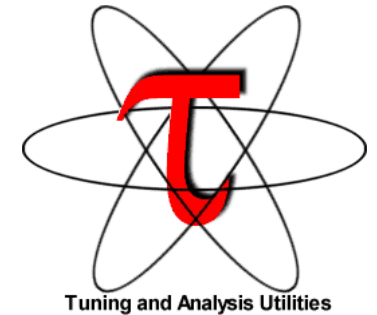


TAU Performance System®



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https://tau.uoregon.edu/TAU_TW50.pdf

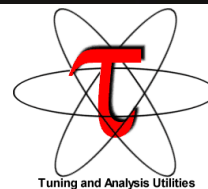
Wouldn't it be nice if we could ...

- Instrument and measure performance of MPI and CUDA/ROCm/SYCL/OpenMP applications with:
 - No change to the source code
 - No change to the build system
 - No change to the application binary!

And get detailed performance data with the functionality of the tools we are already familiar with like MAQAO, Vampir, Likwid, Score-P, Scalasca, CUBE, PAPI, Perfetto.dev...

A unifying framework: TAU

TAU Performance System®



- ⑩ Versatile profiling and tracing toolkit that supports:
 - ✧ MPI, CUDA, ROCm, DPC++/SYCL (Level Zero), OpenCL, OpenMP (OpenMP Tools Interface for Target Offload), OpenSHMEM
- ⑩ Scalable, portable, performance evaluation toolkit for HPC and AI/ML workloads that supports:
 - ✧ C++/C/DPC++, Fortran, Python, Julia
- ⑩ Supports PAPI, Likwid for hardware performance counter information
- ⑩ Instrumentation includes support for PETSc (Perfstubs), GPTL, PhiProf, XGC (CAMTIMERS), Kokkos, MPI, pthread, event-based sampling, GPU runtimes
- ⑩ A single tool (tau_exec) is used to launch un-instrumented, un-modified binaries
- ⑩ TAU's paraprof, pprof, perfexplorer for profile analysis; Vampir, Jumpshot, Perfetto.dev for traces
- ⑩ <https://tau.uoregon.edu>

TAU Performance System®

- Simple tool
 - No change to the application source code
 - No change to its build system
 - No change to its executable
 - Simply launch the application binary with `tau_exec`
- Works with MAQAO, OTF2/Vampir, Perfetto.dev
- paraprof and perfexplorer: GUI tools
- pprof: text based browser
- Open Source: BSD style license

Application Performance Engineering using TAU

- How much time is spent in each application routine and outer *loops*? Within loops, what is the contribution of each *statement*? What is the time spent in OpenMP loops? In kernels on GPUs and at the level of each statement inside GPU kernels.
- How many instructions are executed in these code regions? Using Likwid or PAPI, TAU measures floating point, Level 1 and 2 *data cache misses*, hits, branches taken. Accessing counters on both CPUs and GPUs.
- What is the time taken in OS routines for thread scheduling? How much time is wasted?
- How much time did my application waste waiting at a barrier in an MPI collective operation?
- What is the memory usage of the code? When and where is memory allocated/de-allocated? Are there any memory leaks? What is the memory footprint of the application? What is the memory high water mark?
- What are the I/O characteristics of the code? What is the peak read and write *bandwidth* of individual calls, total volume?
- What is the contribution of each *phase* of the program? What is the time wasted/spent waiting for collectives, and I/O operations in Initialization, Computation, I/O phases?
- How does the application *scale*? What is the efficiency, runtime breakdown of performance across different core counts?

TAU: Quickstart Guide

Profiling:

MPI: `% mpirun -np 16 tau_exec -ebs ./a.out`

- Pthread: `% mpirun -np 16 tau_exec -T mpi,pthread -ebs ./a.out`
- CUDA: `% mpirun -np 16 tau_exec -T cupti,mpi -cupti -ebs ./a.out`
- ROCm: `% mpirun -np 16 tau_exec -T rocm,mpi -rocm -ebs ./a.out`
- Intel Level Zero: `% mpirun -np 16 tau_exec -T l0,mpi -l0 -ebs ./a.out`
- Python: `% tau_python ./foo.py`

Analysis: `% pprof -a -m | more;` `% paraprof (GUI)`

Tracing:

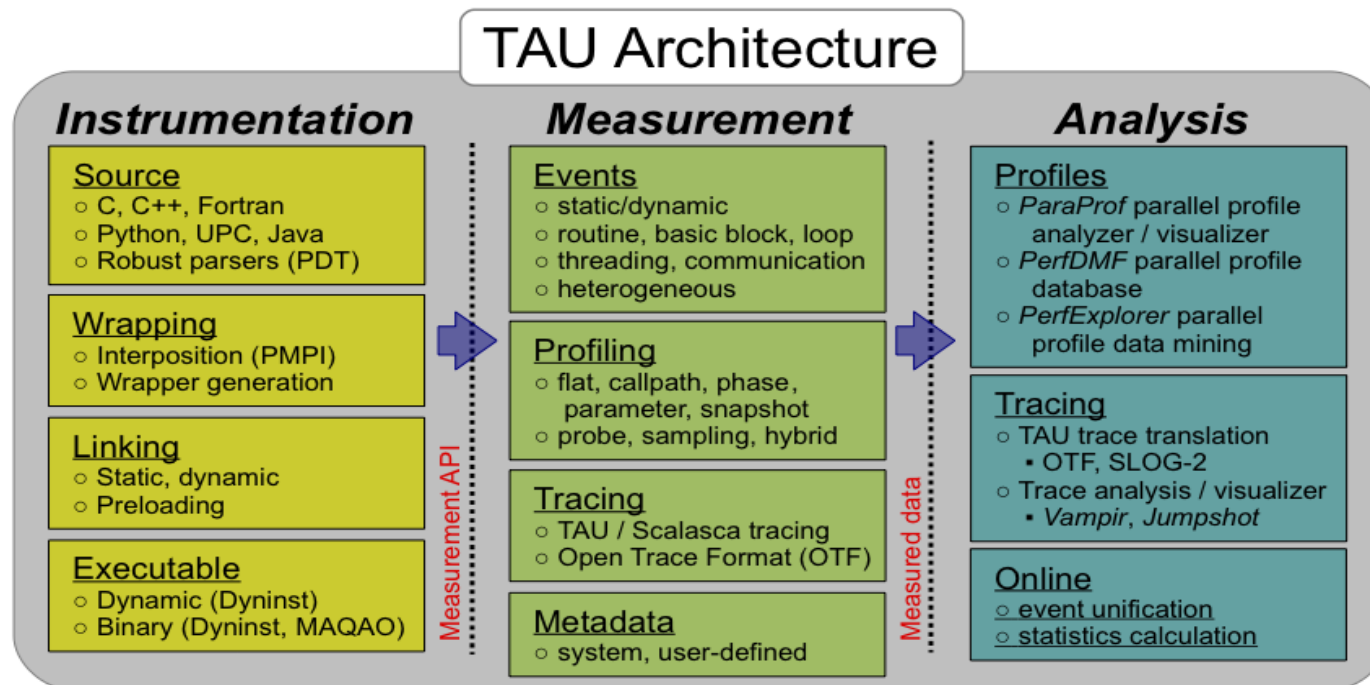
Vampir: MPI: `% export TAU_TRACE=1; export TAU_TRACE_FORMAT=otf2`
`% mpirun -np 16 tau_exec ./a.out; vampir traces.otf2 &`

Perfetto.dev: `% export TAU_TRACE=1; export TAU_FORMAT=perfetto;`
`mpirun -np 16 tau_exec ./a.out; firefox https://perfetto.dev load tau.perfetto.gz`

Jumpshot: `% export TAU_TRACE=1; mpirun -np 16 tau_exec [Options] ./a.out;`
`% tau_treemerge.pl; tau2slog2 tau.trc tau.edf -o app.slog2; jumpshot app.slog2 &`

TAU Performance System®

- Parallel performance framework and toolkit
 - Supports all HPC platforms, compilers, runtime system
 - Provides portable instrumentation, measurement, analysis



TAU Performance System®

- Instrumentation
 - Fortran, C++, C, UPC, Java, Python, Chapel, Julia
 - Automatic instrumentation
- Measurement and analysis support
 - MPI, OpenSHMEM, ARMCI, PGAS, DMAPP
 - pthreads, OpenMP, OMPT interface, hybrid, other thread models
 - GPU, CUDA, OpenCL, OpenACC, ROCm, HIP
 - Parallel profiling and tracing
 - Use of Score-P for native OTF2 and CUBEX generation
 - Efficient callpath profiles and trace generation using Score-P
- Analysis
 - Parallel profile analysis (ParaProf), data mining (PerfExplorer)
 - Performance database technology (TAUdb)
 - 3D profile browser

Instrumentation

Add hooks in the code to perform measurements

- **Source instrumentation using a preprocessor**
 - Add timer start/stop calls in a copy of the source code.
 - Use Program Database Toolkit (PDT) for parsing source code.
 - Requires recompiling the code using TAU shell scripts (tau_cc.sh, tau_f90.sh)
 - Selective instrumentation (filter file) can reduce runtime overhead and narrow instrumentation focus.
- **Compiler-based instrumentation**
 - Use system compiler to add a special flag to insert hooks at routine entry/exit.
 - Requires recompiling using TAU compiler scripts (tau_cc.sh, tau_f90.sh...)
- **Runtime preloading of TAU's Dynamic Shared Object (DSO)**
 - No need to recompile code! Use **mpirun tau_exec ./app**
- **Rewriting binary and shared libraries**
 - MAQAO based tau_rewrite
 - DyninstAPI based tau_run

TAU's Support for Runtime Systems

- *MPI*
 - PMPI profiling interface
 - MPI_T tools interface using performance and control variables
 - MPI Collective Sync time: time in an implicit barrier in MPI collective operations
- *Pthread*
 - Captures time spent in routines per thread of execution
- *OpenMP*
 - OMPT tools interface to track salient OpenMP runtime events
 - Opari source rewriter
 - Preloading wrapper OpenMP runtime library when OMPT is not supported
- *Intel Level Zero*
 - Captures time spent in kernels on GPUs using oneAPI Level Zero
 - Captures time spent in Intel Level Zero runtime calls
- *OpenACC*
 - OpenACC instrumentation API
 - Track data transfers between host and device (per-variable)
 - Track time spent in kernels

TAU's Support for Runtime Systems (contd.)

- *OpenCL*
 - OpenCL profiling interface
 - Track timings of kernels
- *CUDA*
 - Cuda Profiling Tools Interface (CUPTI)
 - Track data transfers between host and GPU
 - Track access to uniform shared memory between host and GPU
- *ROCm*
 - Rocprofiler and Roctracer instrumentation interfaces
 - Track data transfers and kernel execution between host and GPU
- *Kokkos*
 - Kokkos profiling API
 - Push/pop interface for region, kernel execution interface
- *Python*
 - Python interpreter instrumentation API
 - Tracks Python routine transitions as well as Python to C transitions
- *Julia*
 - Julia instrumentation at the compiler/IR level to rewrite code, manual to track time in Julia code

Examples of Multi-Level Instrumentation

- *MPI + OpenMP*
 - MPI_T + PMPI + OMPT may be used to track MPI and OpenMP
- *MPI + CUDA*
 - PMPI + CUPTI interfaces
- *OpenCL + ROCm*
 - Rocprofiler + OpenCL instrumentation interfaces
- *Kokkos + OpenMP*
 - Kokkos profiling API + OMPT to transparently track events
- *Kokkos + pthread + MPI*
 - Kokkos + pthread wrapper interposition library + PMPI layer
- *Python + CUDA*
 - Python + CUPTI + pthread profiling interfaces (e.g., Tensorflow, PyTorch)
- *MPI + OpenCL*
 - PMPI + OpenCL profiling interfaces

Using TAU's Runtime Preloading Tool: `tau_exec`

- Preload a wrapper that intercepts the runtime system call and substitutes with another
 - MPI
 - OpenMP
 - POSIX I/O
 - Memory allocation/deallocation routines
 - Wrapper library for an external package
- No modification to the binary executable!
- Enable other TAU options (communication matrix, OTF2, event-based sampling)

TAU Execution Command (tau_exec) for uninstrumented executables

- Uninstrumented execution
 - % mpirun -np 256 ./a.out
- Track GPU operations
 - % mpirun -np 256 **tau_exec** **-rocm** ./a.out (-rocm_pc for PC sampling on GPU)
 - % mpirun -np 256 **tau_exec** **-cupti** ./a.out (-cupti_pc for PC sampling on GPU)
 - % mpirun -np 256 **tau_exec** **-cupti -um** ./a.out (for Unified Memory) (-cupti_pc for PC sampling on GPU, elevated privilege)
 - % mpirun -np 256 **tau_exec** **-l0** ./a.out (-l0_pc for PC sampling on GPU)
 - % mpirun -np 256 **tau_exec** **-opencl** ./a.out
 - % mpirun -np 256 **tau_exec** **-openacc** ./a.out
- Track MPI performance
 - % mpirun -np 256 **tau_exec** ./a.out
- Track I/O, and MPI performance (MPI enabled by default)
 - % mpirun -np 256 **tau_exec** **-io** ./a.out
- Track OpenMP and MPI execution (using OMPT for Intel or LLVM compilers that support OMPT)
 - % export TAU_OMPT_SUPPORT_LEVEL=**full**;
 - % mpirun -np 256 **tau_exec** **-T ompt,mpi -ompt** ./a.out
- Use event based sampling (compile with -g)
 - % mpirun -np 256 **tau_exec** **-ebs** ./a.out
 - Also export TAU_METRICS=TIME,PAPI_L1_DCM... -ebs_resolution=<file | function | line>
 - export TAU_METRICS=ROCM_|L0|CUPTI_<GPU_metric> for access to GPU counters

Example: TAU Configuration on Grete (GWDG)

```
% salloc -N 1 -n 8 -G A100:4 -t 0:50:00 -p grete:shared --reservation=vi-hps-tuning --x11
% module use $PROJECT/modules; module load tau; cd $TAU;
% pwd
/projects/intern/gwdg_training/tr_20260831-vi-hps-tuning/dir.project/software/tau/tau2/x86_64/lib
% ls Makefile*
Makefile.tau-emmy-p3-gcc1420-openmpi417-papi-mpi-pdt
Makefile.tau-papi-mpi-pthread-cupti-pdt
Makefile.tau-papi-pthread-cupti-pdt
```

For an uninstrumented binary:

```
% mpirun -np 4 tau_exec -T cupti,mpi -cupti -ebs ./a.out
Picks the configuration represented by
/projects/intern/gwdg_training/tr_20260831-vi-hps-tuning/dir.project/software/tau/tau2/x86_64/lib/
Makefile.tau-papi-mpi-pthread-cupti-pdt
```

```
% pprof -a | more
% paraprof
% paraprof --pack foo.ppk
# Copy it to your local machine and launch: % paraprof foo.ppk
```

Configurations available on CoolMuc2, LRZ

```
% module use /lrz/sys/courses/vihps/2024/modulefiles/
% module load tau
% ls $TAU/Makefile*
/lrz/sys/courses/vihps/2024/tools/tau/tau-2.33.2/x86_64/lib/Makefile.tau-intel-papi-mpi-pdt-scorep
/lrz/sys/courses/vihps/2024/tools/tau/tau-2.33.2/x86_64/lib/Makefile.tau-intel-papi-mpi-pthread-pdt
/lrz/sys/courses/vihps/2024/tools/tau/tau-2.33.2/x86_64/lib/Makefile.tau-intel-papi-ompt-mpi-pdt-openmp
/lrz/sys/courses/vihps/2024/tools/tau/tau-2.33.2/x86_64/lib/Makefile.tau-papi-mpi-pdt
/lrz/sys/courses/vihps/2024/tools/tau/tau-2.33.2/x86_64/lib/Makefile.tau-papi-pdt
/lrz/sys/courses/vihps/2024/tools/tau/tau-2.33.2/x86_64/lib/Makefile.tau-papi-pthread-pdt
/lrz/sys/courses/vihps/2024/tools/tau/tau-2.33.2/x86_64/lib/Makefile.tau-papi-tbb-pdt
For an uninstrumented binary:
% mpirun -np 16 tau_exec -T mpi,scorep ./a.out
Picks the configuration represented by
/lrz/sys/courses/vihps/2024/tools/tau/tau-2.33.2/x86_64/lib/Makefile.tau-intel-papi-mpi-pdt-scorep
To use OpenMP instrumentation:
% export TAU_OMPT_SUPPORT_LEVEL=full
% export OMP_NUM_THREADS=<N>
% mpirun -np 16 tau_exec -T ompt,mpi -ompt -ebs ./a.out

% pprof -a | more
% paraprof
% paraprof --pack foo.ppk
# Copy it to your local machine and launch: % paraprof foo.ppk
```

Configuration tags for tau_exec

```
% ./configure -pdt=<dir> -mpi -papi=<dir>; make install
Creates in $TAU:
Makefile.tau-papi-mpi-pdt (Configuration parameters in stub makefile)
shared-papi-mpi-pdt/libTAU.so

% ./configure -pdt=<dir> -mpi; make install creates
Makefile.tau-mpi-pdt
shared-mpi-pdt/libTAU.so

To explicitly choose preloading of shared-<options>/libTAU.so change:
% mpirun -np 256 ./a.out to
% mpirun -np 256 tau_exec -T <comma_separated_options> ./a.out

% mpirun -np 256 tau_exec -T papi,mpi,pdt ./a.out
Preloads $TAU/shared-papi-mpi-pdt/libTAU.so
% mpirun -np 256 tau_exec -T papi ./a.out
Preloads $TAU/shared-papi-mpi-pdt/libTAU.so by matching.
% aprun -n 256 tau_exec -T papi,mpi,pdt -s ./a.out
Does not execute the program. Just displays the library that it will preload if executed without the -s option.
NOTE: -mpi configuration is selected by default. Use -T serial for
Sequential programs.
```

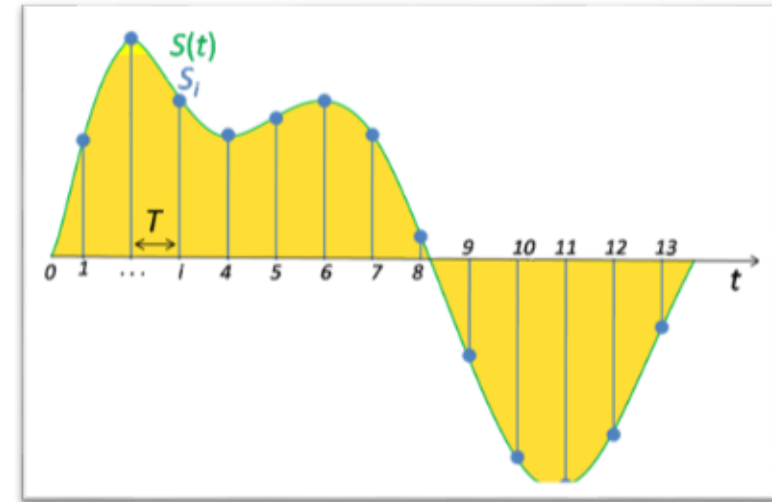
Performance Data Measurement

Direct via Probes

```
Call START('potential')  
// code  
Call STOP('potential')
```

- Exact measurement
- Fine-grain control
- Calls inserted into code

Indirect via Sampling



- No code modification
- Minimal effort
- Relies on debug symbols (**-g**)

Types of Performance Profiles

- *Flat* profiles
 - Metric (e.g., time) spent in an event
 - Exclusive/inclusive, # of calls, child calls, ...
- *Callpath* profiles
 - Time spent along a calling path (edges in callgraph)
 - “*main*=> *f1* => *f2* => *MPI_Send*”
 - Set the **TAU_CALLPATH** and **TAU_CALLPATH_DEPTH** environment variables
- *Callsite* profiles
 - Time spent along in an event at a given source location
 - Set the **TAU_CALLSITE** environment variable
- *Phase* profiles
 - Flat profiles under a phase (nested phases allowed)
 - Default “main” phase
 - Supports static or dynamic (e.g. per-iteration) phases

Binary rewriting of libraries: DyninstAPI work in progress, use E4S

- `% tau_run a.out -o a.inst`
instruments a binary. Other flags `-T <tags>`, `-f <selective instrumentation file>`
- `% tau_run -l /path/to/libhdf5.so.310 -o libhdf5.so.310`
instruments a DSO
- `% tau_exec ./a.out`
executes the uninstrumented application with the instrumented shared object.
- Works on x86_64 with `-g` (`-O2` has issues)

Binary rewriting of executables: MAQAO

- `% tau_rewrite a.out -o a.inst`

instruments a binary. Other flags `-T <tags>`, `-f <selective instrumentation file>`

- `% mpirun -np 4 ./a.inst`

executes the uninstrumented application with function level instrumentation.

Installing TAU on your laptop for paraprof (GUI)

▪ Microsoft Windows

- Install Java from Oracle.com
- <http://tau.uoregon.edu/tau.exe>
- Install, click on a ppk file to launch paraprof

▪ macOS

- Install Java 11.0.3:
 - Download <http://tau.uoregon.edu/java.dmg>
 - If you have multiple Java installations, add to your ~/.zshrc (or ~/.bashrc as appropriate):
 - export PATH=/Library/Java/JavaVirtualMachines/jdk-11.0.3.jdk/Contents/Home/bin:\$PATH
 - java -version
- Download and install TAU (copy to /Applications from dmg):
 - <http://tau.uoregon.edu/tau.dmg>
 - export PATH=/Applications/TAU/tau/apple/bin:\$PATH
 - paraprof app.ppk &
- macOS (arm64, M1/M2)
 - http://tau.uoregon.edu/java_arm64.dmg
 - http://tau.uoregon.edu/tau_arm64.dmg
- Linux (<http://tau.uoregon.edu/tau.tgz>)
 - ./configure; make install; export PATH=<taudir>/x86_64/bin:\$PATH
 - paraprof app.ppk &

TAU's Runtime Environment Variables

Environment Variable	Default	Description
TAU_TRACE	0	Setting to 1 turns on tracing
TAU_CALLPATH	0	Setting to 1 turns on callpath profiling
TAU_TRACK_MEMORY_FOOTPRINT	0	Setting to 1 turns on tracking memory usage by sampling periodically the resident set size and high water mark of memory usage
TAU_TRACK_POWER	0	Tracks power usage by sampling periodically.
TAU_CALLPATH_DEPTH	2	Specifies depth of callpath. Setting to 0 generates no callpath or routine information, setting to 1 generates flat profile and context events have just parent information (e.g., Heap Entry: foo)
TAU_SAMPLING	1	Setting to 1 enables event-based sampling.
TAU_TRACK_SIGNALS	0	Setting to 1 generate debugging callstack info when a program crashes
TAU_COMM_MATRIX	0	Setting to 1 generates communication matrix display using context events
TAU_THROTTLE	1	Setting to 0 turns off throttling. Throttles instrumentation in lightweight routines that are called frequently
TAU_THROTTLE_NUMCALLS	100000	Specifies the number of calls before testing for throttling
TAU_THROTTLE_PERCALL	10	Specifies value in microseconds. Throttle a routine if it is called over 100000 times and takes less than 10 usec of inclusive time per call
TAU_CALLSITE	0	Setting to 1 enables callsite profiling that shows where an instrumented function was called. Also compatible with tracing.
TAU_PROFILE_FORMAT	Profile	Setting to “merged” generates a single file. “snapshot” generates xml format

Runtime Environment Variables

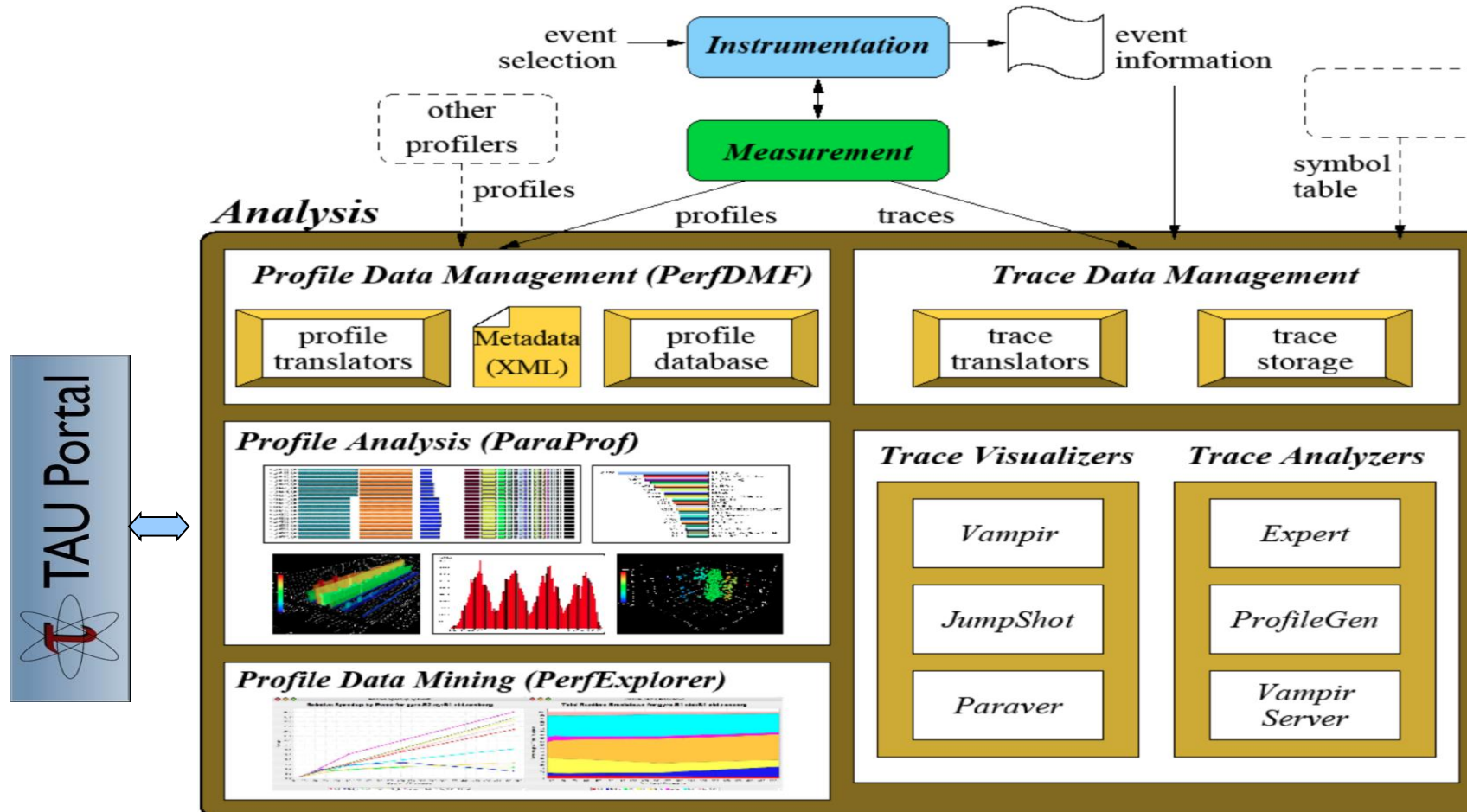
Environment Variable	Default	Description
TAU_METRICS	TIME	Setting to a comma separated list generates other metrics. (e.g., ENERGY,TIME,P_VIRTUAL_TIME,PAPI_FP_INS,PAPI_NATIVE_<event>:<subevent>)
TAU_TRACE	0	Setting to 1 turns on tracing
TAU_TRACE_FORMAT	Default	Setting to “otf2” turns on TAU’s native OTF2 trace generation (configure with –otf=download)
TAU_EBS_UNWIND	0	Setting to 1 turns on unwinding the callstack during sampling (use with tau_exec –ebs or TAU_SAMPLING=1)
TAU_EBS_RESOLUTION	line	Setting to “function” or “file” changes the sampling resolution to function or file level respectively.
TAU_TRACK_LOAD	0	Setting to 1 tracks system load on the node
TAU_SELECT_FILE	Default	Setting to a file name, enables selective instrumentation based on exclude/include lists specified in the file.
TAU_OMPT_SUPPORT_LEVEL	basic	Setting to “full” improves resolution of OMPT TR6 regions on threads 1.. N-1. Also, “lowoverhead” option is available.
TAU_OMPT_RESOLVE_ADDRESS_EAGERLY	1	Setting to 1 is necessary for event based sampling to resolve addresses with OMPT. Setting to 0 allows the user to do offline address translation.
TAU_EVENT_THRESHOLD	0.5	Define a threshold value (e.g., .25 is 25%) to trigger marker events for min/max

Runtime Environment Variables

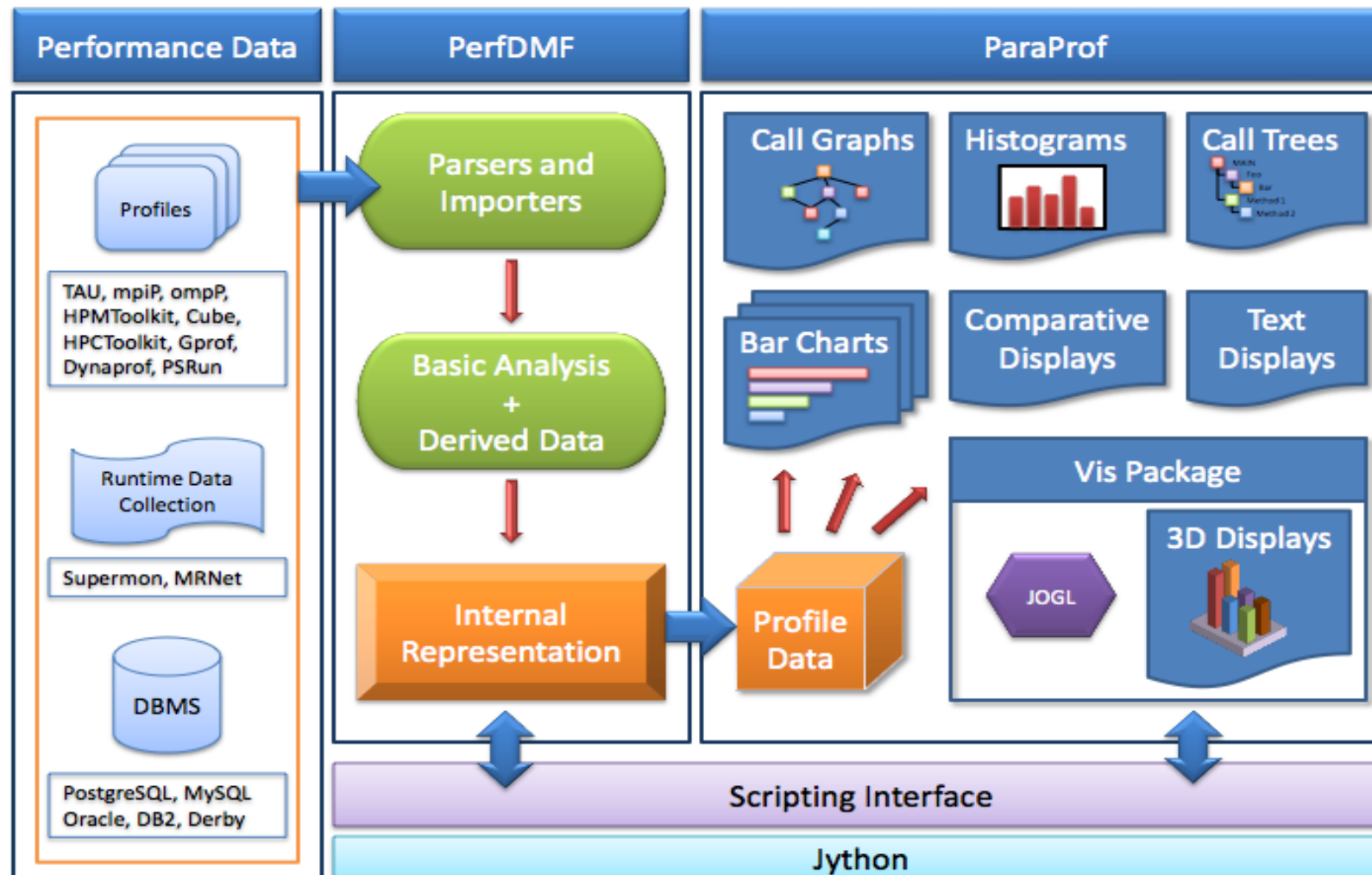
Environment Variable	Default	Description
TAU_TRACK_MEMORY_LEAKS	0	Tracks allocates that were not de-allocated (needs <code>–optMemDbg</code> or <code>tau_exec –memory</code>)
TAU_EBS_SOURCE	TIME	Allows using PAPI hardware counters for periodic interrupts for EBS (e.g., <code>TAU_EBS_SOURCE=PAPI_TOT_INS</code> when <code>TAU_SAMPLING=1</code>)
TAU_EBS_PERIOD	100000	Specifies the overflow count for interrupts
TAU_MEMDBG_ALLOC_MIN/MAX	0	Byte size minimum and maximum subject to bounds checking (used with <code>TAU_MEMDBG_PROTECT_*</code>)
TAU_MEMDBG_OVERHEAD	0	Specifies the number of bytes for TAU’s memory overhead for memory debugging.
TAU_MEMDBG_PROTECT_BELOW/ABOVE	0	Setting to 1 enables tracking runtime bounds checking below or above the array bounds (requires <code>–optMemDbg</code> while building or <code>tau_exec –memory</code>)
TAU_MEMDBG_ZERO_MALLOC	0	Setting to 1 enables tracking zero byte allocations as invalid memory allocations.
TAU_MEMDBG_PROTECT_FREE	0	Setting to 1 detects invalid accesses to deallocated memory that should not be referenced until it is reallocated (requires <code>–optMemDbg</code> or <code>tau_exec –memory</code>)
TAU_MEMDBG_ATTEMPT_CONTINUE	0	Setting to 1 allows TAU to record and continue execution when a memory error occurs at runtime.
TAU_MEMDBG_FILL_GAP	Undefined	Initial value for gap bytes
TAU_MEMDBG_ALINGMENT	Sizeof(int)	Byte alignment for memory allocations

TAU's Analysis Tools: ParaProf

TAU Analysis



ParaProf Profile Analysis Framework



TAU Analysis Tools: paraprof

▪ Launch paraprof

```
% paraprof
```

Metric

TAU: ParaProf Manager

Applications

- Standard Applications
 - Default App
 - Default Exp
 - bt_ompt.ppk
 - TIME

Default (jdbc:h2:/Users/sameer/.ParaProf/perfdmf/perfdmf;AUTO_SERVER=TRUE)

TrialField	Value
Name	bt_ompt.ppk
Application ID	0
Experiment ID	0
Trial ID	0
CPU Cores	8
CPU MHz	2600.000
CPU Type	Intel(R) Xeon(R) CPU E5-2670 0 @ 2.60GHz
CPU Vendor	GenuineIntel
CWD	/scratch/sameer/NPB3.3-MZ-MPI/bin
Cache Size	20480 KB
Command Line	./bt-mz_C.8
Executable	/scratch/sameer/NPB3.3-MZ-MPI/bin/bt-mz_C.8
File Type Index	0
File Type Name	ParaProf Packed Profile
Hostname	frog9
Local Time	2015-05-18T00:37:38+02:00
MPI Processor Name	frog9
Memory Size	65944056 kB
Node Name	frog9
OMP_CHUNK_SIZE	1
OMP_DYNAMIC	off
OMP_MAX_THREADS	4
OMP_NESTED	off
OMP_NUM_PROCS	4
OMP_SCHEDULE	UNKNOWN
OS Machine	x86_64
OS Name	Linux
OS Release	2.6.32-279.5.2.el6.Bull.33.x86_64
OS Version	#1 SMP Sat Nov 10 01:48:00 CET 2012

ParaProf Manager Widow: scout.cubex

TAU: ParaProf Manager

File Options Help

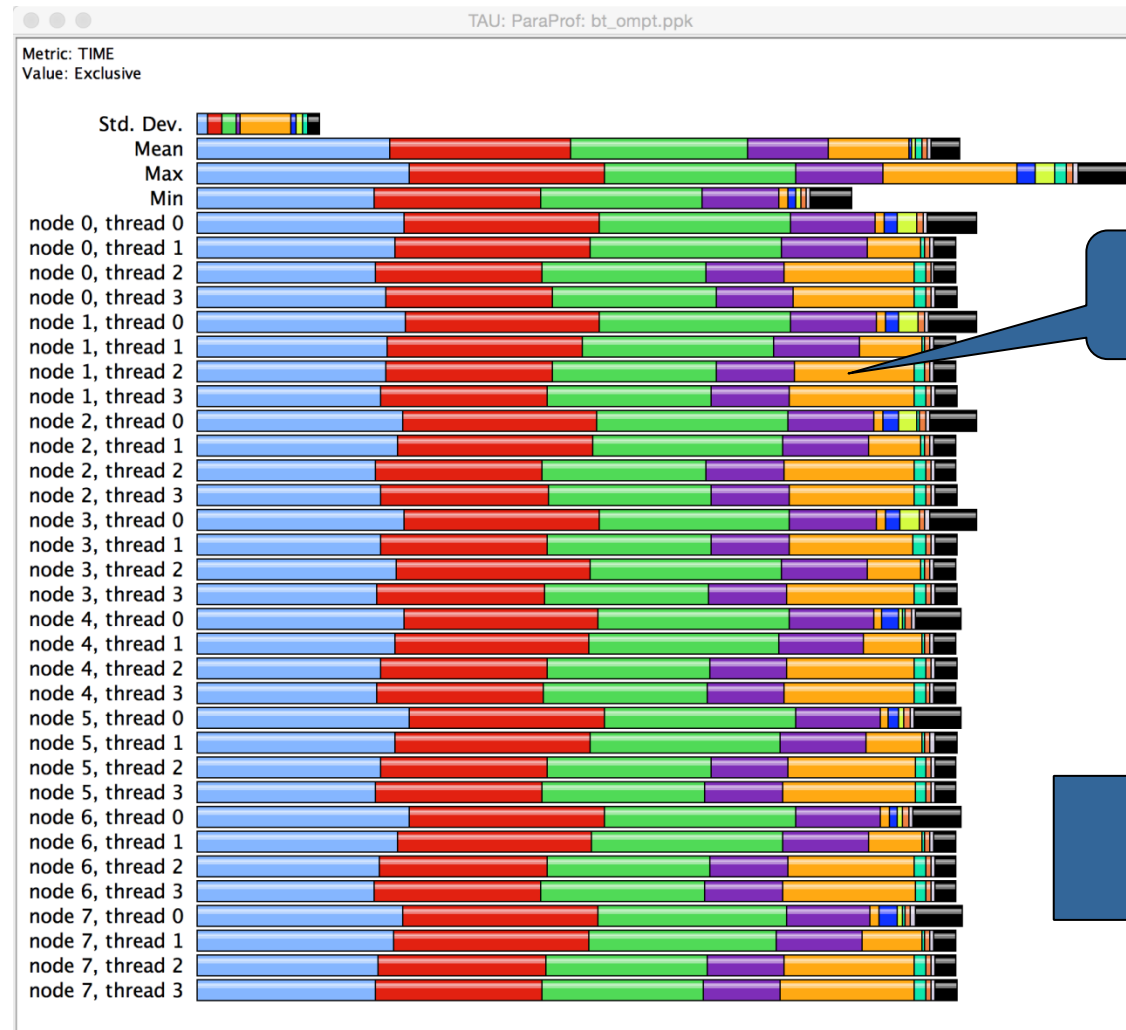
Applications

- Standard Applications
 - Default App
 - Default Exp
 - scout.cubex
 - Time
 - Wait at Barrier
 - Barrier Completion
 - Late Sender
 - Late Sender => Messages in Wrong Order
 - Late Sender => Messages in Wrong Order => Messages from different sources
 - Late Sender => Messages in Wrong Order => Messages from same source
 - Late Receiver
 - Early Reduce
 - Early Scan
 - Late Broadcast
 - Wait at N x N
 - N x N Completion
 - Management
 - Management => Fork
 - P2P send synchronizations
 - P2P send synchronizations => Late Receivers
 - P2P recv synchronizations
 - P2P recv synchronizations => Late Senders
 - P2P recv synchronizations => Late Senders => Messages in Wrong Order
 - Collective synchronizations
 - P2P send communications
 - P2P send communications => Late Receivers
 - P2P recv communications
 - P2P recv communications => Late Senders
 - P2P recv communications => Late Senders => Messages in Wrong Order
 - Collective exchange communications
 - Collective communications as source
 - Collective communications as destination
 - P2P bytes sent
 - P2P bytes received
 - Collective bytes outgoing
 - Collective bytes incoming
 - RMA bytes received
 - RMA bytes put

TrialField	Value
Name	scout.cubex
Application ID	0
Experiment ID	0
Trial ID	0
File Type Index	9
File Type Name	Cube

Metrics in the profile

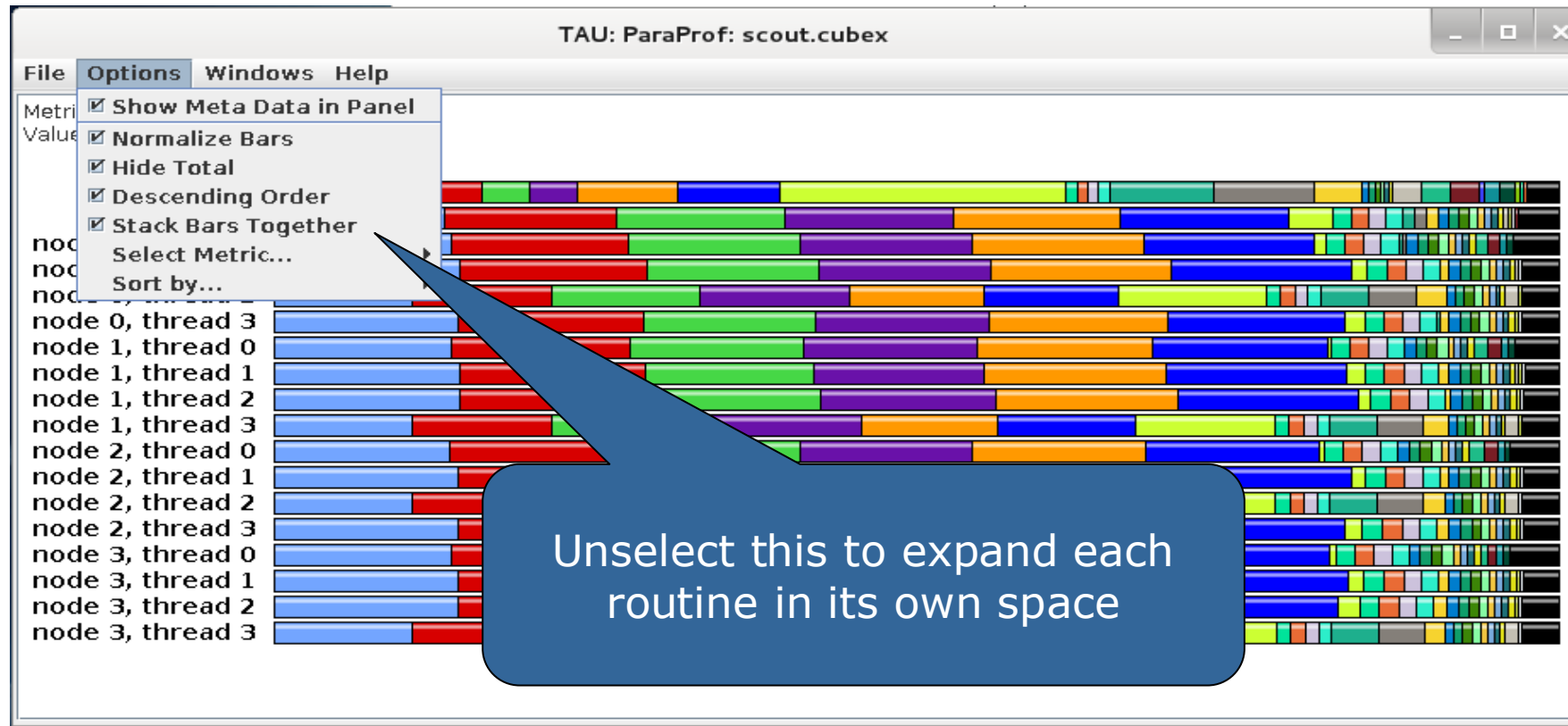
Paraprof main window



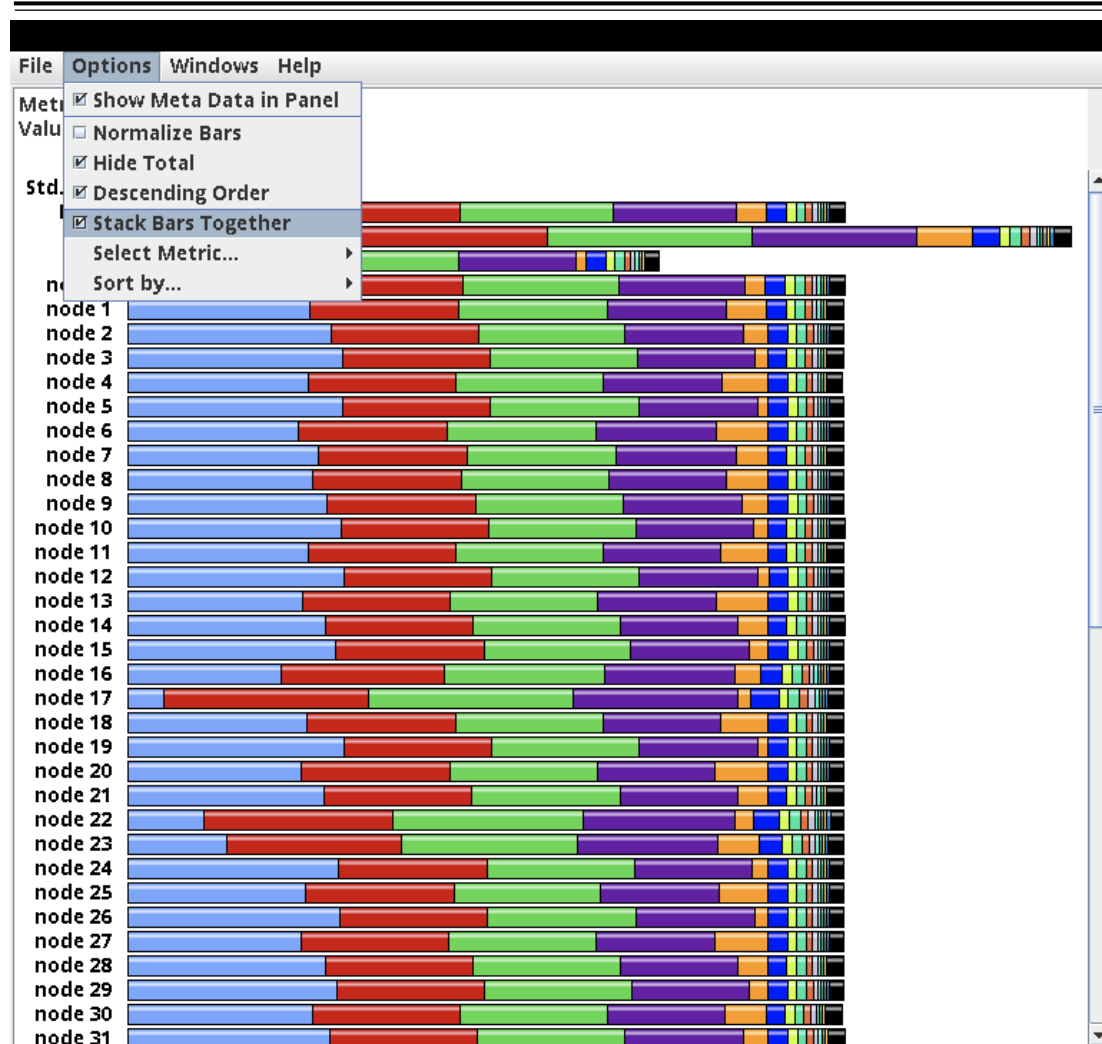
Colors represent
code regions

Options -> uncheck Stack Bars
Together

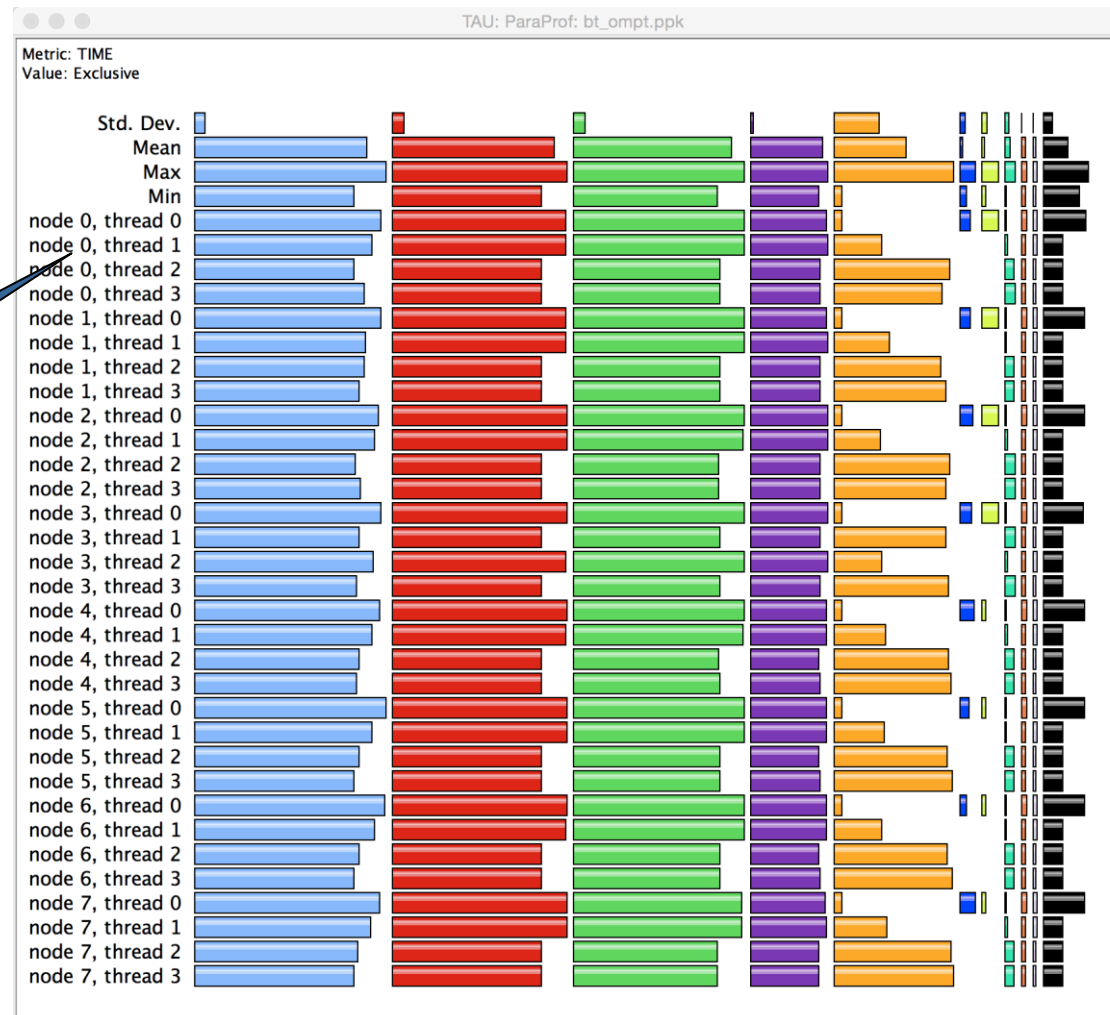
Paraprof main window



ParaProf Profile Browser

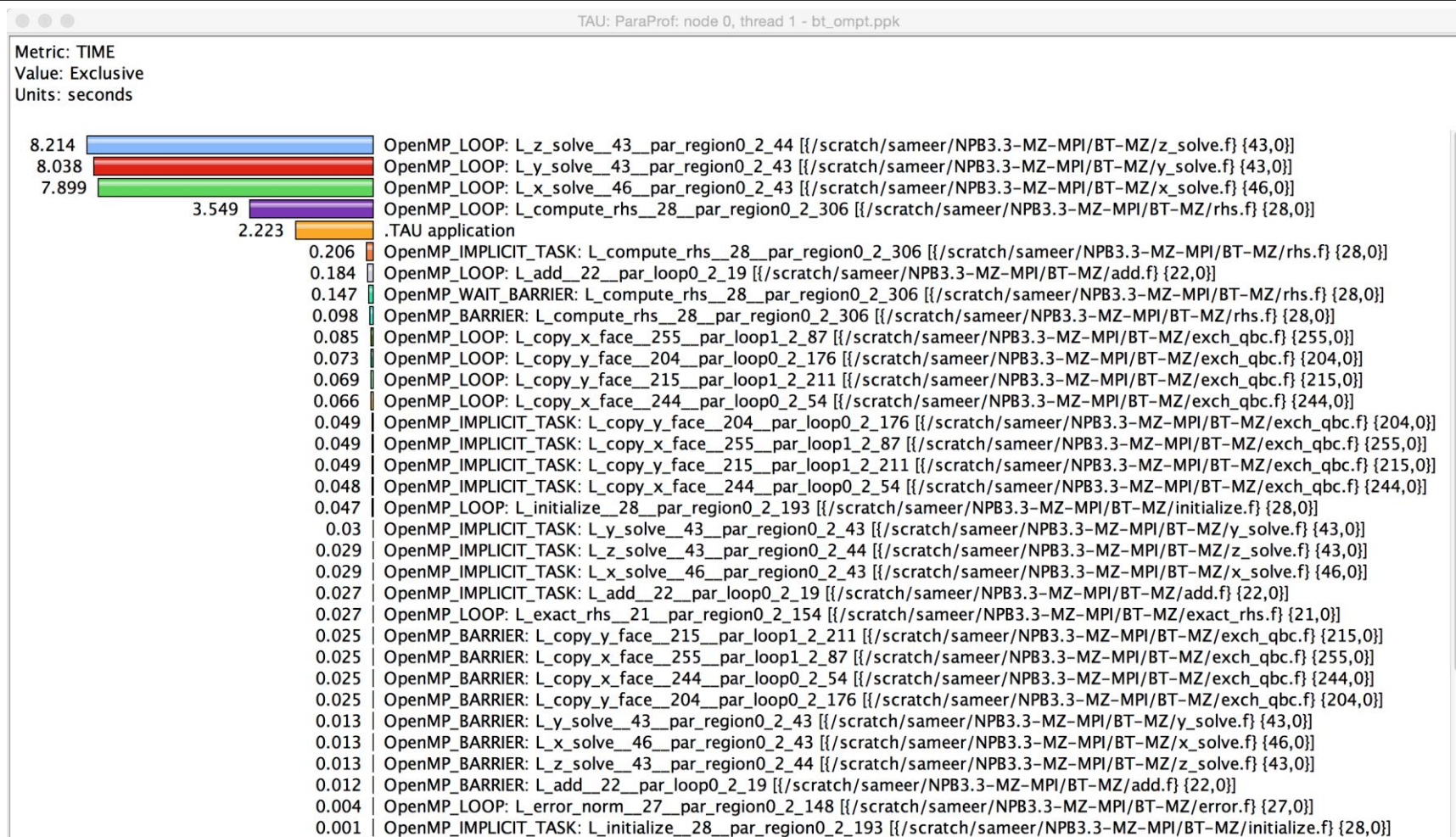


Paraprof main window



Each routine occupies its own space.
Can see the extent of imbalance
across all threads.

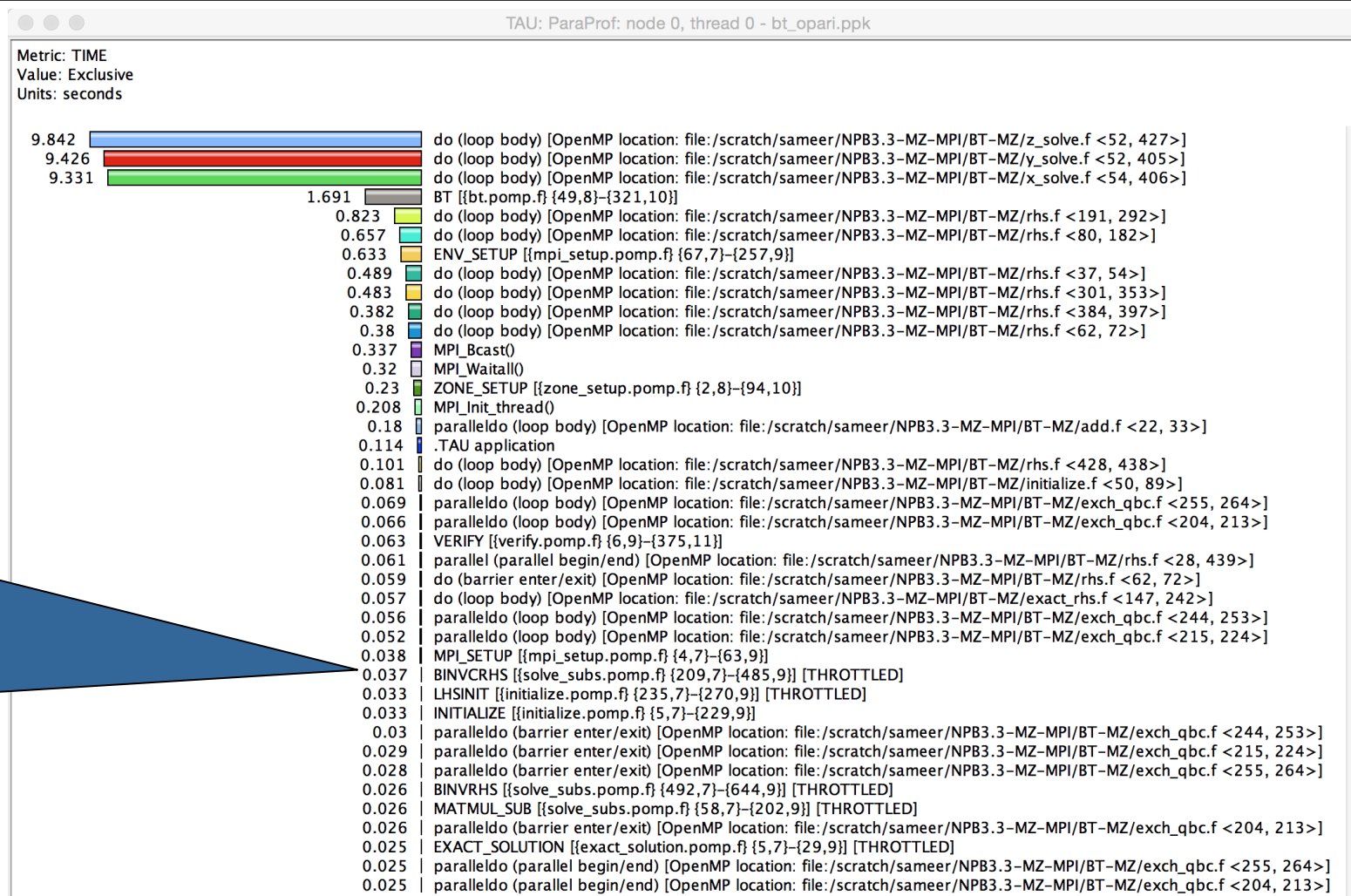
Paraprof node window (function barchart window)



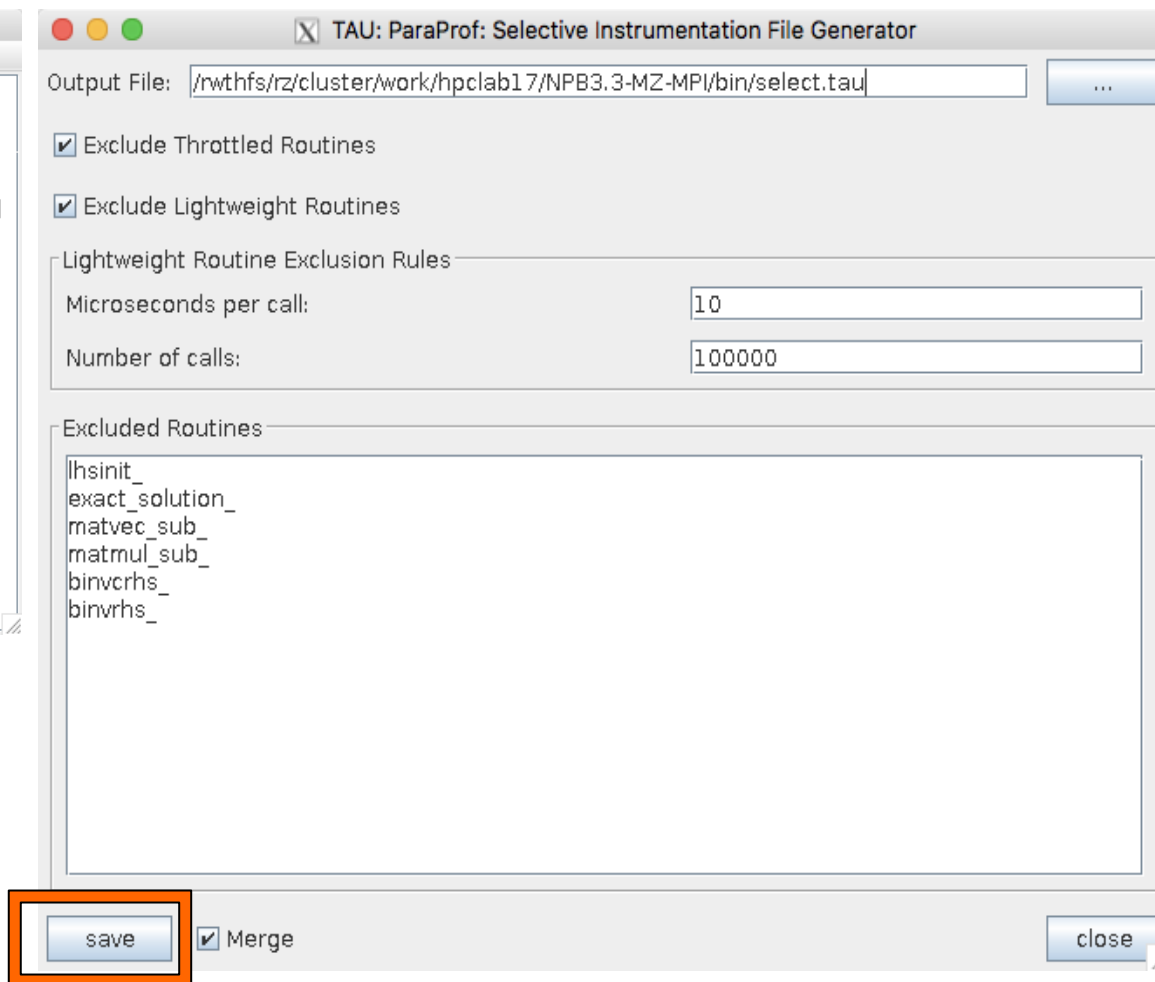
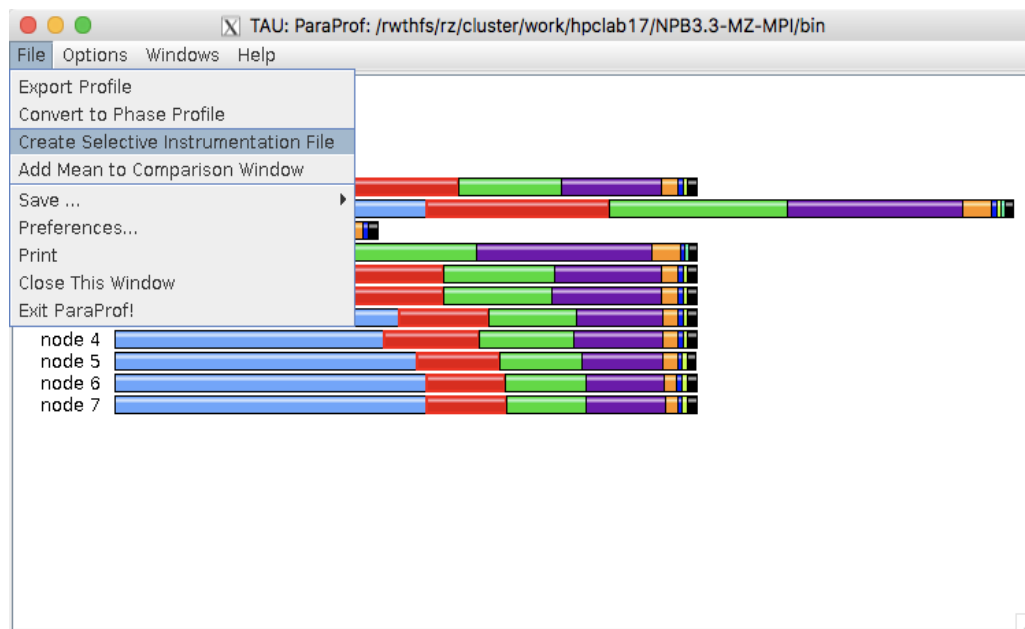
Exclusive time spent in each code region (OpenMP loop) is shown here for MPI rank 0 thread 1

Instrumenting Source Code with PDT and Opari

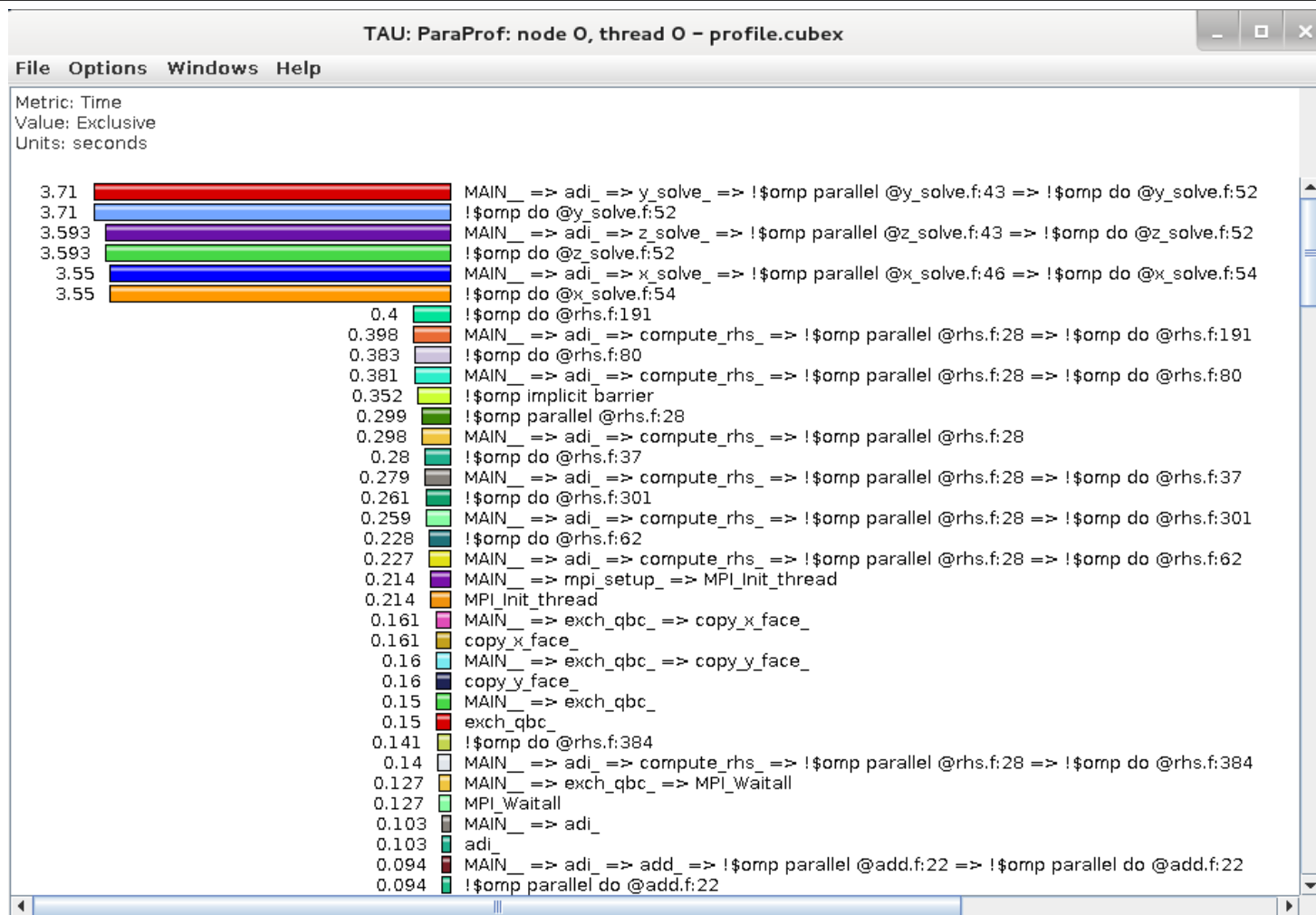
Frequently
executing
lightweight
routines
are
automatical-
ly throttled
at runtime.
Reduces
runtime
dilation.



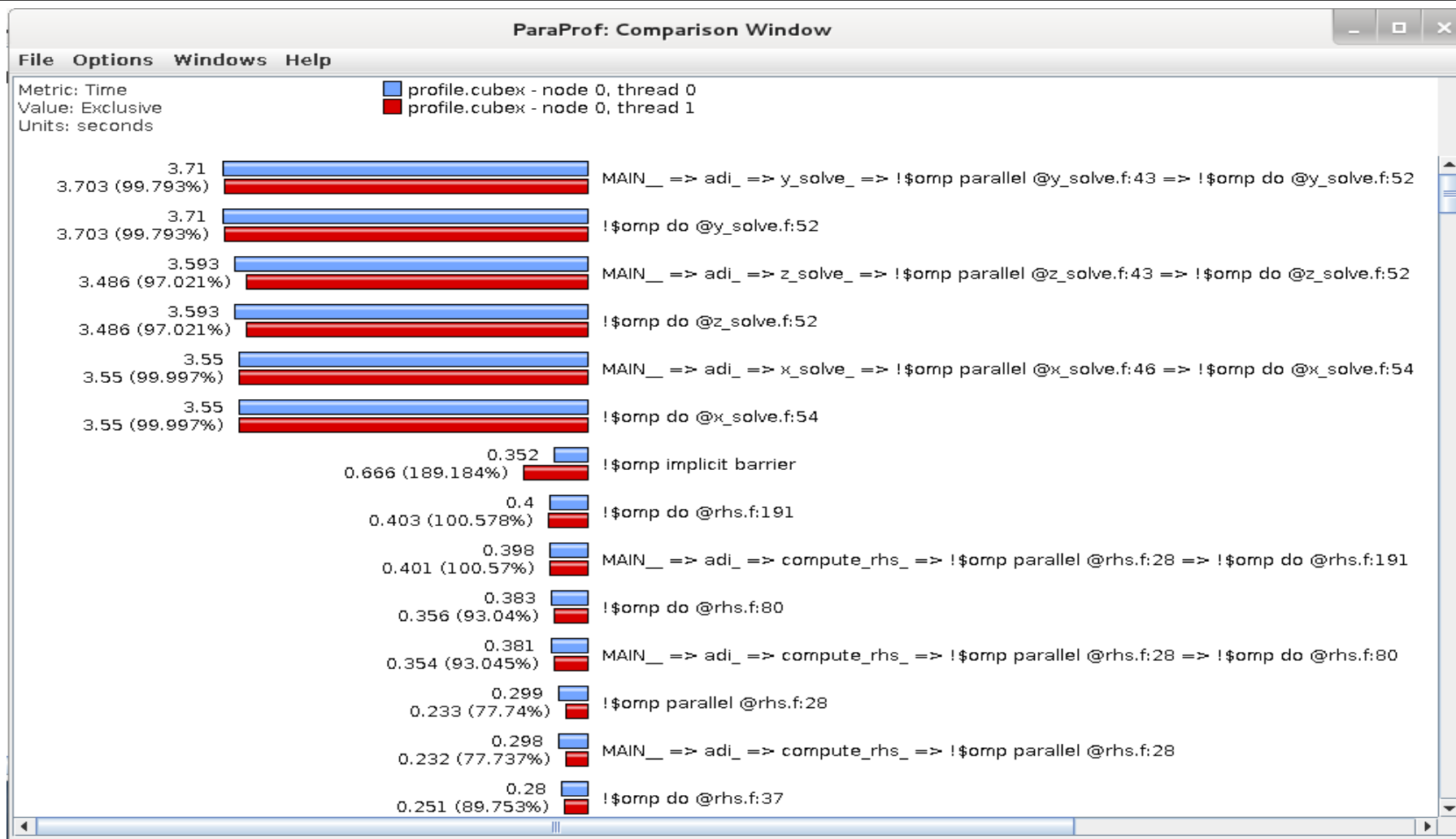
Create a Selective Instrumentation File, Re-instrument, Re-run



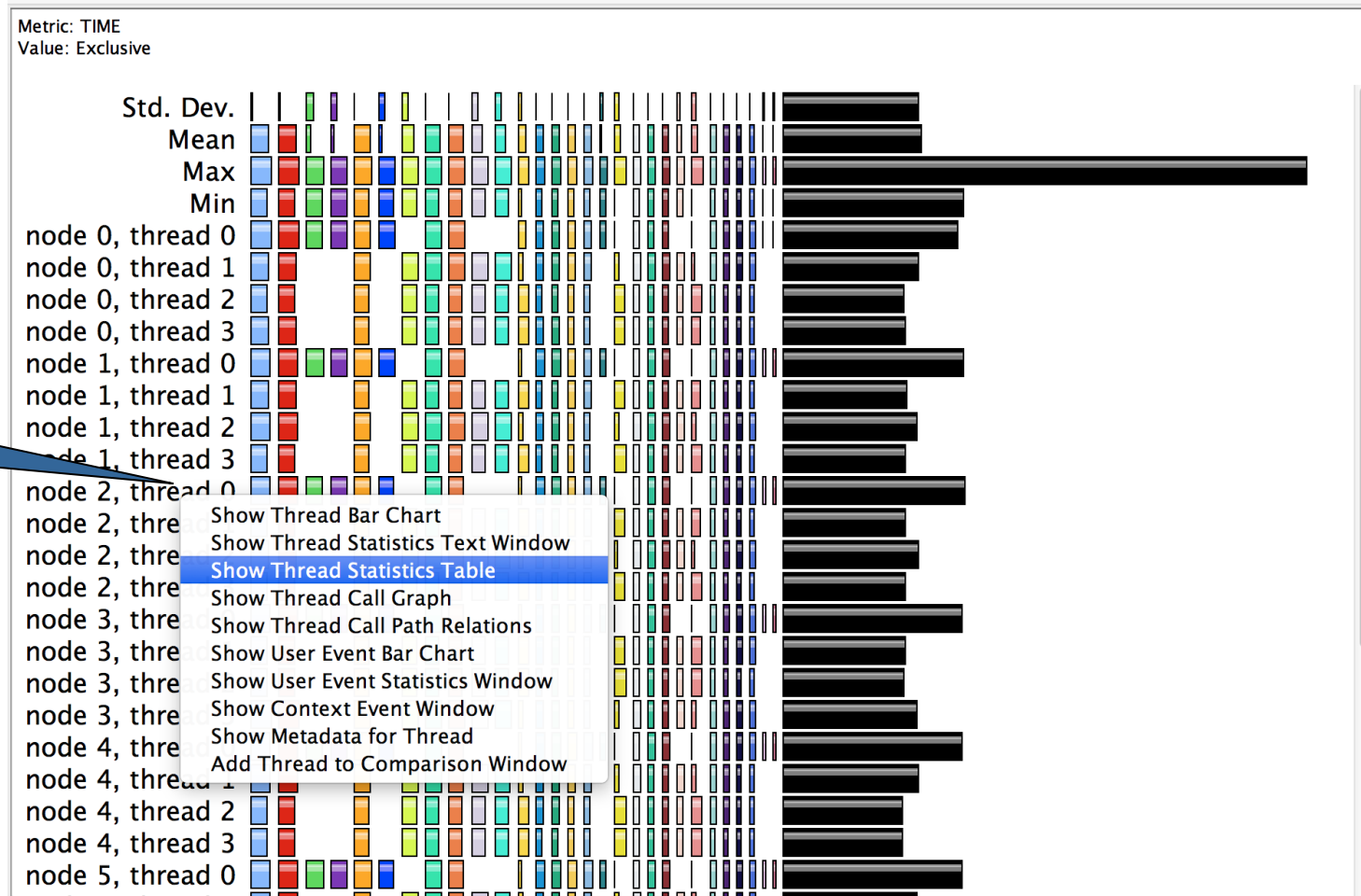
ParaProf: Node view in a callpath profile



ParaProf: Add thread to comparison window



Paraprof Thread Statistics Table with TAU_SAMPLING=1



Right
click here

ParaProf: Thread Statistics Table

TAU: ParaProf: Statistics for: node 0, thread 0 - scout.cubex

File Options Windows Help

Time

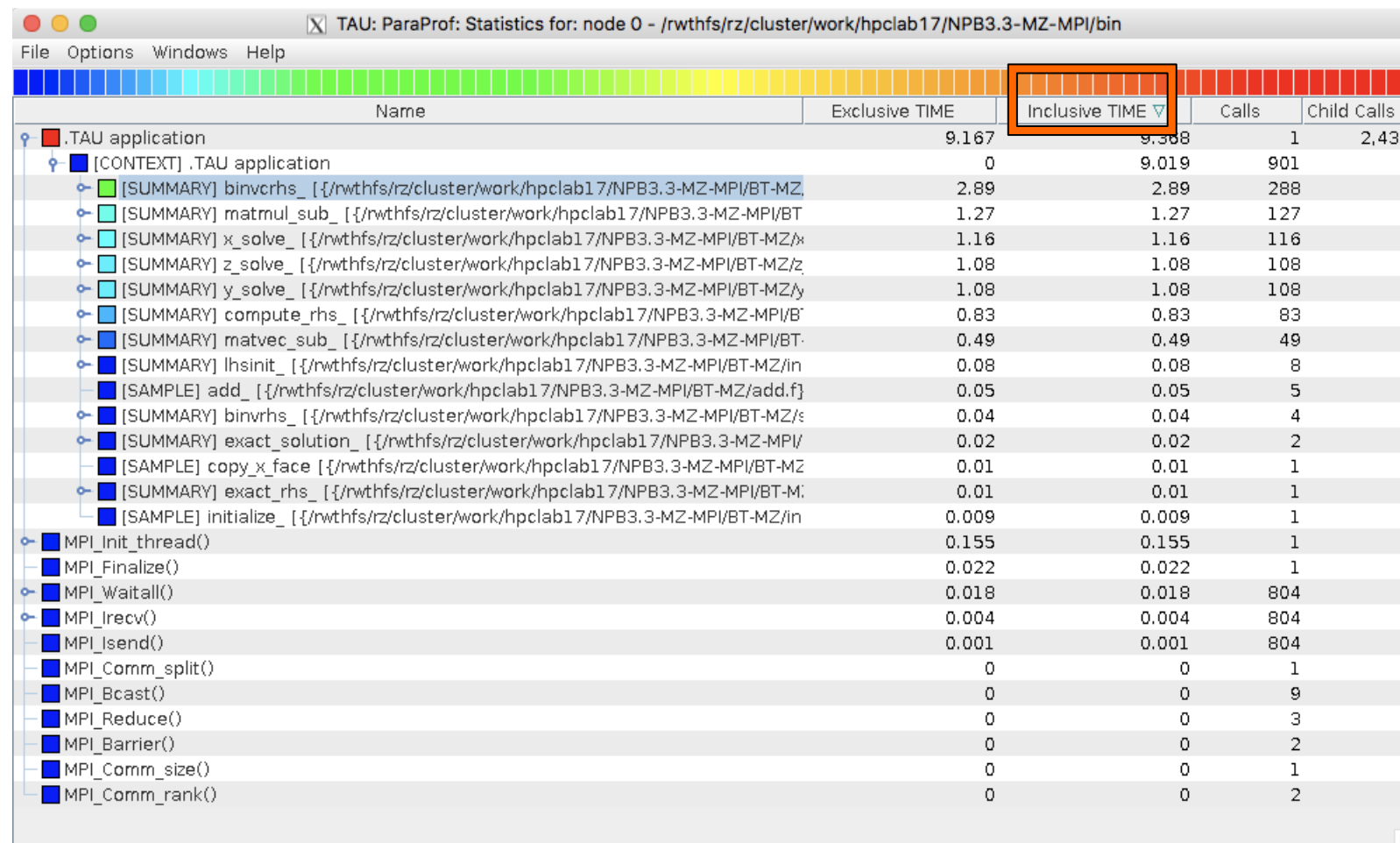
Name	Exclusive Time	Inclusive Time	Calls	Child Calls
!\$omp do @y_solve.f:52	5.817	5.817	3,216	0
!\$omp do @z_solve.f:52	5.657	5.657	3,216	0
!\$omp do @x_solve.f:54	5.609	5.609	3,216	0
!\$omp do @rhs.f:191	0.609	0.609	3,232	0
!\$omp do @rhs.f:80	0.583	0.583	3,232	0
MPI_Waitall	0.402	0.402	603	0
!\$omp implicit barrier	0.402	0.402		
!\$omp do @rhs.f:301	0.36	0.36		
!\$omp implicit barrier	0.026	0.026		
!\$omp implicit barrier	0	0		
!\$omp do @rhs.f:37	0.343	0.343		
!\$omp do @rhs.f:62	0.225	0.225		
!\$omp implicit barrier	0.004	0.004	3,216	0
!\$omp implicit barrier	0	0	16	0
MPI_Init_thread	0.218	0.218	1	0
!\$omp do @rhs.f:384	0.199	0.199	3,232	0
!\$omp parallel do @add.f:22	0.099	0.111	3,216	3,216
!\$omp do @rhs.f:428	0.069	0.069	3,232	0
MPI_Isend	0.043	0.043	603	0
!\$omp do @initialize.f:50	0.04	0.04	32	0
!\$omp parallel @rhs.f:28	0.03	2.536	3,232	51,712
!\$omp parallel do @exch_qbc.f:215	0.021	0.029	6,432	6,432
!\$omp parallel do @exch_qbc.f:255	0.02	0.033	6,432	6,432
!\$omp parallel @exch_qbc.f:255	0.02	0.053	6,432	6,432
!\$omp parallel @exch_qbc.f:244				

FinderScreenSnapz003.png

Click to sort by a given metric,
drag and move to rearrange
columns

ParaProf

- Click on Columns:
- to sort by incl time
- Open binvcrhs
- Click on Sample



TAU: ParaProf: Statistics for: node 0 - /rwthfs/rz/cluster/work/hpclub17/NPB3.3-MZ-MPI/bin

Name	Exclusive TIME	Inclusive TIME	Calls	Child Calls
.TAU application	9.167	9.368	1	2,432
[CONTEXT] .TAU application	0	9.019	901	0
[SUMMARY] binvcrhs_ [{/rwthfs/rz/cluster/work/hpclub17/NPB3.3-MZ-MPI/BT-MZ/	2.89	2.89	288	0
[SUMMARY] matmul_sub_ [{/rwthfs/rz/cluster/work/hpclub17/NPB3.3-MZ-MPI/BT	1.27	1.27	127	0
[SUMMARY] x_solve_ [{/rwthfs/rz/cluster/work/hpclub17/NPB3.3-MZ-MPI/BT-MZ/x	1.16	1.16	116	0
[SUMMARY] z_solve_ [{/rwthfs/rz/cluster/work/hpclub17/NPB3.3-MZ-MPI/BT-MZ/z	1.08	1.08	108	0
[SUMMARY] y_solve_ [{/rwthfs/rz/cluster/work/hpclub17/NPB3.3-MZ-MPI/BT-MZ/y	1.08	1.08	108	0
[SUMMARY] compute_rhs_ [{/rwthfs/rz/cluster/work/hpclub17/NPB3.3-MZ-MPI/B	0.83	0.83	83	0
[SUMMARY] matvec_sub_ [{/rwthfs/rz/cluster/work/hpclub17/NPB3.3-MZ-MPI/BT	0.49	0.49	49	0
[SUMMARY] lhsinit_ [{/rwthfs/rz/cluster/work/hpclub17/NPB3.3-MZ-MPI/BT-MZ/in	0.08	0.08	8	0
[SAMPLE] add_ [{/rwthfs/rz/cluster/work/hpclub17/NPB3.3-MZ-MPI/BT-MZ/add.f}	0.05	0.05	5	0
[SUMMARY] binvrhs_ [{/rwthfs/rz/cluster/work/hpclub17/NPB3.3-MZ-MPI/BT-MZ/s	0.04	0.04	4	0
[SUMMARY] exact_solution_ [{/rwthfs/rz/cluster/work/hpclub17/NPB3.3-MZ-MPI/	0.02	0.02	2	0
[SAMPLE] copy_x_face [{/rwthfs/rz/cluster/work/hpclub17/NPB3.3-MZ-MPI/BT-MZ	0.01	0.01	1	0
[SUMMARY] exact_rhs_ [{/rwthfs/rz/cluster/work/hpclub17/NPB3.3-MZ-MPI/BT-M	0.01	0.01	1	0
[SAMPLE] initialize_ [{/rwthfs/rz/cluster/work/hpclub17/NPB3.3-MZ-MPI/BT-MZ/in	0.009	0.009	1	0
MPI_Init_thread()	0.155	0.155	1	0
MPI_Finalize()	0.022	0.022	1	0
MPI_Waitall()	0.018	0.018	804	0
MPI_Irecv()	0.004	0.004	804	0
MPI_Isend()	0.001	0.001	804	0
MPI_Comm_split()	0	0	1	0
MPI_Bcast()	0	0	9	0
MPI_Reduce()	0	0	3	0
MPI_Barrier()	0	0	2	0
MPI_Comm_size()	0	0	1	0
MPI_Comm_rank()	0	0	2	0

Paraprof Thread Statistics Table

TAU: ParaProf: Statistics for: node 2, thread 0 - bt_ebs.ppk

Name	Exclusive TIME	Inclusive TIME	Calls	Child Calls
TAU application	1.754	36.26	1	88,049
OpenMP_PARALLEL_REGION: L_z_solve_43_par_region0_2_44 [/{scratch/sameer/NPB3.3-MZ-MPI/BT-MZ/z_solve.f} {43,0}]	0.061	8.692	6,432	12,864
OpenMP_IMPLICIT_TASK: L_z_solve_43_par_region0_2_44 [/{scratch/sameer/NPB3.3-MZ-MPI/BT-MZ/z_solve.f} {43,0}]	0.04	8.568	6,432	6,432
OpenMP_LOOP: L_z_solve_43_par_region0_2_44 [/{scratch/sameer/NPB3.3-MZ-MPI/BT-MZ/z_solve.f} {43,0}]	8.528	8.528	6,432	0
[CONTEXT] OpenMP_LOOP: L_z_solve_43_par_region0_2_44 [/{scratch/sameer/NPB3.3-MZ-MPI/BT-MZ/z_solve.f} {43,0}]	0	9.23	847	0
[SUMMARY] L_z_solve_43_par_region0_2_44 [/{scratch/sameer/NPB3.3-MZ-MPI/BT-MZ/z_solve.f}]	3.67	3.67	340	0
[SAMPLE] L_z_solve_43_par_region0_2_44 [/{scratch/sameer/NPB3.3-MZ-MPI/BT-MZ/z_solve.f}]	3.67	3.67	340	0
[SAMPLE] L_z_solve_43_par_region0_2_44 [/{scratch/sameer/NPB3.3-MZ-MPI/BT-MZ/z_solve.f} {419}]	0.22	0.22	21	0
[SAMPLE] L_z_solve_43_par_region0_2_44 [/{scratch/sameer/NPB3.3-MZ-MPI/BT-MZ/z_solve.f} {58}]	0.17	0.17	16	0
[SAMPLE] L_z_solve_43_par_region0_2_44 [/{scratch/sameer/NPB3.3-MZ-MPI/BT-MZ/z_solve.f} {418}]	0.16	0.16	12	0
[SAMPLE] L_z_solve_43_par_region0_2_44 [/{scratch/sameer/NPB3.3-MZ-MPI/BT-MZ/z_solve.f} {123}]	0.11	0.11	11	0
[SAMPLE] L_z_solve_43_par_region0_2_44 [/{scratch/sameer/NPB3.3-MZ-MPI/BT-MZ/z_solve.f} {193}]	0.08	0.08	5	0
[SAMPLE] L_z_solve_43_par_region0_2_44 [/{scratch/sameer/NPB3.3-MZ-MPI/BT-MZ/z_solve.f} {126}]	0.07	0.07	7	0
[SAMPLE] L_z_solve_43_par_region0_2_44 [/{scratch/sameer/NPB3.3-MZ-MPI/BT-MZ/z_solve.f} {247}]	0.07	0.07	6	0
[SAMPLE] L_z_solve_43_par_region0_2_44 [/{scratch/sameer/NPB3.3-MZ-MPI/BT-MZ/z_solve.f} {158}]	0.06	0.06	5	0
[SAMPLE] L_z_solve_43_par_region0_2_44 [/{scratch/sameer/NPB3.3-MZ-MPI/BT-MZ/z_solve.f} {313}]	0.06	0.06	4	0
[SAMPLE] L_z_solve_43_par_region0_2_44 [/{scratch/sameer/NPB3.3-MZ-MPI/BT-MZ/z_solve.f} {230}]	0.06	0.06	4	0
[SAMPLE] L_z_solve_43_par_region0_2_44 [/{scratch/sameer/NPB3.3-MZ-MPI/BT-MZ/z_solve.f} {308}]	0.05	0.05	3	0
[SAMPLE] L_z_solve_43_par_region0_2_44 [/{scratch/sameer/NPB3.3-MZ-MPI/BT-MZ/z_solve.f} {191}]	0.05	0.05	3	0
[SAMPLE] L_z_solve_43_par_region0_2_44 [/{scratch/sameer/NPB3.3-MZ-MPI/BT-MZ/z_solve.f} {81}]	0.05	0.05	4	0
[SAMPLE] L_z_solve_43_par_region0_2_44 [/{scratch/sameer/NPB3.3-MZ-MPI/BT-MZ/z_solve.f} {301}]	0.05	0.05	5	0
[SAMPLE] L_z_solve_43_par_region0_2_44 [/{scratch/sameer/NPB3.3-MZ-MPI/BT-MZ/z_solve.f} {67}]	0.05	0.05	5	0
[SAMPLE] L_z_solve_43_par_region0_2_44 [/{scratch/sameer/NPB3.3-MZ-MPI/BT-MZ/z_solve.f} {175}]	0.04	0.04	4	0
[SAMPLE] L_z_solve_43_par_region0_2_44 [/{scratch/sameer/NPB3.3-MZ-MPI/BT-MZ/z_solve.f} {89}]	0.04	0.04	4	0
[SAMPLE] L_z_solve_43_par_region0_2_44 [/{scratch/sameer/NPB3.3-MZ-MPI/BT-MZ/z_solve.f} {55}]	0.04	0.04	4	0
[SAMPLE] L_z_solve_43_par_region0_2_44 [/{scratch/sameer/NPB3.3-MZ-MPI/BT-MZ/z_solve.f} {275}]	0.04	0.04	4	0
[SAMPLE] L_z_solve_43_par_region0_2_44 [/{scratch/sameer/NPB3.3-MZ-MPI/BT-MZ/z_solve.f} {129}]	0.04	0.04	4	0
[SAMPLE] L_z_solve_43_par_region0_2_44 [/{scratch/sameer/NPB3.3-MZ-MPI/BT-MZ/z_solve.f} {168}]	0.04	0.04	4	0
[SAMPLE] L_z_solve_43_par_region0_2_44 [/{scratch/sameer/NPB3.3-MZ-MPI/BT-MZ/z_solve.f} {238}]	0.04	0.04	4	0

Right click here and choose "Show Source Code" for a sample

Show Source Code
Show Function Bar Chart
Show Function Histogram
Assign Function Color
Reset to Default Color

ParaProf

TAU: ParaProf: Statistics for: node 0 - /rwthfs/rz/cluster/work/hpclab17/NPB3.3-MZ-MPI/bin

File Options Windows Help

Name	Exclusive TIME	Inclusive TIME ▾	Calls	Child Calls
.TAU application	9.167	9.368	1	2,432
[CONTEXT] .TAU application	0	9.019	901	0
[SUMMARY] binvrchs_ [{/rwthfs/rz/cluster/work/hpclab17/NPB3.3-MZ-MPI/BT-MZ/solve_subs.f}]	2.89	2.89	288	0
[SAMPLE] binvrchs_ [{/rwthfs/rz/cluster/work/hpclab17/NPB3.3-MZ-MPI/BT-MZ/solve_subs.f}] {228}	0.14	0.14	14	0
[SAMPLE] binvrchs_ [{/rwthfs/rz/cluster/work/hpclab17/NPB3.3-MZ-MPI/BT-MZ/solve_subs.f}]	0.09	0.09	9	0
[SAMPLE] binvrchs_ [{/rwthfs/rz/cluster/work/hpclab17/NPB3.3-MZ-MPI/BT-MZ/solve_subs.f}]	0.09	0.09	9	0
[SAMPLE] binvrchs_ [{/rwthfs/rz/cluster/work/hpclab17/NPB3.3-MZ-MPI/BT-MZ/solve_subs.f}]	0.06	0.06	6	0
[SAMPLE] binvrchs_ [{/rwthfs/rz/cluster/work/hpclab17/NPB3.3-MZ-MPI/BT-MZ/solve_subs.f}]	0.06	0.06	6	0
[SAMPLE] binvrchs_ [{/rwthfs/rz/cluster/work/hpclab17/NPB3.3-MZ-MPI/BT-MZ/solve_subs.f}]	0.06	0.06	6	0
[SAMPLE] binvrchs_ [{/rwthfs/rz/cluster/work/hpclab17/NPB3.3-MZ-MPI/BT-MZ/solve_subs.f}]	0.06	0.06	6	0
[SAMPLE] binvrchs_ [{/rwthfs/rz/cluster/work/hpclab17/NPB3.3-MZ-MPI/BT-MZ/solve_subs.f}] {244}	0.05	0.05	5	0
[SAMPLE] binvrchs_ [{/rwthfs/rz/cluster/work/hpclab17/NPB3.3-MZ-MPI/BT-MZ/solve_subs.f}] {332}	0.05	0.05	5	0
[SAMPLE] binvrchs_ [{/rwthfs/rz/cluster/work/hpclab17/NPB3.3-MZ-MPI/BT-MZ/solve_subs.f}] {275}	0.05	0.05	5	0
[SAMPLE] binvrchs_ [{/rwthfs/rz/cluster/work/hpclab17/NPB3.3-MZ-MPI/BT-MZ/solve_subs.f}] {331}	0.04	0.04	4	0
[SAMPLE] binvrchs_ [{/rwthfs/rz/cluster/work/hpclab17/NPB3.3-MZ-MPI/BT-MZ/solve_subs.f}] {445}	0.04	0.04	4	0
[SAMPLE] binvrchs_ [{/rwthfs/rz/cluster/work/hpclab17/NPB3.3-MZ-MPI/BT-MZ/solve_subs.f}] {254}	0.04	0.04	4	0
[SAMPLE] binvrchs_ [{/rwthfs/rz/cluster/work/hpclab17/NPB3.3-MZ-MPI/BT-MZ/solve_subs.f}] {314}	0.04	0.04	4	0
[SAMPLE] binvrchs_ [{/rwthfs/rz/cluster/work/hpclab17/NPB3.3-MZ-MPI/BT-MZ/solve_subs.f}] {343}	0.04	0.04	4	0
[SAMPLE] binvrchs_ [{/rwthfs/rz/cluster/work/hpclab17/NPB3.3-MZ-MPI/BT-MZ/solve_subs.f}] {403}	0.04	0.04	4	0
[SAMPLE] binvrchs_ [{/rwthfs/rz/cluster/work/hpclab17/NPB3.3-MZ-MPI/BT-MZ/solve_subs.f}] {389}	0.03	0.03	3	0
[SAMPLE] binvrchs_ [{/rwthfs/rz/cluster/work/hpclab17/NPB3.3-MZ-MPI/BT-MZ/solve_subs.f}] {415}	0.03	0.03	3	0
[SAMPLE] binvrchs_ [{/rwthfs/rz/cluster/work/hpclab17/NPB3.3-MZ-MPI/BT-MZ/solve_subs.f}] {247}	0.03	0.03	3	0
[SAMPLE] binvrchs_ [{/rwthfs/rz/cluster/work/hpclab17/NPB3.3-MZ-MPI/BT-MZ/solve_subs.f}] {300}	0.03	0.03	3	0
[SAMPLE] binvrchs_ [{/rwthfs/rz/cluster/work/hpclab17/NPB3.3-MZ-MPI/BT-MZ/solve_subs.f}] {309}	0.03	0.03	3	0
[SAMPLE] binvrchs_ [{/rwthfs/rz/cluster/work/hpclab17/NPB3.3-MZ-MPI/BT-MZ/solve_subs.f}] {444}	0.03	0.03	3	0
[SAMPLE] binvrchs_ [{/rwthfs/rz/cluster/work/hpclab17/NPB3.3-MZ-MPI/BT-MZ/solve_subs.f}] {468}	0.03	0.03	3	0
[SAMPLE] binvrchs_ [{/rwthfs/rz/cluster/work/hpclab17/NPB3.3-MZ-MPI/BT-MZ/solve_subs.f}] {242}	0.03	0.03	3	0
[SAMPLE] binvrchs_ [{/rwthfs/rz/cluster/work/hpclab17/NPB3.3-MZ-MPI/BT-MZ/solve_subs.f}] {407}	0.03	0.03	3	0
[SAMPLE] binvrchs_ [{/rwthfs/rz/cluster/work/hpclab17/NPB3.3-MZ-MPI/BT-MZ/solve_subs.f}] {412}	0.03	0.03	3	0

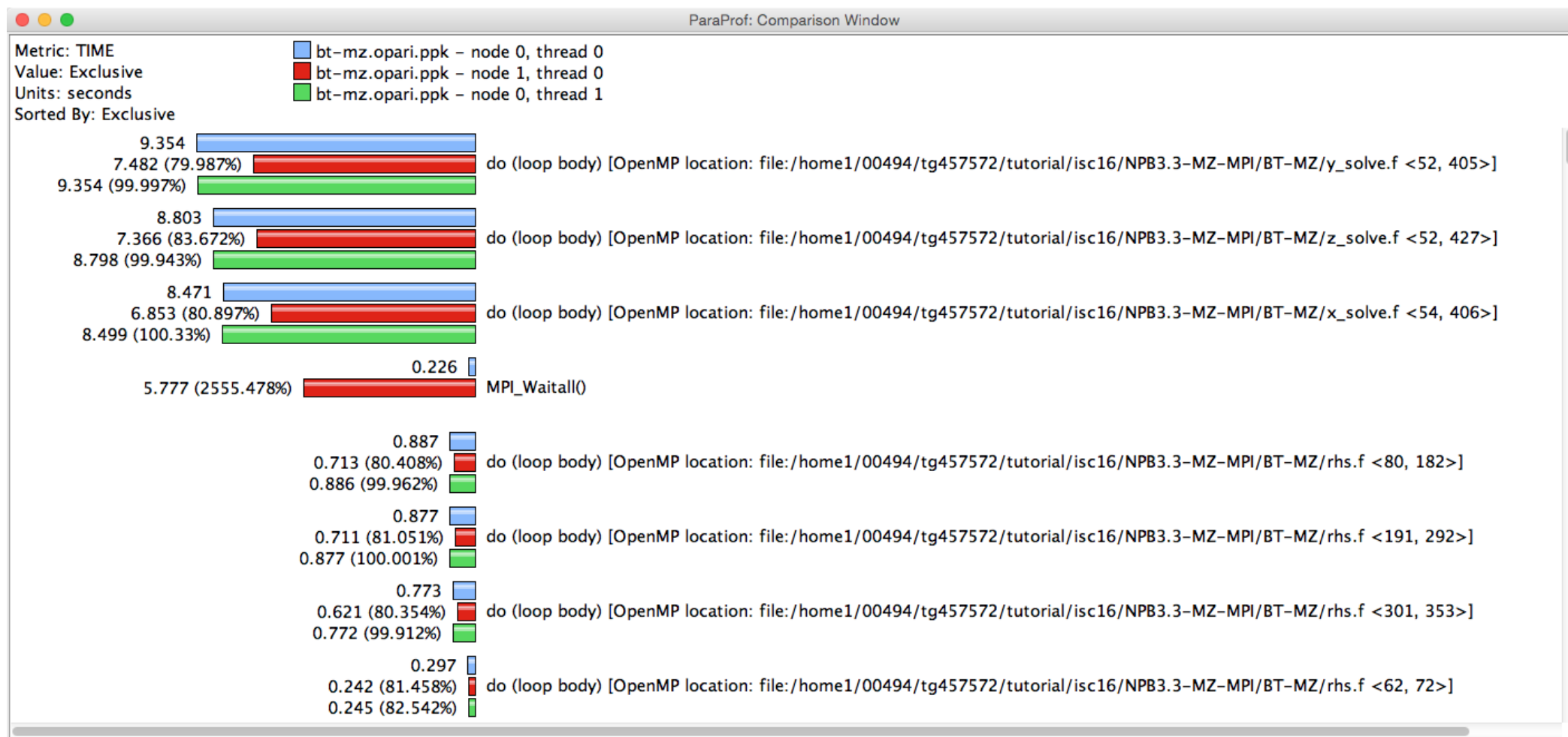
Show Source Code
 Show In Statistics Table
 Show Function Histogram
 Show Function Bar Chart
 Assign Function Color
 Reset to Default Color

Statement Level Profiling with TAU

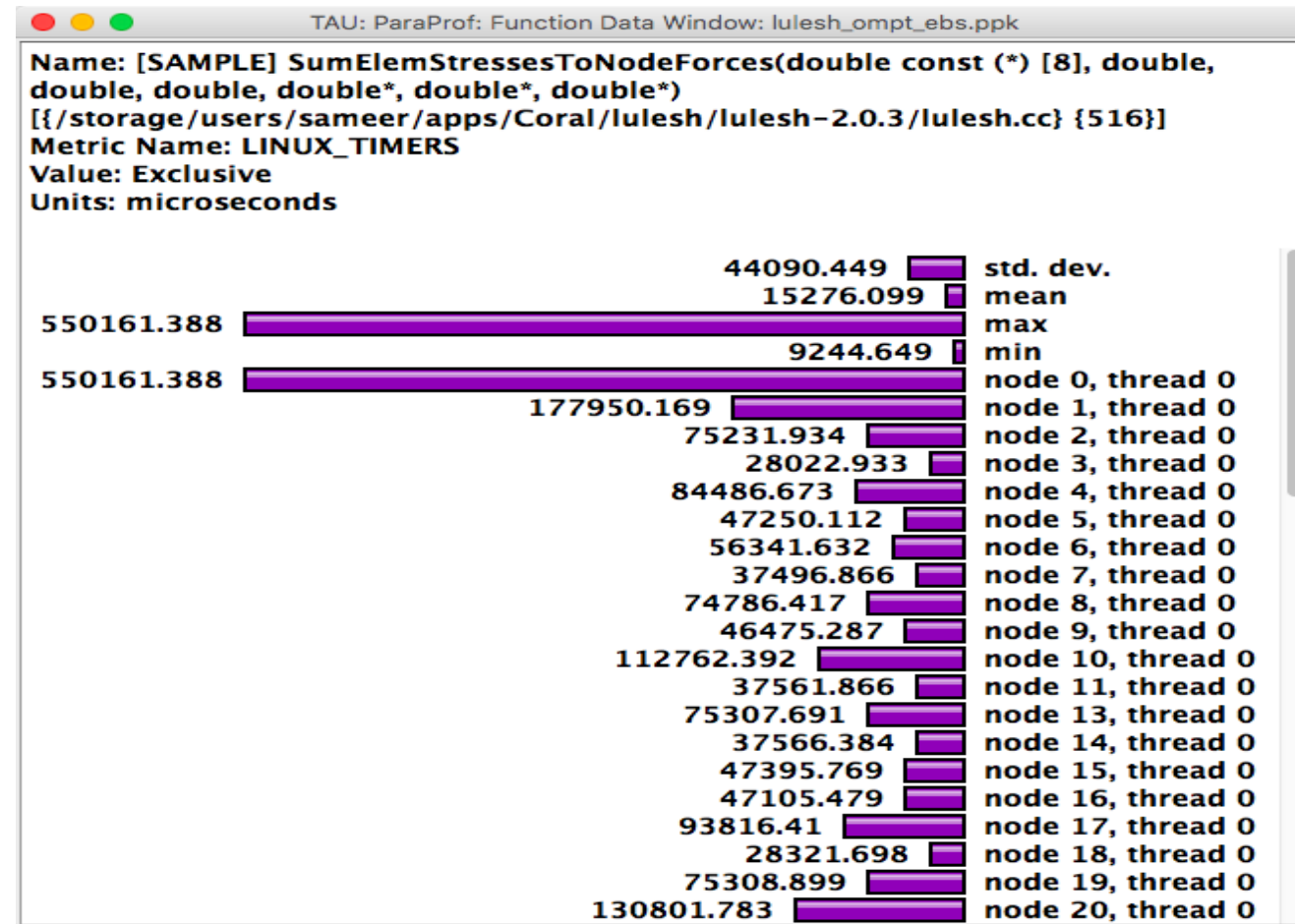
Source location where samples are taken. Compute intensive region.

```
TAU: ParaProf: Source Browser: /scratch/sameer/NPB3.3-MZ-MPI/BT-MZ/x_solve.f
File Help
353      call matmul_sub(lhs(1,1,aa,i),
354      >      lhs(1,1,cc,i-1),
355      >      lhs(1,1,bb,i))
356
357
358 C-----
359 c  multiply c(i,j,k) by b_inverse and copy back to c
360 c  multiply rhs(1,j,k) by b_inverse(1,j,k) and copy to rhs
361 C-----
362      call binvrhs( lhs(1,1,bb,i),
363      >      lhs(1,1,cc,i),
364      >      rhs(1,i,j,k) )
365
366      enddo
367
368 C-----
369 c  rhs(isize) = rhs(isize) - A*rhs(isize-1)
370 C-----
371      call matvec_sub(lhs(1,1,aa, isize),
372      >      rhs(1, isize-1,j,k), rhs(1, isize,j,k))
373
374 C-----
375 c  B(isize) = B(isize) - C(isize-1)*A(isize)
376 C-----
377      call matmul_sub(lhs(1,1,aa, isize),
378      >      lhs(1,1,cc, isize-1),
379      >      lhs(1,1,bb, isize))
380
381 C-----
382 c  multiply rhs() by b_inverse() and copy to rhs
383 C-----
384      call binvrhs( lhs(1,1,bb, isize),
385      >      rhs(1, isize,j,k) )
386
387
388 C-----
389 c  back solve: if last cell, then generate U(isize)=rhs(isize)
390 c  else assume U(isize) is loaded in un pack backsub_info
391 c  so just use it
392 c  after call u(istart) will be sent to next cell
393 C-----
394
395      do i= isize-1,0,-1
396      do m=1,BLOCK_SIZE
397      do n=1,BLOCK_SIZE
398      >      rhs(m,i,j,k) = rhs(m,i,j,k)
399      >      - lhs(m,n,cc,i)*rhs(n,i+1,j,k)
400      enddo
401      enddo
402      enddo
```


ParaProf Comparison Window



TAU – Event Based Sampling (EBS)



% export TAU_SAMPLING=1

Examples: Callstack Sampling in TAU

TAU: ParaProf: Statistics for: n,c,t 2,0,0 - gamess_unw_call_ebs.ppk

Name	Inclusive TIME ▾	Calls
■ .TAU application	79.592	1
▾ ■ MPI_Recv()	75.607	6,870
▾ ■ [CONTEXT] MPI_Recv()	74.848	1,497
▸ ■ [UNWIND] /gpfs/mira-home/sameer/gamess-theta-tau/object/unport.f.410 [@] MAIN__ [{ /gpfs/mira-home/sameer/gamess-theta-t	26.196	524
▸ ■ [UNWIND] /gpfs/mira-home/yuri/dist/Github/gamess-theta-tau/ddi/src/ddi_fortran.c.67 [@] beging_ [{ /gpfs/mira-home/sameer/g	21.7	434
▸ ■ [UNWIND] /gpfs/mira-home/sameer/gamess-theta-tau/object/gamess.f.538 [@] main [{ /gpfs/mira-home/sameer/gamess-theta-ta	11.85	237
▸ ■ [UNWIND] /gpfs/mira-home/yuri/dist/Github/gamess-theta-tau/ddi/src/ddi_init.c.113 [@] ddi_init_ [{ /gpfs/mira-home/yuri/dist/Gi	8.701	174
▸ ■ [UNWIND] /gpfs/mira-home/yuri/dist/Github/gamess-theta-tau/ddi/src/ddi_server.c.99 [@] DDI_Init [{ /gpfs/mira-home/yuri/dist/C	5.75	115
▸ ■ [UNWIND] /lib64/libc-2.22.so.0 [@] _start [{ /home/abuild/rpmbuild/BUILD/glibc-2.22/csu/./sysdeps/x86_64/start.S } { 118 } }	0.2	4
▸ ■ [SAMPLE] GNII_DlaProgress [{ /opt/cray/ugni/6.0.14-6.0.4.0_14.1__ge7db4a2.ari/lib64/libugni.so.0.6.0 } { 0 } }	0.2	4
▸ ■ [UNWIND] [/opt/cray/ugni/6.0.14-6.0.4.0_14.1__ge7db4a2.ari/lib64/libugni.so.0.6.0.0] [@] UNRESOLVED UNKNOWN	0.15	3
▸ ■ [SAMPLE] GNI_CqGetEvent [{ /opt/cray/ugni/6.0.14-6.0.4.0_14.1__ge7db4a2.ari/lib64/libugni.so.0.6.0 } { 0 } }	0.051	1
▸ ■ [UNWIND] /opt/cray/pe/mpt/7.6.3/gni/mpich-intel/16.0/lib/libmpich_intel.so.3.0.1.0 [@] MPIDI_CH3I_Progress [{ /opt/cray/pe/mpt/7	0.05	1
■ MPI_Finalize()	3.601	1
▸ ■ MPI_Send()	0.122	6,866
▸ ■ MPI_Init_thread()	0.112	1
▸ ■ [CONTEXT] .TAU application	0.05	1
▸ ■ MPI_Bcast()	0.014	6
■ MPI_Allgather()	0.004	3
■ MPI_Barrier()	0.003	7
■ MPI_Comm_create()	0.002	4
■ MPI_Gather()	0.002	1
■ MPI_Comm_split()	0.002	1
■ MPI_Group_intersection()	0.001	1
■ MPI_Comm_group()	0.001	1
■ MPI_Group_incl()	0	3
■ MPI_Comm_rank()	0	6
■ MPI_Comm_size()	0	2

% export TAU_SAMPLING=1; export TAU_EBS_UNWIND=1

UNWINDING CALLSTACKS

TAU: ParaProf: Statistics for: n,c,t 2,0,0 - gamess_unw_call_ebs.ppk

Name	Inclusive TIME ▾	Calls
■ .TAU application	79.592	1
▾ ■ MPI_Recv()	75.607	6,870
▾ ▾ ■ [CONTEXT] MPI_Recv()	74.848	1,497
▾ ▾ ▾ ■ [UNWIND] /gpfs/mira-home/sameer/gamess-theta-tau/object/unport.f.410 [@] MAIN_ [{ /gpfs/mira-home/sameer/gamess-theta-	26.196	524
▾ ▾ ▾ ▾ ■ [UNWIND] /gpfs/mira-home/yuri/dist/Github/gamess-theta-tau/ddi/src/ddi_fortran.c.67 [@] beging_ [{ /gpfs/mira-home/sameer/g	21.7	434
▾ ▾ ▾ ▾ ▾ ■ [UNWIND] /gpfs/mira-home/yuri/dist/Github/gamess-theta-tau/ddi/src/ddi_init.c.113 [@] ddi_init_ [{ /gpfs/mira-home/yuri/dist	21.7	434
▾ ▾ ▾ ▾ ▾ ▾ ■ [UNWIND] /gpfs/mira-home/yuri/dist/Github/gamess-theta-tau/ddi/src/ddi_server.c.99 [@] DDI_Init [{ /gpfs/mira-home/yuri/	21.7	434
▾ ▾ ▾ ▾ ▾ ▾ ▾ ■ [UNWIND] /gpfs/mira-home/yuri/dist/Github/gamess-theta-tau/ddi/src/ddi_recv.c.65 [@] DDI_Server [{ /gpfs/mira-home/y	21.7	434
▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ■ [UNWIND] /lus/theta-fs0/software/perftools/tau/tau-2.26.3/src/Profile/TauMpi.c.2371 [@] DDI_Recv_request [{ /gpfs/mira	21.7	434
▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ■ [UNWIND] /opt/cray/pe/mpt/7.6.3/gni/mpich-intel/16.0/lib/libmpich_intel.so.3.0.1.0 [@] MPI_Recv [{ /lus/theta-fs0/sof	21.7	434
▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ■ [UNWIND] /opt/cray/pe/mpt/7.6.3/gni/mpich-intel/16.0/lib/libmpich_intel.so.3.0.1.0 [@] PMPI_Recv [{ /opt/cray/pe/n	21.7	434
▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ■ [UNWIND] /opt/cray/pe/mpt/7.6.3/gni/mpich-intel/16.0/lib/libmpich_intel.so.3.0.1.0 [@] MPIDI_CH3I_Progress [{ /c	21.45	429
▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ■ [UNWIND] /opt/cray/ugni/6.0.14-6.0.4.0_14.1__ge7db4a2.ari/lib64/libugni.so.0.6.0.0 [@] MPID_nem_gni_poll [{ /	15.95	319
▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ■ [SAMPLE] GNI_SmsgGetNextWTag [{ /opt/cray/ugni/6.0.14-6.0.4.0_14.1__ge7db4a2.ari/lib64/libugni.so.0.6.0.0	10.349	207
▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ■ [SAMPLE] GNI_CqGetEvent [{ /opt/cray/ugni/6.0.14-6.0.4.0_14.1__ge7db4a2.ari/lib64/libugni.so.0.6.0.0 } { 0 } }	5.6	112
▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ■ [UNWIND] gni_poll.c.0 [@] MPID_nem_gni_poll [{ /opt/cray/pe/mpt/7.6.3/gni/mpich-intel/16.0/lib/libmpich_inte	5.25	105
▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ■ [UNWIND] /opt/cray/pe/mpt/7.6.3/gni/mpich-intel/16.0/lib/libmpich_intel.so.3.0.1.0 [@] MPID_nem_gni_poll [{ /	0.25	5
▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ■ [UNWIND] UNRESOLVED [@] MPIDI_CH3I_Progress [{ /opt/cray/pe/mpt/7.6.3/gni/mpich-intel/16.0/lib/libmpich_int	0.25	5
▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ■ [UNWIND] /gpfs/mira-home/sameer/gamess-theta-tau/object/gamess.f.538 [@] main [{ /gpfs/mira-home/sameer/gamess-theta-ta	11.85	237
▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ▾ ■ [UNWIND] /gpfs/mira-home/yuri/dist/Github/gamess-theta-tau/ddi/src/ddi_init.c.113 [@] ddi_init_ [{ /gpfs/mira-home/yuri/dist/G	8.701	174
▾ ■ [UNWIND] /gpfs/mira-home/yuri/dist/Github/gamess-theta-tau/ddi/src/ddi_server.c.99 [@] DDI_Init [{ /gpfs/mira-home/yuri/dist/	5.75	115
▾ ■ [UNWIND] /lib64/libc-2.22.so.0 [@] _start [{ /home/abuild/rpmbuild/BUILD/glibc-2.22/csu/./sysdeps/x86_64/start.S } { 118 } }	0.2	4
▾ ■ [SAMPLE] GNI_DlaProgress [{ /opt/cray/ugni/6.0.14-6.0.4.0_14.1__ge7db4a2.ari/lib64/libugni.so.0.6.0.0 } { 0 } }	0.2	4
▾ ■ [UNWIND] [/opt/cray/ugni/6.0.14-6.0.4.0_14.1__ge7db4a2.ari/lib64/libugni.so.0.6.0.0] [@] UNRESOLVED UNKNOWN	0.15	3
▾ ■ [SAMPLE] GNI_CqGetEvent [{ /opt/cray/ugni/6.0.14-6.0.4.0_14.1__ge7db4a2.ari/lib64/libugni.so.0.6.0.0 } { 0 } }	0.051	1
▾ ■ [UNWIND] /opt/cray/pe/mpt/7.6.3/gni/mpich-intel/16.0/lib/libmpich_intel.so.3.0.1.0 [@] MPIDI_CH3I_Progress [{ /opt/cray/pe/mpt/	0.05	1
▾ ■ MPI_Finalize()	3.601	1
▾ ■ MPI_Send()	0.122	6,866
▾ ■ MPI_Init_thread()	0.112	1
▾ ■ [CONTEXT] .TAU application	0.05	1

% export TAU_SAMPLING=1; export TAU_EBS_UNWIND=1

UNWINDING CALLSTACKS

TAU: ParaProf: Statistics for: n,c,t 2,0,0 - gamess_unw_call_ebs.ppk

Name	Inclusive TIME ▾	Calls
■ .TAU application	79.592	1
▼ ■ MPI_Recv()	75.607	6,870
▼ ■ [CONTEXT] MPI_Recv()	74.848	1,497
▶ ■ [UNWIND] /gpfs/mira-home/sameer/gamess-theta-tau/object/unport.f.410 [@] MAIN__ [{ /gpfs/mira-home/sameer/gamess-theta-	26.196	524
▶ ■ [UNWIND] /gpfs/mira-home/yuri/dist/Github/gamess-theta-tau/ddi/src/ddi_fortran.c.67 [@] beging_ [{ /gpfs/mira-home/sameer/g	21.7	434
▼ ■ [UNWIND] /gpfs/mira-home/sameer/gamess-theta-tau/object/gamess.f.538 [@] main [{ /gpfs/mira-home/sameer/gamess-theta-ta	11.85	237
▼ ■ [UNWIND] /gpfs/mira-home/sameer/gamess-theta-tau/object/unport.f.410 [@] MAIN__ [{ /gpfs/mira-home/sameer/gamess-thet	11.85	237
▼ ■ [UNWIND] /gpfs/mira-home/yuri/dist/Github/gamess-theta-tau/ddi/src/ddi_fortran.c.67 [@] beging_ [{ /gpfs/mira-home/sam	11.85	237
▼ ■ [UNWIND] /gpfs/mira-home/yuri/dist/Github/gamess-theta-tau/ddi/src/ddi_init.c.113 [@] ddi_init_ [{ /gpfs/mira-home/yur	11.85	237
▼ ■ [UNWIND] /gpfs/mira-home/yuri/dist/Github/gamess-theta-tau/ddi/src/ddi_server.c.99 [@] DDI_Init [{ /gpfs/mira-home/	11.85	237
▼ ■ [UNWIND] /gpfs/mira-home/yuri/dist/Github/gamess-theta-tau/ddi/src/ddi_recv.c.65 [@] DDI_Server [{ /gpfs/mira-ho	11.85	237
▼ ■ [UNWIND] /lus/theta-fs0/software/perftools/tau/tau-2.26.3/src/Profile/TauMpi.c.2371 [@] DDI_Recv_request [{ /gpfs	11.85	237
▼ ■ [UNWIND] /opt/cray/pe/mpt/7.6.3/gni/mpich-intel/16.0/lib/libmpich_intel.so.3.0.1.0 [@] MPI_Recv [{ /lus/theta-fs0	11.85	237
▼ ■ [UNWIND] /opt/cray/pe/mpt/7.6.3/gni/mpich-intel/16.0/lib/libmpich_intel.so.3.0.1.0 [@] PMPI_Recv [{ /opt/cray,	11.7	234
▶ ■ [SAMPLE] MPIDI_CH3I_Progress [{ /opt/cray/pe/mpt/7.6.3/gni/mpich-intel/16.0/lib/libmpich_intel.so.3.0.1 } { 0	11.3	226
▶ ■ [SAMPLE] MPIDU_Sched_are_pending [{ /opt/cray/pe/mpt/7.6.3/gni/mpich-intel/16.0/lib/libmpich_intel.so.3.0	0.2	4
▶ ■ [SAMPLE] MPID_nem_gni_poll [{ /opt/cray/pe/mpt/7.6.3/gni/mpich-intel/16.0/lib/libmpich_intel.so.3.0.1 } { 0 } }	0.15	3
▶ ■ [SAMPLE] MPID_nem_network_poll [{ /opt/cray/pe/mpt/7.6.3/gni/mpich-intel/16.0/lib/libmpich_intel.so.3.0.1	0.05	1
▶ ■ [UNWIND] ch3_progress.c.0 [@] PMPI_Recv [{ /opt/cray/pe/mpt/7.6.3/gni/mpich-intel/16.0/lib/libmpich_intel.so.	0.15	3
▶ ■ [UNWIND] /gpfs/mira-home/yuri/dist/Github/gamess-theta-tau/ddi/src/ddi_init.c.113 [@] ddi_init_ [{ /gpfs/mira-home/yuri/dist/G	8.701	174
▶ ■ [UNWIND] /gpfs/mira-home/yuri/dist/Github/gamess-theta-tau/ddi/src/ddi_server.c.99 [@] DDI_Init [{ /gpfs/mira-home/yuri/dist/	5.75	115
▶ ■ [UNWIND] /lib64/libc-2.22.so.0 [@] _start [{ /home/abuild/rpmbuild/BUILD/glibc-2.22/csu/./sysdeps/x86_64/start.S } { 118 } }	0.2	4
▶ ■ [SAMPLE] GNII_DlaProgress [{ /opt/cray/ugni/6.0.14-6.0.4.0_14.1_ge7db4a2.ari/lib64/libugni.so.0.6.0 } { 0 } }	0.2	4
▶ ■ [UNWIND] [/opt/cray/ugni/6.0.14-6.0.4.0_14.1_ge7db4a2.ari/lib64/libugni.so.0.6.0.0] [@] UNRESOLVED UNKNOWN	0.15	3
▶ ■ [SAMPLE] GNI_CqGetEvent [{ /opt/cray/ugni/6.0.14-6.0.4.0_14.1_ge7db4a2.ari/lib64/libugni.so.0.6.0 } { 0 } }	0.051	1
▶ ■ [UNWIND] /opt/cray/pe/mpt/7.6.3/gni/mpich-intel/16.0/lib/libmpich_intel.so.3.0.1.0 [@] MPIDI_CH3I_Progress [{ /opt/cray/pe/mpt/	0.05	1
■ MPI_Finalize()	3.601	1
▶ ■ MPI_Send()	0.122	6,866
▶ ■ MPI_Init_thread()	0.112	1
▶ ■ [CONTEXT] .TAU application	0.05	1

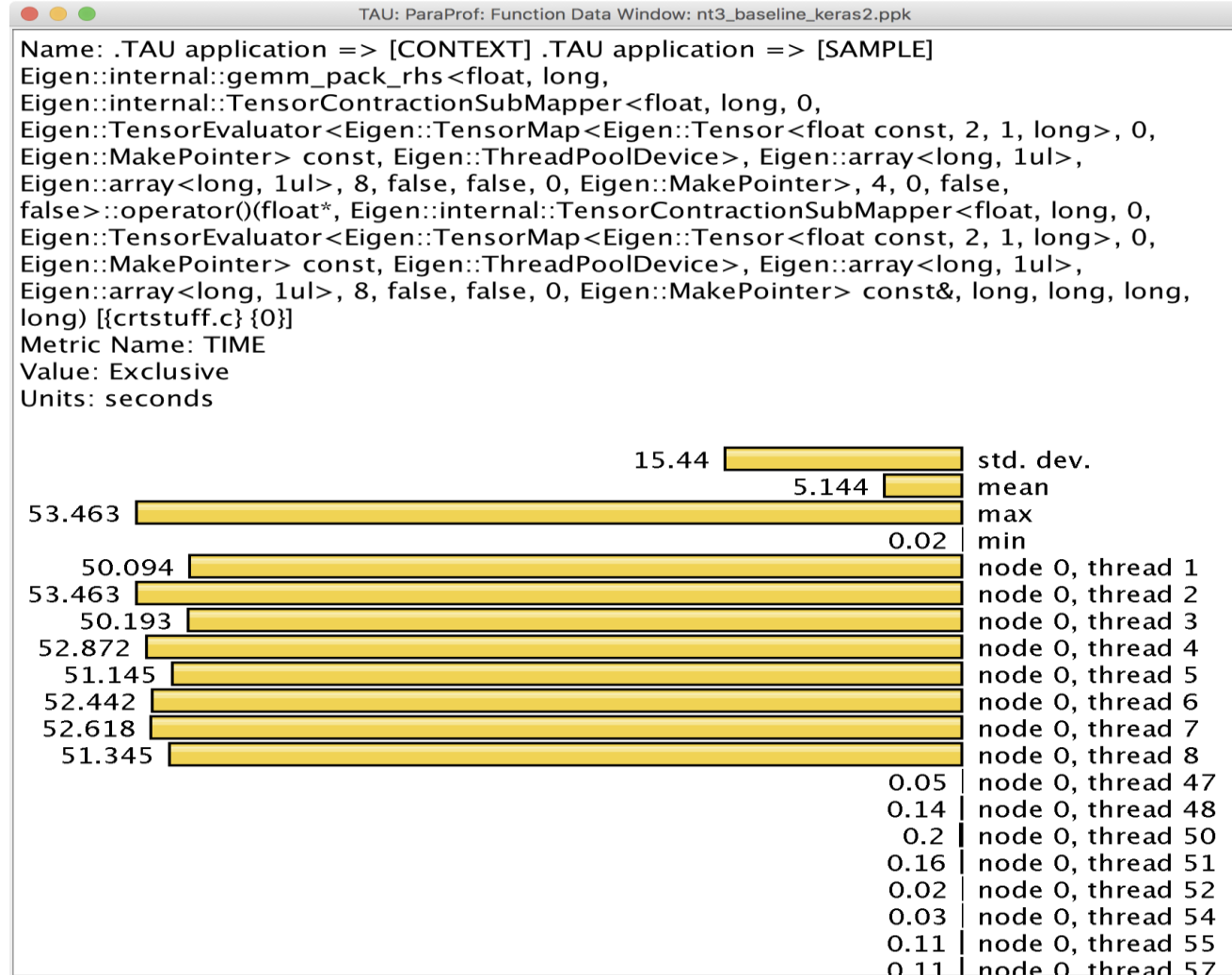
Deep Learning: Tensorflow

TAU: ParaProf: Statistics for: node 0, thread 8 - nt3_baseline_keras2.ppk

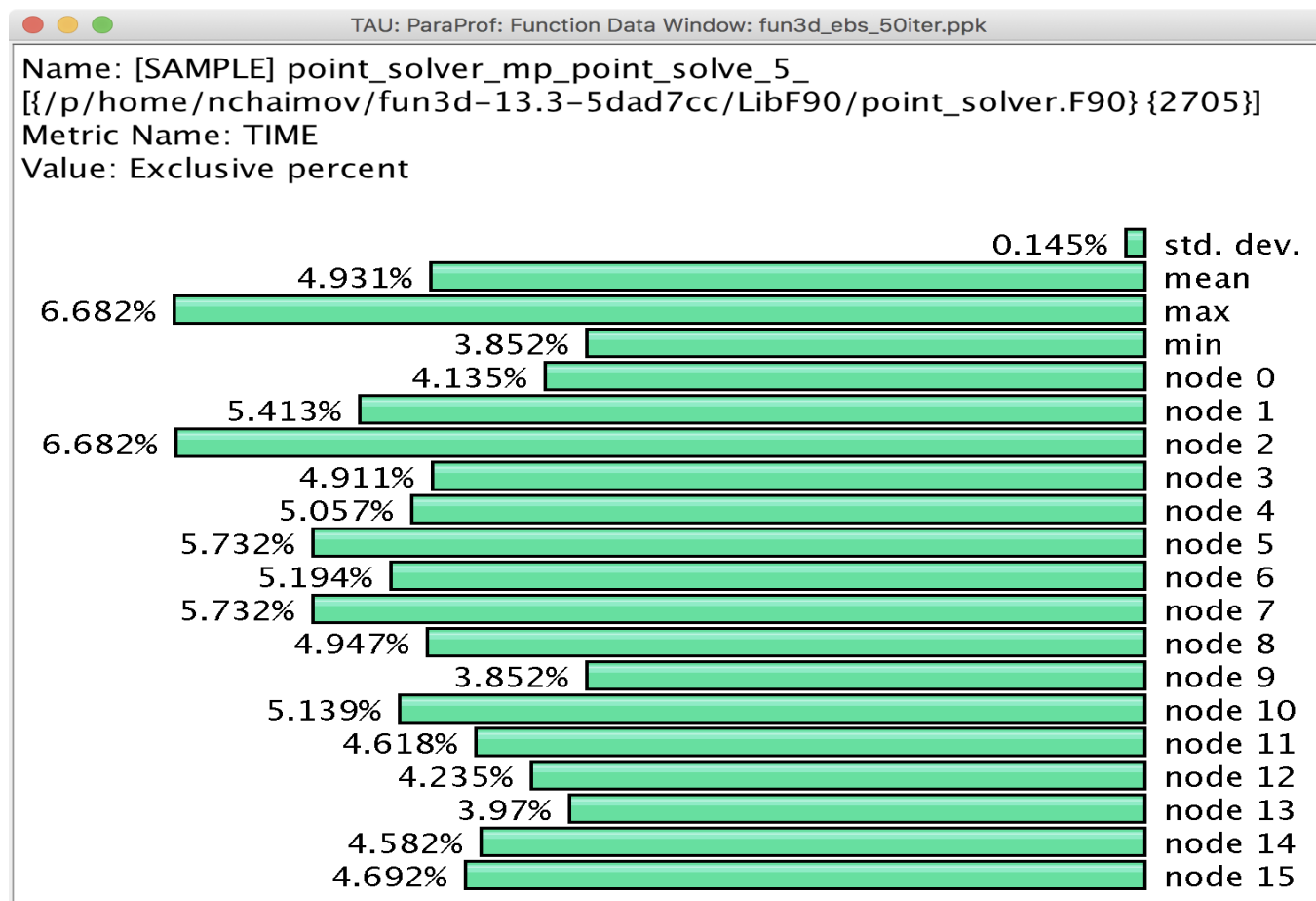
Name	Inclusiv...	Calls ▾
▾ .TAU application	519.211	1
▾ [CONTEXT] .TAU application	509.222	50,915
▾ [SAMPLE] Eigen::internal::gebp_kernel<float, float, long, Eigen::internal::blas_data_mapper<float, long, 0, 0>,	240.632	24,089
▾ [SAMPLE] __pthread_cond_wait [{0}]	86.384	8,634
▾ [SAMPLE] Eigen::internal::gemm_pack_rhs<float, long, Eigen::internal::TensorContractionSubMapper<float, lor	51.345	5,135
▾ [SAMPLE] Eigen::internal::gemm_pack_rhs<float, long, Eigen::internal::TensorContractionSubMapper<float, lor	24.375	2,416
▾ [SAMPLE] void tensorflow::SpatialMaxPoolWithArgMaxHelper<Eigen::ThreadPoolDevice, float>(tensorflow::OpK	16.301	1,630
▾ [SAMPLE] __memset_sse2 [{0}]	13.446	1,336
▾ [SAMPLE] Eigen::TensorEvaluator<Eigen::TensorContractionOp<Eigen::array<Eigen::IndexPair<long>, 1ul> co	5.99	599
▾ [SAMPLE] long Eigen::internal::operator/(<long, false>(long const&, Eigen::internal::TensorIntDivisor<long, fals	5.843	585
▾ [SAMPLE] std::_Function_handler<void (long, long), Eigen::internal::TensorExecutor<Eigen::TensorAssignOp<l	5.377	538
▾ [SAMPLE] float __vector Eigen::TensorEvaluator<Eigen::TensorBroadcastingOp<Eigen::IndexList<int, Eigen::typ	4.862	487
▾ [SAMPLE] Eigen::TensorEvaluator<Eigen::TensorContractionOp<Eigen::array<Eigen::IndexPair<long>, 1ul> co	4.775	478
▾ [SAMPLE] Eigen::TensorEvaluator<Eigen::TensorAssignOp<Eigen::TensorMap<Eigen::Tensor<float, 1, 1, long>	4.037	404
▾ [SAMPLE] Eigen::internal::gemm_pack_lhs<float, long, Eigen::internal::TensorContractionSubMapper<float, lon	3.679	367
▾ [SAMPLE] Eigen::internal::EvalRange<Eigen::TensorEvaluator<Eigen::TensorAssignOp<Eigen::TensorMap<Eigei	2.981	298
▾ [SAMPLE] tensorflow::MaxPoolingOp<Eigen::ThreadPoolDevice, float>::SpatialMaxPool(tensorflow::OpKernelCo	2.915	295
▾ [SAMPLE] std::_Function_handler<void (long, long), Eigen::internal::TensorExecutor<Eigen::TensorAssignOp<l	2.91	291
▾ [SAMPLE] std::_Function_handler<void (long, long), Eigen::internal::TensorExecutor<Eigen::TensorAssignOp<l	2.772	277
▾ [SAMPLE] Eigen::internal::gemm_pack_lhs<float, long, Eigen::internal::TensorContractionSubMapper<float, lon	2.481	248
▾ [SAMPLE] std::_Function_handler<void (long, long), Eigen::internal::TensorExecutor<Eigen::TensorAssignOp<l	2.148	215
▾ [SAMPLE] void Eigen::internal::call_dense_assignment_loop<Eigen::Map<Eigen::Matrix<float, -1, -1, 0, -1, -1>	2.008	197
▾ [SAMPLE] Eigen::NonBlockingThreadPoolTempl<tensorflow::thread::EigenEnvironment>::WorkerLoop(int) [{/hc	1.999	200
▾ [SAMPLE] Eigen::internal::ptrtranspose(Eigen::internal::PacketBlock<float __vector, 4>&) [{crtstuff.c} {0}]	1.919	192
▾ [SAMPLE] Eigen::internal::gemm_pack_rhs<float, long, Eigen::internal::TensorContractionSubMapper<float, lor	1.607	160
▾ [SAMPLE] Eigen::TensorEvaluator<Eigen::TensorContractionOp<Eigen::array<Eigen::IndexPair<long>, 1ul> co	1.518	152

```
% tau_python -ebs nt3_baseline_keras2.py (CANDLE)
```


Sampling Tensorflow



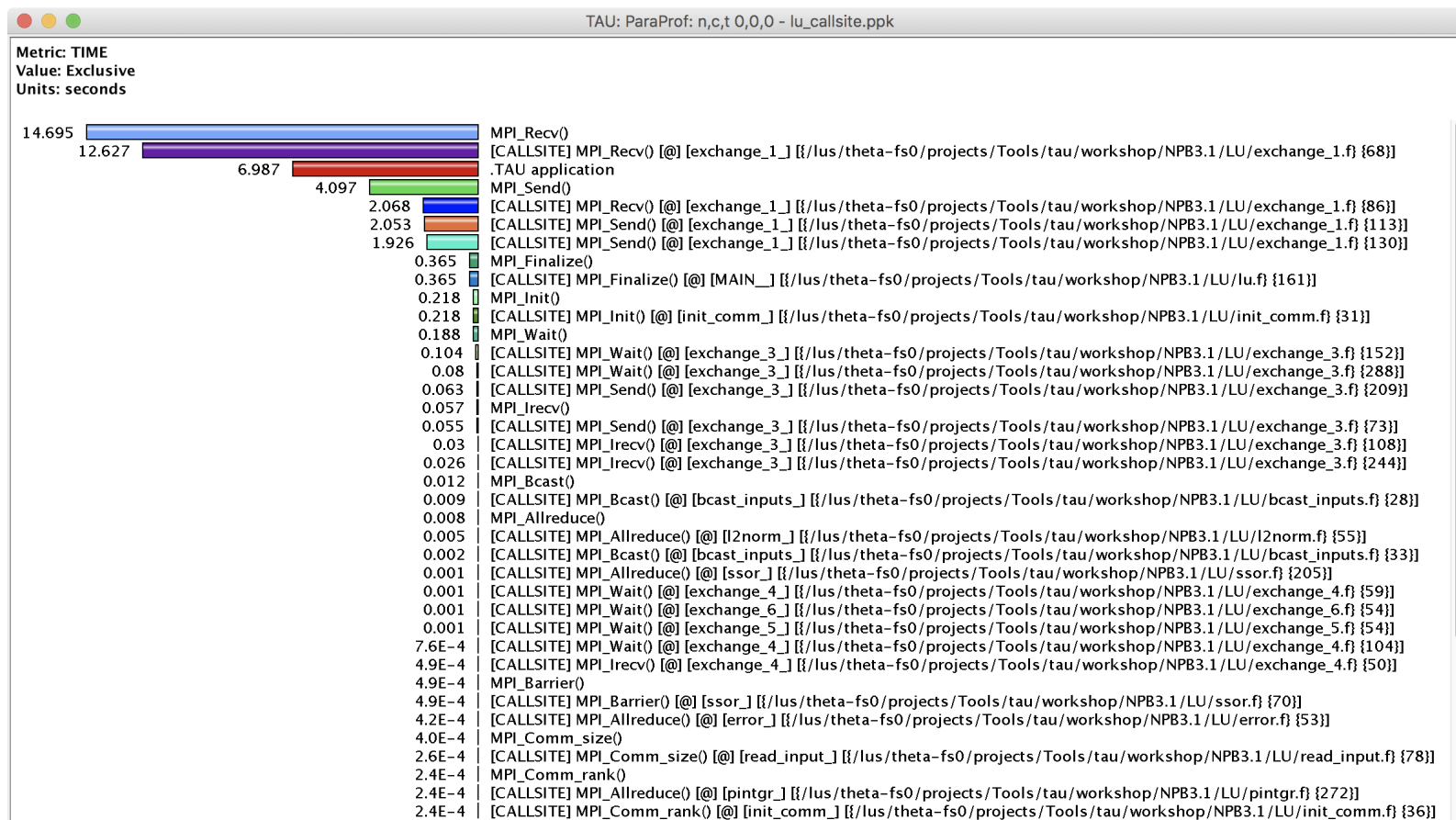
Event Based Sampling (EBS)



Uninstrumented!

```
% mpirun -np 16 tau_exec -ebs a.out
```

Callsite Profiling and Tracing



% export TAU_CALLSITE=1

ParaProf: Callpath Thread Relations Window

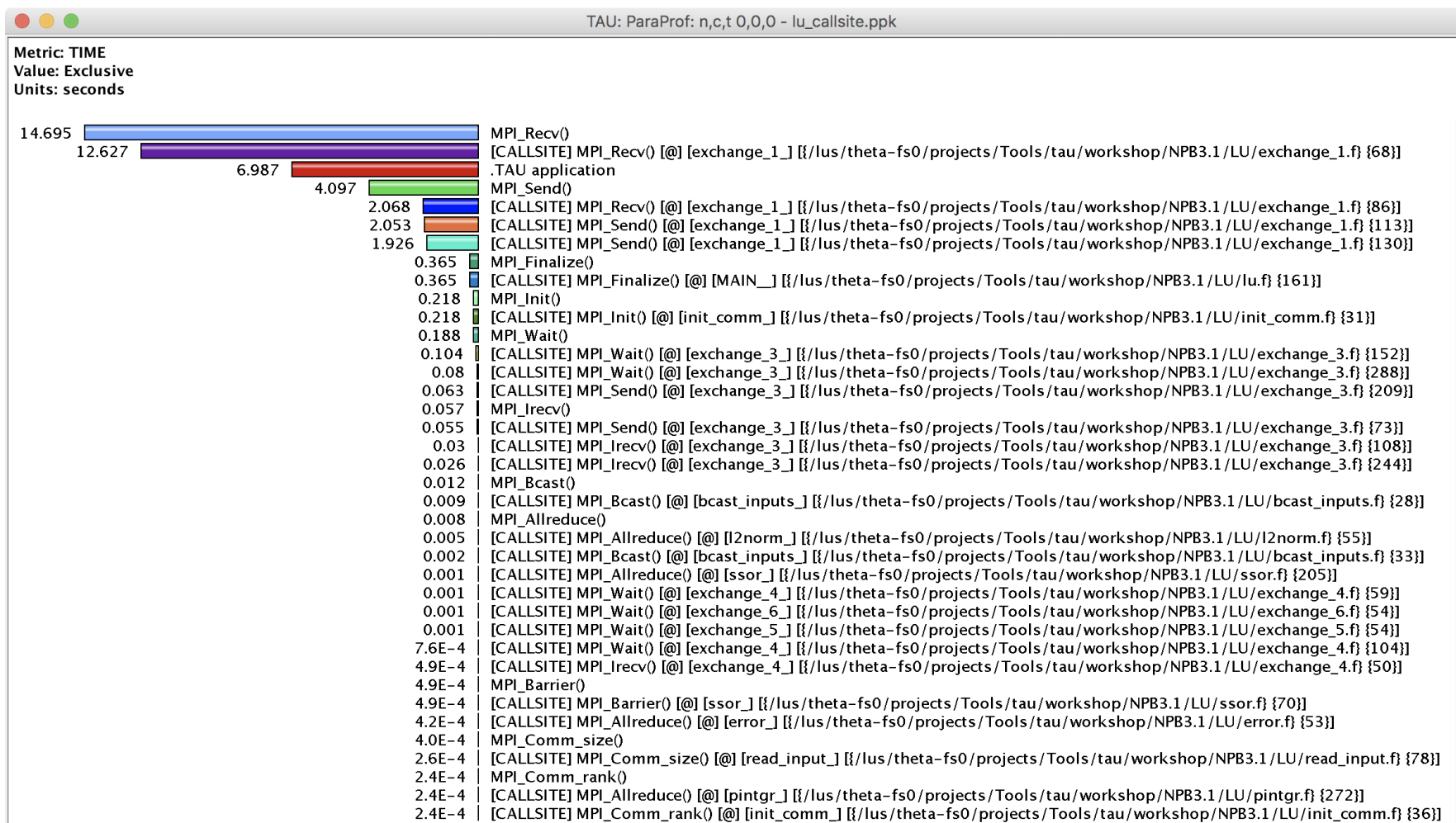
TAU: ParaProf: Call Path Data n,c,t, 0,0,0 - scout.cubex

File Options Windows Help

Metric Name: Time
Sorted By: Exclusive
Units: seconds

-->	0.04	0.04	32/32	!\$omp parallel @initialize.f:28
	0.04	0.04	32	!\$omp do @initialize.f:50
-->	0.03	2.536	3232/3232	compute_rhs_
	0.03	2.536	3232	!\$omp parallel @rhs.f:28
	9.8E-4	9.8E-4	3232/3232	!\$omp master @rhs.f:424
	0.225	0.228	3232/3232	!\$omp do @rhs.f:62
	0.002	0.002	3232/3232	!\$omp master @rhs.f:74
	0.002	0.002	3232/3232	!\$omp master @rhs.f:293
	0.199	0.199	3232/3232	!\$omp do @rhs.f:384
	0.002	0.002	3232/3232	!\$omp master @rhs.f:183
	0.343	0.343	3232/3232	!\$omp do @rhs.f:37
	0.016	0.016	3232/3232	!\$omp do @rhs.f:372
	0.014	0.027	3232/3232	!\$omp do @rhs.f:413
	0.609	0.609	3232/3232	!\$omp do @rhs.f:191
	0.36	0.386	3232/3232	!\$omp do @rhs.f:301
	0.583	0.583	3232/3232	!\$omp do @rhs.f:80
	0.019	0.019	3232/3232	!\$omp do @rhs.f:400
	0.006	0.006	3232/51680	!\$omp implicit barrier
	0.069	0.069	3232/3232	!\$omp do @rhs.f:428
	0.015	0.015	3232/3232	!\$omp do @rhs.f:359
-->	0.021	0.029	6432/6432	!\$omp parallel @exch_qbc.f:215
	0.021	0.029	6432	!\$omp parallel do @exch_qbc.f:215
	0.007	0.007	6432/51680	!\$omp implicit barrier
-->	0.02	0.033	6432/6432	!\$omp parallel @exch_qbc.f:255
	0.02	0.033	6432	!\$omp parallel do @exch_qbc.f:255
	0.013	0.013	6432/51680	!\$omp implicit barrier

Callsite Profiling and Tracing (TAU_CALLSITE=1)



Identifying MPI Collective Sync Wait in Thread Callpath Relations

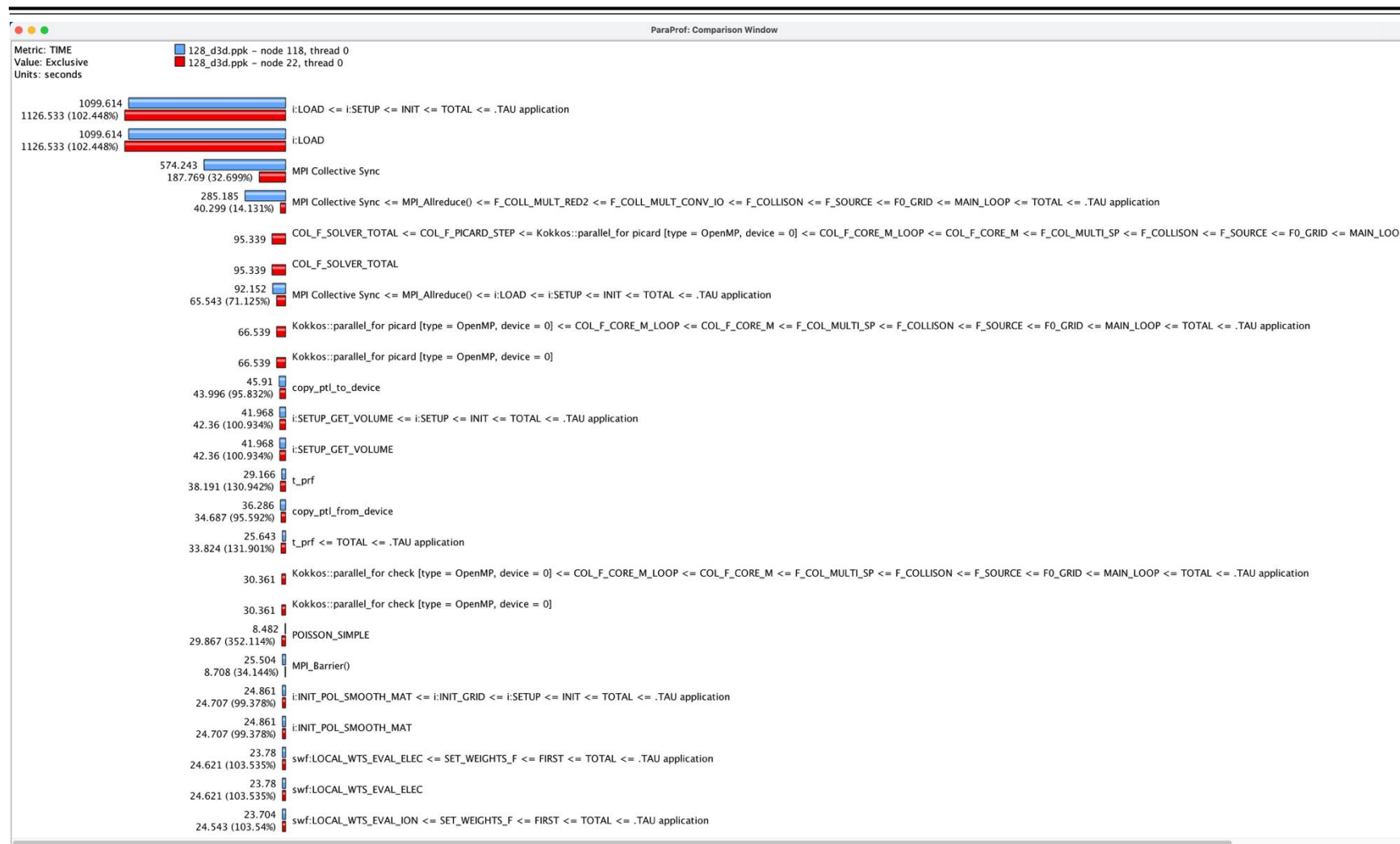
TAU: ParaProf: Call Path Data n,c,t, 118,0,0 - 128_d3d.ppk

Metric Name: TIME
Sorted By: Exclusive
Units: seconds

	Exclusive	Inclusive	Calls/Tot.Calls	Name[id]
	1099.614	1191.772	1/1	i:SETUP
-->	1099.614	1191.772	1	i:LOAD
	0.006	92.158	3/9543	MPI_Allreduce()
	9.8E-4	9.8E-4	11/15177	MPI_Gatherv()
	1.448	1.448	43/15177	MPI_Gather()
	15.353	15.353	46/15177	MPI_Alltoall()
	89.821	89.821	4311/15177	MPI_Bcast()
	6.777	6.777	195/15177	MPI_Allgather()
	68.678	68.678	991/15177	MPI_Reduce()
	9.179	9.179	12/15177	MPI_Comm_dup()
	0.125	0.125	25/15177	MPI_Allgatherv()
	382.861	382.861	9543/15177	MPI_Allreduce()
-->	574.243	574.243	15177	MPI Collective Sync
	2.507	2.508	10/186	DISTRIBUTE_F0G
	2.433	2.434	10/186	F_UPD_F0_SP
	5.156	5.158	20/186	F0_CHARGE_SEARCH_INDEX
	5.505	5.507	22/186	PULLBACK_WEIGHT
	24.86	24.872	102/186	UPDATE_PTL_WEIGHT
	0.473	0.473	2/186	MAIN_LOOP
	4.975	4.977	20/186	DIAG_f0_PORT1_PTL
-->	45.91	45.93	186	copy_ptl_to_device
	0.02	0.02	186/272	Kokkos::parallel_for set_buffer_particles_d [type = Cuda, device = 0]

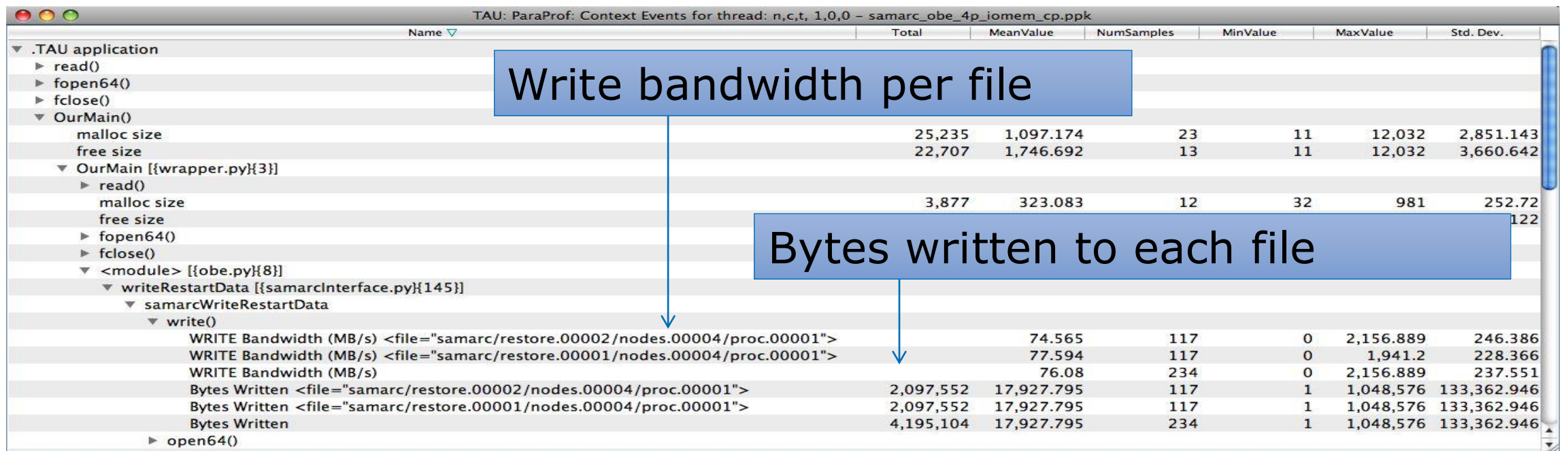
MPI Collective Sync is the time spent in a barrier operation inside a collective

Thread Comparison Window



Comparing Rank 118 with 22.
Right click on "node 118" ->
Add node to comparison window

TAU – Context Events



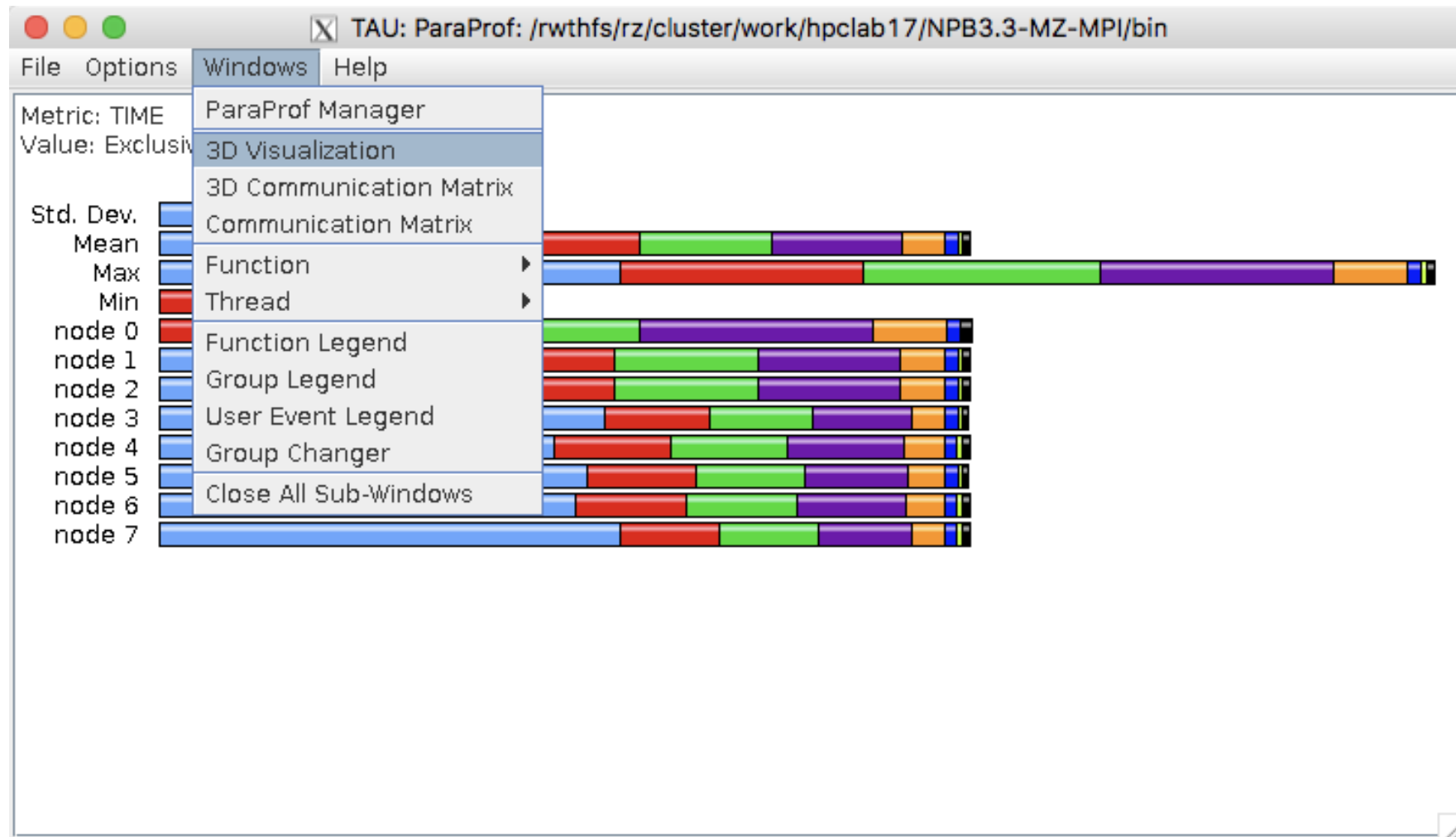
TAU: ParaProf: Context Events for thread: n,c,t, 1,0,0 – samarc_obe_4p_iomem_cp.ppk

Name ▼	Total	MeanValue	NumSamples	MinValue	MaxValue	Std. Dev.
▼ .TAU application						
▶ read()						
▶ fopen64()						
▶ fclose()						
▼ OurMain()						
malloc size	25,235	1,097.174	23	11	12,032	2,851.143
free size	22,707	1,746.692	13	11	12,032	3,660.642
▼ OurMain [{wrapper.py}{3}]						
▶ read()						
malloc size	3,877	323.083	12	32	981	252.72
free size						122
▶ fopen64()						
▶ fclose()						
▼ <module> [{obe.py}{8}]						
▼ writeRestartData [{samarcInterface.py}{145}]						
▼ samarcWriteRestartData						
▼ write()						
WRITE Bandwidth (MB/s) <file="samarc/restore.00002/nodes.00004/proc.00001">		74.565	117	0	2,156.889	246.386
WRITE Bandwidth (MB/s) <file="samarc/restore.00001/nodes.00004/proc.00001">		77.594	117	0	1,941.2	228.366
WRITE Bandwidth (MB/s)		76.08	234	0	2,156.889	237.551
Bytes Written <file="samarc/restore.00002/nodes.00004/proc.00001">	2,097,552	17,927.795	117	1	1,048,576	133,362.946
Bytes Written <file="samarc/restore.00001/nodes.00004/proc.00001">	2,097,552	17,927.795	117	1	1,048,576	133,362.946
Bytes Written	4,195,104	17,927.795	234	1	1,048,576	133,362.946
▶ open64()						

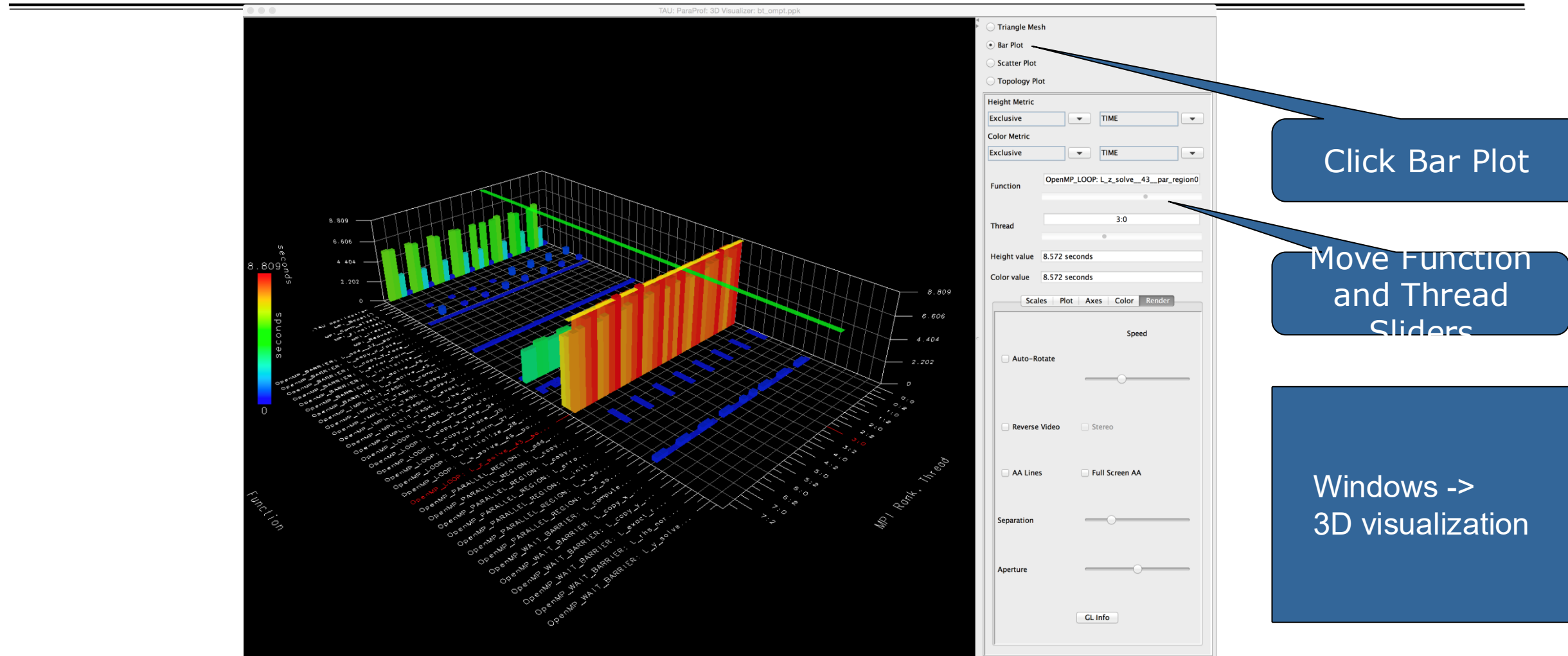
Write bandwidth per file

Bytes written to each file

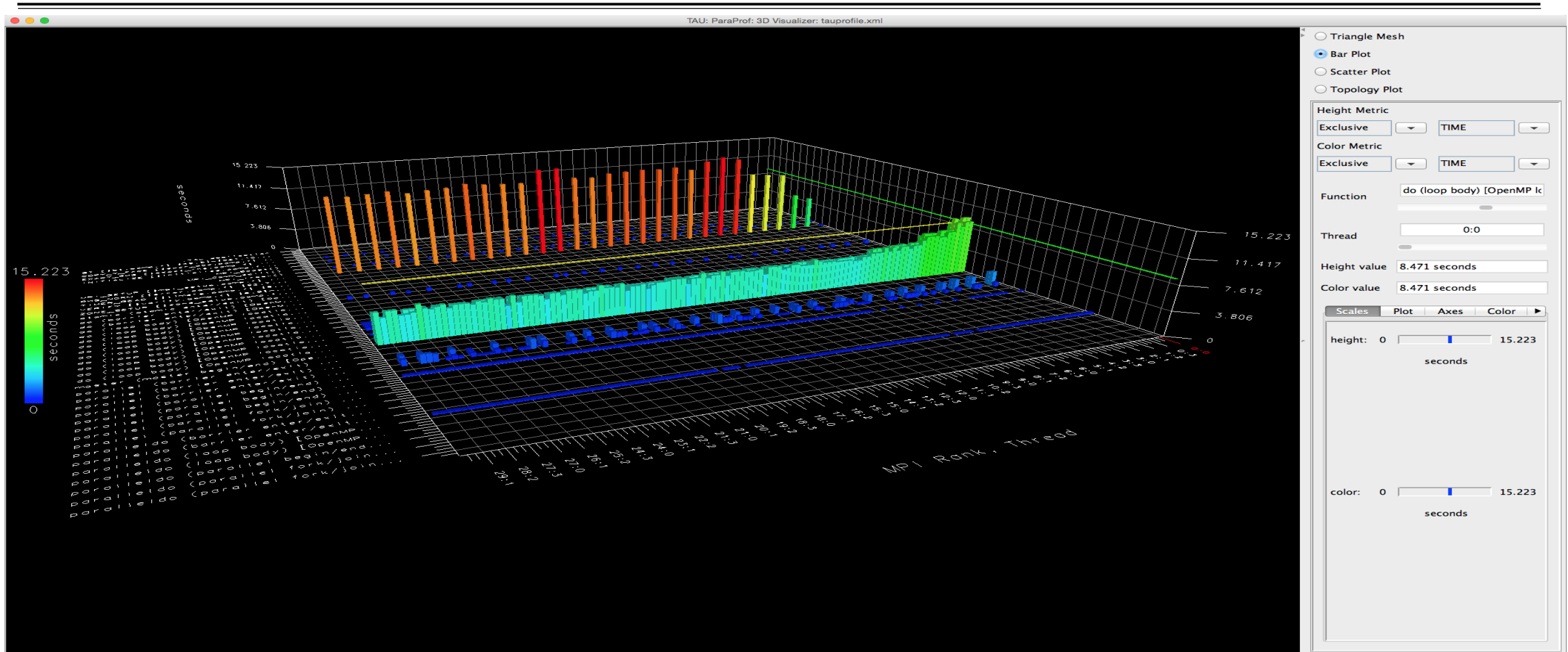
ParaProf with Optimized Instrumentation



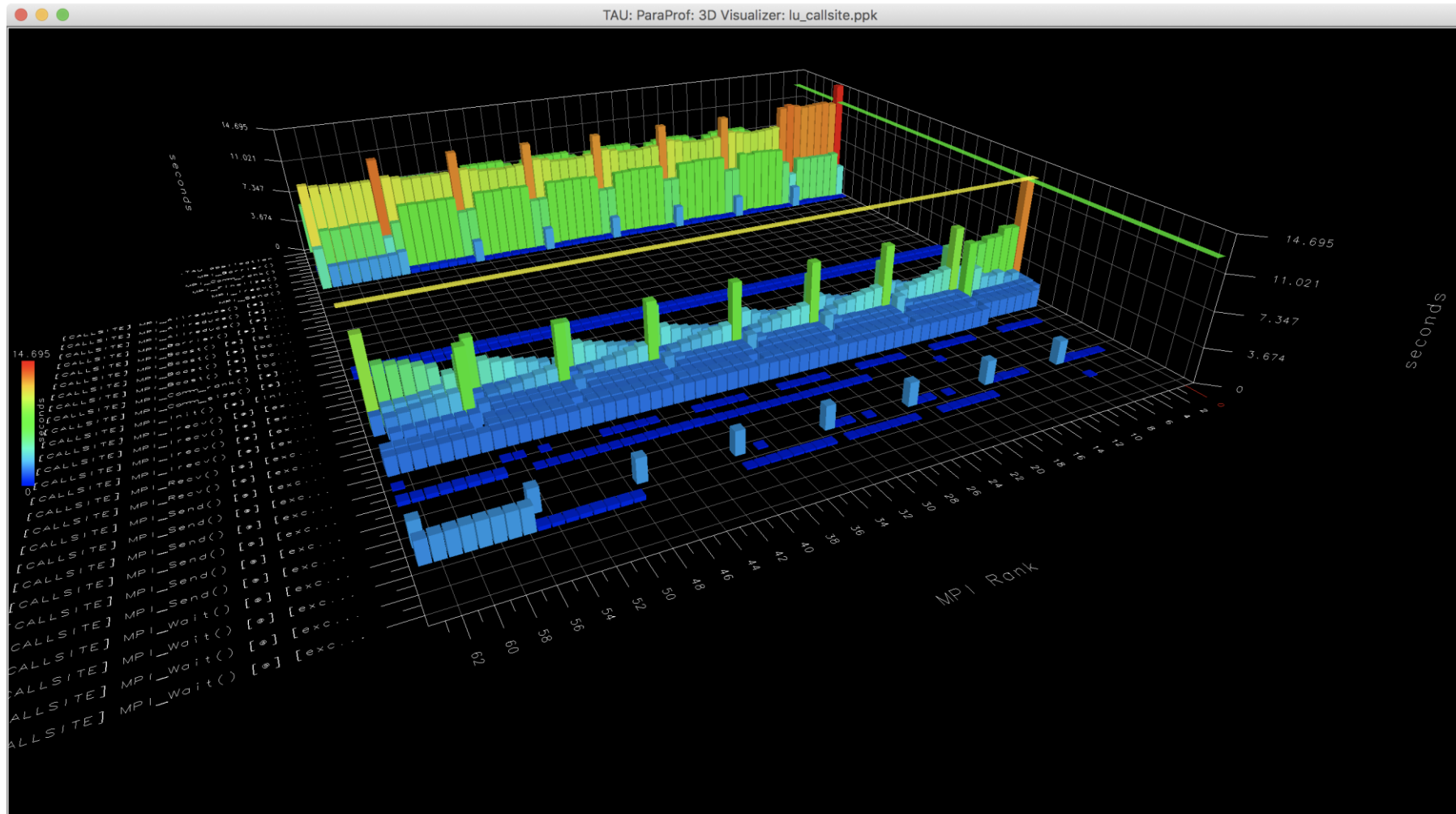
Paraprof 3D visualization window



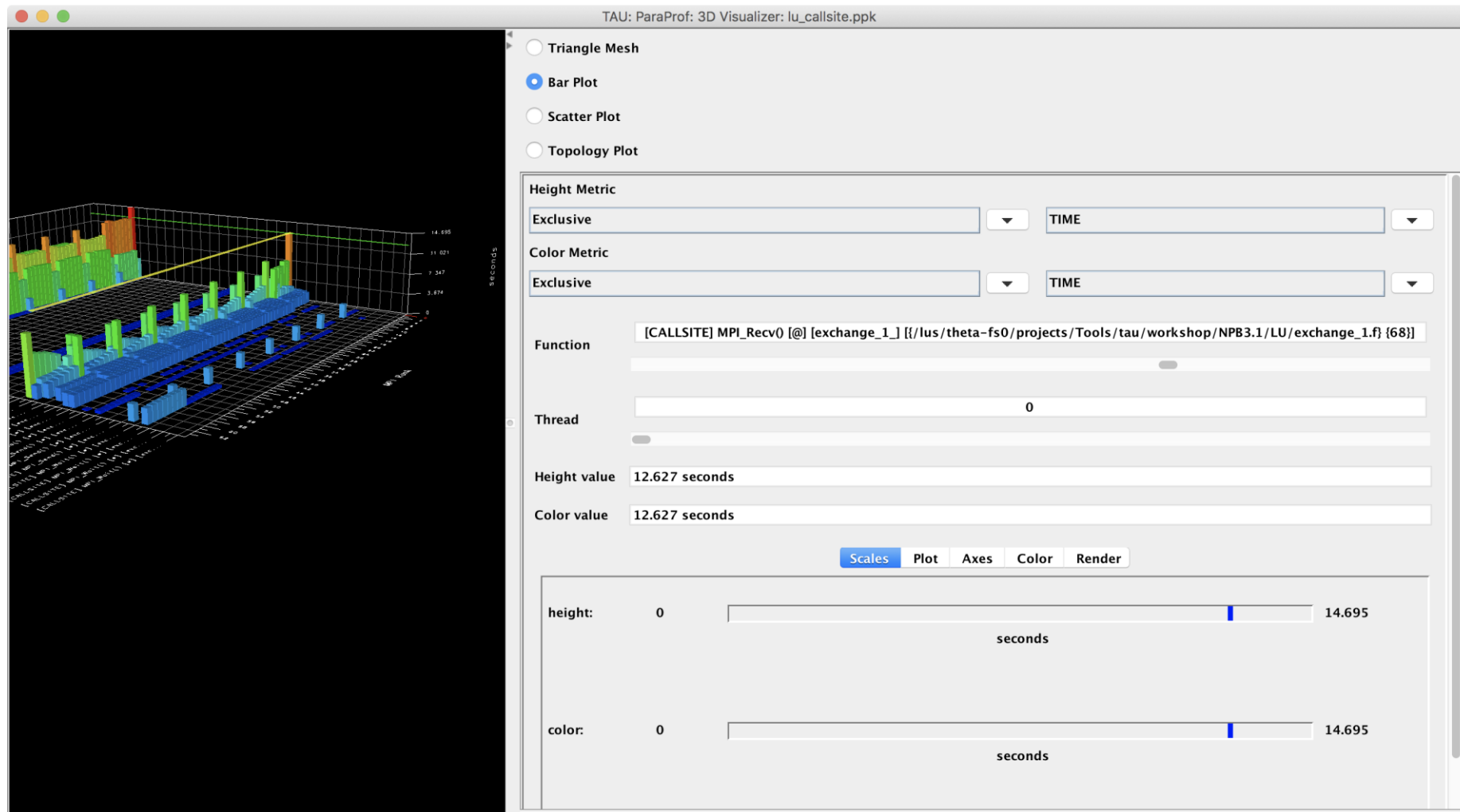
ParaProf: 3D Visualization Window Showing Entire Profile



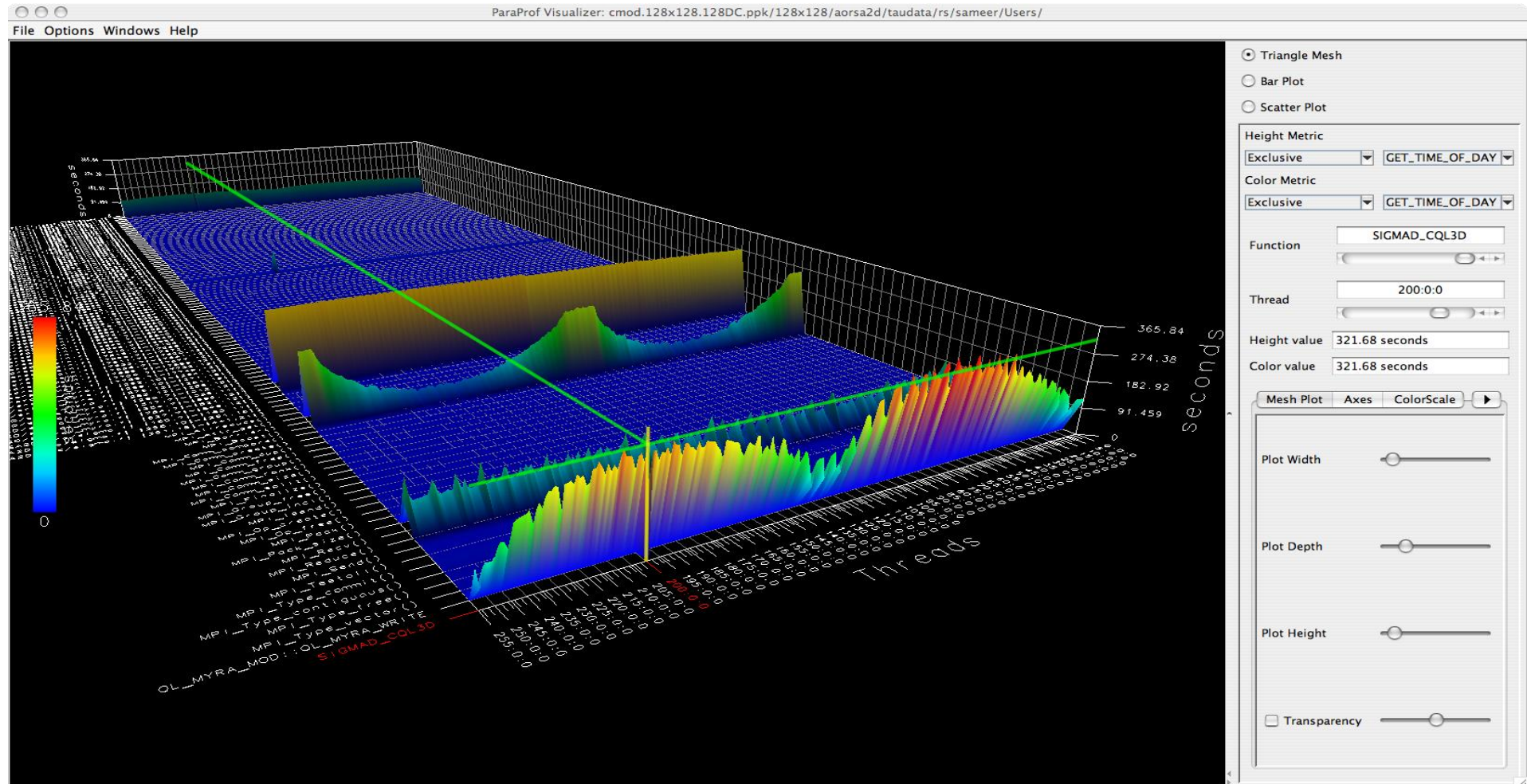
Callsite Profiling and Tracing



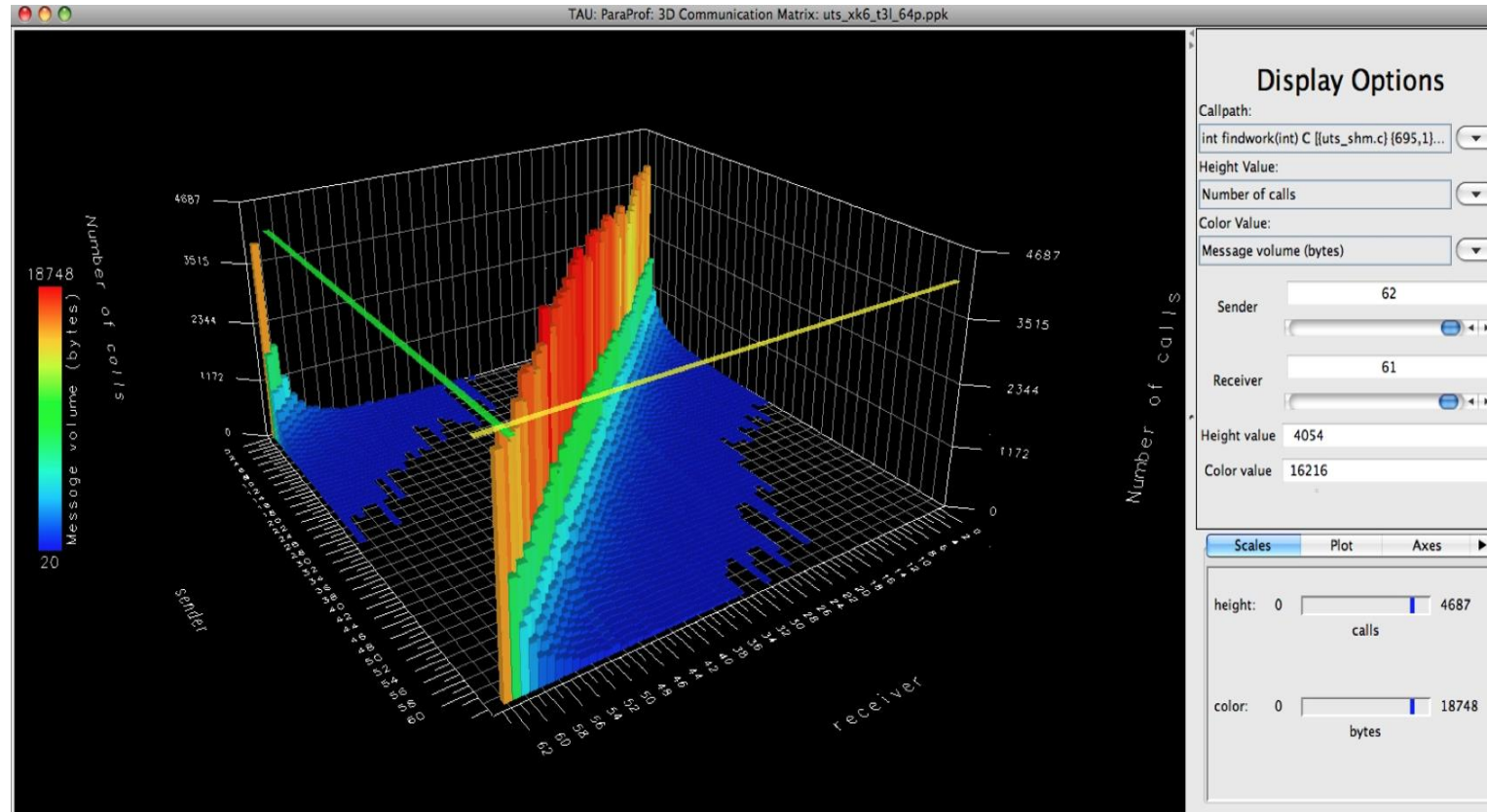
Callsite Profiling and Tracing



Parallel Profile Visualization: ParaProf

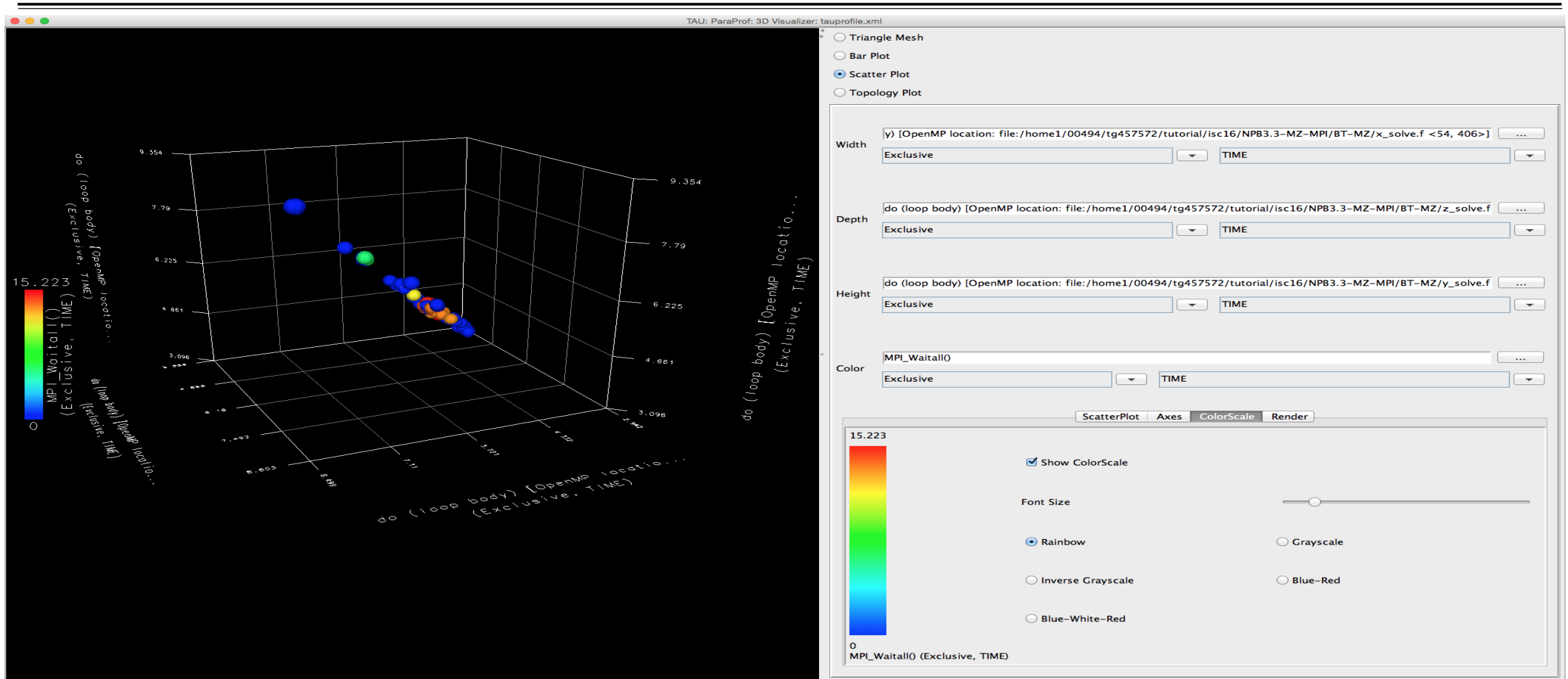


ParaProf 3D Communication Matrix



```
% export TAU_COMM_MATRIX=1
```

ParaProf: 3D Scatter Plot



ParaProf: Score-P Profile Files, Database

TAU: ParaProf Manager

File Options Help

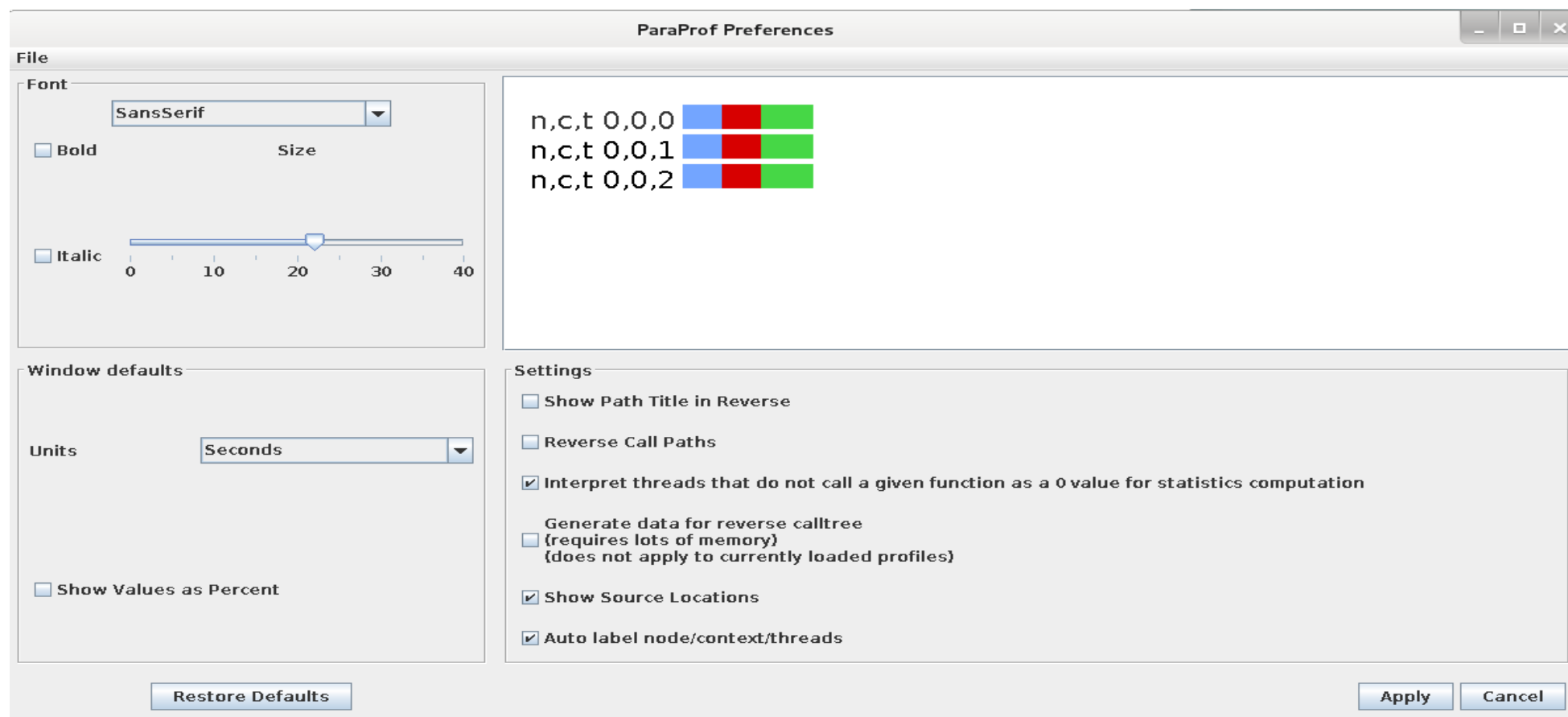
Applications

- Standard Applications
 - Default App
 - Default Exp
 - profile.cubex
 - Time
 - Minimum Inclusive Time
 - Maximum Inclusive Time
 - PAPI_TOT_CYC
 - PAPI_TOT_INS
 - PAPI_FP_INS
 - ru_utime
 - ru_stime
 - ru_maxrss
 - ru_ixrss
 - ru_idrss
 - ru_isrss
 - ru_minflt
 - ru_majflt
 - ru_nswap
 - ru_inblock
 - ru_oublock
 - ru_msgsnd
 - ru_msgrcv
 - ru_nsignals
 - ru_nvcsw
 - ru_nivcsw
 - bytes_sent
 - bytes_received
- Default (jdbc:h2:/home/livetau/.ParaProf/perfdmf;AUTO_SERVER=TRUE)
- perfexplorer_working (jdbc:h2:/home/livetau/.ParaProf/perfexplorer_wo

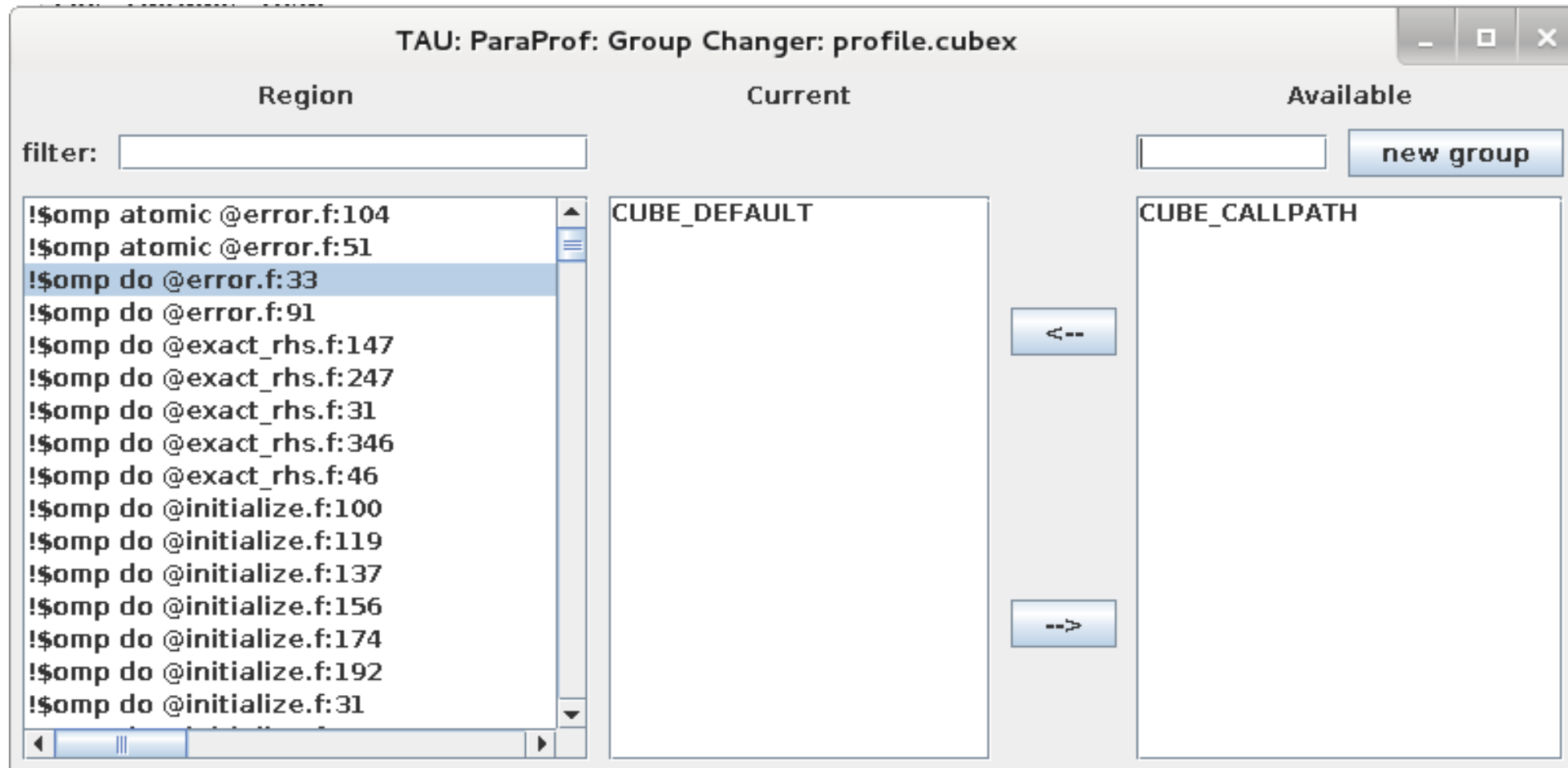
Add Application
Add Experiment
Add Trial

TrialField	Value
Name	profile.cubex
Application ID	0
Experiment ID	0
Trial ID	0
File Type Index	9
File Type Name	Cube

ParaProf: File Preferences Window



ParaProf: Group Changer Window



ParaProf: Derived Metric Panel in Manager Window

TAU: ParaProf Manager

File Options Help

Applications

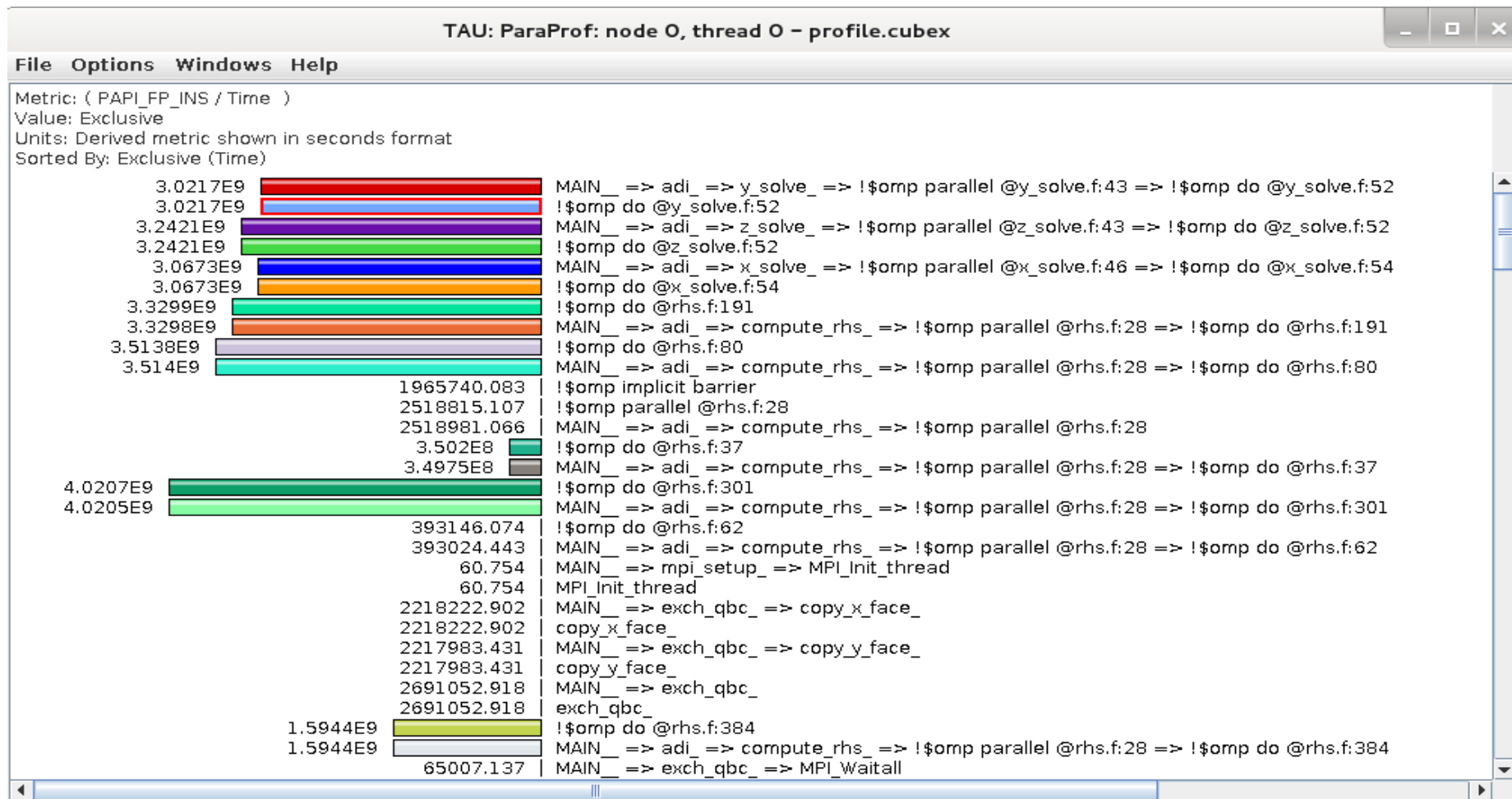
- Standard Applications
 - Default App
 - Default Exp
 - profile.cubex
 - Time**
 - Minimum Inclusive Time
 - Maximum Inclusive Time
 - PAPI_TOT_CYC
 - PAPI_TOT_INS
 - PAPI_FP_INS
 - ru_utime
 - ru_stime
 - ru_maxrss
 - ru_ixrss
 - ru_idrss
 - ru_isrss
 - ru_minflt
 - ru_majflt
 - ru_nswap
 - ru_inblock
 - ru_oublock
 - ru_msgsnd
 - ru_msgrcv
 - ru_nsignals
 - ru_nvcsw

MetricField	Value
Name	Time
Application ID	0
Experiment ID	0
Trial ID	0
Metric ID	0

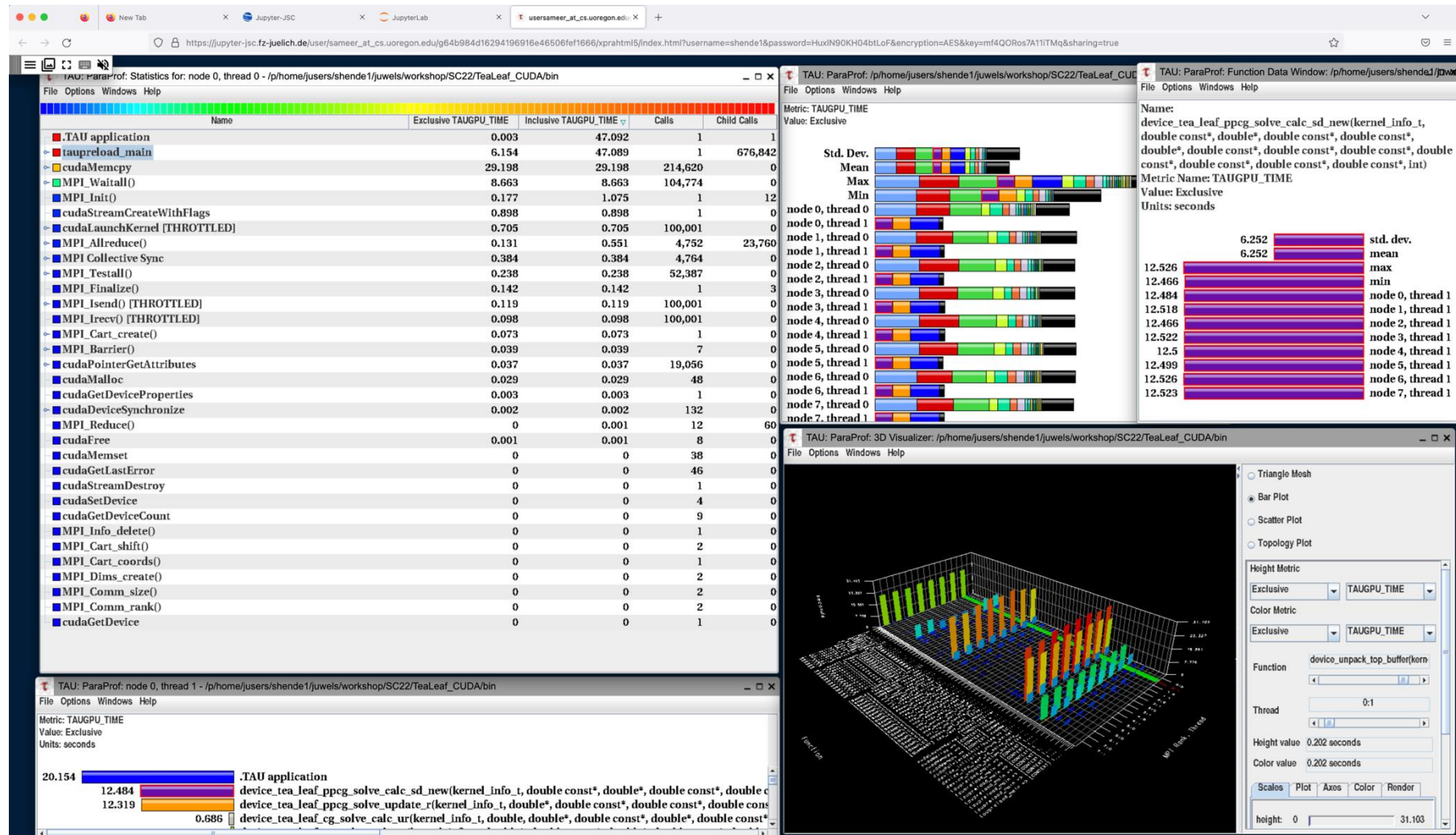
Expression: "PAPI_FP_INS"/"Time" Clear

+ - * / = { } Apply

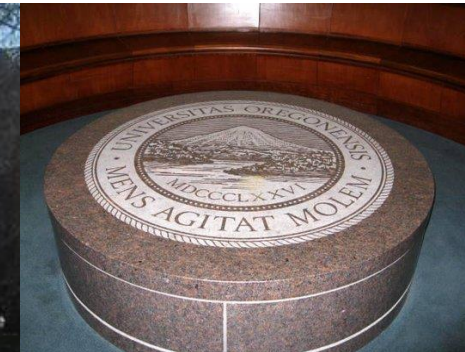
Sorting Derived FLOPS metric by Exclusive Time



ParaProf:



Performance Research Lab, University of Oregon, Eugene, USA



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⑩ <https://science.osti.gov/ascr>

⑩ <https://pesoproject.org>

⑩ <https://ascr-step.org>

⑩ <https://hpsf.io>

⑩ <https://www.energy.gov/technologytransitions/sbirsttr>



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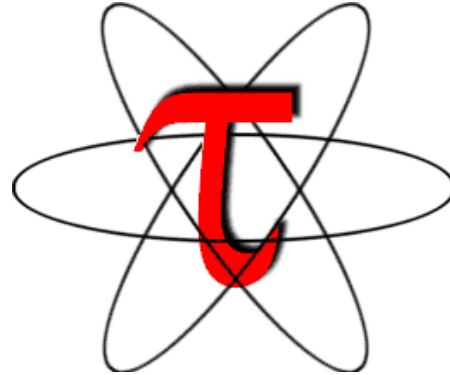


ParaTools

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