeoS
4.09	1.52	47 172 629	malloc	libc-2.15.so: mallo
4.06	0.00	15 947	deflate	libz.so.1.2.7
4.06	0.50	15 809	0x000000000000032d0	libz.so.1.2.7
3.56	0.00	6 912	AliMUONStringIntMap::Set(...)	libMUONcore.so: A
3.55	0.40	10 113	AliMUONStringIntMap::Get(...)	libMUONcore.so: A
3.42	0.47	34 740 653	TString::TString(TString co...	libCore.so: TString
3.40	0.08	752 979	TGeoShapeAssembly::DistF...	libGeom.so: TGeoS
3.08	0.09	32 083 519	operator new[](unsigned lo...	libstdc++.so.6.0.1
3.04	3.04	134 949	adler32	libz.so.1.2.7
2.82	0.11	265 791	<cycle 14>	libGeom.so
2.79	0.53	30 165 469	TString::Init(int, int)	libCore.so: TString
2.74	0.54	53 140 186	free	libc-2.15.so: mallo
2.68	0.10	49 679 985	operator delete(void*)	libstdc++.so.6.0.1
2.66	2.66	15 579 080	_GI_memset	libc-2.15.so: mems
2.57	2.50	47 175 945	_int_malloc	libc-2.15.so: mallo
2.38	0.58	10 159 168	TGeoXtru::DistToPlane(dou...	libGeom.so: TGeoX
2.37	0.27	6 912	AliMUONStringIntMap::Cont...	libMUONcore.so: A
2.28	0.15	35 708 772	exp	libm-2.15.so: w_ex
2.20	2.13	44 643 643	_int_free	libc-2.15.so: mallo
2.19	0.00	3 374	TKey::TKey(TObject const*, ...)	libRIO.so: TKey.cxx
2.18	0.02	41 958	TTF::LayoutGlyphs()	libGraf.so: TTF.cxx
2.13	1.66	468 832	0x00000000000002bd0	libz.so.1.2.7
2.13	2.12	35 708 717	_ieee754_exp_sse2	libm-2.15.so: e_ex
2.01	0.00	12 554	TBasket::WriteBuffer() <cy...	libTree.so: TBasket
1.98	0.11	244 730	TGeoXtru::DistFromOutside...	libGeom.so: TGeoX
1.98	0.02	31 730 139	operator delete[](void*)	libstdc++.so.6.0.1

Application::ExecuteFile(char const\*, int\*, bool)

Types Callers All Callers Callee Map Source Code

Ir Count Callee

99.03	2	TCint::ProcessLineSynch(char const*, TInterpreter::EErrorCode*) (libCore.so: TCint.cxx, ...)
0.00	8	_dl_runtime_resolve (ld-2.15.so: dl-trampoline.S)
0.00	4	std::basic_filebuf<char, std::char_traits<char> >::close() (libstdc++.so.6.0.17)
0.00	2	std::istream::getline(char*, long, char) (libstdc++.so.6.0.17)
0.00	2	std::basic_filebuf<char, std::char_traits<char> >::open(char const*, std::_ios_Openmode) (libstdc++.so.6.0.17)
0.00	2	TSystem::Which(char const*, char const*, EAccessMode) <cycle 15> (libCore.so: TSystem.cxx, ...)
0.00	2	std::basic_filebuf<char, std::char_traits<char> >::basic_filebuf() (libstdc++.so.6.0.17)
0.00	2	TString::Form(char const*, ...) (libCore.so: TString.cxx)
0.00	4	std::basic_ios<char, std::char_traits<char> >::init(std::basic_streambuf<char, std::char_traits<char> >) (libstdc++.so.6.0.17)
0.00	2	TSystem::SplitAclicMode(char const*, TString&, TString&) const (libCore.so: TSystem.cxx, ...)
0.00	1	std::ctype<char>::_M_widen_init() const (libstdc++.so.6.0.17)
0.00	2	TString::TString(char const*) (libCore.so: TString.cxx, ...)
0.00	12	TString::~TString() (libCore.so: TString.cxx, ...)
0.00	6	TString::Replace(int, int, char const*, int) (libCore.so: TString.cxx, ...)
0.00	2	std::ios_base::_ios_base() (libstdc++.so.6.0.17)
0.00	2	operator delete[](void*) (libstdc++.so.6.0.17)
0.00	2	std::ios_base::~_ios_base() (libstdc++.so.6.0.17)
0.00	8	TString::TString() (libCore.so: TString.cxx, ...)
0.00	2	TROOT::GetMacroPath() <cycle 15> (libCore.so: TROOT.cxx, ...)
0.00	2	std::_basic_file<char>::~_~_basic_file() (libstdc++.so.6.0.17)
0.00	2	std::locale::~_locale() (libstdc++.so.6.0.17)
0.00	2	std::basic_ios<char, std::char_traits<char> >::clear(std::_ios_state) (libstdc++.so.6.0.17)
0.00	2	TInterpreter::Instance() (libCore.so: TInterpreter.cxx)
0.00	1	std::ctype<char>::_do_widen(char) const (libstdc++.so.6.0.17)

Parts Callees Call Graph All Callees Caller Map Machine Code

callgrind.out.9769 [1] - Total Instruction Fetch Cost: 143 206 021 816

# Reconstruction: Root6 (20pp ev.)

callgrind.out.2678 [aliroot -b -q rec.c]

File View Go Settings Help

Open Back Forward Up % Relative Cycle Detection Relative to Parent Shorten Templates Instruction Fetch

Flat Profile

Search: (No Grouping)

Incl.	Self	Called	Function	Location
100.00	0.00	(0)	0x00000000000016c0	ld-2.15.so
99.74	0.00	1	0x00000000004019d0	aliroot
99.74	0.00	1	(below main)	libc-2.15.so: libc-start.c
99.74	0.00	1	main	aliroot: aliroot.cxx, TObject.h
95.90	0.00	1	TRint::Run(bool)	libRint.so: TRint.cxx, TString.h, T...
95.77	0.00	6	TCling::ProcessLineSynch(c...	libCling.so: TCling.cxx, TVirtualM...
95.77	0.00	6	TCling::ProcessLine(char co...	libCling.so: TCling.cxx, string.h, ...
95.77	0.00	5	cling::MetaProcessor::proc...	libCling.so: MetaProcessor.cpp, I...
95.76	0.00	2	TApplication::ProcessFile(c...	libCore.so: TApplication.cxx
95.76	0.00	2	TApplication::ExecuteFile(c...	libCore.so: TApplication.cxx, TSt...
95.76	0.00	5	cling::MetaParser::isMetaC...	libCling.so: MetaParser.cpp
95.76	0.00	2	cling::MetaParser::isComm...	libCling.so: MetaParser.cpp, Intr...
95.76	0.00	2	cling::MetaParser::isXCom...	libCling.so: MetaParser.cpp, Intr...
95.76	0.00	2	cling::MetaSema::actOnxC...	libCling.so: MetaSema.cpp, Strin...
95.76	0.00	2	cling::MetaProcessor::exec...	libCling.so: MetaProcessor.cpp, ...
95.76	0.00	4	TApplication::ProcessLine(c...	libCore.so: TApplication.cxx
95.75	0.00	5	cling::Interpreter::process(...	libCling.so: Interpreter.cpp, Com...
95.75	0.00	2	cling::Interpreter::Evaluate...	libCling.so: Interpreter.cpp, basi...
95.75	0.00	2	cling::Interpreter::RunFunc...	libCling.so: Interpreter.cpp, Own...
95.75	0.00	2	cling::ExecutionContext::ex...	libCling.so: ExecutionContext.cp...
95.74	0.00	2	llvm::JIT::runFunction(llvm...	libCling.so
95.74	0.00	1	0x0000000000407c0c0	(unknown)
95.74	0.00	1	0x00000000024fd6030	(unknown)
95.73	0.00	1	AliReconstruction::Run(char...	libSTEER.so: AliReconstruction.c...
63.19	0.00	20	AliReconstruction::ProcessE...	libSTEER.so: AliReconstruction.c...
45.23	5.97	52 512 183	<cycle 60>	libCling.so
36.97	0.00	40	AliReconstruction::RunLocal...	libSTEER.so: AliReconstruction.c...
16.02	0.00	1	AliReconstruction::Begin(TT...	libSTEER.so: AliReconstruction.c...
15.66	0.00	20	AliReconstruction::RunTrack...	libSTEER.so: AliReconstruction.c...
14.95	0.00	20	AliTPCReconstructor::Recon...	libTPCrec.so: AliTPCReconstruct...
14.95	0.07	20	AliTPCClusterer::Digits2Clu...	libTPCrec.so: AliTPCclusterer.cxx...
12.11	0.00	1	AliReconstruction::LoadCDB()	libSTEER.so: AliReconstruction.c...
12.02	0.00	32	AliCDBManager::GetAll(AliC...	libCDB.so: AliCDBManager.cxx
12.02	0.00	32	AliCDBManager::GetAll(AliC...	libCDB.so: AliCDBManager.cxx, ...
11.96	0.22	7 549 115	TBranch::GetEntry(long lon...	libTree.so: TBranch.cxx, TBuffer...
11.81	0.06	819 364	TBranchElement::GetEntry(...	libTree.so: TBranchElement.cxx, ...
11.65	0.00	32	AliCDBStorage::GetAll(AliC...	libCDB.so: AliCDBStorage.cxx, A...
11.65	0.00	32	AliCDBLocal::GetEntries(Ali...	libCDB.so: AliCDBLocal.cxx, TStr...
11.64	0.00	32	AliCDBLocal::GetEntriesFor...	libCDB.so: AliCDBLocal.cxx, TStr...
11.64	0.00	31	AliCDBLocal::GetEntriesFor...	libCDB.so: AliCDBLocal.cxx, TStr...
10.31	10.31	18 432 342	_GI_memset	libc-2.15.so: memset.S
10.12	0.23	7 721 636	TBranchElement::GetEntry(...	libTree.so: TBranchElement.cxx, ...
9.90	0.00	1	AliReconstruction::SlaveTer...	libSTEER.so: AliReconstruction.c...
9.84	0.01	322 835	TTree::GetEntry(long long, i...	libTree.so: TTree.cxx, TObject.h
9.32	0.00	860	AliQADDataMakerRec::Exec(...	libSTEER.so: AliQADDataMakerRe...
9.12	0.00	46 051	R_unzip	libCore.so: ZInflate.c, stdio2.h
9.10	0.37	46 047	inflate	libz.so.1.2.7
9.03	0.00	560	AliQAManager::RunOneEve...	libSTEER.so: AliQAManager.cxx, ...
7.36	0.00	1	AliQAManager::EndOfCycle...	libSTEER.so: AliQAManager.cxx, ...
7.28	0.00	45	AliQADDataMakerRec::EndOf...	libSTEER.so: AliQADDataMakerRe...
6.64	0.00	114 480	AliSimDigits::ExpandTrackB...	libTPCbase.so: AliSimDigits.cxx
6.64	0.45	114 480	AliSimDigits::ExpandTrackB...	libTPCbase.so: AliSimDigits.cxx, ...
6.61	0.03	7 981	TDataMember::TDataMem...	libCore.so: TDataMember.cxx, T...

AliReconstruction::Run(char const\*)

Types Callers All Callers Callee Map Source Code

lr	Count	Callee
63.19	20	AliReconstruction::ProcessEvent(int) (libSTEER.so: AliReconstruction.cxx, ...)
16.02	1	AliReconstruction::Begin(TTree*) (libSTEER.so: AliReconstruction.cxx, ...)
9.90	1	AliReconstruction::SlaveTerminate() (libSTEER.so: AliReconstruction.cxx, ...)
4.37	1	AliReconstruction::SlaveBegin(TTree*) (libSTEER.so: AliReconstruction.cxx, ...)
1.79	1	AliReconstruction::InitRun(char const*) (libSTEER.so: AliReconstruction.cxx, ...)
0.44	1	AliReconstruction::Terminate() (libSTEER.so: AliReconstruction.cxx, ...)
0.02	20	AliReconstruction::CleanProcessedEvent() (libSTEER.so: AliReconstruction.cxx, ...)
0.00	21	AliRunLoader::GetNumberOfEvents() (libSTEER.so: AliRunLoader.cxx)
0.00	1	AliCodeTimer::Start(char const*, char const*, char const*) <cycle 60> (libSTEERBase.so: AliCodeTimer.cxx, ...)
0.00	6	_dl_runtime_resolve (ld-2.15.so: dl-trampoline.S)
0.00	2	AliCodeTimer::Instance() (libSTEERBase.so: AliCodeTimer.cxx, ...)
0.00	1	AliLog::Message(unsigned int, char const*, char const*, char const*, char const*, int) <cycle 60> (libSTEERBase.so: AliLog.cxx, ...)
0.00	1	AliCodeTimer::Stop(char const*, char const*, char const*) <cycle 60> (libSTEERBase.so: AliCodeTimer.cxx)
0.00	20	AliReconstruction::HasEnoughResources(int) (libSTEER.so: AliReconstruction.cxx)
0.00	3	TString::TString(char const*) (libCore.so: TString.cxx, ...)
0.00	3	TString::~~TString() (libCore.so: TString.cxx, ...)
0.00	2	TObject::ClassName() const <cycle 60> (libCore.so: TObject.cxx)
0.00	5	TSelector::GetAbort() const (libSTEER.so: TSelector.h)

Parts Callee Call Graph All Callee Caller Map Machine Code

callgrind.out.2678 [1] - Total Instruction Fetch Cost: 204 591 877 987

# Plans

- More comparisons and performance studies:
  - Using predefined kinematics tree in the simulation and the same digits/raw in the reconstruction
  - Using PbPb benchmark
  - Using real data (pp, PbPb, pPb)
- Solve the performance issues (if they are confirmed)
- GRID test with Root6: simulation and reconstruction
- GRID test: analysis train
- Profit from these studies to improve AliRoot

# Conclusions

- We are ready to test Root6 in production
- The transition to Root6 will depend on the results of the tests
- Everybody is encouraged to try Root6 in “test mode”