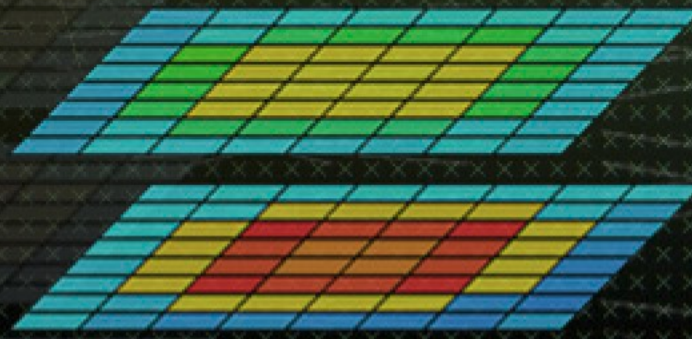
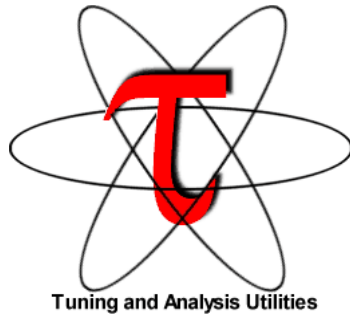




TAU Performance System®



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http://tau.uoregon.edu/TAU_TW44.pptx



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?
- 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.
- What is the time taken in OS routines for thread scheduling? How much time is wasted?
- 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 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 Score-P, OTF2/Vampir
- paraprof and perfexplorer: GUI tools
- pprof: text based browser
- Open Source: BSD style license

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`
- Score-P: `% mpirun -np 16 tau_exec -T scorep,mpi ./a.out`

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 &`
- Chrome/Jumpshot: `% export TAU_TRACE=1; mpirun -np 64 tau_exec ./a.out`
`% tau_treemerge.pl;`

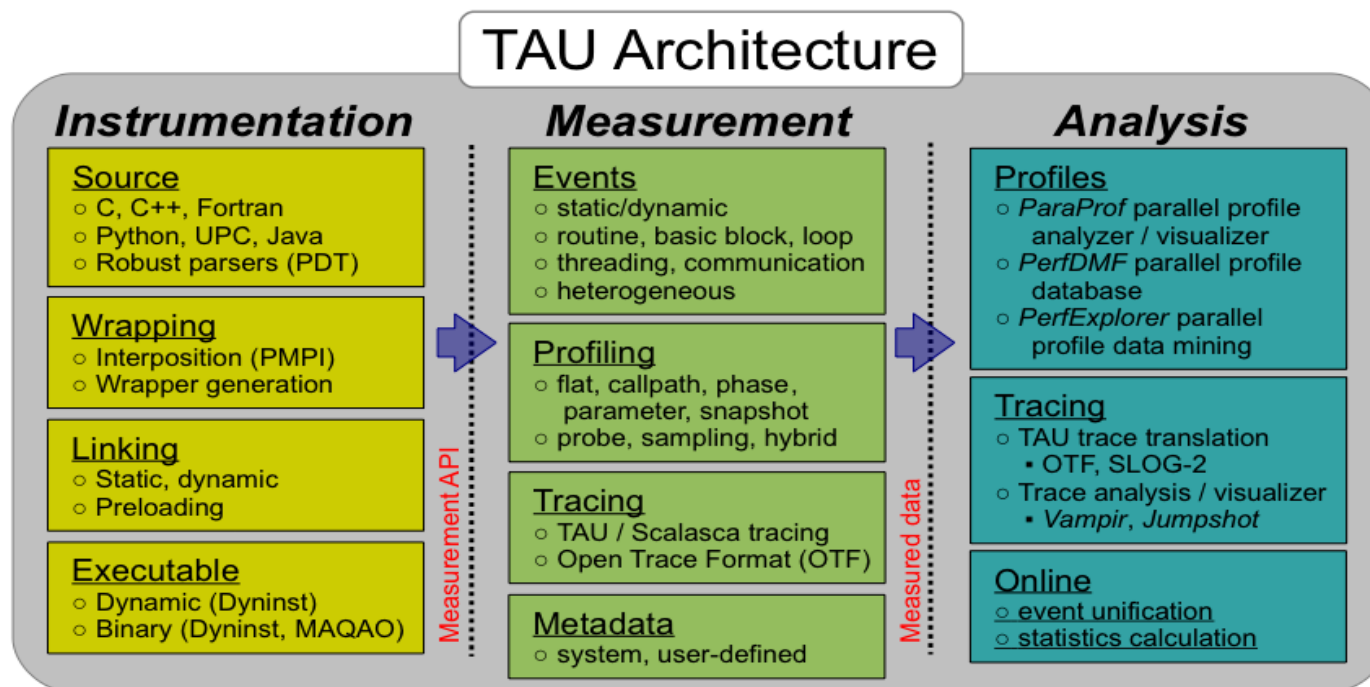
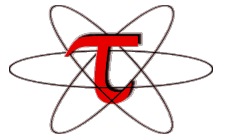
Chrome: `% tau_trace2json tau.trc tau.edf -chrome -ignoreatomic -o app.json`

Chrome browser: `chrome://tracing` (Load -> app.json) or Perfetto.dev

- Jumpshot: `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
 - 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

TAU's Support for Runtime Systems

■ *MPI*

- PMPI profiling interface
- MPI_T tools interface using performance and control variables

■ *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

■ *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
- *Intel® OneAPI*
 - Level Zero
 - Track time spent in kernels executing on GPU
 - Track time spent in OneAPI runtime calls
- *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

Examples of Multi-Level Instrumentation

- *MPI + OpenMP*

- MPI_T + PMPI + OMPT may be used to track MPI and OpenMP

- *MPI + CUDA*

- PMPI + CUPTI interfaces

- *Kokkos + OpenMP*

- Kokkos profiling API + OMPT to transparently track events

- *Kokkos + pthread + MPI*

- Kokkos + pthread wrapper interposition library + PMPI layer

- *Python + CUDA + MPI*

- Python + CUPTI + pthread profiling interfaces (e.g., Tensorflow, PyTorch) + MPI

- *MPI + OpenCL*

- PMPI + OpenCL profiling interfaces

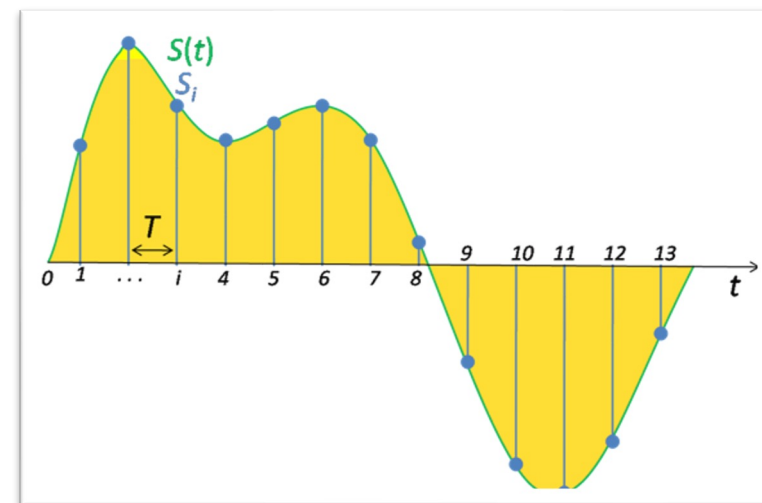
Performance Data Measurement

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

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)
- Add `tau_exec` before the name of the binary
 - `mpirun -np 64 tau_exec ./a.out`
 - `mpirun tau_exec -T ompt,mpi,papi -ompt ./a.out`

tau_exec

```
$ tau_exec
```

```
Usage: tau_exec [options] [--] <exe> <exe options>
```

Options:

```
-v          Verbose mode
-s          Show what will be done but don't actually do anything (dryrun)
-qsub       Use qsub mode (BG/P only, see below)
-io         Track I/O
-memory     Track memory allocation/deallocation
-memory_debug Enable memory debugger
-cuda       Track GPU events via CUDA
-cupti      Track GPU events via CUPTI (Also see env. variable TAU_CUPTI_API)
-opencl     Track GPU events via OpenCL
-openacc    Track GPU events via OpenACC (currently PGI only)
-ompt       Track OpenMP events via OMPT interface
-armci      Track ARMCI events via PARMCI
-ebs        Enable event-based sampling
-ebs_period=<count> Sampling period (default 1000)
-ebs_source=<counter> Counter (default itimer)
-um         Enable Unified Memory events via CUPTI
-T <DISABLE,GNU,ICPC,MPI,OMPT,OPENMP,PAPI,PDT,PROFILE,PTHREAD,SCOREP,SERIAL> : Specify TAU tags
-loadlib=<file.so> : Specify additional load library
-XrunTAUsh-<options> : Specify TAU library directly
-gdb        Run program in the gdb debugger
```

Notes:

```
Defaults if unspecified: -T MPI
MPI is assumed unless SERIAL is specified
```

- Tau_exec preloads the TAU wrapper libraries and performs measurements.

No need to recompile the application!

tau_exec Example (continued)

Example:

```
mpirun -np 2 tau_exec -T icpc,ompt,mpi -ompt ./a.out
```

```
mpirun -np 2 tau_exec -io ./a.out
```

Example - event-based sampling with samples taken every 1,000,000 FP instructions

```
mpirun -np 8 tau_exec -ebs -ebs_period=1000000 -ebs_source=PAPI_FP_INS ./ring
```

Examples - GPU:

```
tau_exec -T serial,cupti -cupti ./matmult (Preferred for CUDA 4.1 or later)
```

```
tau_exec -openacc ./a.out
```

```
tau_exec -T serial -opencl ./a.out (OPENCL)
```

```
mpirun -np 2 tau_exec -T mpi,cupti,papi -cupti -um ./a.out (Unified Virtual Memory in CUDA 6.0+)
```

qsub mode (IBM BG/Q only):

Original:

```
qsub -n 1 --mode smp -t 10 ./a.out
```

With TAU:

```
tau_exec -qsub -io -memory -- qsub -n 1 ... -t 10 ./a.out
```

Memory Debugging:

-memory option:

Tracks heap allocation/deallocation and memory leaks.

-memory_debug option:

Detects memory leaks, checks for invalid alignment, and checks for array overflow. This is exactly like setting TAU_TRACK_MEMORY_LEAKS=1 and TAU_MEMDBG_PROTECT_ABOVE=1 and running with -memory

- tau_exec can enable event based sampling while launching the executable using the **-ebs** flag!

Simplifying TAU's usage (tau_exec)

- Uninstrumented execution linked with `–dynamic` (dynamic executables only!)
% mpirun -np 16 ./a.out
- Track MPI performance
% mpirun -np 16 **tau_exec** ./a.out
- Track OpenMP, and MPI performance (MPI enabled by default; OMPT in Clang 9+, Intel 19+)
% export TAU_OMPT_SUPPORT_LEVEL=full;
% mpirun -np 16 **tau_exec** **–T** mpi,pdt,ompt,papi **–ompt** ./a.out
- Track memory operations
% export TAU_TRACK_MEMORY_LEAKS=1
% mpirun -np 16 **tau_exec** **–memory_debug** ./a.out (bounds check)
- Use event based sampling (compile with `–g`)
% mpirun -np 16 **tau_exec** **–ebs** ./a.out
Also `–ebs_source=<PAPI_COUNTER>` `–ebs_period=<overflow_count>` `–ebs_resolution=<file|function|line>`
- Load wrapper interposition library
% mpirun -np 16 **tau_exec** **–loadlib=<path/libwrapper.so>** ./a.out
- **Track GPGPU operations** (`–rocm`, `–l0`, `–opencl`, `–cupti`, `–cupti –um`, `–openacc`):
% mpirun -np 16 **tau_exec** **–cupti** ./a.out

Installing and Configuring TAU

■ Installing PDT:

- `wget http://tau.uoregon.edu/pdt.tgz`
- `./configure; make ; make install`

■ Installing TAU :

- `wget http://tau.uoregon.edu/tau.tgz`
- `./configure -mpi -c++=mpicxx -cc=mpicc -fortran=mpif90 -mpi -bfd=download -pdt=<dir> -papi=<dir> ...`
- `make install; export PATH=<taudir>/arm64_linux/bin:$PATH`
- All configurations are stored in `<taudir>/all_configs` if you wish to see how TAU was configured!

■ Using TAU for source instrumentation:

- `export TAU_MAKEFILE=<taudir>/x86_64/lib/Makefile.tau-<TAGS>`
- `make CC=tau_cc.sh CXX=tau_cxx.sh F90=tau_f90.sh`
- Use `tau_exec` with uninstrumented binaries instead of recompiling the source code.

Configurations available on Barnard, TU Dresden

```
% module load intel TAU Java
% ls $EBROOTTAU/x86_64/lib/Makefile*
/software/rapids/r23.10/TAU/2.33.1-iimpi-2022b-intel/x86_64/lib/Makefile.tau-icpc-papi-mpi-pdt
/software/rapids/r23.10/TAU/2.33.1-iimpi-2022b-intel/x86_64/lib/Makefile.tau-icpc-papi-mpi-pdt-scorep
/software/rapids/r23.10/TAU/2.33.1-iimpi-2022b-intel/x86_64/lib/Makefile.tau-icpc-papi-ompt-mpi-pdt-openmp
/software/rapids/r23.10/TAU/2.33.1-iimpi-2022b-intel/x86_64/lib/Makefile.tau-icpc-papi-ompt-mpi-pdt-openmp-scorep
/software/rapids/r23.10/TAU/2.33.1-iimpi-2022b-intel/x86_64/lib/Makefile.tau-icpc-papi-ompt-pdt-openmp
/software/rapids/r23.10/TAU/2.33.1-iimpi-2022b-intel/x86_64/lib/Makefile.tau-icpc-papi-ompt-pdt-openmp-scorep

For an uninstrumented binary:
% mpirun -np 16 tau_exec -T mpi,scorep ./a.out
Picks the configuration represented by
/software/rapids/r23.10/TAU/2.33.1-iimpi-2022b-intel/x86_64/lib/Makefile.tau-icpc-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
```

Configurations available on CLAIX, RWTH

```
% . /home/hpc/vihps-tw44/setup.sh
% module load TAU
% $ ls $EBR00TTAU/x86_64/lib/Makefile*
/cvmfs/software.hpc.rwth.de/Linux/RH8/x86_64/intel/sapphirerapids/software/TAU/2.33.1-iimpi-2022b/x86_64/lib/Makefile.tau-icpc-papi-mpi-pdt
/cvmfs/software.hpc.rwth.de/Linux/RH8/x86_64/intel/sapphirerapids/software/TAU/2.33.1-iimpi-2022b/x86_64/lib/Makefile.tau-icpc-papi-mpi-pdt-scorep
/cvmfs/software.hpc.rwth.de/Linux/RH8/x86_64/intel/sapphirerapids/software/TAU/2.33.1-iimpi-2022b/x86_64/lib/Makefile.tau-icpc-papi-ompt-mpi-pdt-openmp
/cvmfs/software.hpc.rwth.de/Linux/RH8/x86_64/intel/sapphirerapids/software/TAU/2.33.1-iimpi-2022b/x86_64/lib/Makefile.tau-icpc-papi-ompt-mpi-pdt-openmp-scorep
/cvmfs/software.hpc.rwth.de/Linux/RH8/x86_64/intel/sapphirerapids/software/TAU/2.33.1-iimpi-2022b/x86_64/lib/Makefile.tau-icpc-papi-ompt-pdt-openmp
/cvmfs/software.hpc.rwth.de/Linux/RH8/x86_64/intel/sapphirerapids/software/TAU/2.33.1-iimpi-2022b/x86_64/lib/Makefile.tau-icpc-papi-ompt-pdt-openmp-scorep
For an uninstrumented binary:
% mpirun -np 16 tau_exec -T mpi,scorep ./a.out
Picks the configuration represented by
/cvmfs/software.hpc.rwth.de/Linux/RH8/x86_64/intel/sapphirerapids/software/TAU/2.33.1-iimpi-2022b/x86_64/lib/Makefile.tau-icpc-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.
```

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 Execution Command (tau_exec)

- Uninstrumented execution
 - % mpirun -np 256 ./a.out
- Track GPU operations
 - % mpirun -np 256 tau_exec -rocm ./a.out
 - % mpirun -np 256 tau_exec -cupti ./a.out
 - % mpirun -np 256 tau_exec -opencl ./a.out
 - % mpirun -np 256 tau_exec -openacc ./a.out
 - % mpirun -np 256 tau_exec -l0 ./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 v19+ or Clang 8+)
 - % export TAU_OMPT_SUPPORT_LEVEL=full;
 - % mpirun -np 256 tau_exec -T ompt,mpi -ompt ./a.out
- Track memory operations
 - % export TAU_TRACK_MEMORY_LEAKS=1
 - % mpirun -np 256 tau_exec -memory_debug ./a.out (bounds check)
- Use event based sampling (compile with -g)
 - % mpirun -np 256 tau_exec -ebs ./a.out
 - Also -ebs_source=<PAPI_COUNTER> -ebs_period=<overflow_count> -ebs_resolution=<file | function | line>

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

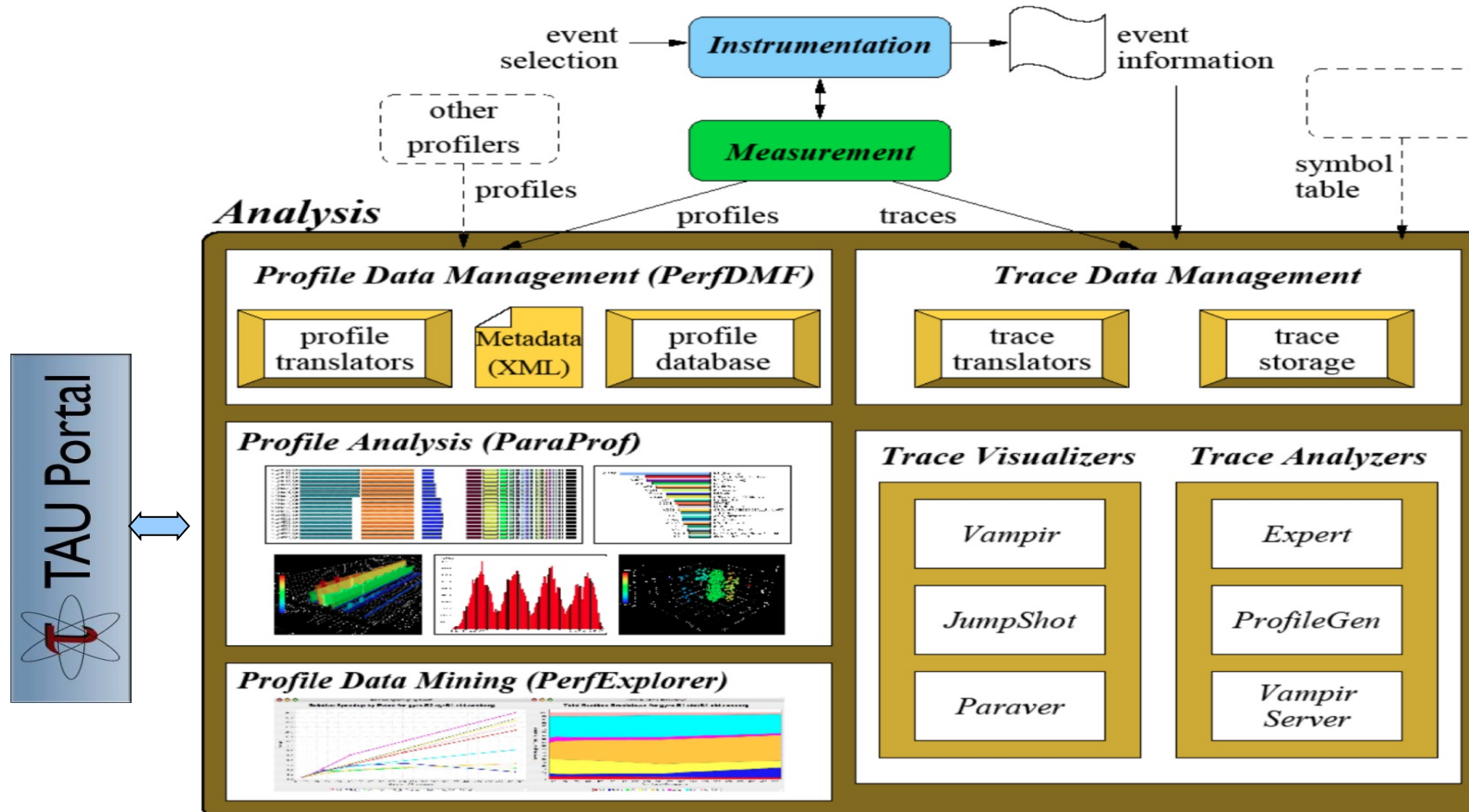
Environment Variable	Default	Description
TAU_METRICS	TIME	Setting to a comma separated list generates other metrics. (e.g., ENERGY,TIME,P_VIRTUAL_TIME,PAPI_FP_INS,PAPI_NATIVE_<event>:<subevent>)
TAU_TRACE	0	Setting to 1 turns on tracing
TAU_TRACE_FORMAT	Default	Setting to “otf2” turns on TAU’s native 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

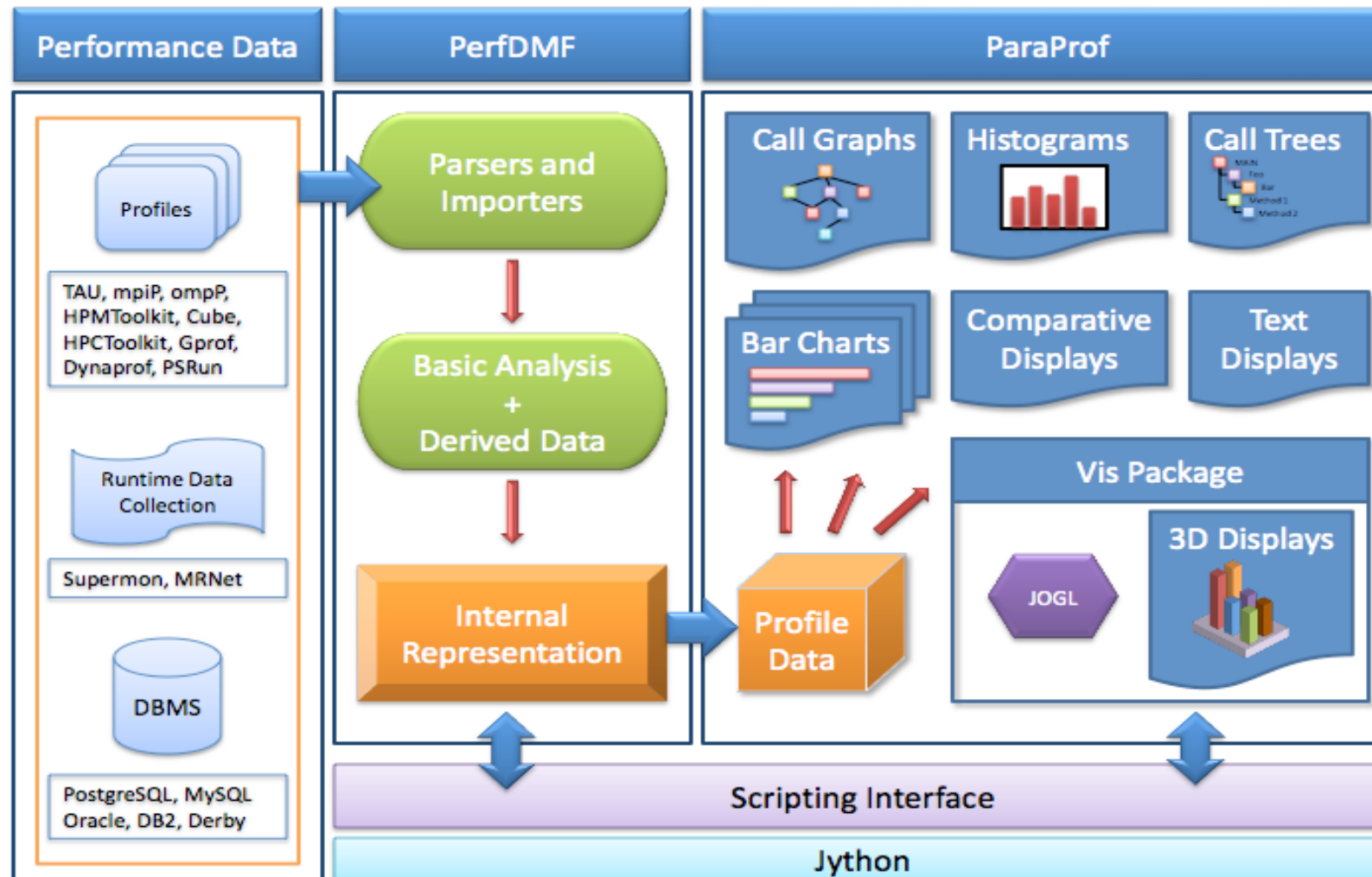
Environment Variable	Default	Description
TAU_TRACK_MEMORY_LEAKS	0	Tracks allocates that were not de-allocated (needs <code>–optMemDbg</code> or <code>tau_exec –memory</code>)
TAU_EBS_SOURCE	TIME	Allows using PAPI hardware counters for periodic interrupts for EBS (e.g., <code>TAU_EBS_SOURCE=PAPI_TOT_INS</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

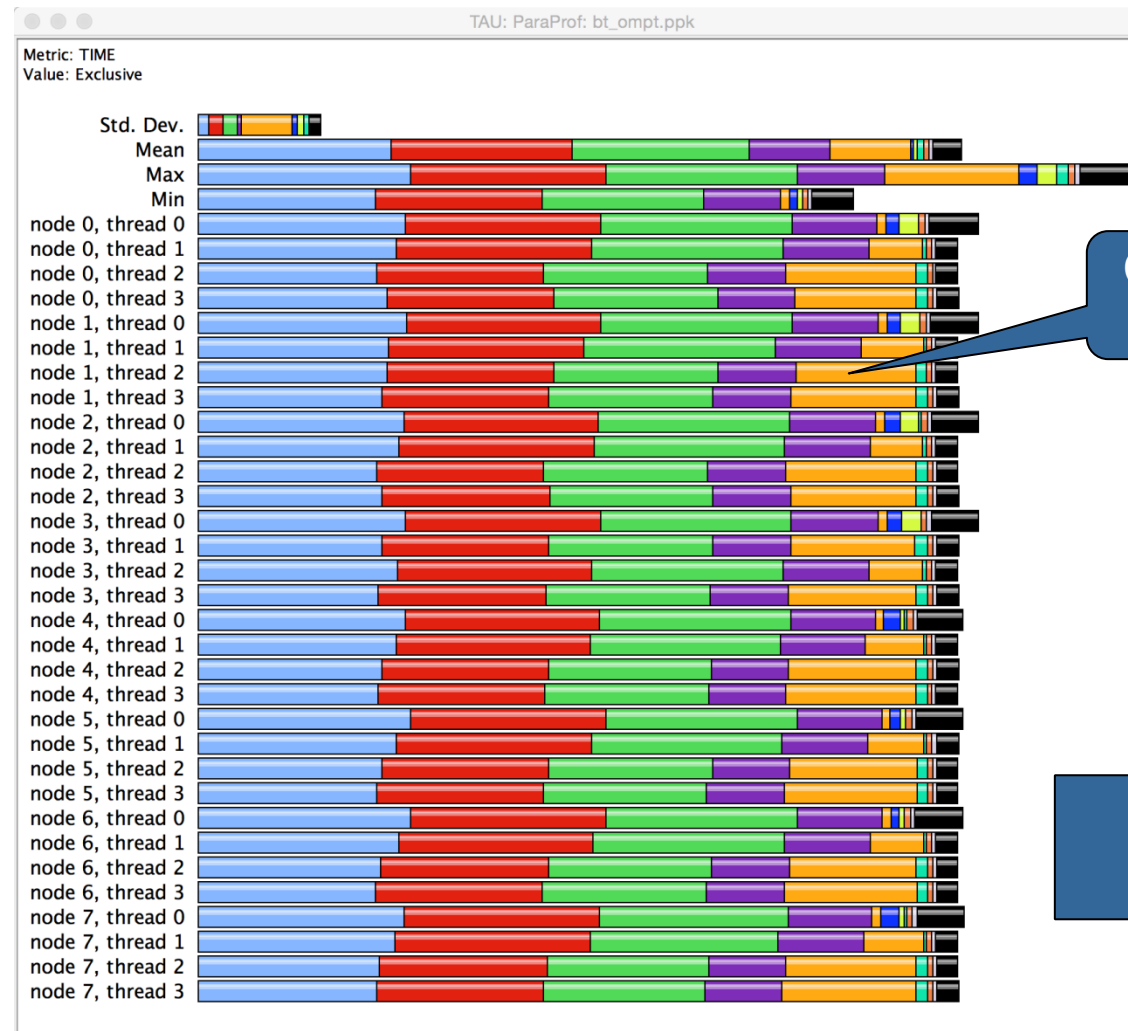
Applications

- 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 rcv synchronizations
 - P2P rcv synchronizations => Late Senders
 - P2P rcv synchronizations => Late Senders => Messages in Wrong Order
 - Collective synchronizations
 - P2P send communications
 - P2P send communications => Late Receivers
 - P2P rcv communications
 - P2P rcv communications => Late Senders
 - P2P rcv 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

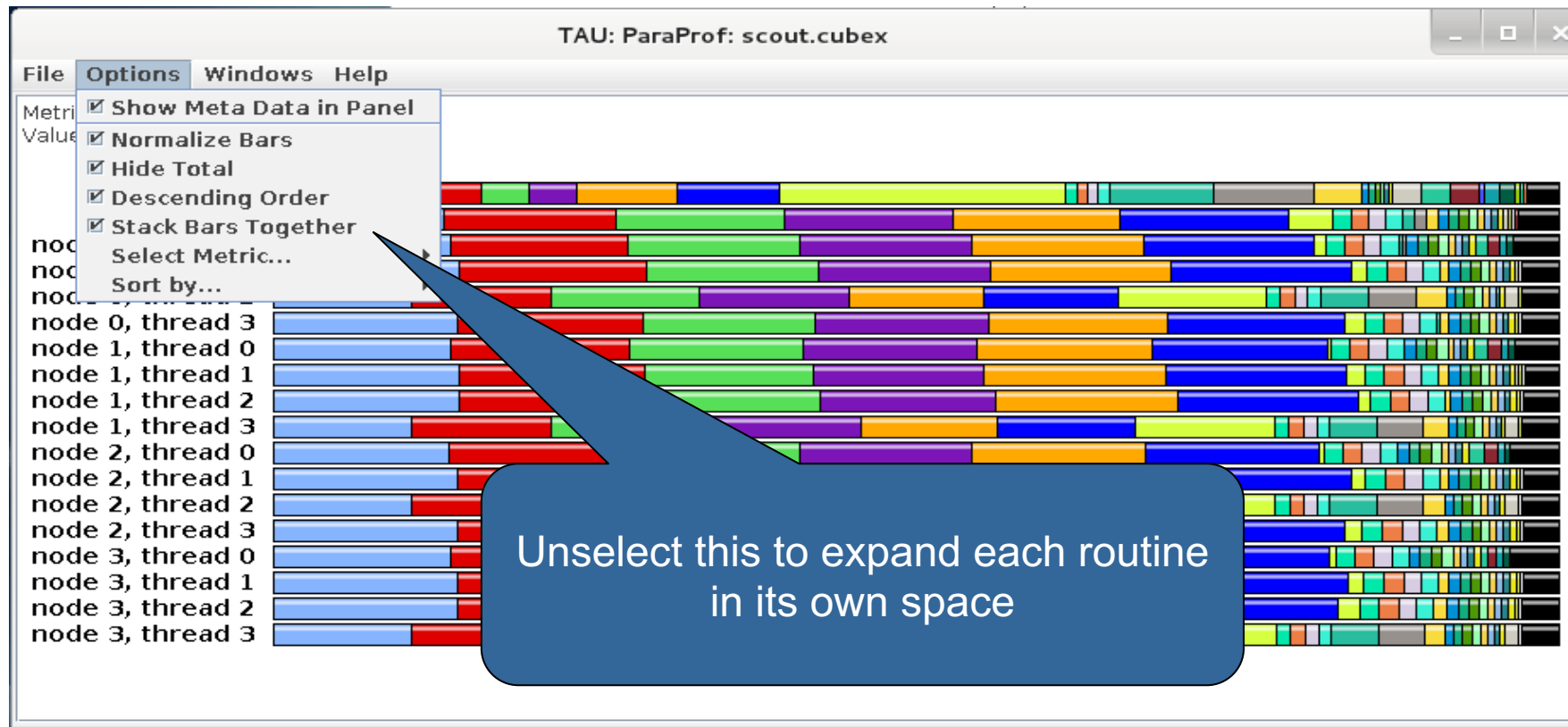
Paraprof main window



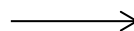
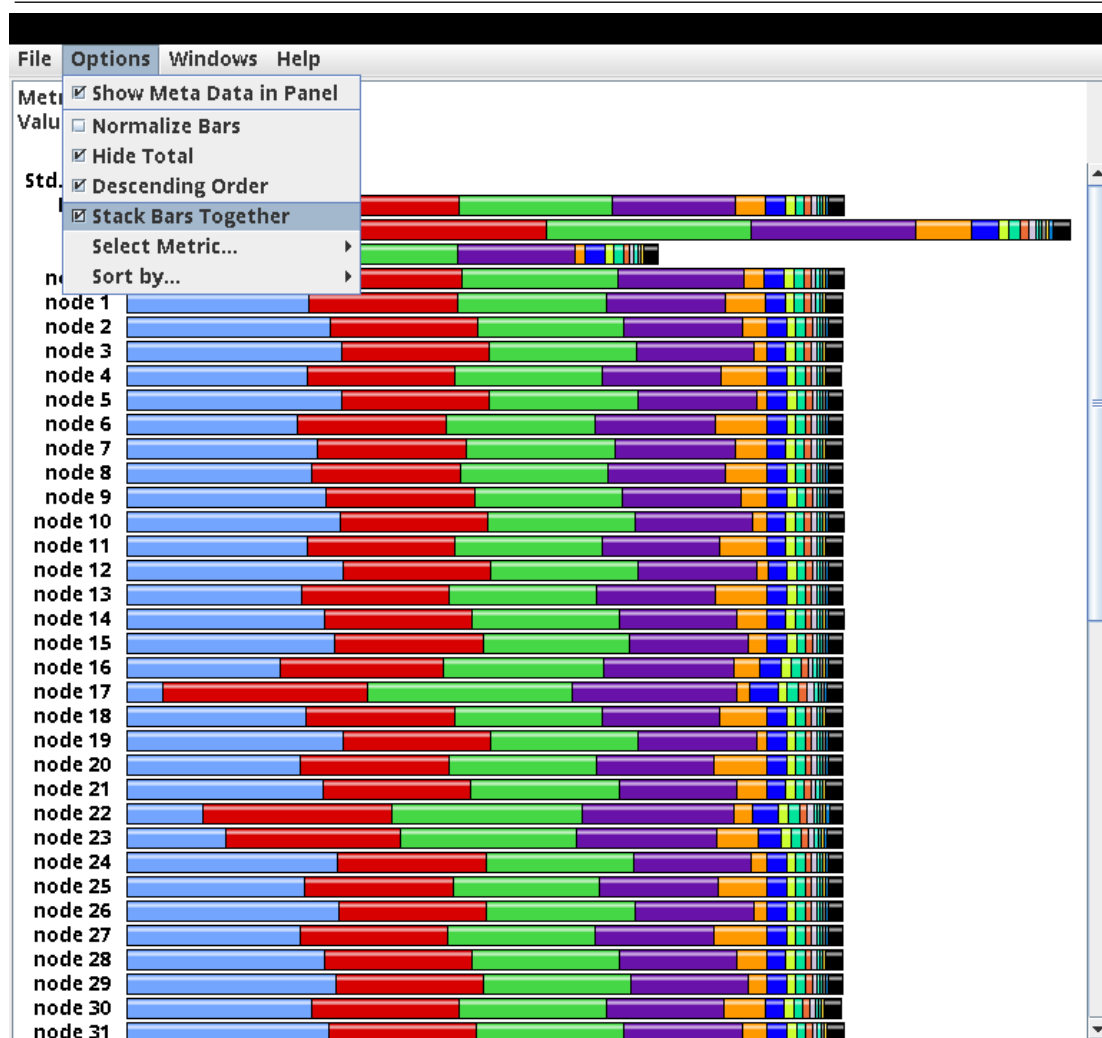
Colors represent code regions

Options -> uncheck Stack Bars Together

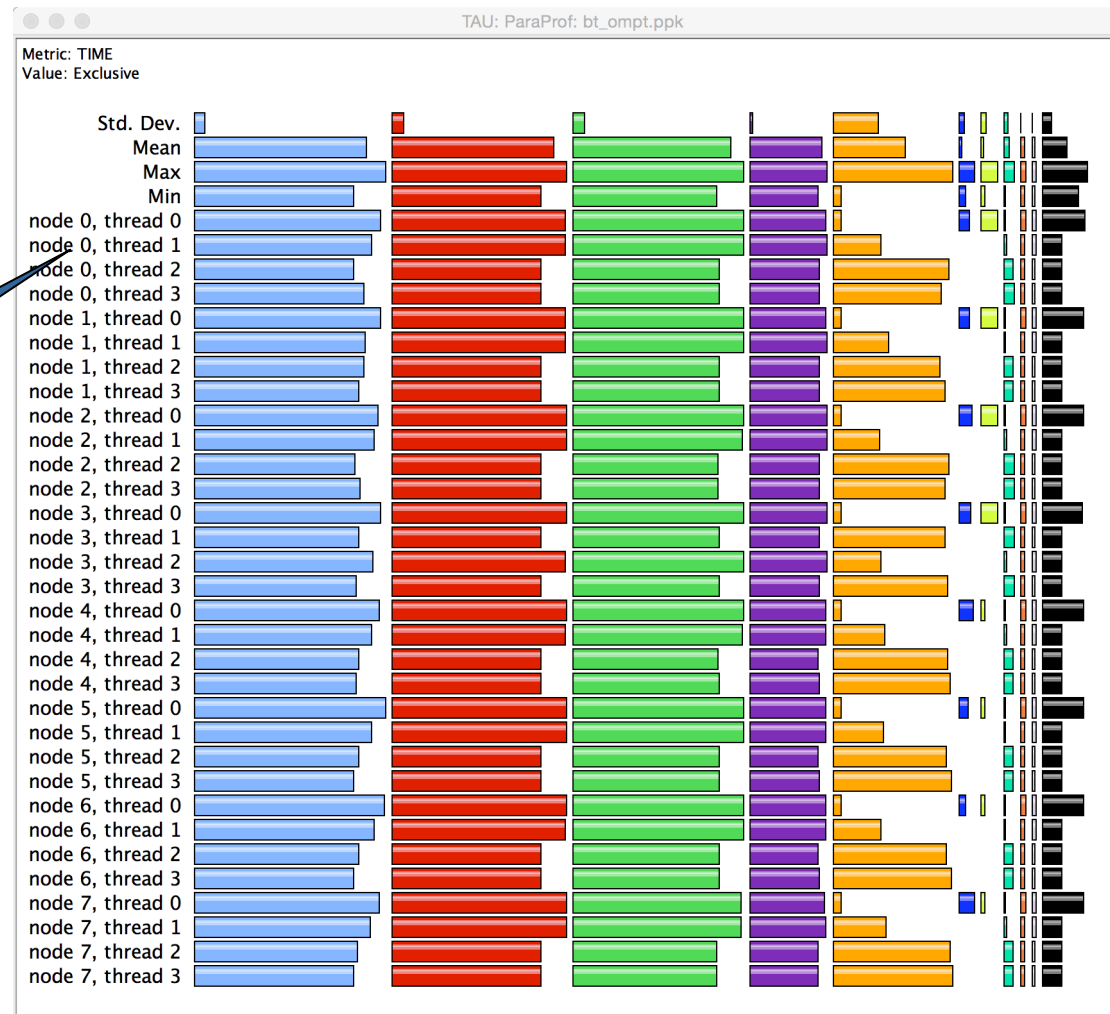
Paraprof main window



ParaProf Profile Browser



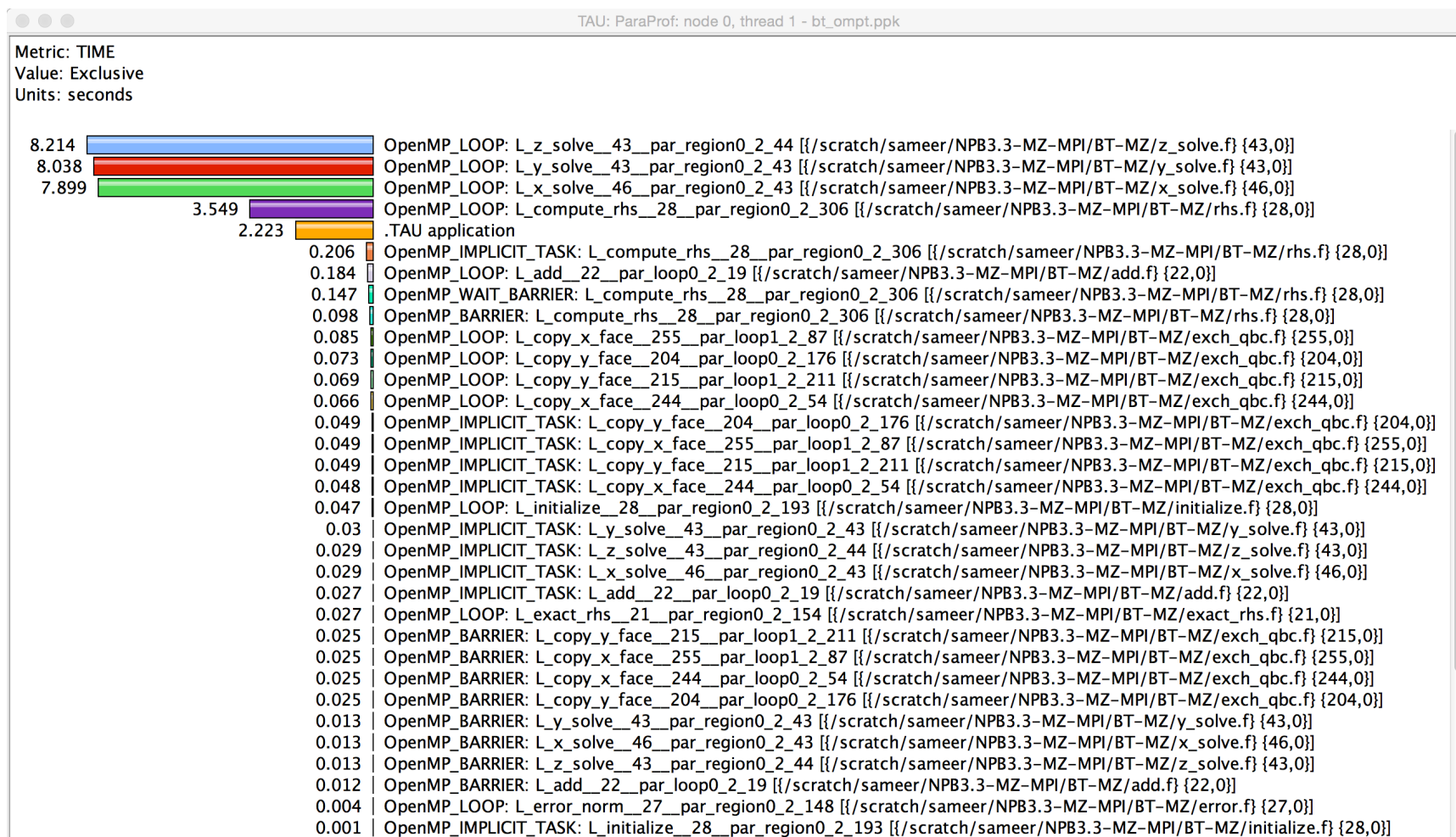
Paraprof main window



Left/right
click here

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

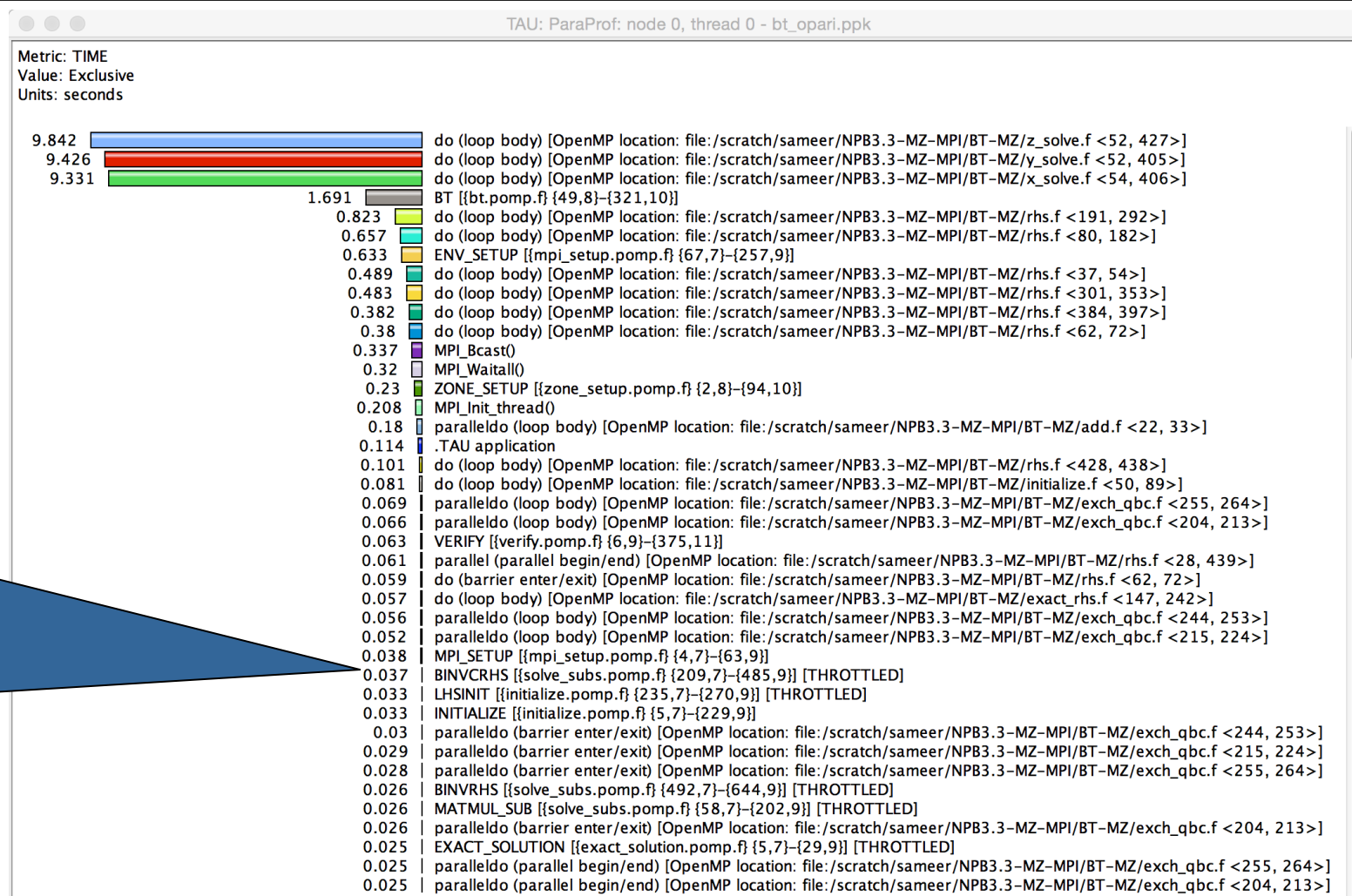
Paraprof node window (function barchart window)



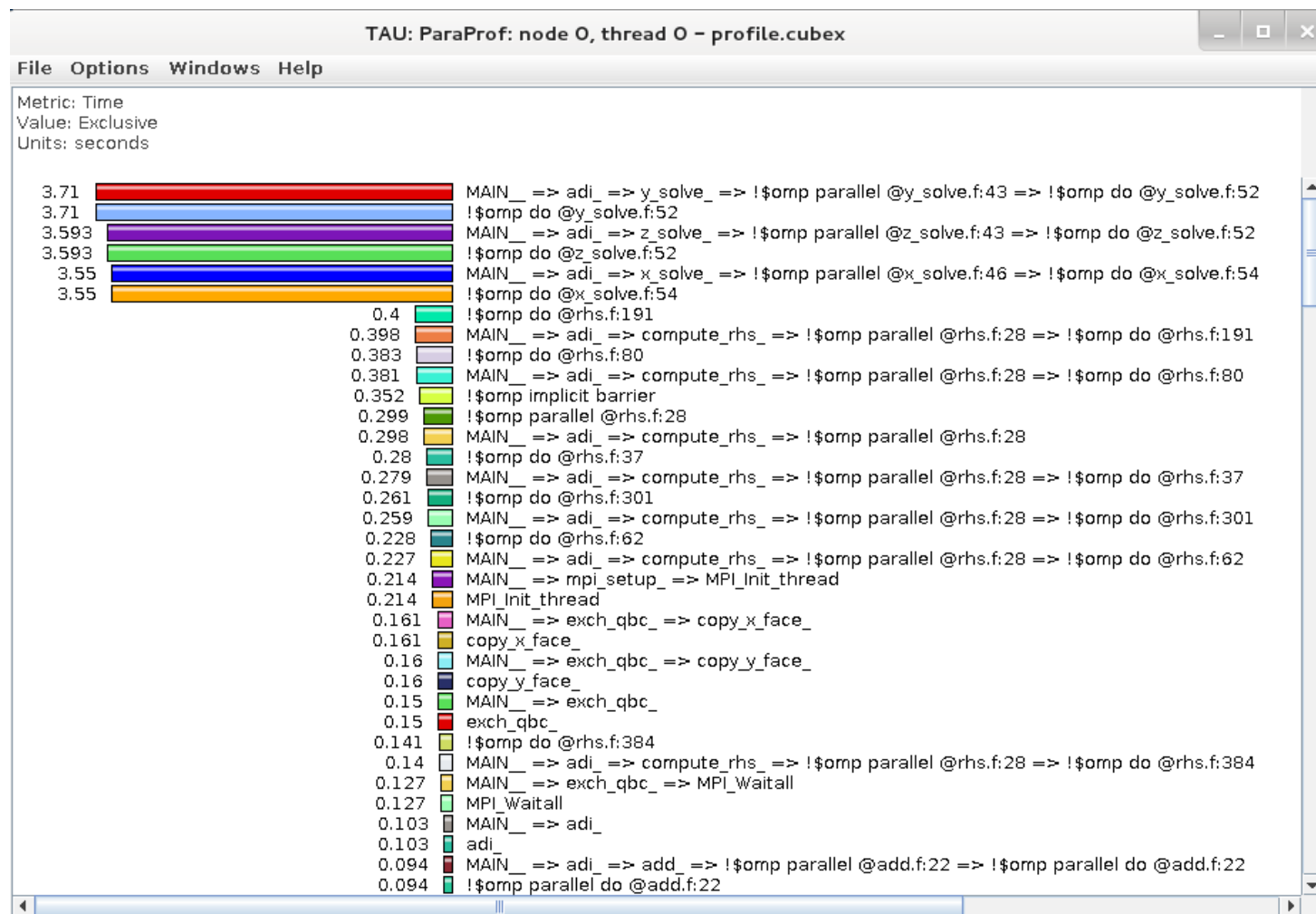
Exclusive time spent in each code region (OpenMP loop) is shown here for MPI rank 0 thread 1

Instrumenting Source Code with PDT and Opari

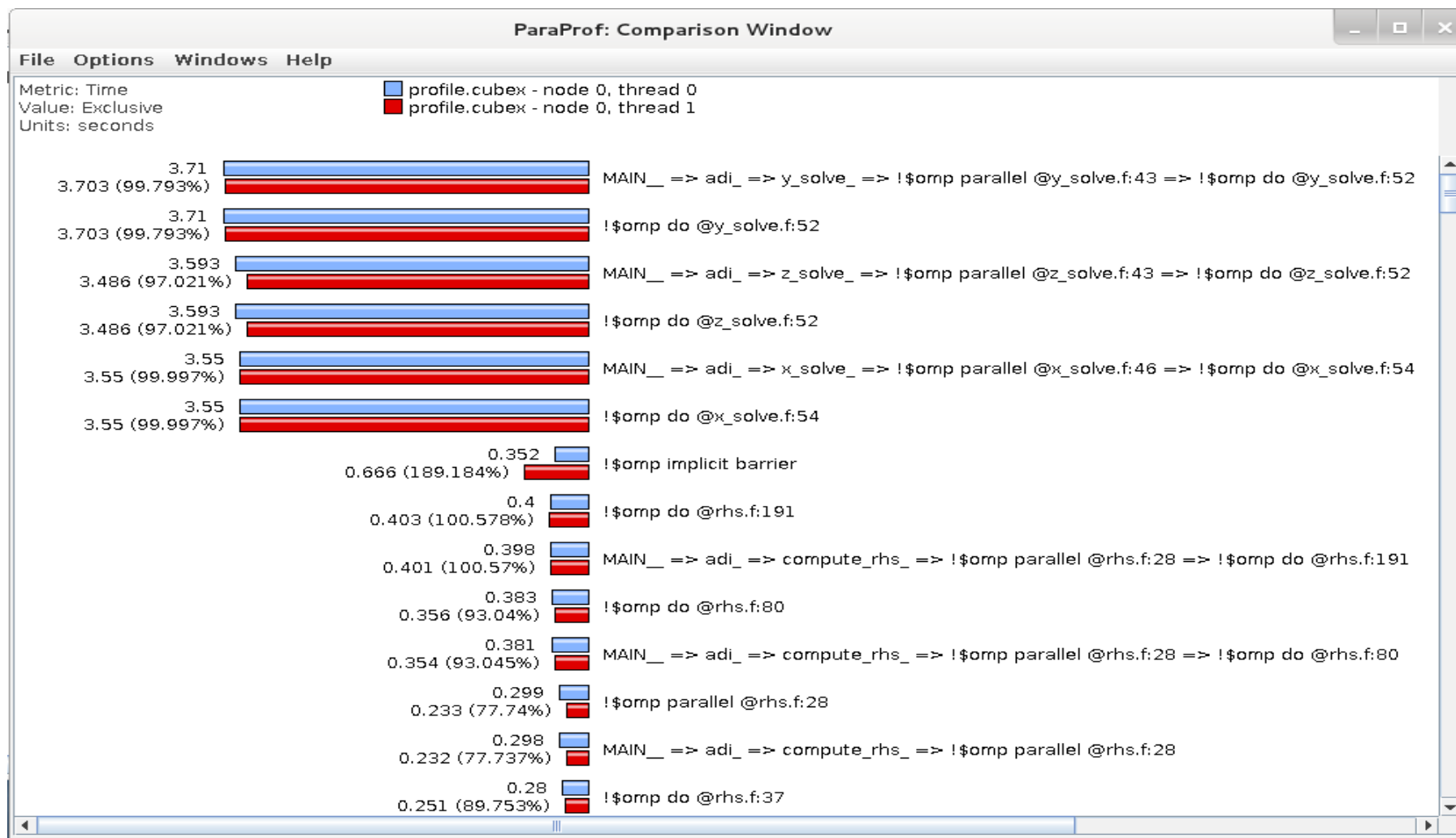
Frequently
executing
lightweight
routines are
automatically
throttled at
runtime.
Reduces
runtime
dilation.



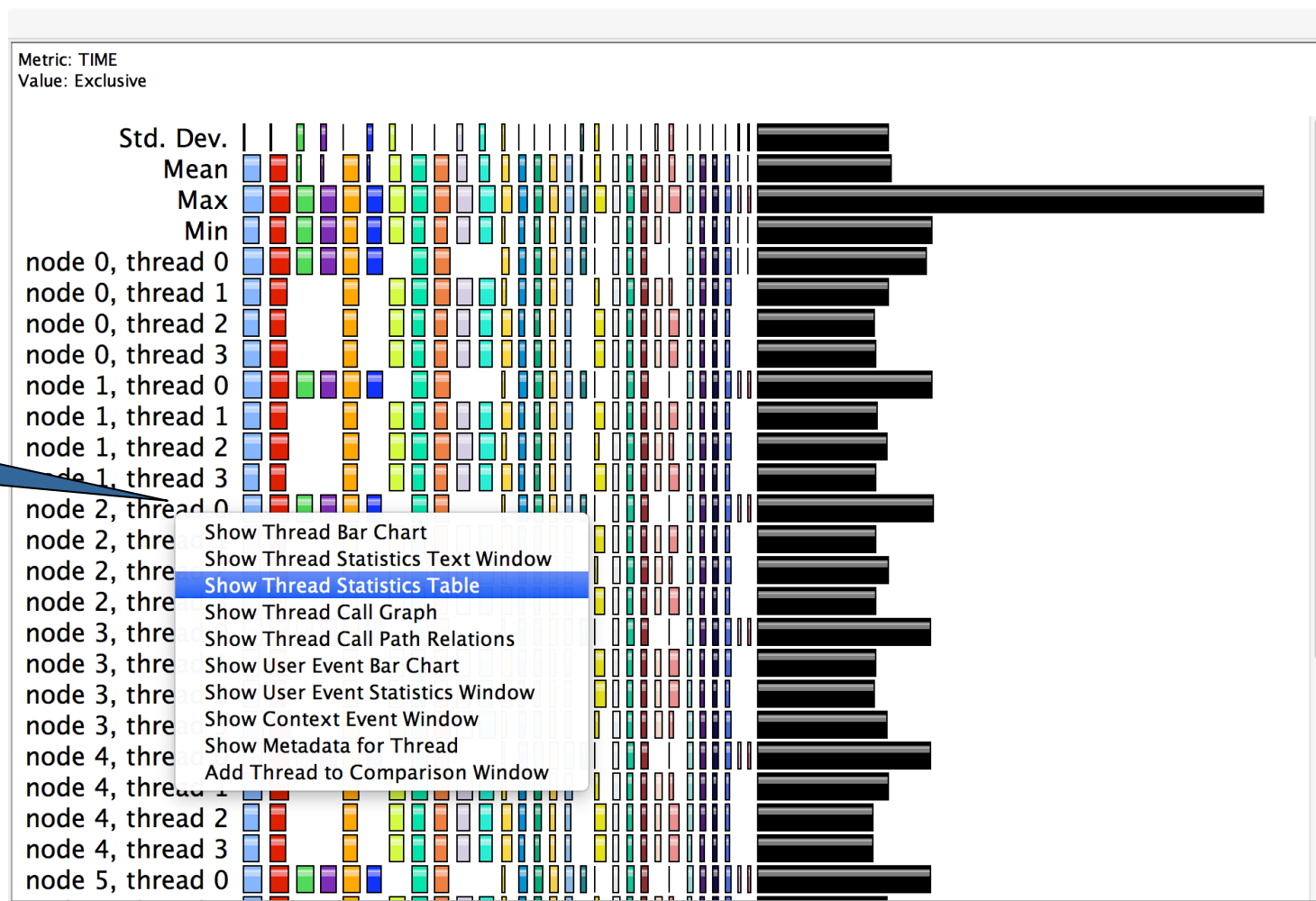
ParaProf: Node view in a callpath profile



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

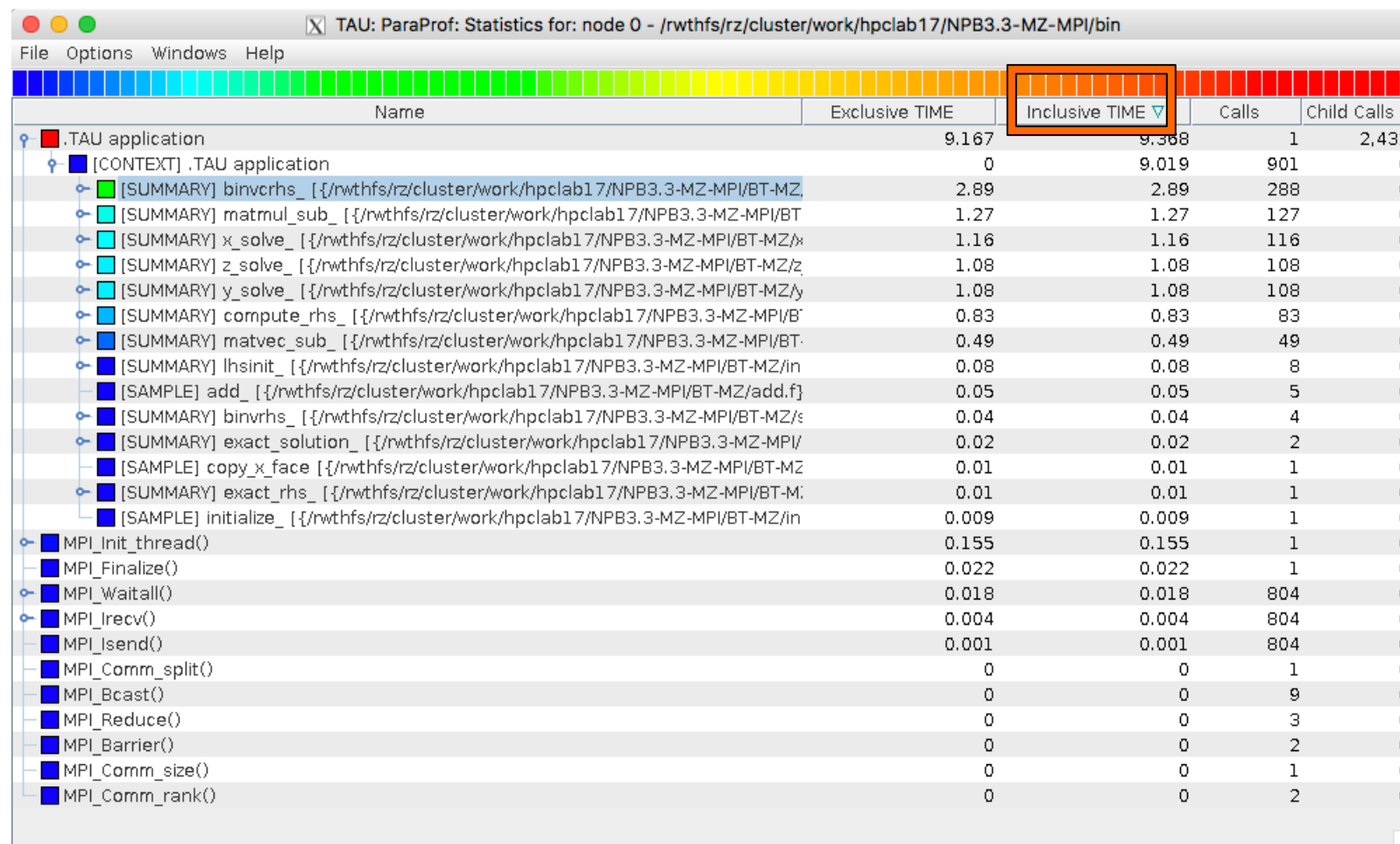
Name	Exclusive Time	Inclusive Time	Calls	Child Calls
!\$omp do @y_solve.f:52	5.817	5.817	3,216	0
!\$omp do @z_solve.f:52	5.657	5.657	3,216	0
!\$omp do @x_solve.f:54	5.609	5.609	3,216	0
!\$omp do @rhs.f:191	0.609	0.609	3,232	0
!\$omp do @rhs.f:80	0.583	0.583	3,232	0
MPI_Waitall	0.402	0.402	603	0
!\$omp implicit barrier	0.402	0.402	0	0
!\$omp do @rhs.f:301	0.36	0.36	0	0
!\$omp implicit barrier	0.026	0.026	0	0
!\$omp implicit barrier	0	0	0	0
!\$omp do @rhs.f:37	0.343	0.343	0	0
!\$omp do @rhs.f:62	0.225	0.225	0	0
!\$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/	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] binvcrhs_ [{/rwthfs/rz/cluster/work/hpclub17/NPB3.3-MZ-MPI/BT-MZ/	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

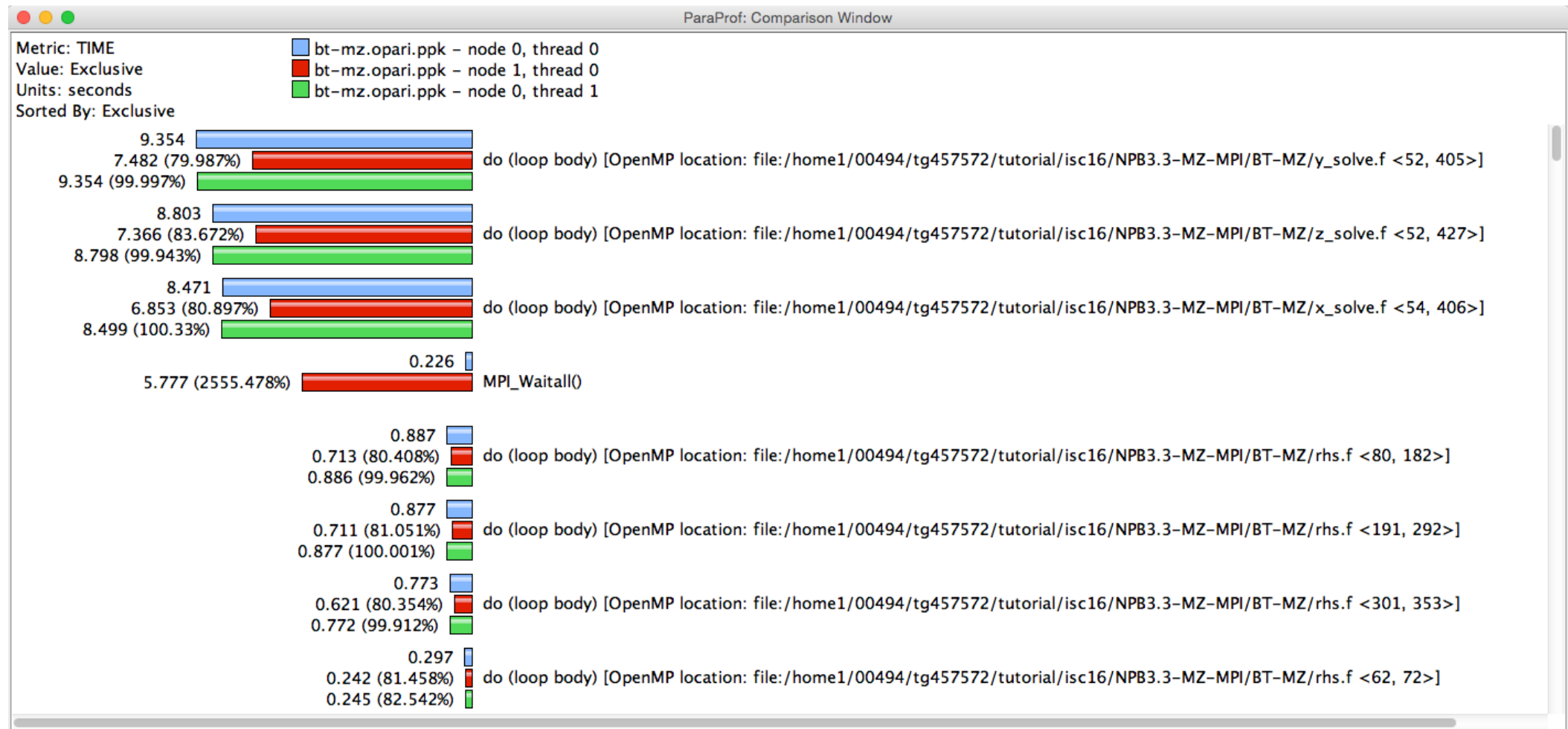
Name	Exclusive TIME	Inclusive TIME ▾	Calls	Child Calls
.TAU application	9.167	9.368	1	2,432
[CONTEXT] .TAU application	0	9.019	901	0
[SUMMARY] binvrchs_ [{/rwthfs/rz/cluster/work/hpclab17/NPB3.3-MZ-MPI/BT-MZ/solve_sub.f}]	2.89	2.89	288	0
[SAMPLE] binvrchs_ [{/rwthfs/rz/cluster/work/hpclab17/NPB3.3-MZ-MPI/BT-MZ/solve_sub.f}]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

Statement Level Profiling with TAU

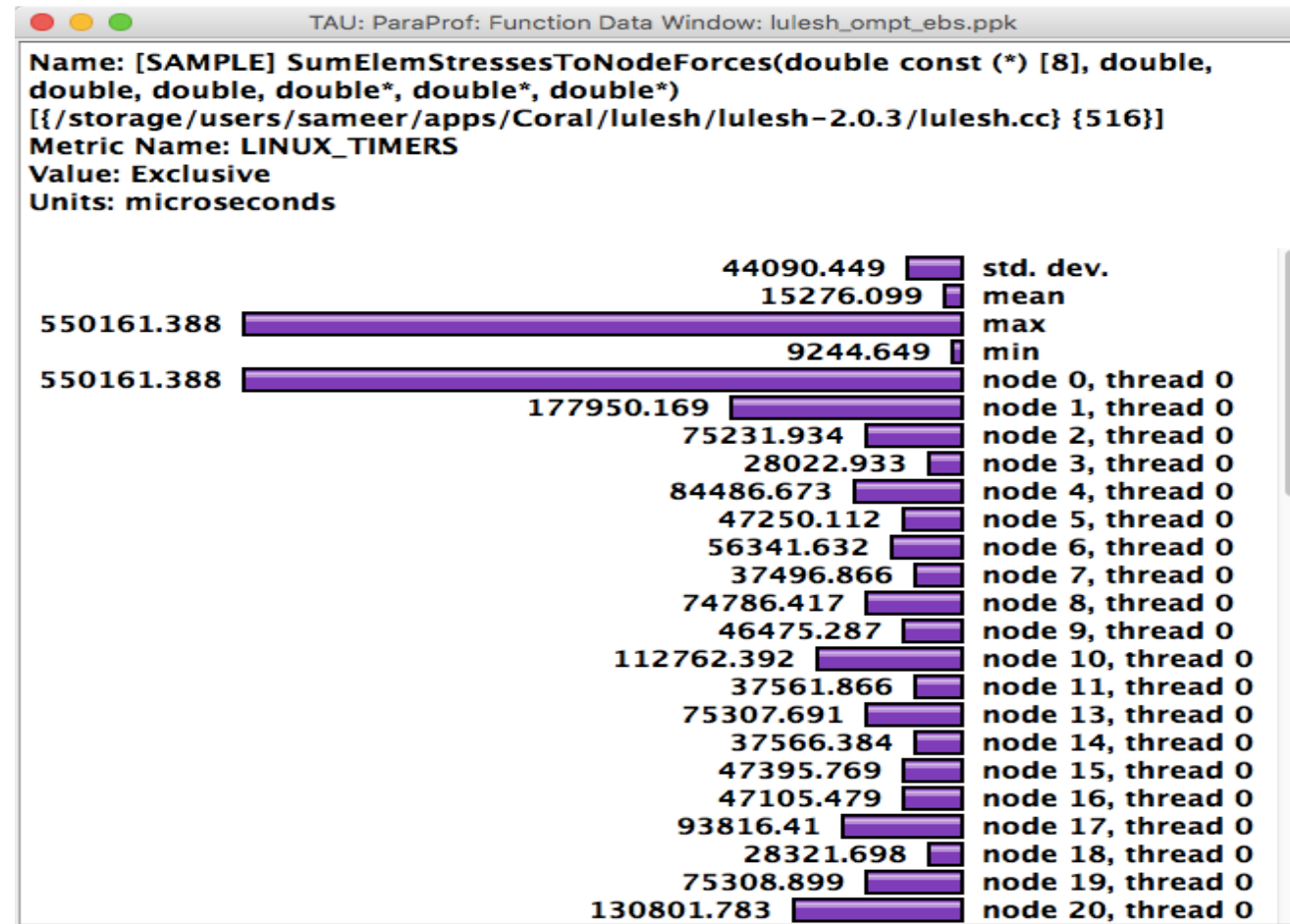
Source
location
where
samples are
taken.
Compute
intensive
region.

```
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]	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}]	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}]	0.2	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

```
% export TAU_SAMPLING=1; export TAU_EBS_UNWIND=1
```

VIHPS 44TH PORTING & TUNING WORKSHOP (AACHEN/DRESDEN, FEB. 2024)

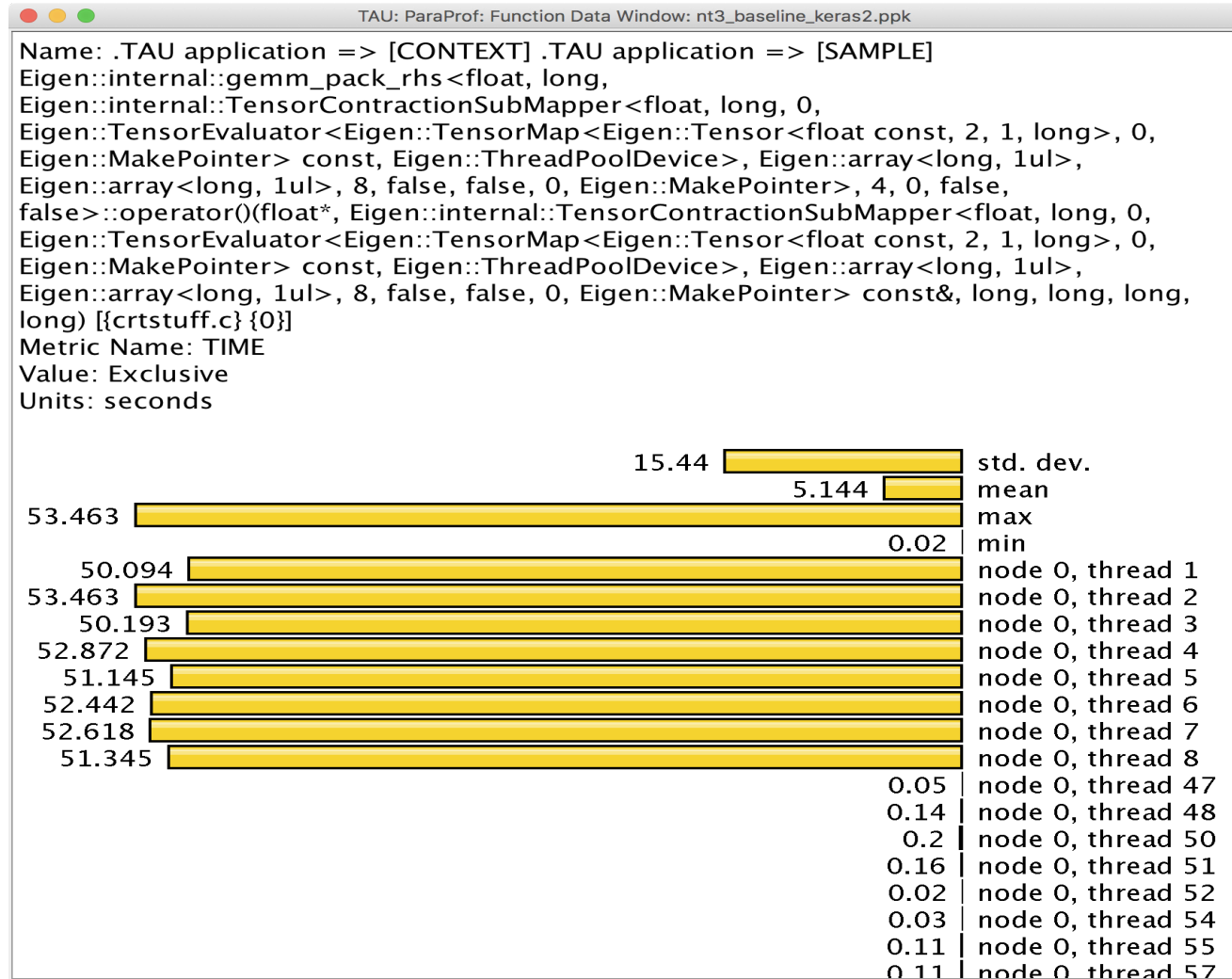
Deep Learning: Tensorflow

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

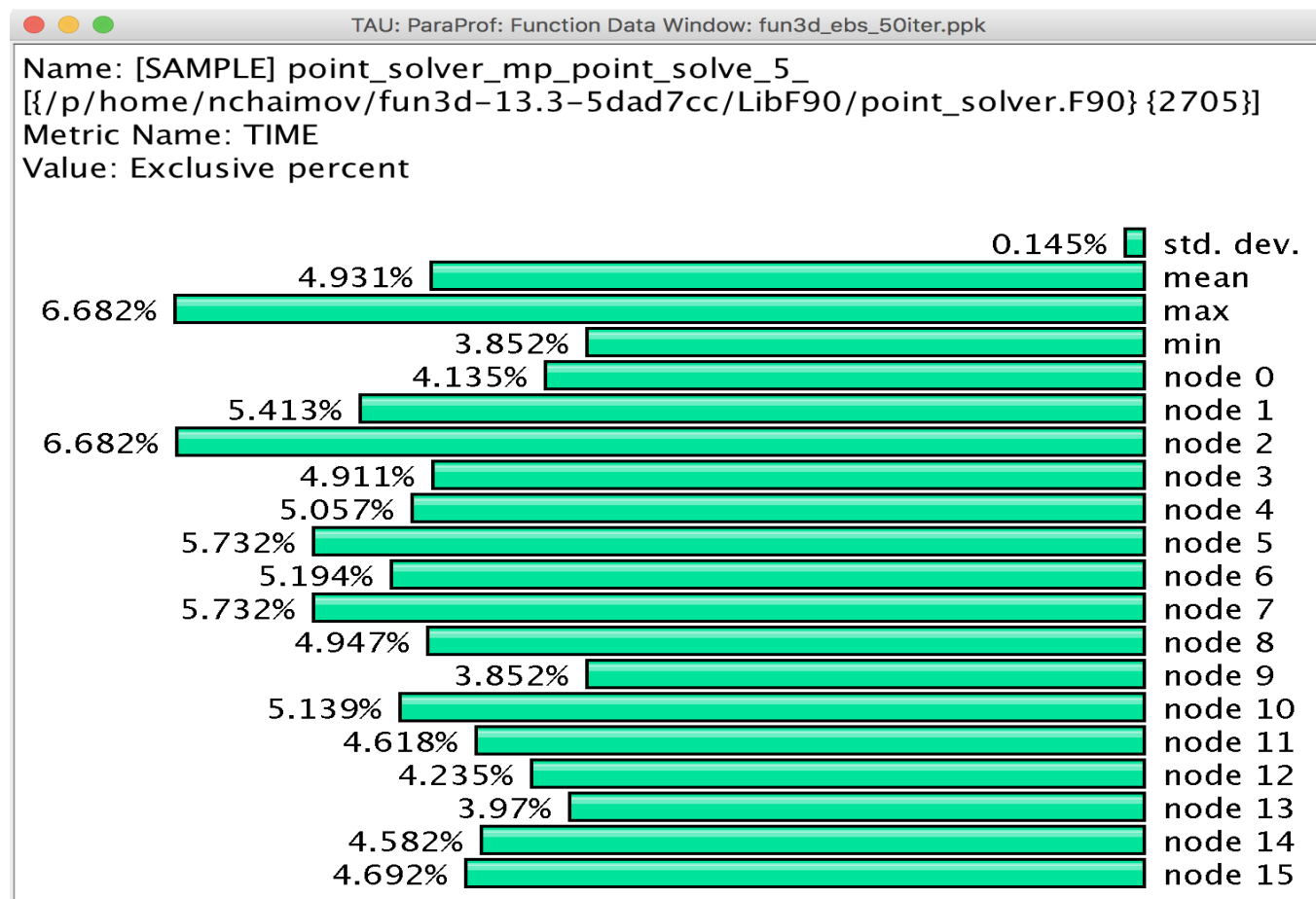
Name	Inclusiv...	Calls ▾
▼ .TAU application	519.211	1
▼ [CONTEXT] .TAU application	509.222	50,915
[SAMPLE] Eigen::internal::gebp_kernel<float, float, long, Eigen::internal::blas_data_mapper<float, long, 0, 0>,	240.632	24,089
[SAMPLE] __pthread_cond_wait [{ } {0}]	86.384	8,634
[SAMPLE] Eigen::internal::gemm_pack_rhs<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<Eigen	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



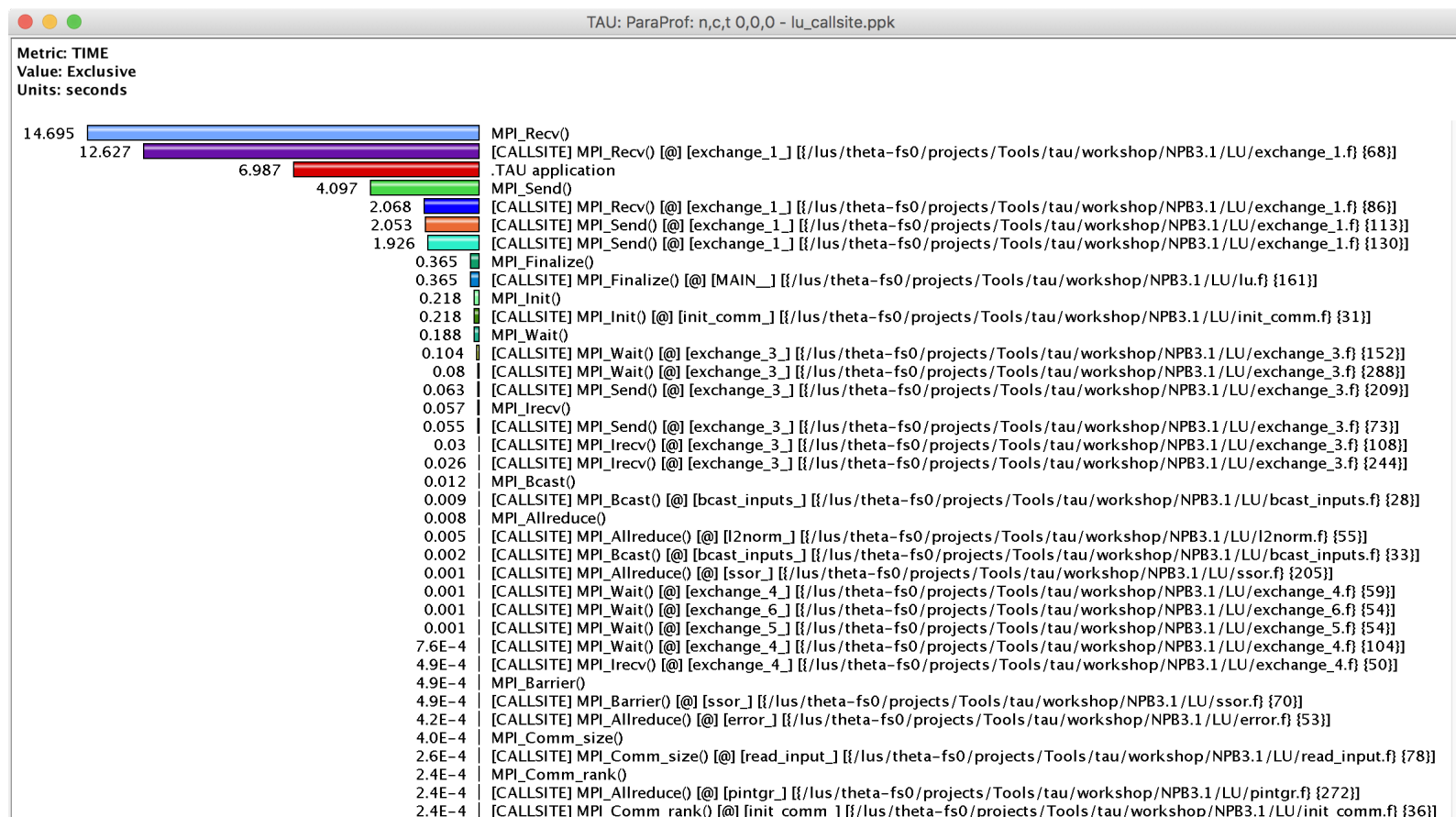
Event Based Sampling (EBS)



Uninstrumented!

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

Callsite Profiling and Tracing



% export TAU_CALLSITE=1

CALLPATH THREAD RELATIONS WINDOW

TAU: ParaProf: Call Path Data n,c,t, 2,0,0 - gamess_unw_call_ebs.ppk

Metric Name: TIME
Sorted By: Inclusive
Units: seconds

	Exclusive	Inclusive	Calls/Tot.Calls	Name[id]
-->	0.121	79.592	1	.TAU application
	0.002	0.002	1/1	MPI_Gather()
	0.004	0.004	3/3	MPI_Allgather()
	0.122	0.122	6866/6866	MPI_Send()
	0.002	0.002	1/1	MPI_Comm_split()
	8.9E-5	8.9E-5	2/2	MPI_Comm_size()
	4.6E-4	4.6E-4	3/3	MPI_Group_incl()
	75.607	75.607	6870/6870	MPI_Recv()
	0.002	0.002	4/4	MPI_Comm_create()
	9.5E-5	9.5E-5	6/6	MPI_Comm_rank()
	5.4E-4	5.4E-4	1/1	MPI_Comm_group()
	0.003	0.003	7/7	MPI_Barrier()
	0.112	0.112	1/1	MPI_Init_thread()
	6.3E-4	6.3E-4	1/1	MPI_Group_intersection()
	0	0.05	1/1	[CONTEXT] .TAU application
	3.601	3.601	1/1	MPI_Finalize()
	0.014	0.014	6/6	MPI_Bcast()
-->	75.607	75.607	6870/6870	.TAU application
	75.607	75.607	6870	MPI_Recv()
	0	74.848	1497/1497	[CONTEXT] MPI_Recv()
-->	0	74.848	1497/1497	MPI_Recv()
	0	74.848	1497	[CONTEXT] MPI_Recv()
	0	8.701	174/1371	[UNWIND] /gpfs/mira-home/yuri/dist/Github/gamess-theta-tau/ddi/src/ddi_init.c.113 [0] ddi_i
	0	26.196	524/763	[UNWIND] /gpfs/mira-home/sameer/gamess-theta-tau/object/unport.f.410 [0] MAIN__ [0] gpfs/mir
	0.2	0.2	4/138	[SAMPLE] GNI_DlaProgress [0] /opt/cray/ugni/6.0.14-6.0.4.0_14.1_ge7db4a2.ari/lib64/libugni.
	0	5.75	115/1484	[UNWIND] /gpfs/mira-home/yuri/dist/Github/gamess-theta-tau/ddi/src/ddi_server.c.99 [0] DDI_
	0	0.2	4/5	[UNWIND] /lib64/libc-2.22.so.0 [0] _start [0] /home/abuild/rpmbuild/BUILD/glibc-2.22/csu/./s
	0	11.85	237/239	[UNWIND] /gpfs/mira-home/sameer/gamess-theta-tau/object/gamess.f.538 [0] main [0] gpfs/mira-l
	0.051	0.051	1/273	[SAMPLE] GNI_CqGetEvent [0] /opt/cray/ugni/6.0.14-6.0.4.0_14.1_ge7db4a2.ari/lib64/libugni.so
	0	0.05	1/1197	[UNWIND] /opt/cray/pe/mpt/7.6.3/gni/mpich-intel/16.0/lib/libmpich_intel.so.3.0.1.0 [0] MPID:
	0	0.15	3/7	[UNWIND] [/opt/cray/ugni/6.0.14-6.0.4.0_14.1_ge7db4a2.ari/lib64/libugni.so.0.6.0.0] [0] UNI
	0	21.7	434/1197	[UNWIND] /gpfs/mira-home/yuri/dist/Github/gamess-theta-tau/ddi/src/ddi_fortran.c.67 [0] beg

CALLPATH THREAD RELATIONS WINDOW

TAU: ParaProf: Call Path Data n,c,t, 2,0,0 - gamess_unw_call_ebs.ppk

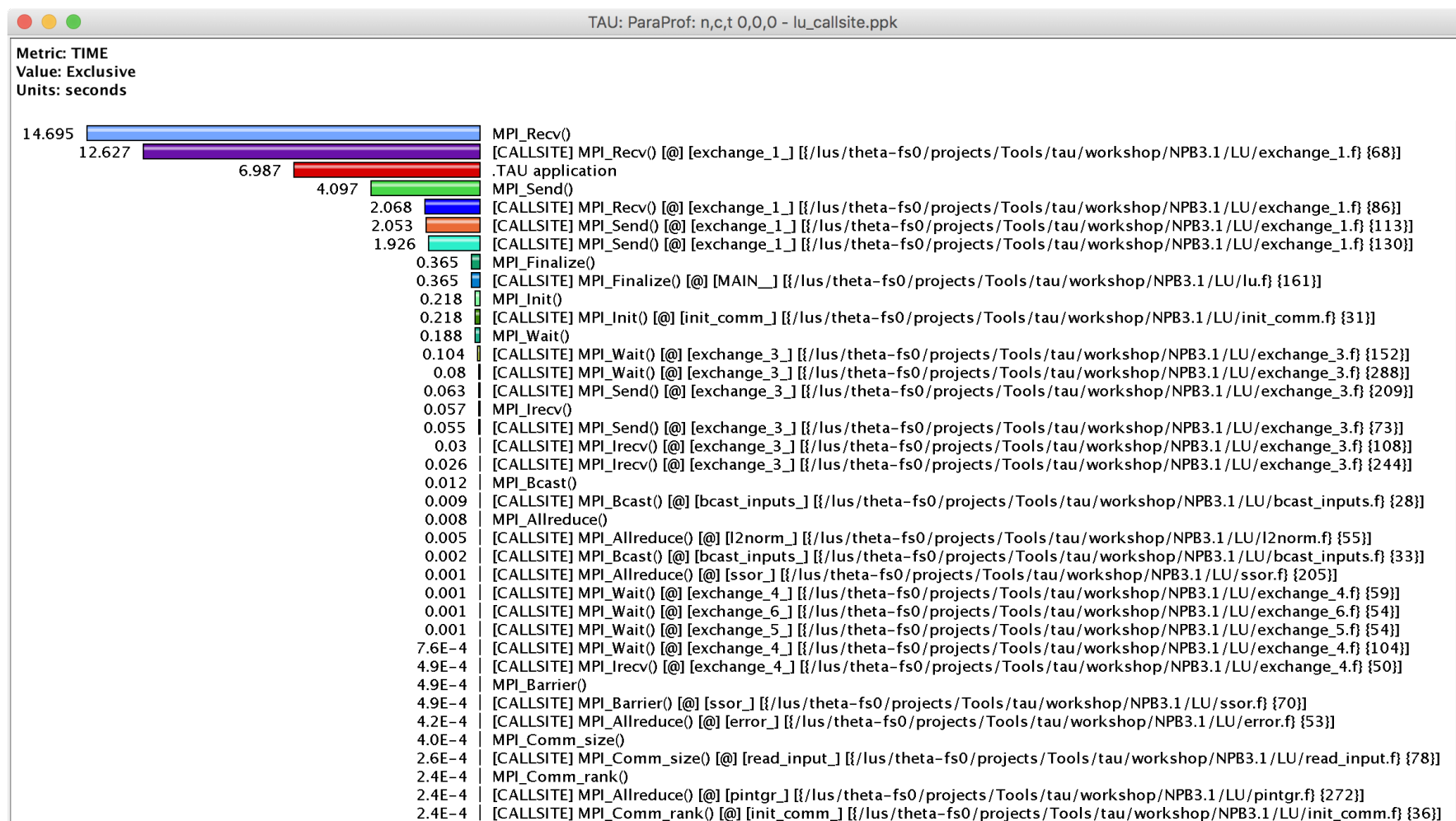
Metric Name: TIME
Sorted By: Exclusive
Units: seconds

	Exclusive	Inclusive	Calls/Tot.Calls	Name[id]
	75.607	75.607	6870/6870	.TAU application
-->	75.607	75.607	6870	MPI_Recv()
	0	74.848	1497/1497	[CONTEXT] MPI_Recv()
	0.15	0.15	3/444	[UNWIND] /opt/cray/pe/mpt/7.6.3/gni/mpich-intel/16.0/lib/libmpich_intel.so.3.0.1.0 [0] PMPI_Recv
	22.046	22.046	441/444	[UNWIND] /opt/cray/pe/mpt/7.6.3/gni/mpich-intel/16.0/lib/libmpich_intel.so.3.0.1.0 [0] MPIDI_CH3I
-->	22.196	22.196	444	[SAMPLE] MPID_nem_gni_poll [{/opt/cray/pe/mpt/7.6.3/gni/mpich-intel/16.0/lib/libmpich_intel.so.3
	5.6	5.6	112/273	[UNWIND] /opt/cray/ugni/6.0.14-6.0.4.0_14.1__ge7db4a2.ari/lib64/libugni.so.0.6.0.0 [0] MPID_nem_
	0.051	0.051	1/273	[CONTEXT] MPI_Recv()
	7.651	7.651	153/273	[UNWIND] /opt/cray/ugni/6.0.14-6.0.4.0_14.1__ge7db4a2.ari/lib64/libugni.so.0.6.0.0 [0] MPID_nem_
	0.35	0.35	7/273	[UNWIND] [/opt/cray/ugni/6.0.14-6.0.4.0_14.1__ge7db4a2.ari/lib64/libugni.so.0.6.0.0] [0] UNRESOLV
-->	13.652	13.652	273	[SAMPLE] GNI_CqGetEvent [{/opt/cray/ugni/6.0.14-6.0.4.0_14.1__ge7db4a2.ari/lib64/libugni.so.0.6.0
	11.3	11.3	226/226	[UNWIND] /opt/cray/pe/mpt/7.6.3/gni/mpich-intel/16.0/lib/libmpich_intel.so.3.0.1.0 [0] PMPI_Recv
-->	11.3	11.3	226	[SAMPLE] MPIDI_CH3I_Progress [{/opt/cray/pe/mpt/7.6.3/gni/mpich-intel/16.0/lib/libmpich_intel.so
	10.349	10.349	207/207	[UNWIND] /opt/cray/ugni/6.0.14-6.0.4.0_14.1__ge7db4a2.ari/lib64/libugni.so.0.6.0.0 [0] MPID_nem_
-->	10.349	10.349	207	[SAMPLE] GNI_SmsgGetNextWTag [{/opt/cray/ugni/6.0.14-6.0.4.0_14.1__ge7db4a2.ari/lib64/libugni.so
	0.2	0.2	4/138	[CONTEXT] MPI_Recv()
	6.701	6.701	134/138	[UNWIND] /opt/cray/ugni/6.0.14-6.0.4.0_14.1__ge7db4a2.ari/lib64/libugni.so.0.6.0.0 [0] GNI_CqGet
-->	6.901	6.901	138	[SAMPLE] GNI_DlaProgress [{/opt/cray/ugni/6.0.14-6.0.4.0_14.1__ge7db4a2.ari/lib64/libugni.so.0.6
	5.25	5.25	105/109	[UNWIND] gni_poll.c.0 [0] MPID_nem_gni_poll [{/opt/cray/pe/mpt/7.6.3/gni/mpich-intel/16.0/lib/li
	0.2	0.2	4/109	[UNWIND] gni_poll.c.0 [0] MPIDI_CH3I_Progress [{/opt/cray/pe/mpt/7.6.3/gni/mpich-intel/16.0/lib/
-->	5.45	5.45	109	[SAMPLE] MPID_nem_gni_check_localCQ [{gni_poll.c} {0}]
	3.601	3.601	1/1	.TAU application
-->	3.601	3.601	1	MPI_Finalize()

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

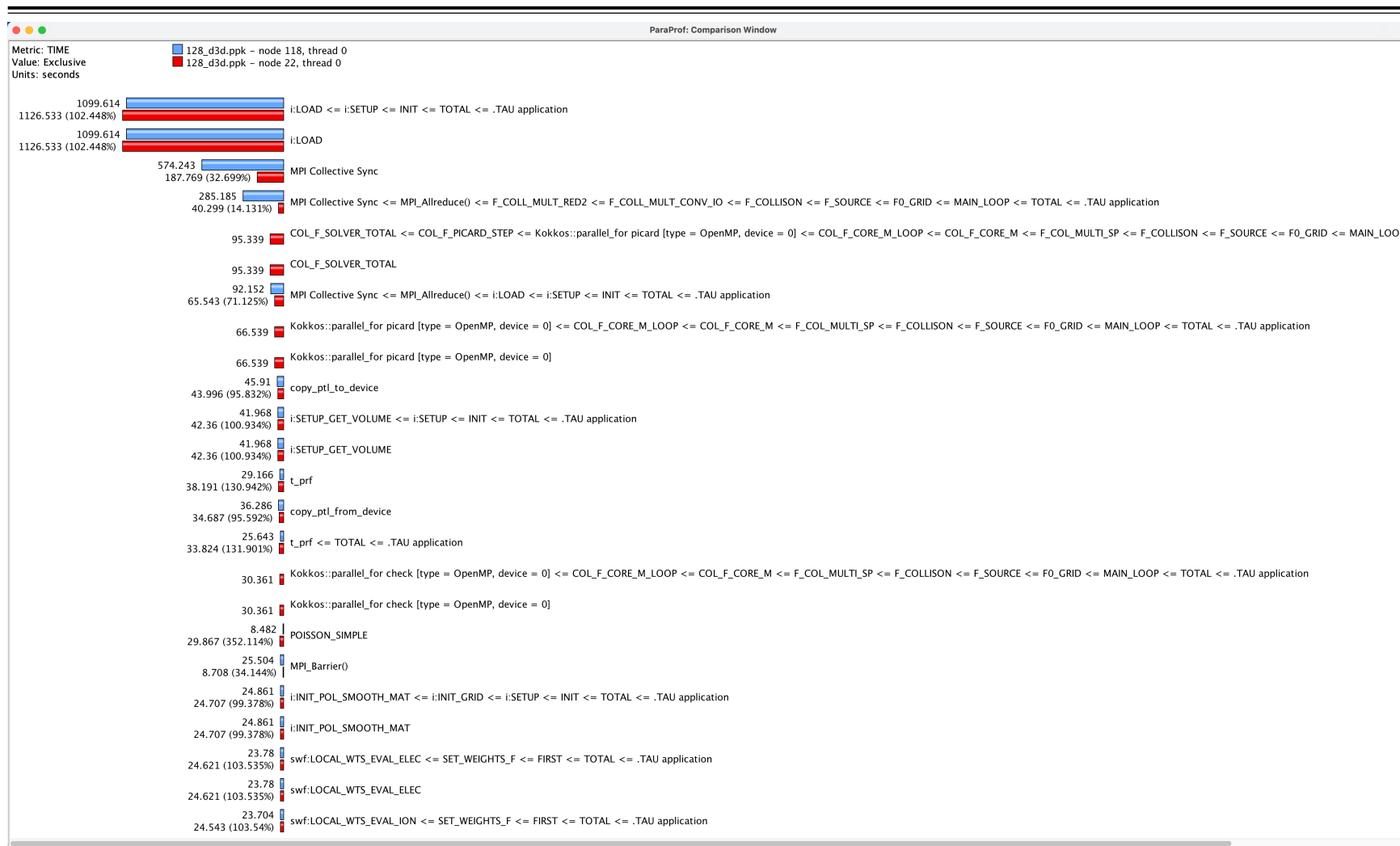
TAU: ParaProf: Call Path Data n,c,t, 118,0,0 - 128_d3d.ppk

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

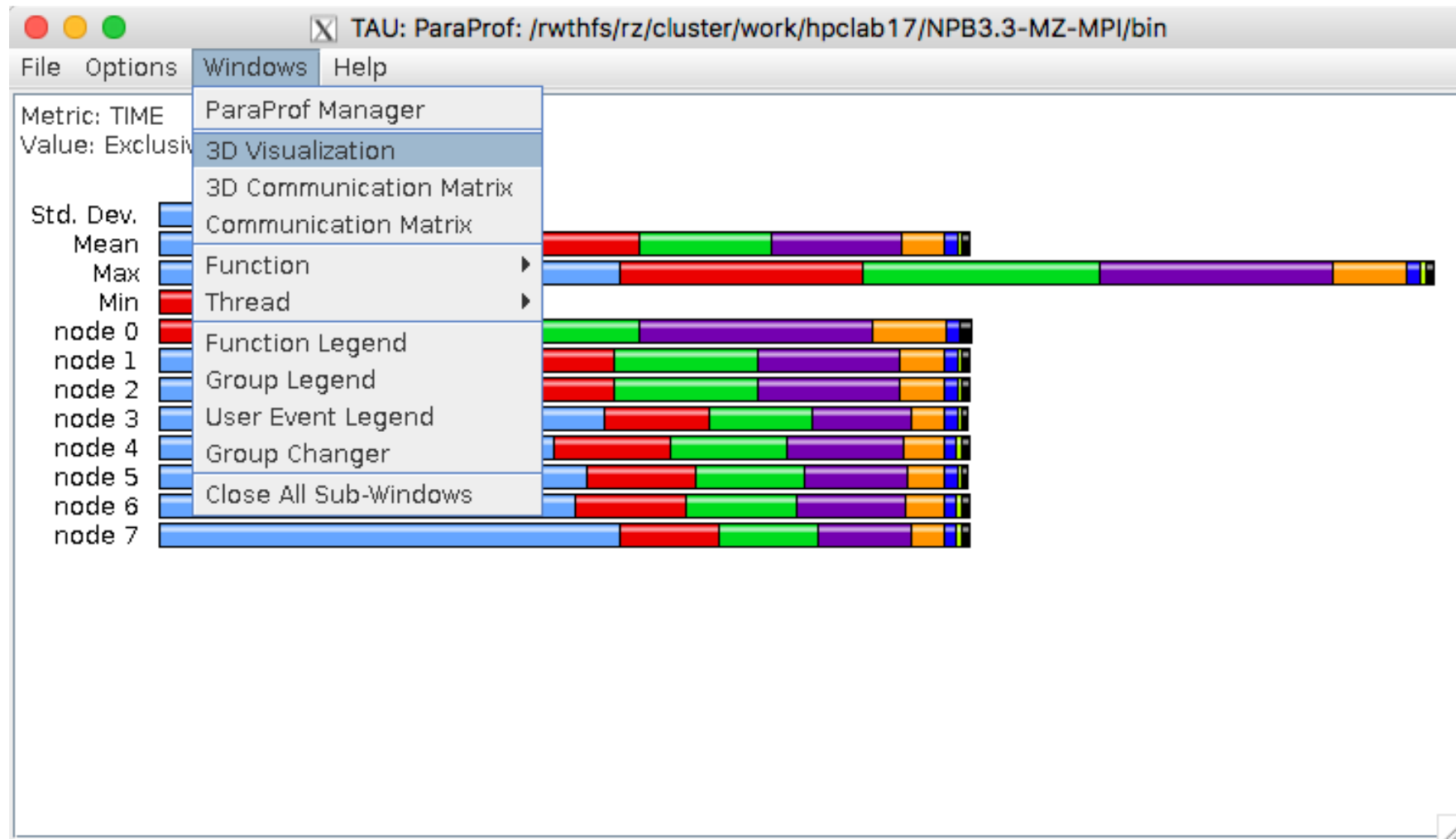
TAU: ParaProf: Context Events for thread: n,c,t, 1,0,0 – samarc_obe_4p_iomem_cp.ppk

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()						

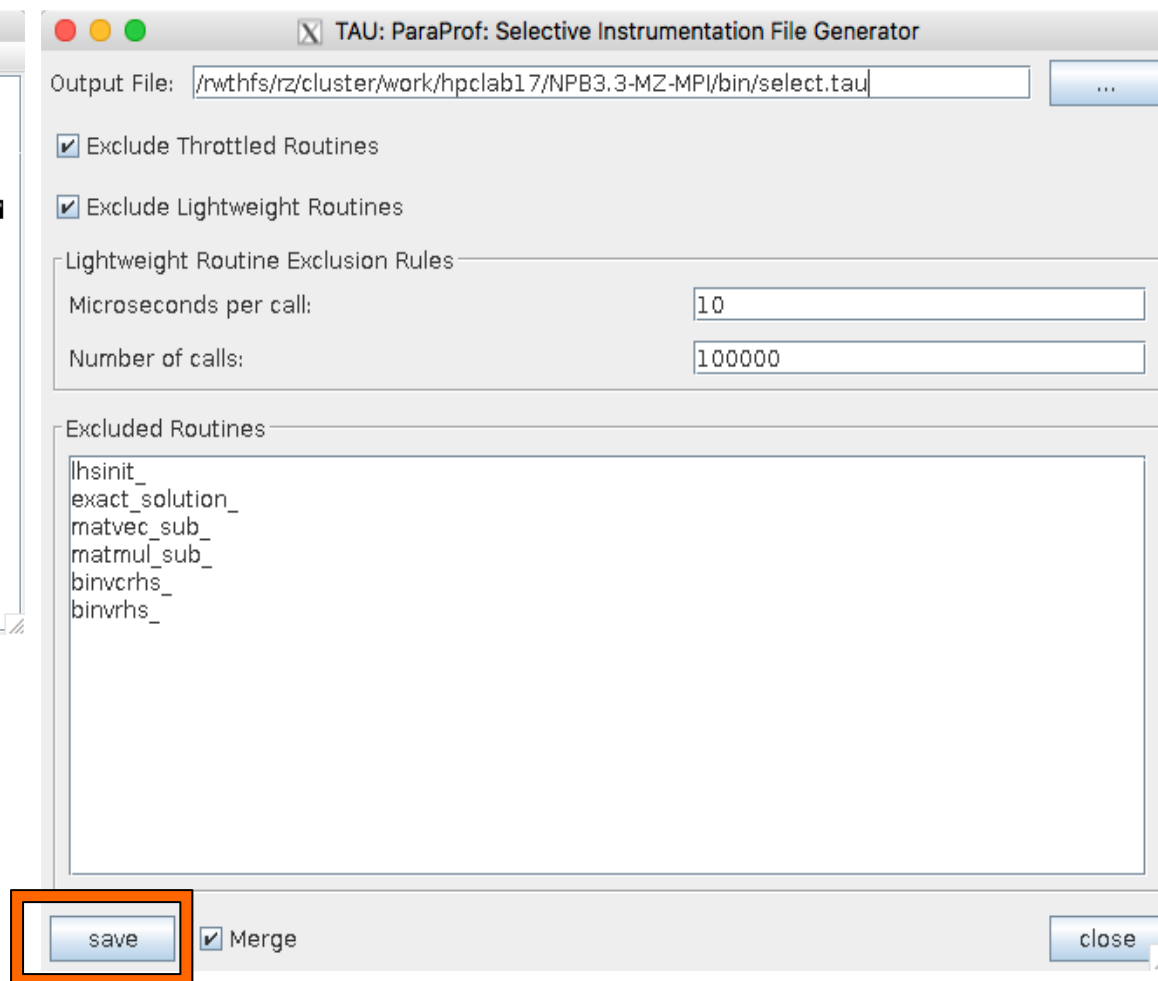
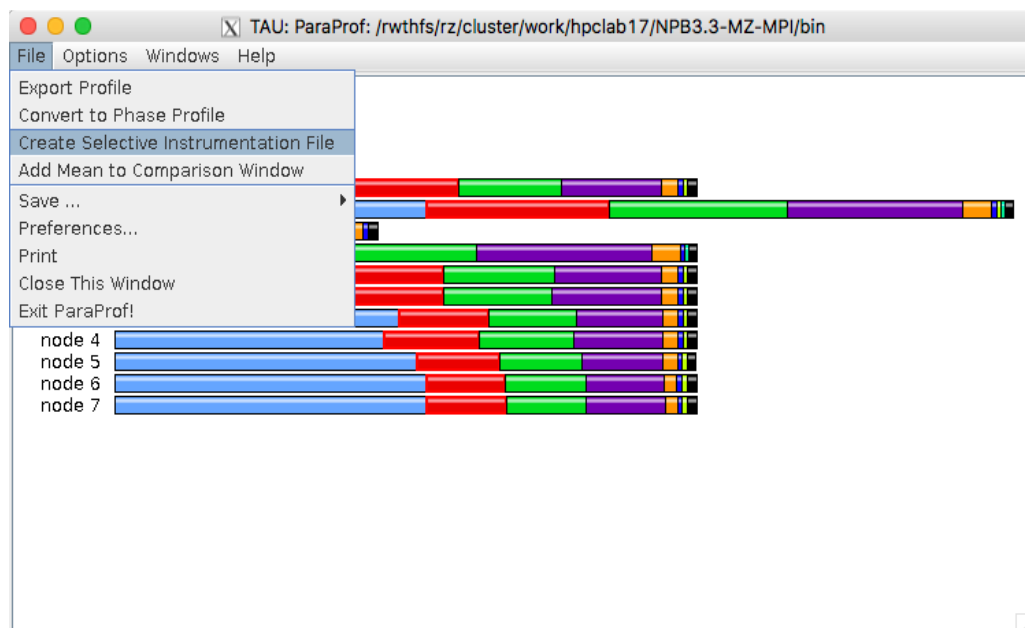
Write bandwidth per file

Bytes written to each file

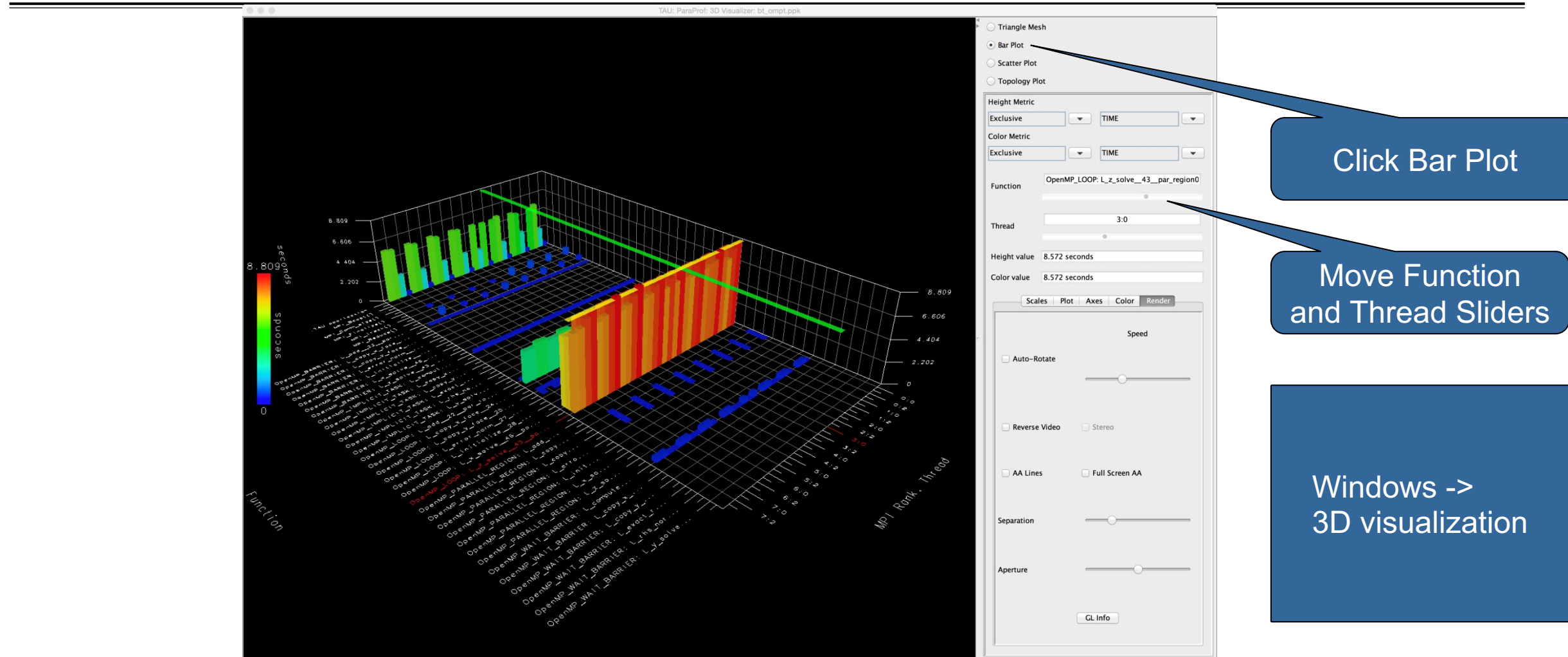
ParaProf with Optimized Instrumentation



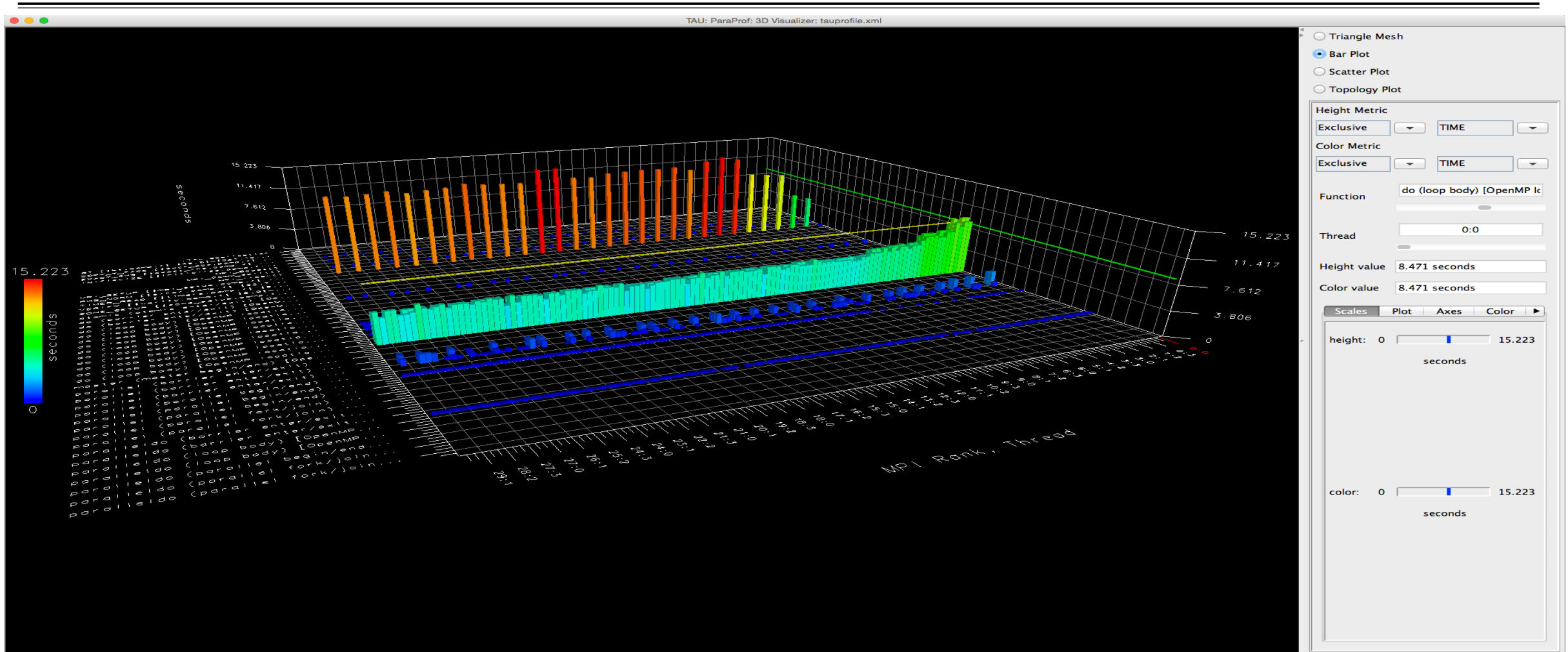
Create a Selective Instrumentation File, Re-instrument, Re-run



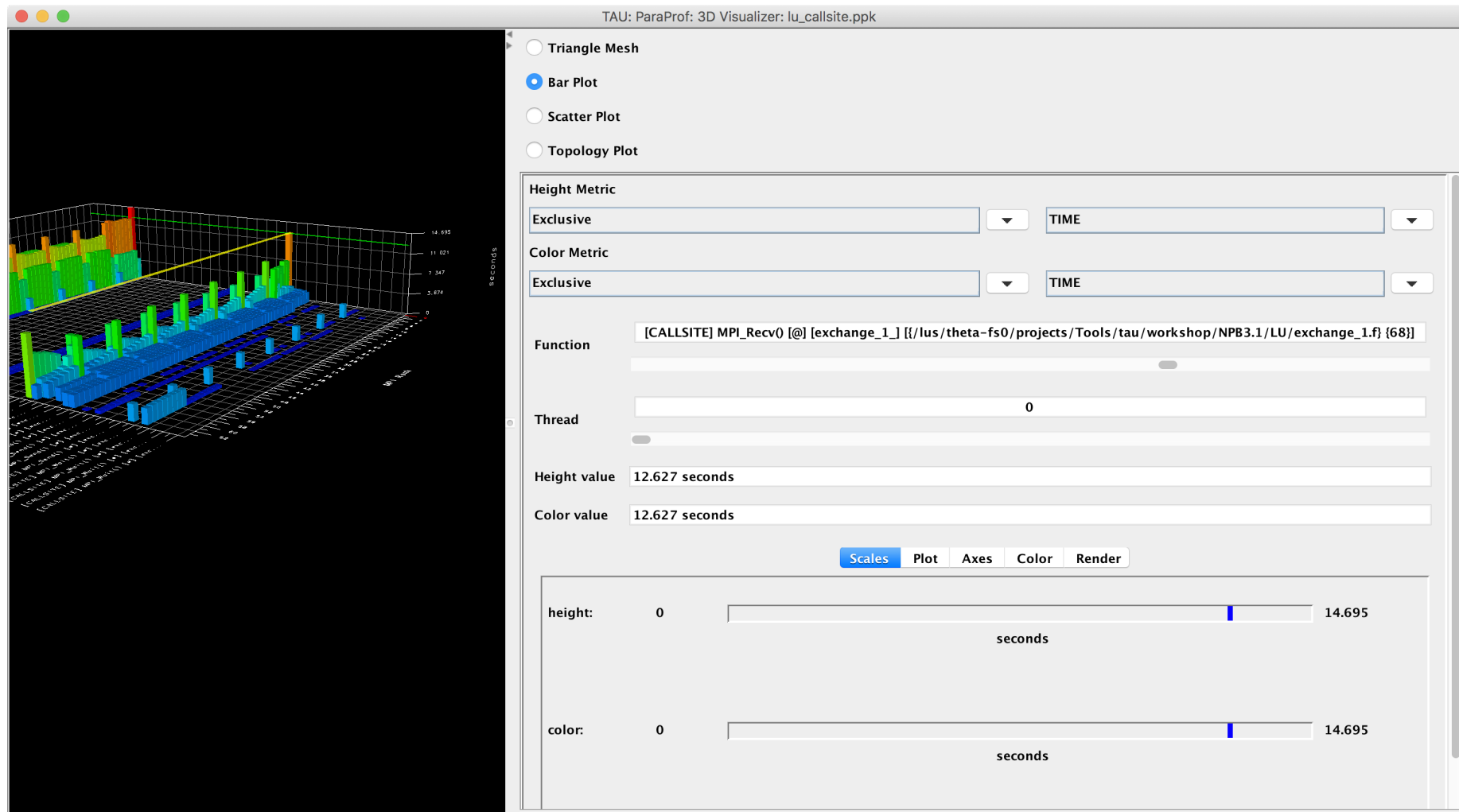
Paraprof 3D visualization window



ParaProf: 3D Visualization Window Showing Entire Profile

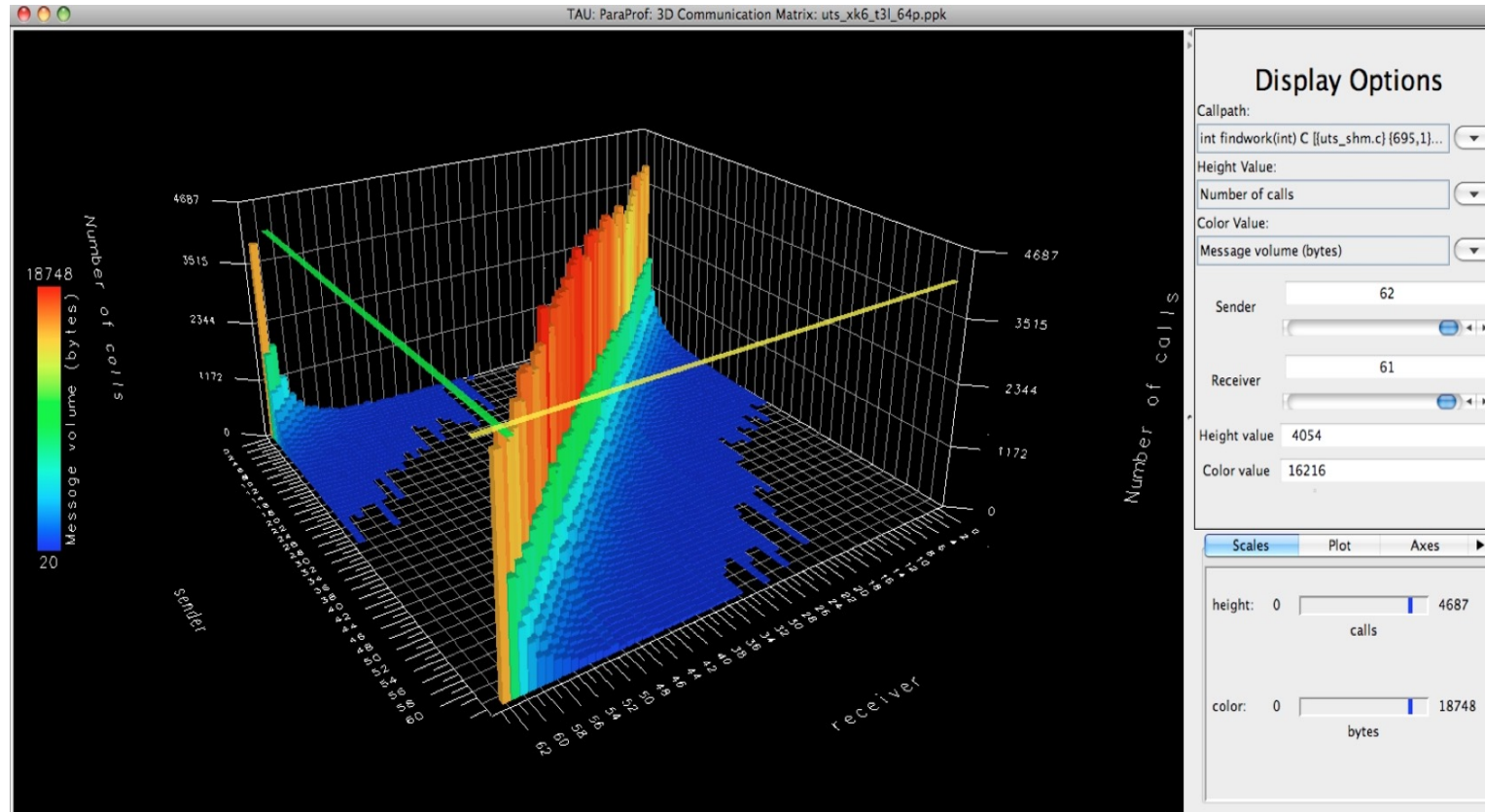


Callsite Profiling and Tracing



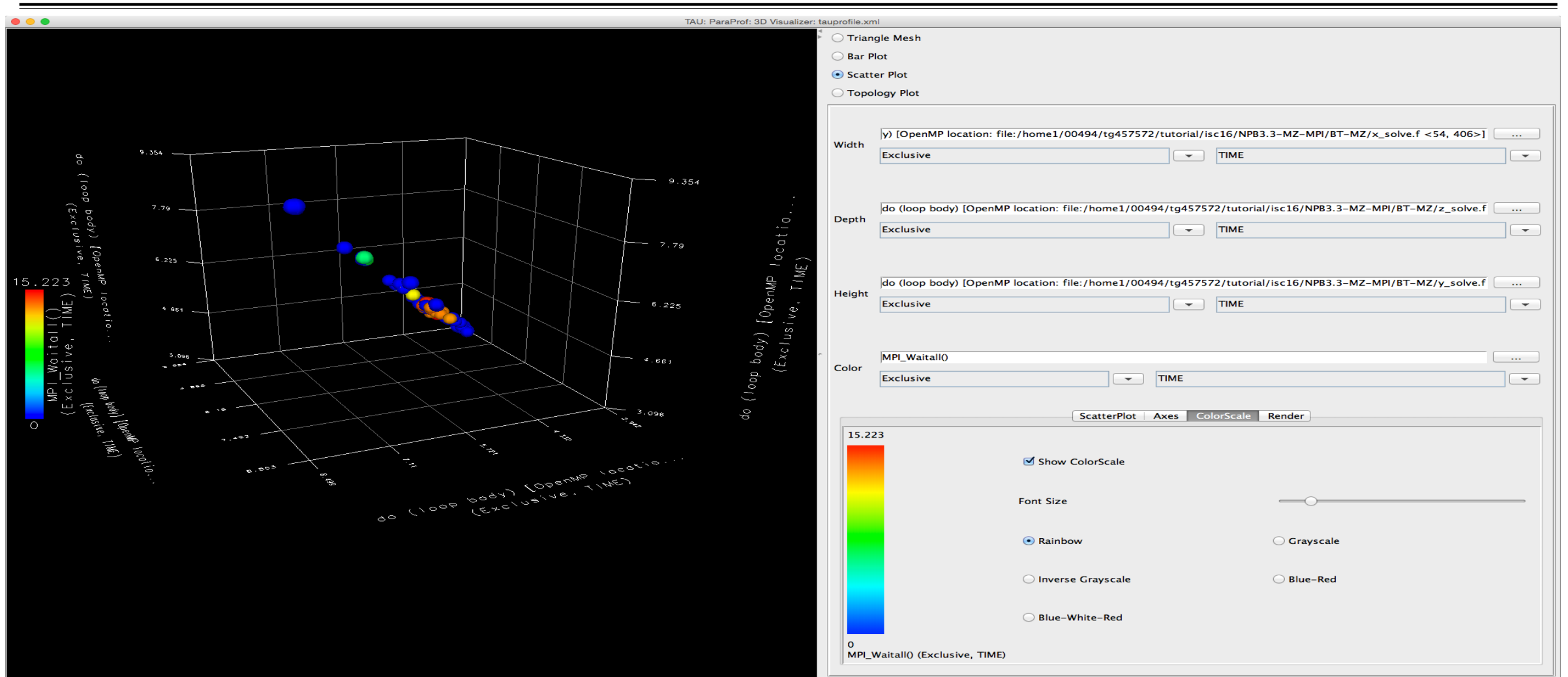


ParaProf 3D Communication Matrix



% export TAU_COMM_MATRIX=1

ParaProf: 3D Scatter Plot



ParaProf: Score-P Profile Files, Database

TAU: ParaProf Manager

File Options Help

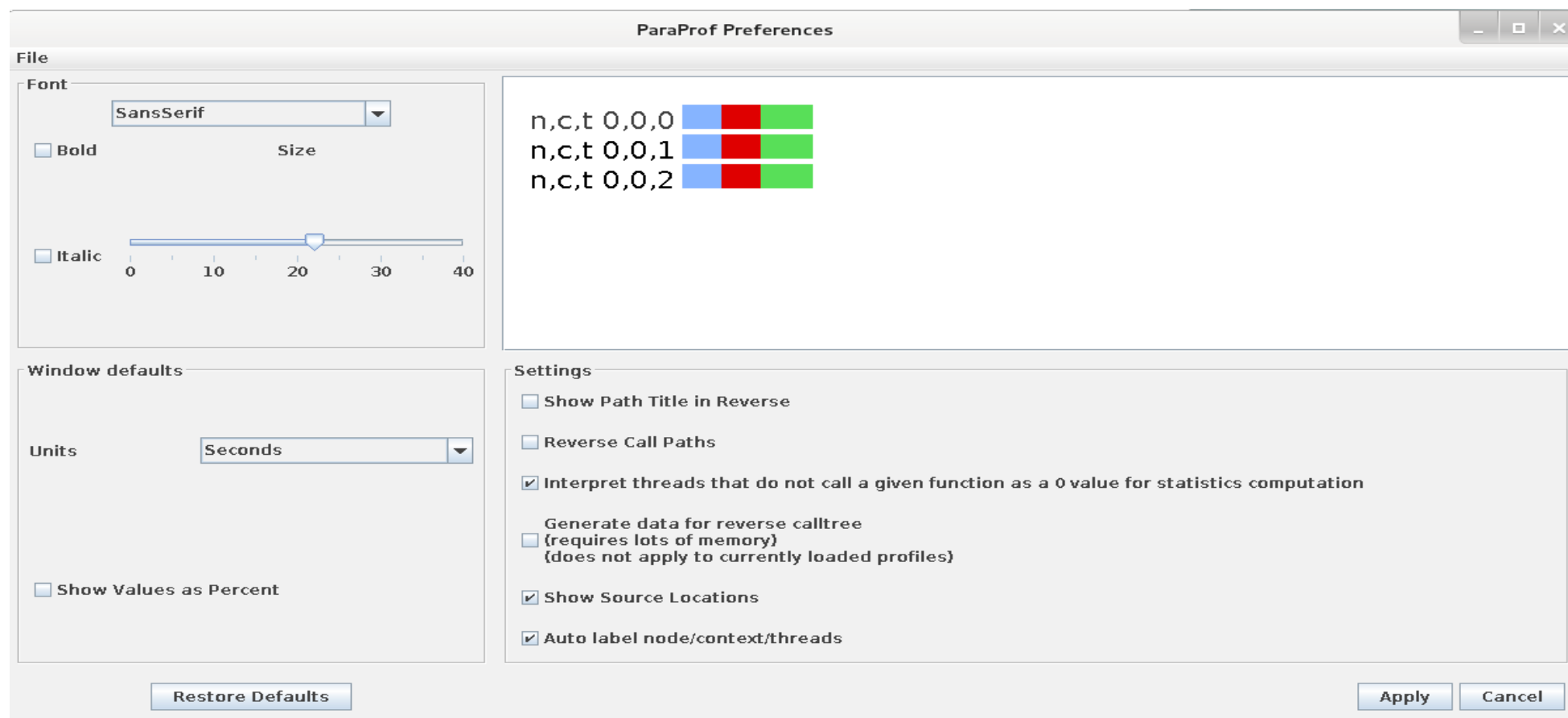
Applications

- 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

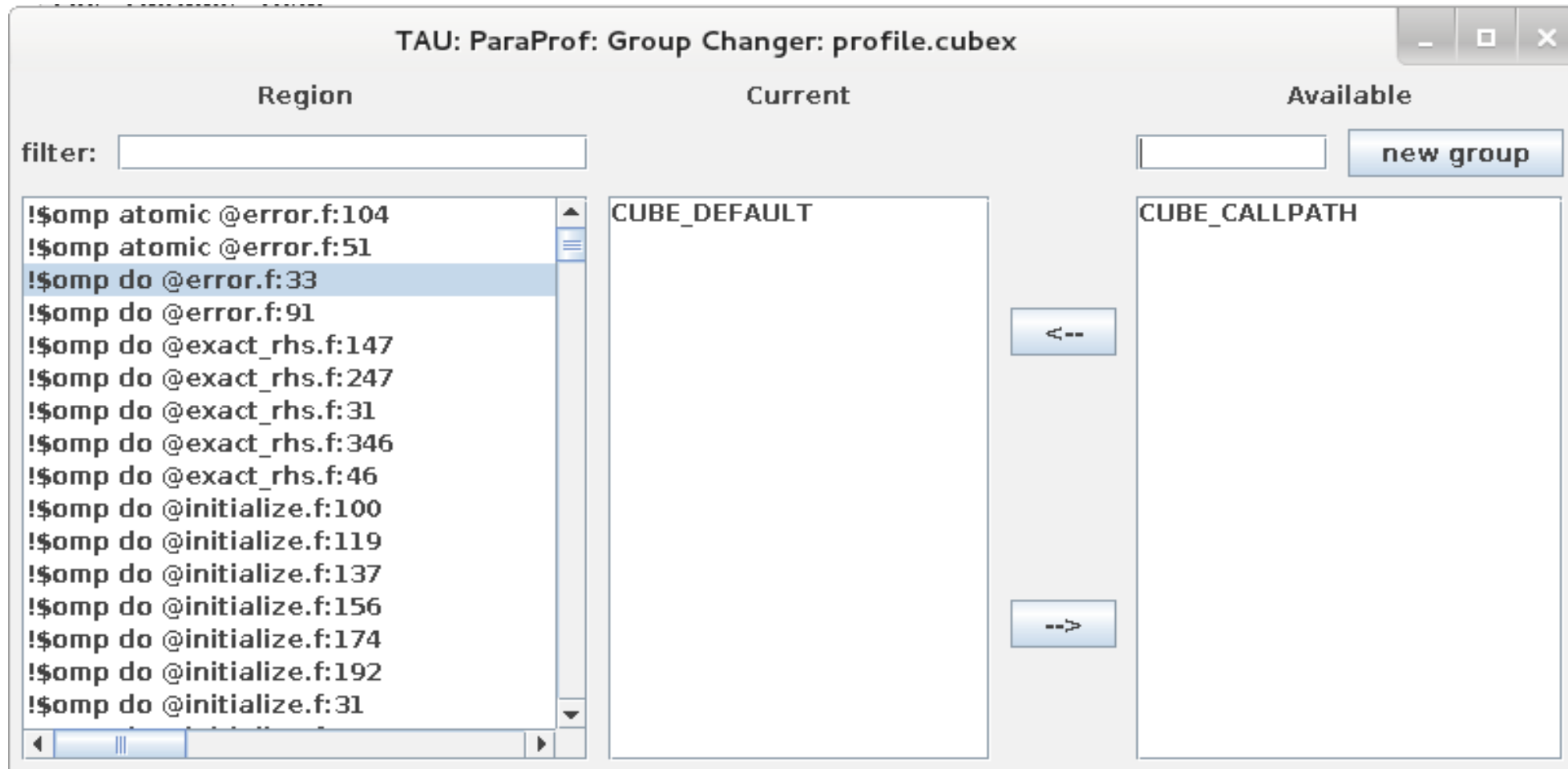
Add Application
Add Experiment
Add Trial

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

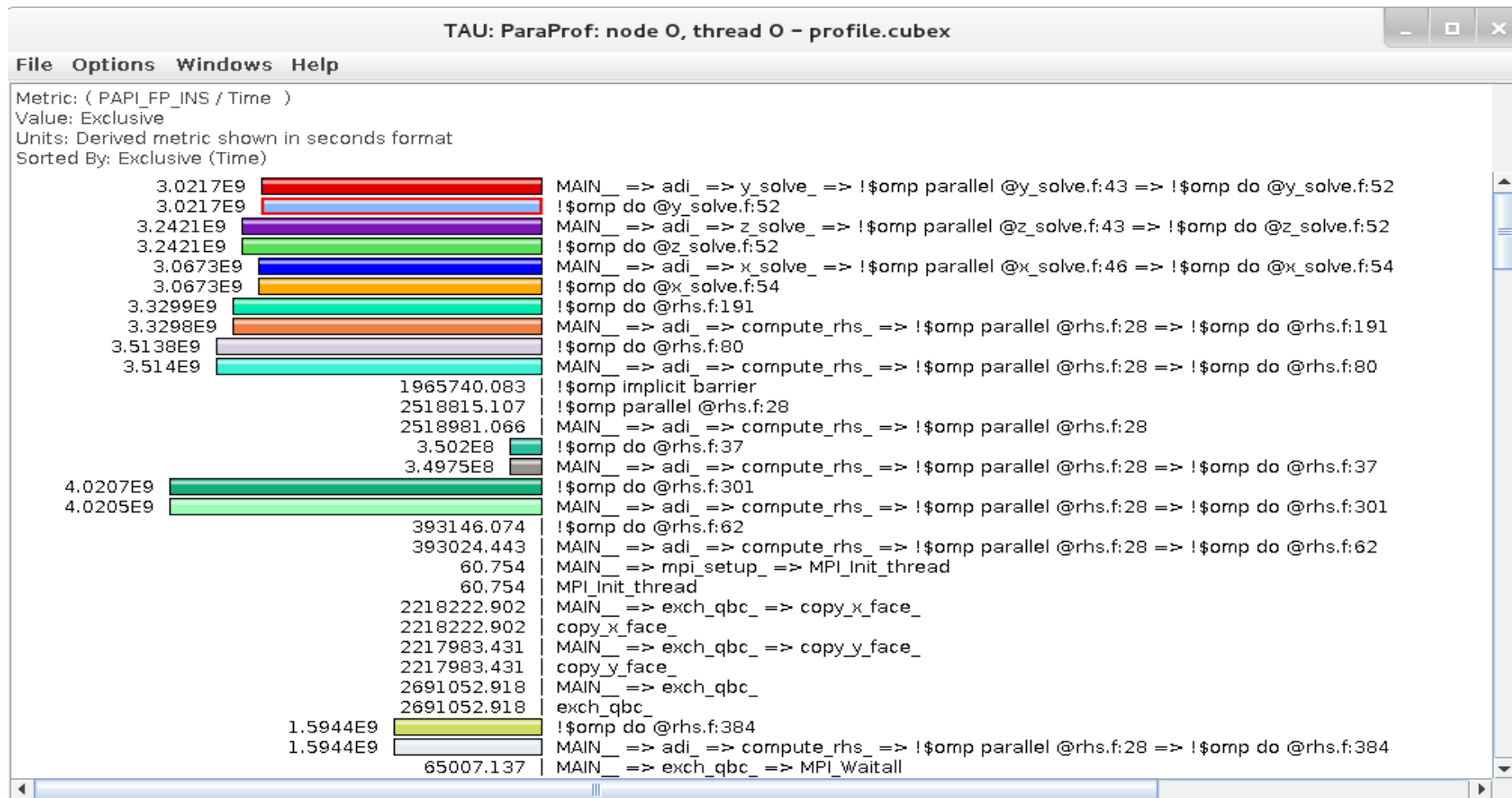
The screenshot displays the TAU: ParaProf Manager window. The interface includes a menu bar with 'File', 'Options', and 'Help'. On the left, a tree view shows the hierarchy: Applications > Standard Applications > Default App > Default Exp > profile.cubex. Under 'profile.cubex', a list of metrics is shown, with 'Time' selected. The right pane contains a table with two columns: 'MetricField' and 'Value'. The table lists several fields with their corresponding values. At the bottom, there is an 'Expression' input field containing the formula '"PAPI_FP_INS"/"Time"', a 'Clear' button, and a row of arithmetic operators (+, -, *, /, =, {, }) followed by an 'Apply' button.

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



TAU Hands-On

Hands-On Exercises for ParaProf

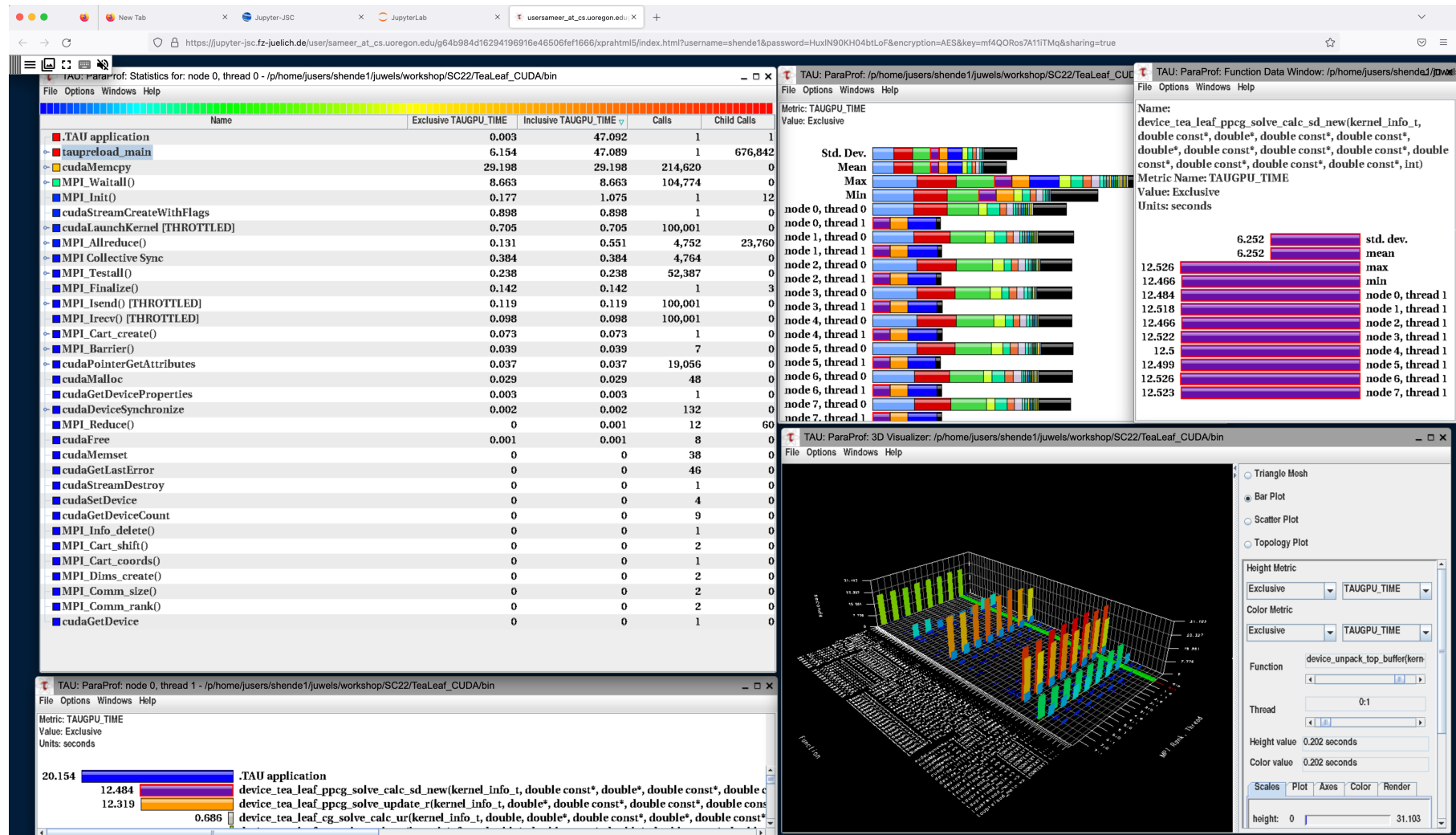
```
% wget http://tau.uoregon.edu/workshop.tgz  
% tar workshop.tgz; cd workshop  
% cat README  
% paraprof demo.ppk &
```

Hands-On Exercises for PerfExplorer

```
% wget http://tau.uoregon.edu/workshop.tgz
% tar workshop.tgz; cd workshop
% cat README
% cd data/tau
% ./upload.sh
% perfexplorer
```

and click on the database, click on the trial, select Charts from the menu and pick one of the charts.

ParaProf:



Performance Research Lab, University of Oregon, Eugene, USA



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 - PETTT, HPCMP
- National Science Foundation (NSF)
 - Glassbox, SI-2
- NASA
- CEA, France
- Partners:
 - University of Oregon
 - ParaTools, Inc., ParaTools, SAS
 - The Ohio State University
 - University of Tennessee, Knoxville
 - T.U. Dresden, GWT
 - Juelich Supercomputing Center



ParaTools

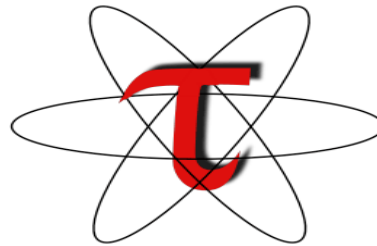
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Acknowledgement

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