

# Intuitive Performance Engineering at the Exascale with TAU and TAU Commander

Presented to  
**ATPESC 2017 Participants**

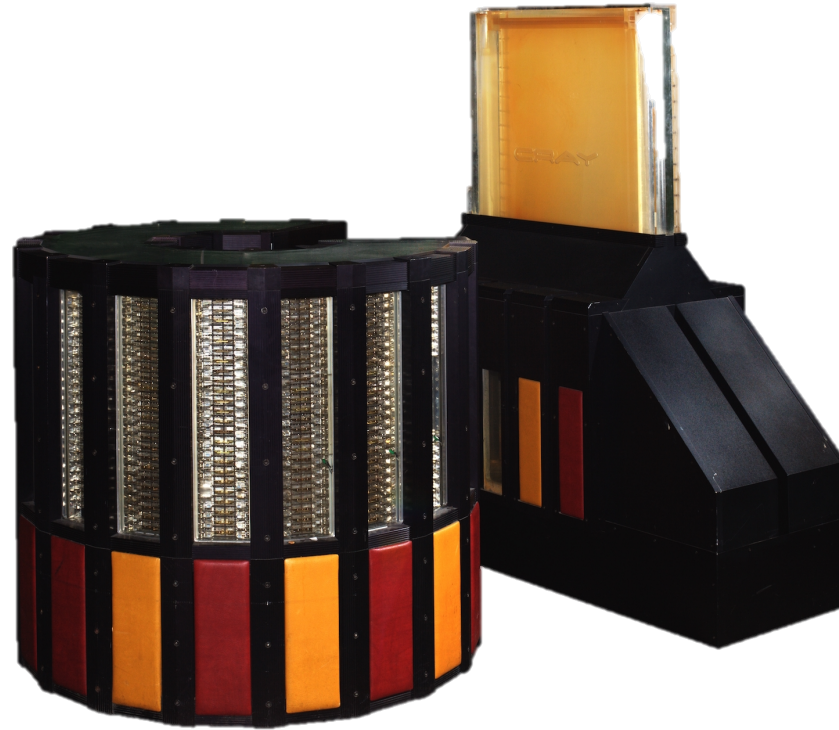
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Q Center, St. Charles, IL (USA)  
Date 08/08/2017



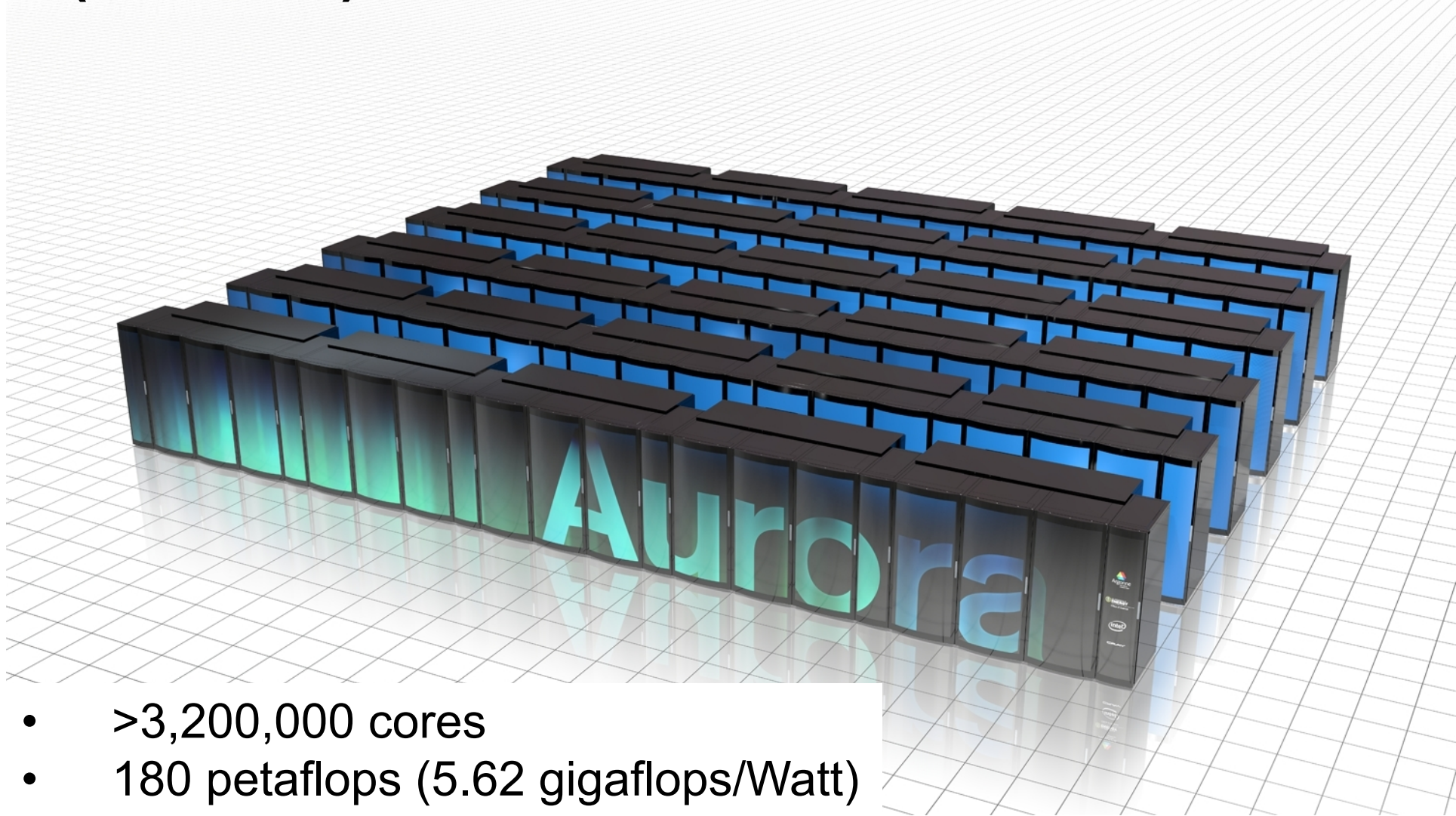
EXASCALE COMPUTING PROJECT

# Cray-2 (1985)



- 4 vector processors
- 1.9 gigaflops (0.0095 gigaflops/Watt)

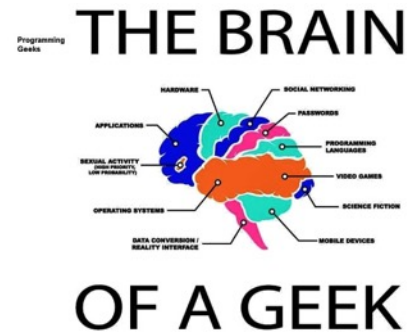
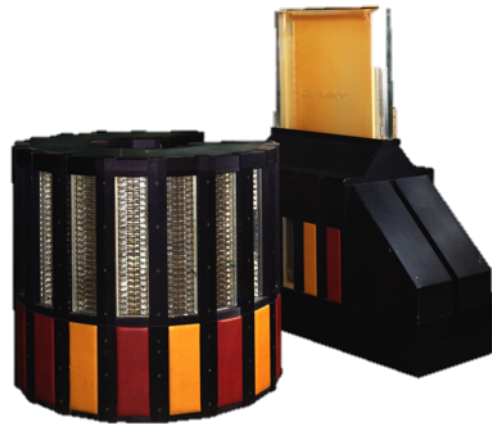
# Aurora (1985+34)



- >3,200,000 cores
- 180 petaflops (5.62 gigaflops/Watt)

# Your Brain is Not Enough

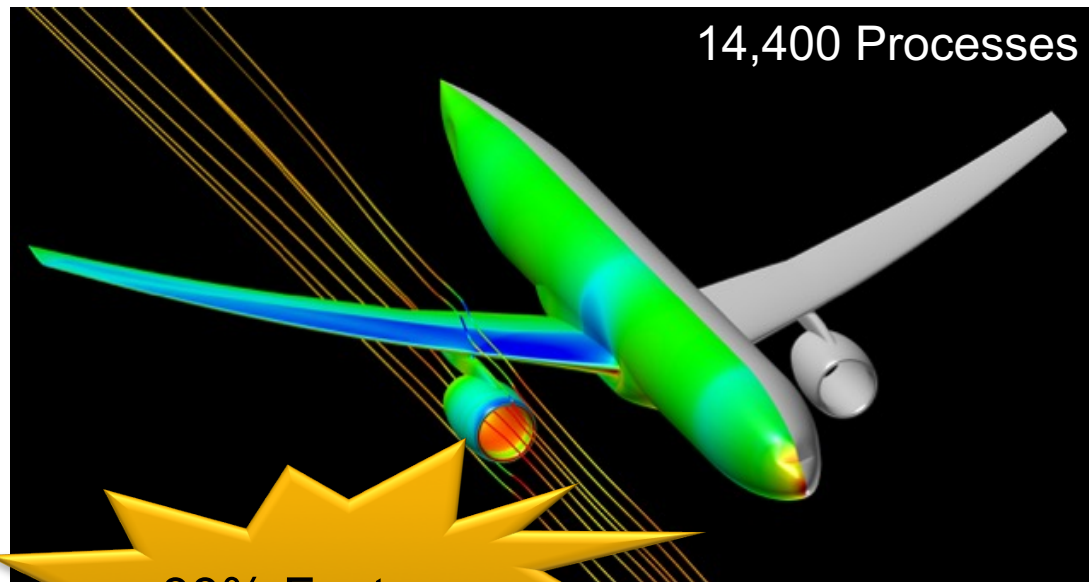
- Supercomputers are incomprehensibly complex.
- Naïve optimization may harm performance.
- Performance engineering **tools are essential** for realizing performance at scale.



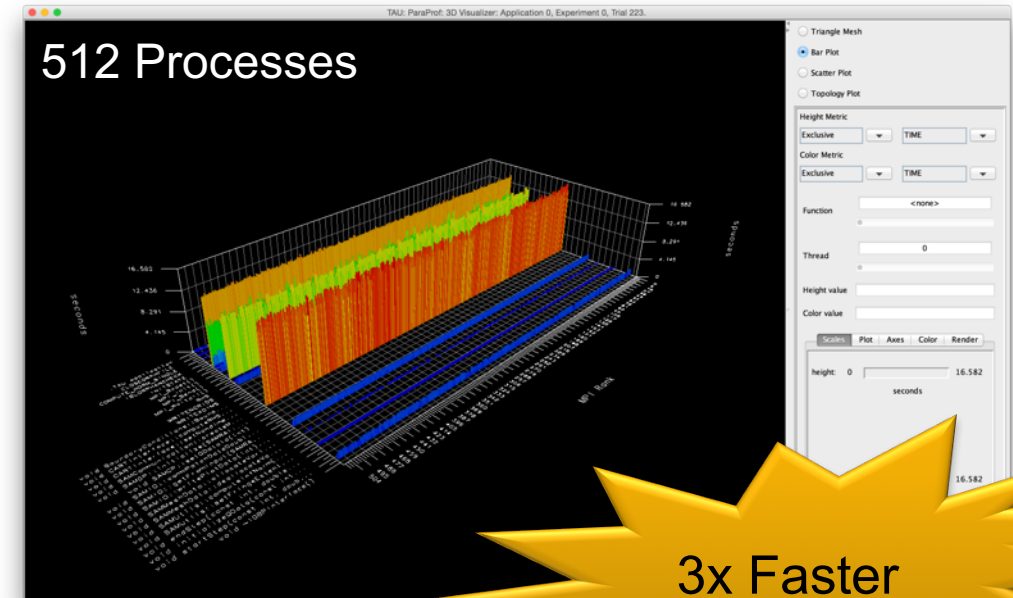


# NASA, DOD, DOE, Industry

*“These days I get excited about 1-2% speedups that I find....quite unusual to find something of this magnitude these days, especially with just a 2-line fix in the code! :)”*



33% Faster



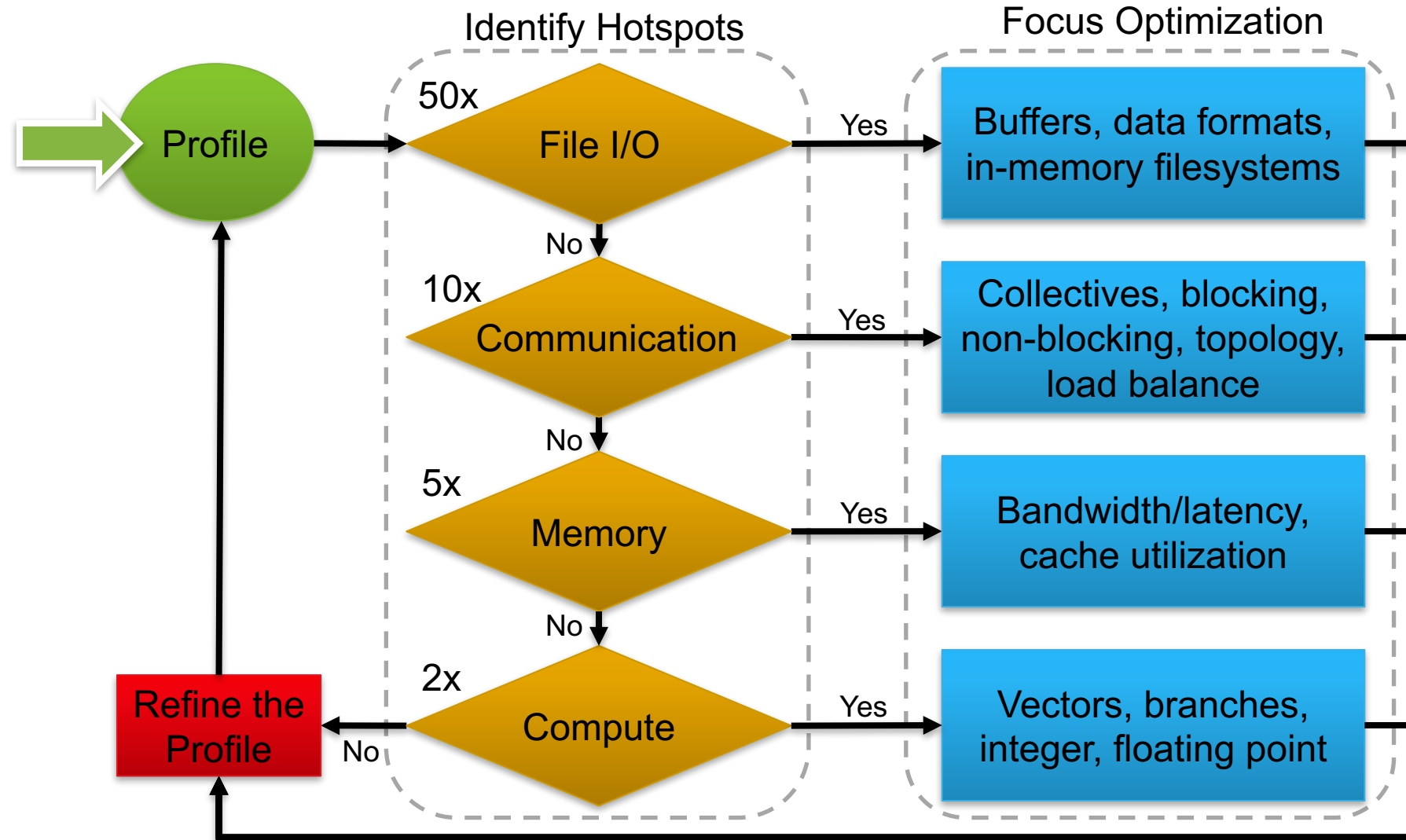
3x Faster

# Software Performance Engineering



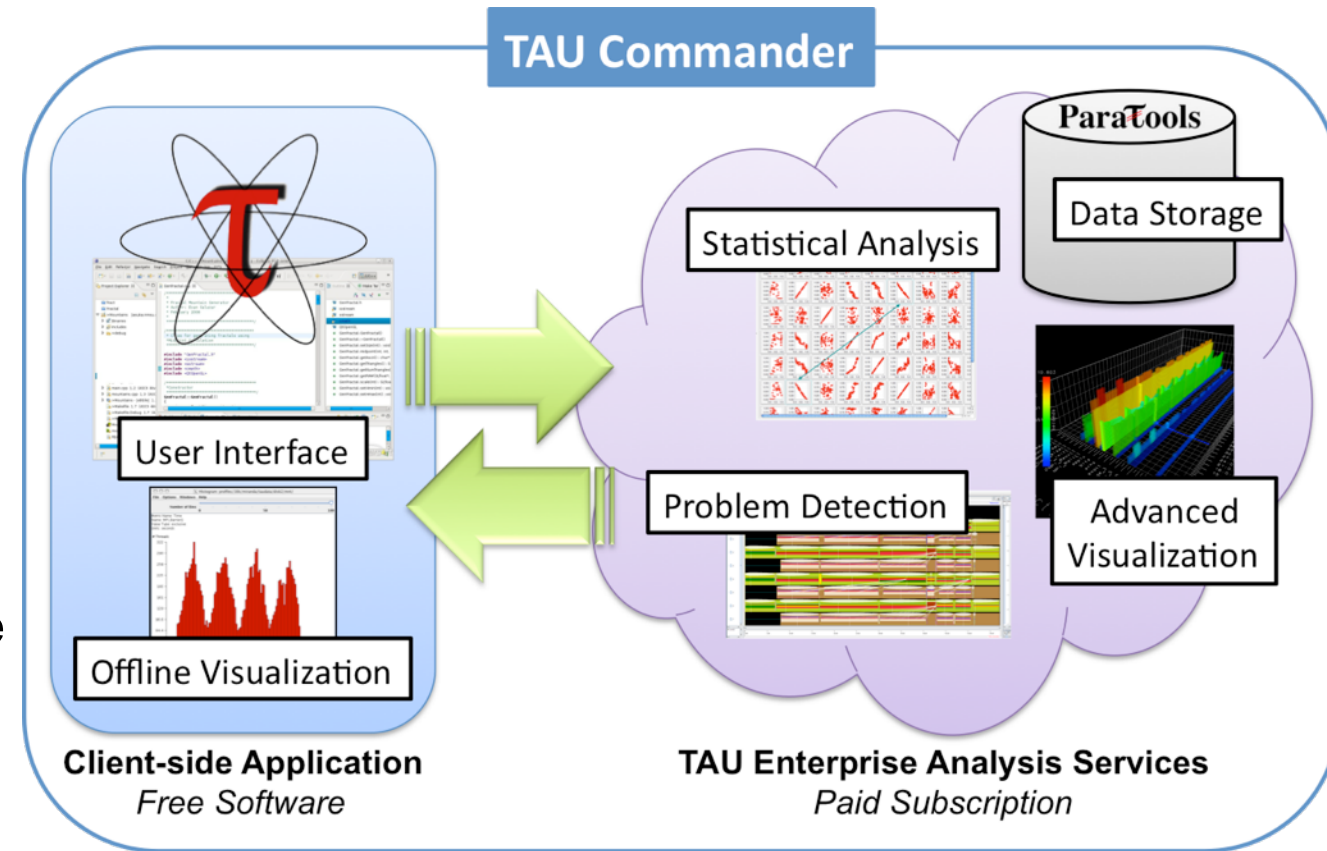
EXASCALE COMPUTING PROJECT

# Identifying and Resolving Performance Issues



# TAU Commander

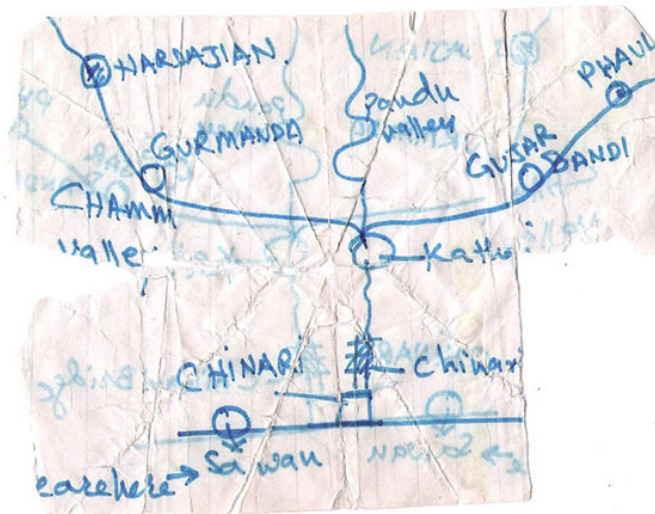
- **Universal tool or integrated toolkit**
- **Unbiased, accurate measurements**
  - File I/O: serial and parallel
  - Communication: inter- and intra-node
  - Memory: allocation and access
  - CPU: vectorization, cache utilization, etc.
- **Minimal overhead**
  - Provide multiple measurement methods
  - Focus on one performance aspect at a time
- **Easy to use**
  - Intuitive, systematic, and well documented
  - Easy to understand and configure





# TAU Commander's Approach

- Say where you're going, not how to get there
- **Experiments** give **context** to the user's actions
  - Defines desired metrics and measurement approach
  - Defines operating environment
  - Establishes a baseline for error checking

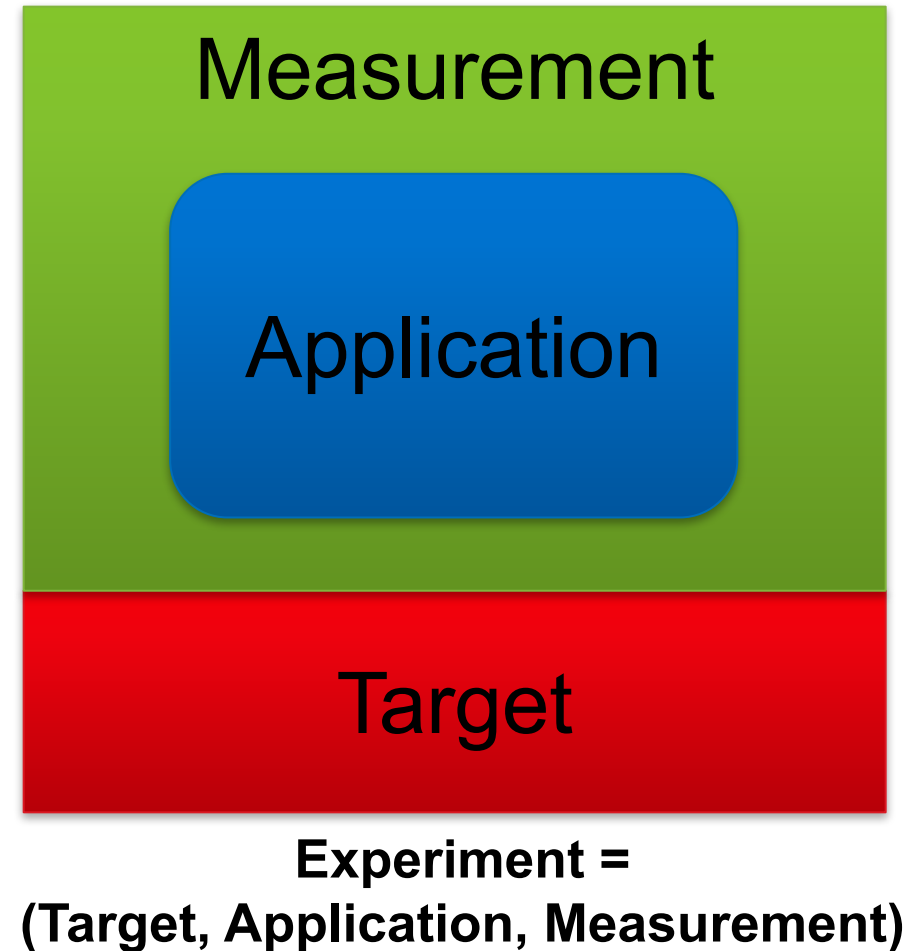


VS.



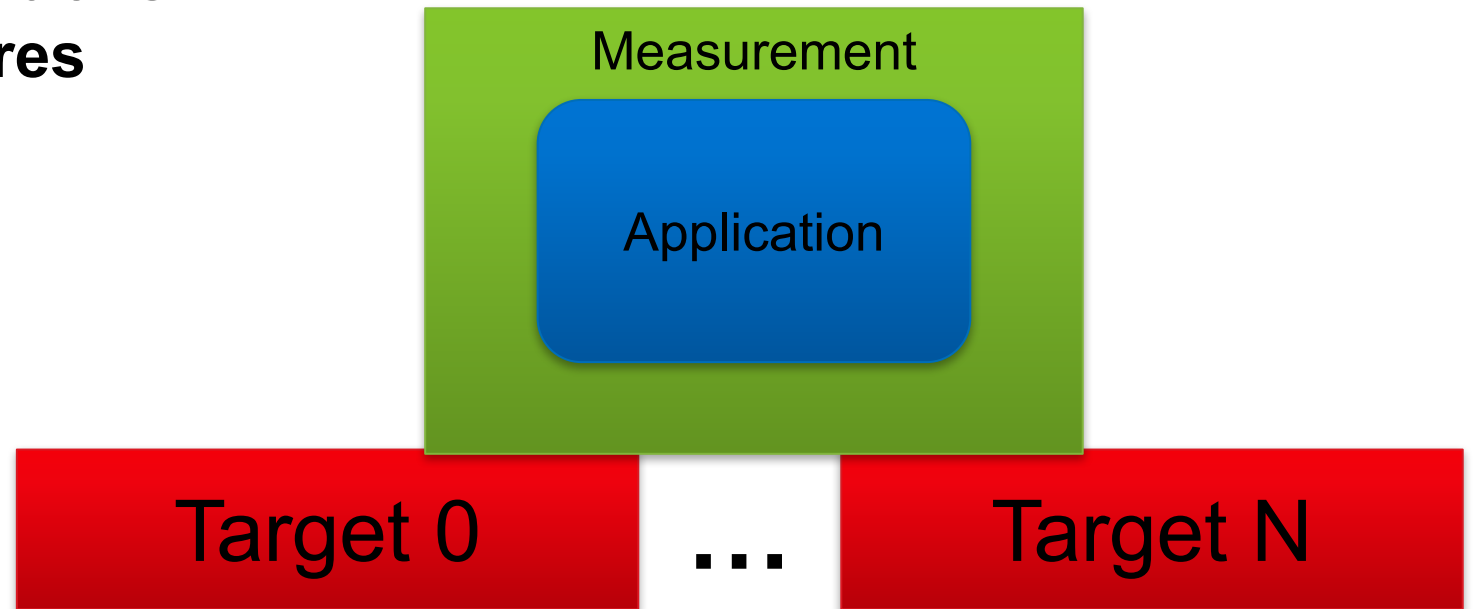
# T-A-M Model for Performance Engineering

- **Target**
  - Installed software
  - Available compilers
  - Host architecture/OS
- **Application**
  - MPI, OpenMP, CUDA, OpenACC, etc.
- **Measurement**
  - Profile, trace, or both
  - Sample, source inst...



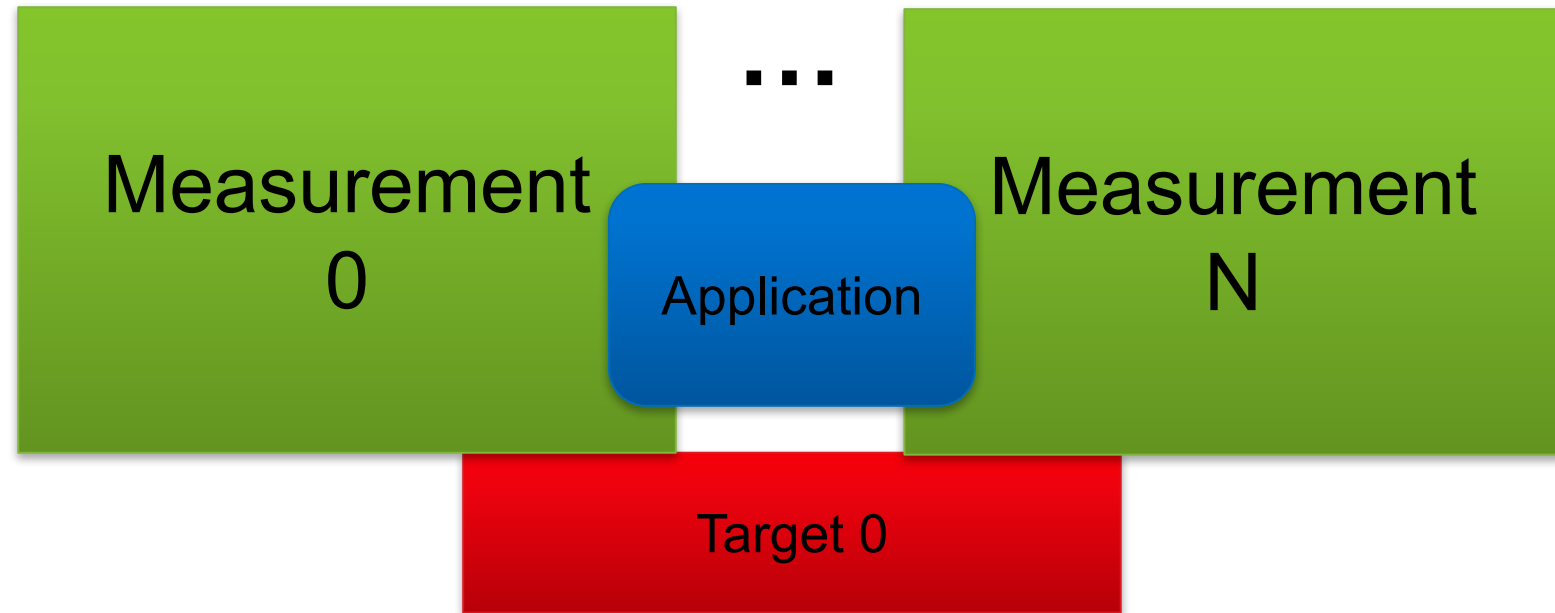
# Which platform is best for my application?

- **Many targets:**
  - Different MPI implementations
  - Different CPU architectures
  - GPU vs MIC
  - Cray vs SGI
- One measurement
- One application



# What are the performance characteristics of my application?

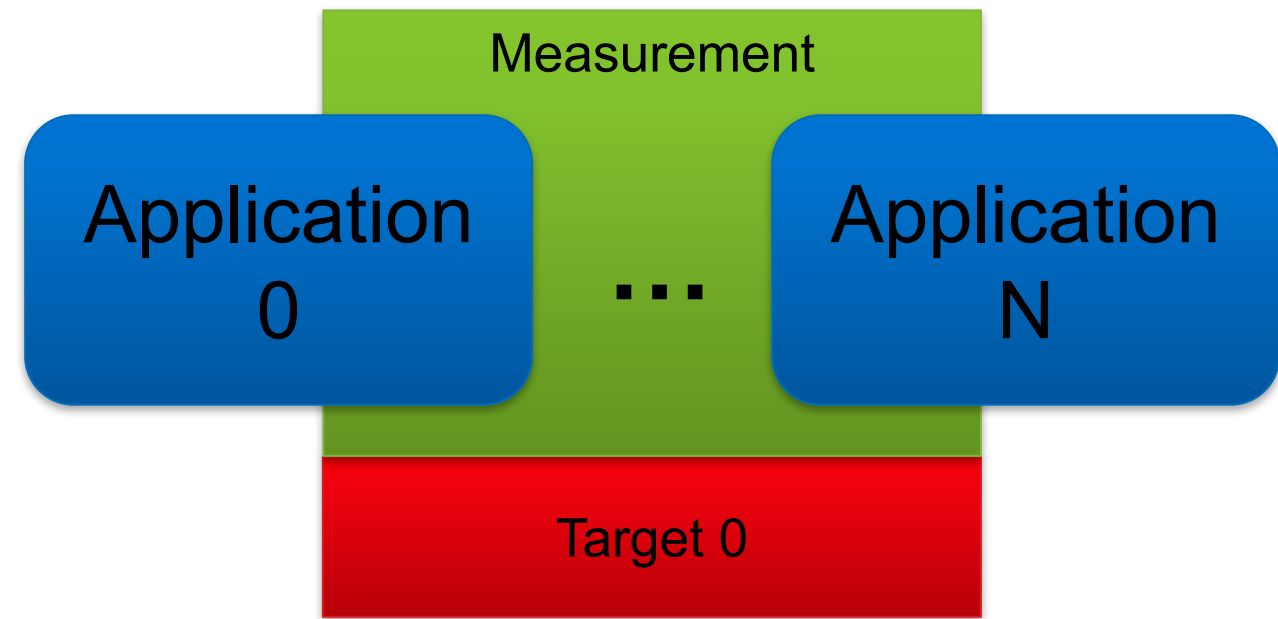
- One target
- **Many measurements:**
  - File I/O
  - Communication
  - Memory allocation
  - Performance counters
  - Vectorization
- One application





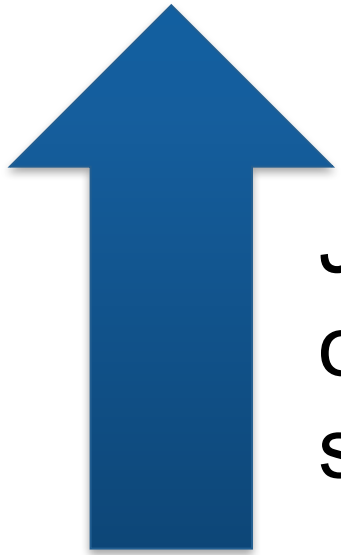
# How well does my target perform various tasks?

- One target
- One measurement
- **Many applications:**
  - **Compute bound**
    - Dense LA
  - **Memory bound**
    - Sparse LA
    - Graph
  - **Scaling**
    - Thread-level
    - Process-level



# Getting Started with TAU Commander

1. **tau** initialize
2. **tau** oshf90 \*.f90 -o foo
3. **tau** oshrun -np 64 ./foo
4. **tau** show



Just put **`tau`** in front of everything and see what happens.

- This works on any supported system, even if TAU is not installed or has not been configured appropriately.
- TAU and all its dependencies will be downloaded and installed if required.

# TAU Commander Online Help

```
jlinford — ssh cori.nersc.gov — 80x47
[jlinford@cori09 ~/workspace/openshmem17/applications/ISx $ tau --help]
usage: tau [arguments] <subcommand> [options]

TAU Commander 1.0a [ www.taucommander.com ]

Positional Arguments:
  <subcommand>  See subcommand descriptions below.
  [options]     Options to be passed to <subcommand>.

Optional Arguments:
  -V, --version  Show program's version number and exit.
  -h, --help     Show this help message and exit.
  -q, --quiet    Suppress all output except error messages.
  -v, --verbose  Show debugging messages.

Configuration Subcommands:
  application  Create and manage application configurations.
  experiment   Create and manage experiments.
  measurement  Create and manage measurement configurations.
  project      Create and manage project configurations.
  target       Create and manage target configurations.
  trial        Create and manage experiment trials.

Subcommands:
  build        Instrument programs during compilation and/or linking.
  configure    Configure TAU Commander.
  dashboard    Show all project components.
  help         Show help for a command or suggest actions for a file.
  initialize   Initialize TAU Commander.
  select       Create a new experiment or select an existing experiment.

Shortcuts:
  tau <compiler> Execute a compiler command
    - Example: tau gcc *.c -o a.out
    - Alias for 'tau build <compiler>'
  tau <program>  Gather data from a program
    - Example: tau ./a.out
    - Alias for 'tau trial create <program>'
  tau metrics    Show metrics available in the current experiment
    - Alias for 'tau target metrics'
  tau select     Select configuration objects to create a new experiment
    - Alias for 'tau experiment create'
  tau show      Show data from the most recent trial
    - Alias for 'tau trial show'

See 'tau help <subcommand>' for more information on <subcommand>.
[jlinford@cori09 ~/workspace/openshmem17/applications/ISx $ ]
```

```
jlinford — ssh cori.nersc.gov — 80x35
[jlinford@cori09 ~/workspace/openshmem17/applications/ISx $ tau app cre --help]
usage: tau application create <application_name> [arguments]

Create application configurations.

Optional Arguments:
  -@ <level>      Create the application at the specified storage
                  level.
                  - <level>: project, user, system
                  - default: project
  -h, --help      Show this help message and exit.

Application Arguments:
  <application_name> Application configuration name.
  --cuda [T/F]      Application uses NVIDIA CUDA.
                  - default: False
  --linkage <linkage> Application linkage.
                  - <linkage>: static, dynamic
                  - default: static
  --mpc [T/F]       Application uses MPC.
                  - default: False
  --mpi [T/F]       Application uses MPI.
                  - default: False
  --opencl [T/F]    Application uses OpenCL.
                  - default: False
  --openmp [T/F]    Application uses OpenMP.
                  - default: False
  --pthreads [T/F]  Application uses pthreads.
                  - default: False
  --select-file path Specify selective instrumentation file.
  --shmem [T/F]     Application uses SHMEM.
                  - default: False
  --tbb [T/F]       Application uses Thread Building Blocks (TBB).
                  - default: False
[jlinford@cori09 ~/workspace/openshmem17/applications/ISx $ ]
```

# Gathering Performance Data

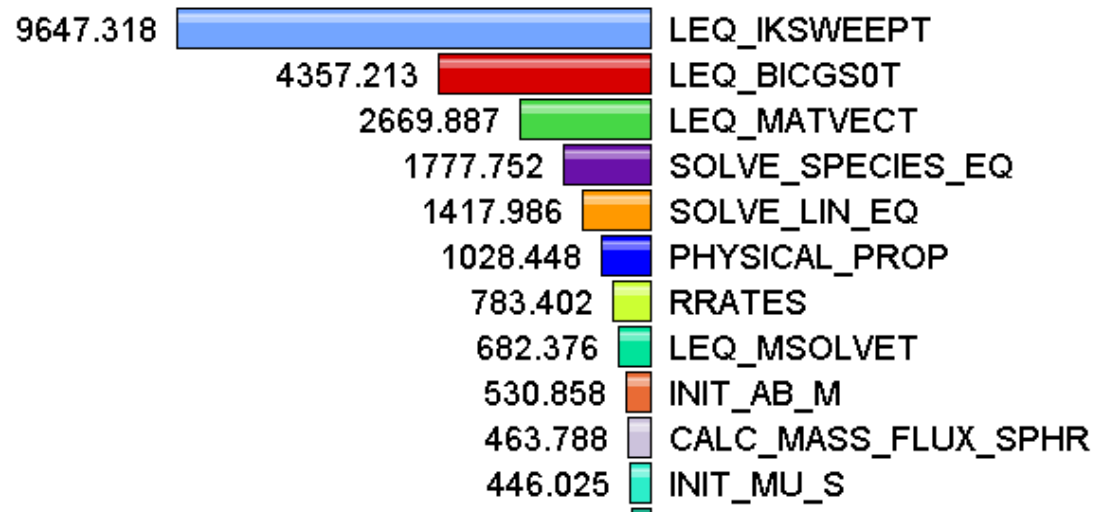


EXASCALE COMPUTING PROJECT

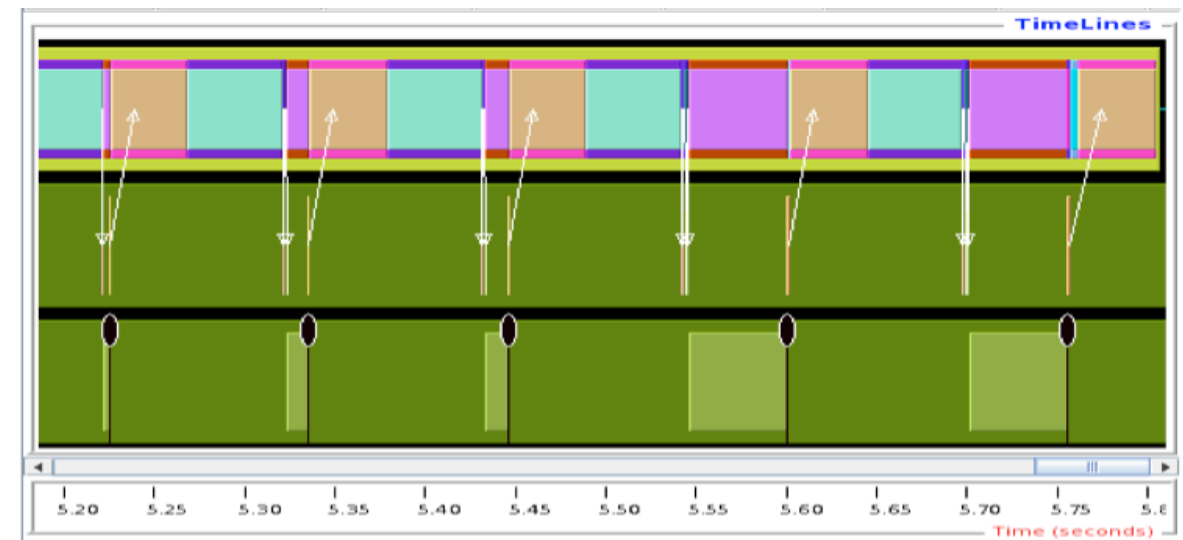


# Measurement Approaches

**Profiling** shows **how much time**

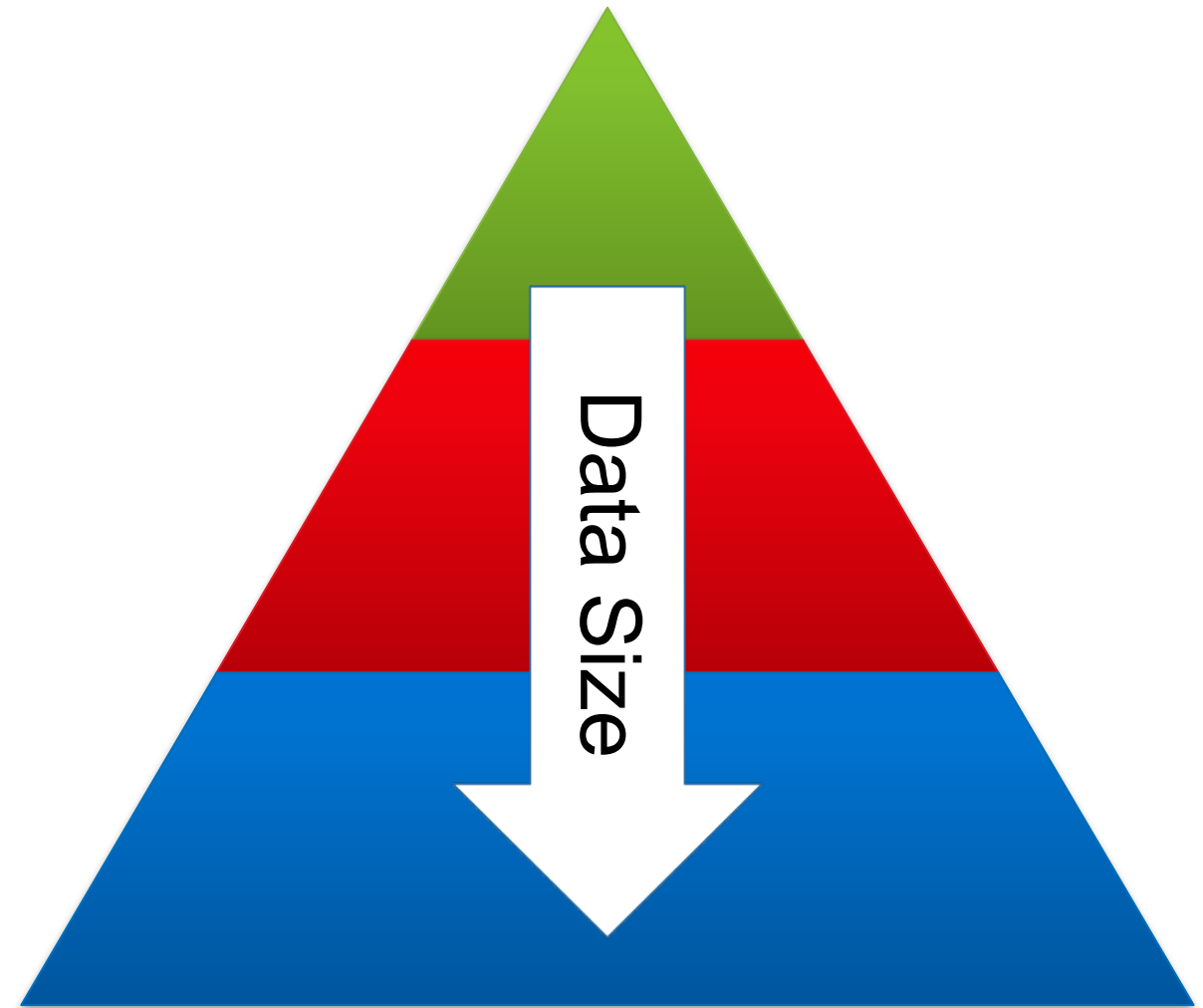


**Tracing** shows the **order of events**

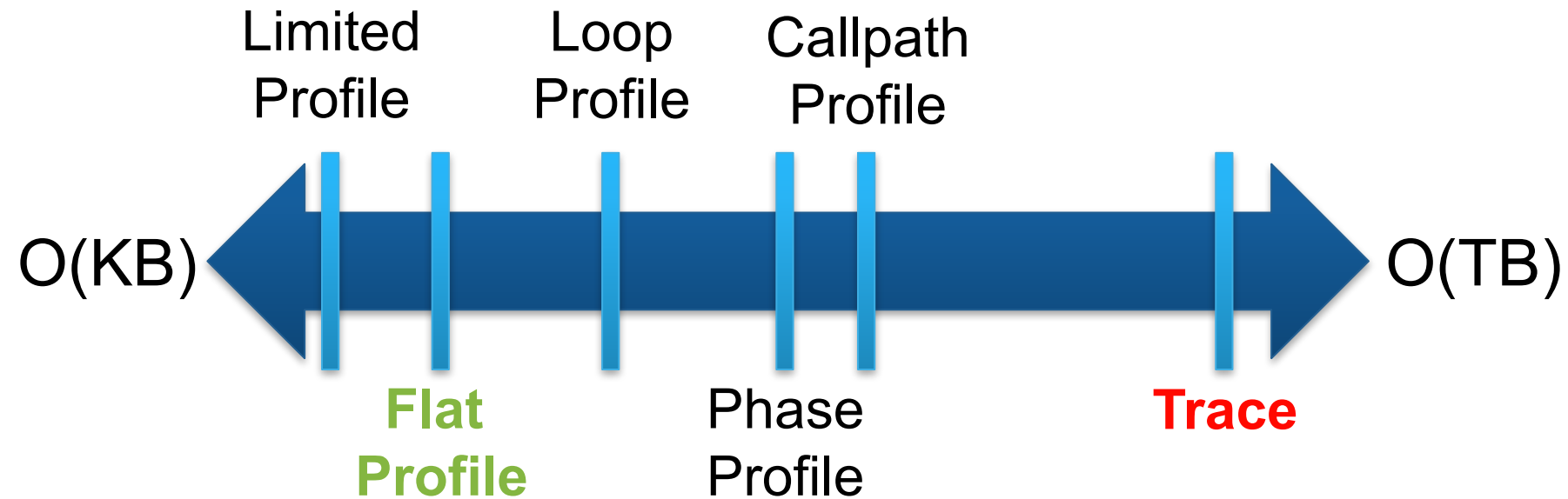


# Types of Performance Profiles

- **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*”
- **Phase** profiles
  - Flat profiles under a phase (nested phases allowed)
  - Default “main” phase
  - Supports static or dynamic (e.g. per-iteration) phases



# How much data do you want?



All levels support multiple metrics/counters

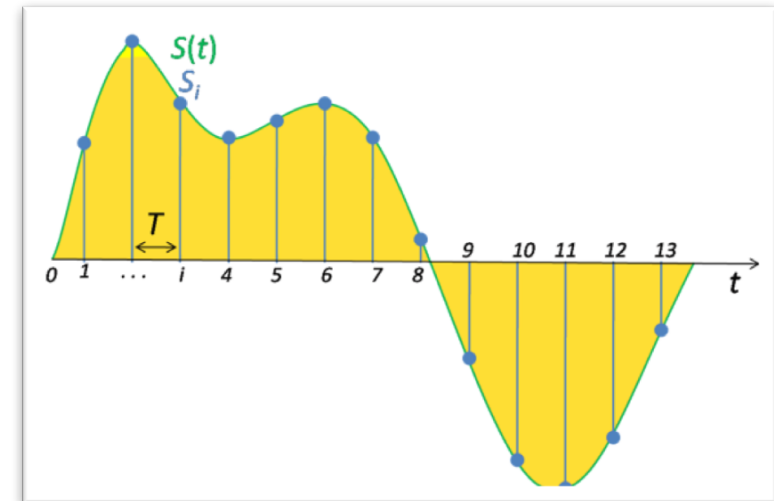
# Performance Data Measurement

## Direct via Probes

```
call TAU_START('potential')  
// code  
call TAU_STOP('potential')
```

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

## Indirect via Sampling



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



# TAU Commander Case Study



EXASCALE COMPUTING PROJECT

# Step 1: Initialize TAU Project

```
$ cd ISx
```

```
$ tau initialize --shmem
```



- Creates a new project configuration using defaults
- Project files exist in a directory named “.tau”
- Like git, all directories below the directory containing the “.tau” directory can access the project
  - E.g. `tau dashboard` works in miniapp1/baseline

# Project Initialization (`tau initialize`)

```
ParaTools — ssh cori.nersc.gov — 120x50
jlinford@cori09 ~/workspace/openshmem17/applications/ISx $ tau initialize --shmem
[TAU] Cray C++ compiler '/opt/cray/pe/craype/2.5.7/bin/CC' wraps
[TAU] '/opt/intel/compilers_and_libraries_2017.2.174/linux/bin/intel64/icpc'
[TAU] Cray Fortran compiler '/opt/cray/pe/craype/2.5.7/bin/ftn' wraps
[TAU] '/opt/intel/compilers_and_libraries_2017.2.174/linux/bin/intel64/ifort'
[TAU] Cray C compiler '/opt/cray/pe/craype/2.5.7/bin/cc' wraps
[TAU] '/opt/intel/compilers_and_libraries_2017.2.174/linux/bin/intel64/icc'
[TAU] Cray MPI C compiler '/opt/cray/pe/craype/2.5.7/bin/cc' wraps
[TAU] '/opt/intel/compilers_and_libraries_2017.2.174/linux/bin/intel64/icc'
[TAU] Cray MPI C++ compiler '/opt/cray/pe/craype/2.5.7/bin/CC' wraps
[TAU] '/opt/intel/compilers_and_libraries_2017.2.174/linux/bin/intel64/icpc'
[TAU] Cray MPI Fortran compiler '/opt/cray/pe/craype/2.5.7/bin/ftn' wraps
[TAU] '/opt/intel/compilers_and_libraries_2017.2.174/linux/bin/intel64/ifort'
[TAU] Cray SHMEM C compiler '/opt/cray/pe/craype/2.5.7/bin/cc' wraps
[TAU] '/opt/intel/compilers_and_libraries_2017.2.174/linux/bin/intel64/icc'
[TAU] Cray SHMEM C++ compiler '/opt/cray/pe/craype/2.5.7/bin/CC' wraps
[TAU] '/opt/intel/compilers_and_libraries_2017.2.174/linux/bin/intel64/icpc'
[TAU] Cray SHMEM Fortran compiler '/opt/cray/pe/craype/2.5.7/bin/ftn' wraps
[TAU] '/opt/intel/compilers_and_libraries_2017.2.174/linux/bin/intel64/ifort'
[TAU] Created a new project named 'ISx'.
[TAU] Added application 'ISx' to project configuration 'ISx'.
[TAU] Added target 'cori09' to project configuration 'ISx'.
[TAU] Added measurement 'sample' to project configuration 'ISx'.
[TAU] Added measurement 'profile' to project configuration 'ISx'.
[TAU] Added measurement 'trace' to project configuration 'ISx'.
[TAU] Created a new experiment 'cori09-ISx-sample'
[TAU] Installing PDT to '/global/project/projectdirs/m88/jlinford/taucmdr-test/system/pdt/77f947dd'
[TAU] Using PDT source archive '/global/project/projectdirs/m88/jlinford/taucmdr-test/system/src/pdt.tgz'
[TAU] Checking contents of '/global/project/projectdirs/m88/jlinford/taucmdr-test/system/src/pdt.tgz'
[TAU] Completed in 8.276 seconds
[TAU] Extracting '/global/project/projectdirs/m88/jlinford/taucmdr-test/system/src/pdt.tgz' to create
[TAU] '/dev/shm/tmpQl6qTD/.pdttoolkit-3.24'
[TAU] Completed in 5.216 seconds
[TAU] Configuring PDT...
[TAU] Completed in 17.439 seconds
[TAU] Compiling PDT...
[TAU] Completed in 6.394 seconds
[TAU] Installing PDT...
[TAU] Completed in 0.115 seconds
[TAU] Checking installed files...
[TAU] Completed in 0.115 seconds
[TAU] Setting file permissions...
[TAU] Completed in 0.136 seconds
[TAU] Verifying PDT installation...
[TAU] Installing TAU Performance System at
[TAU] '/global/project/projectdirs/m88/jlinford/taucmdr-test/system/tau/./tau-2.26.2'
[TAU] Configuring TAU...
[TAU] Completed in 26.358 seconds
[TAU] Compiling and installing TAU...
[TAU] 5.0 seconds [CPU: 32.4
```

Compiler detection

Project initialization

Download and install PDT

TAU installation progress

# Project Dashboard (``tau dashboard``)

ParaTools — ssh cori.nersc.gov — 120x50

== Project Configuration (/global/project/projectdirs/m88/jlinford/openshmem17/applications/ISx/.tau/project.json) ==

Name	Targets	Applications	Measurements	# Experiments
ISx	cori09	ISx	sample, profile, trace	1

== Targets in project 'ISx' ==

Name	Host OS	Host Arch	Host Compilers	MPI Compilers	SHMEM Compilers
cori09	CNL	x86_64	Cray	Cray	Cray

== Applications in project 'ISx' ==

Name	Linkage	OpenMP	Pthreads	TBB	MPI	CUDA	OpenCL	SHMEM	MPC
ISx	static	No	No	No	No	No	No	Yes	No

== Measurements in project 'ISx' ==

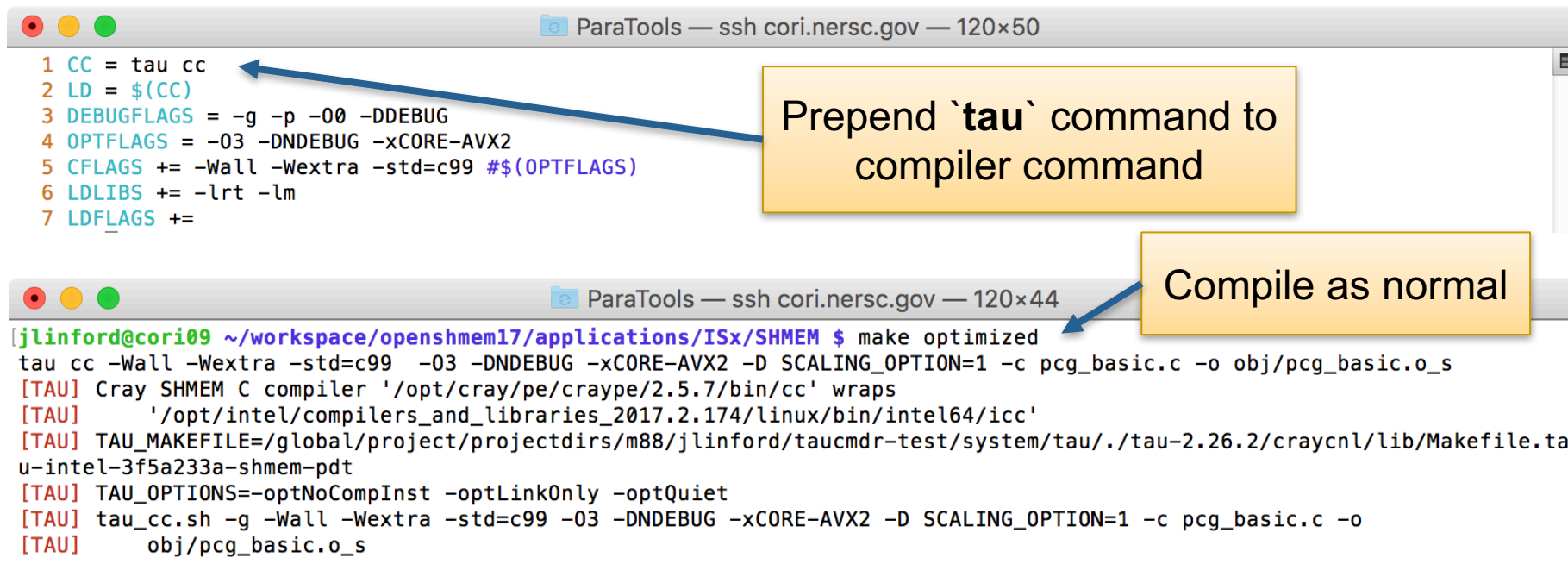
Name	Profile	Trace	Sample	Source Inst.	Compiler Inst.	OpenMP	CUDA	I/O	MPI	SHMEM
sample	tau	none	Yes	never	never	ignore	No	No	No	Yes
profile	tau	none	No	automatic	never	ignore	No	No	No	Yes
trace	none	slog2	No	automatic	never	ignore	No	No	No	Yes

== Experiments in project 'ISx' ==

Name	Trials	Data Size	Target	Application	Measurement	TAU Makefile
cori09-ISx-sample	0	0.0B	cori09	ISx	sample	Makefile.tau-intel-3f5a233a-shmem-pdt

Selected Experiment: cori09-ISx-sample

## Step 2: Use `tau` to compile



The image shows two terminal windows from the ParaTools environment. The top window, titled 'ParaTools — ssh cori.nersc.gov — 120x50', displays the configuration of environment variables for the compiler. The bottom window, titled 'ParaTools — ssh cori.nersc.gov — 120x44', shows the execution of the 'make optimized' command, which uses the 'tau' compiler wrapper. Two yellow callout boxes with arrows provide instructions: 'Prepend `tau` command to compiler command' points to the first line of the top window, and 'Compile as normal' points to the 'make optimized' command in the bottom window.

```
1 CC = tau cc
2 LD = $(CC)
3 DEBUGFLAGS = -g -p -O0 -DDEBUG
4 OPTFLAGS = -O3 -DNDEBUG -xCORE-AVX2
5 CFLAGS += -Wall -Wextra -std=c99 ${OPTFLAGS}
6 LDLIBS += -lrt -lm
7 LDFLAGS +=
```

```
[jlinford@cori09 ~/workspace/openshmem17/applications/ISx/SHMEM $ make optimized
tau cc -Wall -Wextra -std=c99 -O3 -DNDEBUG -xCORE-AVX2 -D SCALING_OPTION=1 -c pcg_basic.c -o obj/pcg_basic.o_s
[TAU] Cray SHMEM C compiler '/opt/cray/pe/craype/2.5.7/bin/cc' wraps
[TAU] '/opt/intel/compilers_and_libraries_2017.2.174/linux/bin/intel64/icc'
[TAU] TAU_MAKEFILE=/global/project/projectdirs/m88/jlinford/taucmdr-test/system/tau/./tau-2.26.2/craycnl/lib/Makefile.ta
u-intel-3f5a233a-shmem-pdt
[TAU] TAU_OPTIONS=-optNoCompInst -optLinkOnly -optQuiet
[TAU] tau_cc.sh -g -Wall -Wextra -std=c99 -O3 -DNDEBUG -xCORE-AVX2 -D SCALING_OPTION=1 -c pcg_basic.c -o
[TAU] obj/pcg_basic.o_s
```

- TAU Commander constructs a new compilation command line.
  - May replace compiler commands with TAU's compiler wrapper scripts.
  - May set environment variables, parse configuration files, etc.
  - If no changes are required then nothing is changed.

# Step 3: Use `tau` to run

```
jlinford — ssh cori.nersc.gov — 150x39
jlinford@nid00030 ~/workspace/openshmem17/applications/ISx/SHMEM $ tau srun -n 64 ./bin/isx.strong 134217728 output_strong
[TAU]
[TAU] == BEGIN Experiment at 2017-06-21 19:57:33.728778 =====
[TAU]
[TAU] PROFILEDIR=/global/project/projectdirs/m88/jlinford/openshmem17/applications/ISx/.tau/ISx/cori09-ISx-sample/0
[TAU] SCOREP_ENABLE_TRACING=false
[TAU] TAU_CALLPATH=1
[TAU] TAU_CALLPATH_DEPTH=100
[TAU] TAU_CALLSITE=1
[TAU] TAU_COMM_MATRIX=0
[TAU] TAU_METRICS=TIME,
[TAU] TAU_PROFILE=1
[TAU] TAU_SAMPLING=1
[TAU] TAU_THROTTLE=1
[TAU] TAU_THROTTLE_NUMCALLS=100000
[TAU] TAU_THROTTLE_PERCALL=10
[TAU] TAU_TRACE=0
[TAU] TAU_TRACK_HEAP=0
[TAU] TAU_VERBOSE=0
[TAU] TRACEDIR=/global/project/projectdirs/m88/jlinford/openshmem17/applications/ISx/.tau/ISx/cori09-ISx-sample/0
[TAU] srun -n 64 ./bin/isx.strong 134217728 output_strong
ISx v1.1
  Number of Keys per PE: 2097152
  Max Key Value: 268435456
  Bucket Width: 4194304
  Number of Iterations: 1
  Number of PEs: 64
  STRONG Scaling!
Average total time (per PE): 0.170602 seconds
Average all2all time (per PE): 0.023284 seconds
[TAU] Trial 0 produced 64 profile files.
[TAU]
[TAU] == END Experiment at 2017-06-21 19:57:38.794719 =====
[TAU]
[TAU] Experiment: cori09-ISx-sample
[TAU] Current working directory: /global/project/projectdirs/m88/jlinford/openshmem17/applications/ISx/SHMEM
[TAU] Data size: 1110404 bytes
[TAU] Command: srun -n 64 ./bin/isx.strong 134217728 output_strong
jlinford@nid00030 ~/workspace/openshmem17/applications/ISx/SHMEM $
```

Prepend `tau` command to environment variables command line

Application executes, possibly with tau\_exec

New data is added to the performance database

# Step 4: Use `tau` to view data ( `tau show` )

TAU: ParaProf: Mean Statistics - cori09-ISx-sample.trial0.ppk

Name	Exclusive TIME	Inclusive TIME ▾	Calls	Child Calls
▼ .TAU application	0.306	1.347	1	326
void shmem_init(void) C	0.498	0.498	1	0
void shmem_finalize(void) C	0.462	0.462	1	0
▼ [CONTEXT] .TAU application	0	0.32	6.406	0
▼ [SUMMARY] main [{}global/project/projectdirs/m88/jlinford/openshmem17/applications/ISx/SHMEM/isx.c]	0.262	0.262	5.172	0
[SAMPLE] main [{}global/project/projectdirs/m88/jlinford/openshmem17/applications/ISx/SHMEM/isx.c] {497}	0.149	0.149	2.922	0
[SAMPLE] main [{}global/project/projectdirs/m88/jlinford/openshmem17/applications/ISx/SHMEM/isx.c] {374}	0.041	0.041	0.812	0
[SAMPLE] main [{}global/project/projectdirs/m88/jlinford/openshmem17/applications/ISx/SHMEM/isx.c] {376}	0.036	0.036	0.719	0
[SAMPLE] main [{}global/project/projectdirs/m88/jlinford/openshmem17/applications/ISx/SHMEM/isx.c] {378}	0.011	0.011	0.219	0
[SAMPLE] main [{}global/project/projectdirs/m88/jlinford/openshmem17/applications/ISx/SHMEM/isx.c] {260}	0.008	0.008	0.172	0
[SAMPLE] main [{}global/project/projectdirs/m88/jlinford/openshmem17/applications/ISx/SHMEM/isx.c] {381}	0.005	0.005	0.094	0
[SAMPLE] main [{}global/project/projectdirs/m88/jlinford/openshmem17/applications/ISx/SHMEM/isx.c] {476}	0.004	0.004	0.078	0
[SAMPLE] main [{}global/project/projectdirs/m88/jlinford/openshmem17/applications/ISx/SHMEM/isx.c] {379}	0.004	0.004	0.078	0
[SAMPLE] main [{}global/project/projectdirs/m88/jlinford/openshmem17/applications/ISx/SHMEM/isx.c] {380}	0.004	0.004	0.078	0
▶ [SUMMARY] pcg32_boundedrand_r [{}global/project/projectdirs/m88/jlinford/openshmem17/applications/ISx/SHMEM/pcg_basic.c]	0.057	0.057	1.203	0
[SAMPLE] __close_nocancel [{}home/abuild/rpmbuild/BUILD/glibc-2.19/nptl/./sysdeps/unix/syscall-template.S] {81}	0.001	0.001	0.016	0
[SAMPLE] __wrap_shmem_n_pes [{}global/project/projectdirs/m88/jlinford/openshmem17/applications/ISx/SHMEM/bin/isx.strong] {0}	0.001	0.001	0.016	0
void shmem_int_put(int *, const int *, size_t, int) C	0.037	0.037	126	0
long long shmem_longlong_fadd(long long *, long long, int) C	0.018	0.018	128	0
void *shmem_malloc(size_t) C	0.015	0.015	16	0
void shmem_barrier_all(void) C	0.009	0.009	27	0
void shmem_fcollect64(void *, const void *, size_t, int, int, int, long *) C	0.001	0.001	7	0
void shmem_collect32(void *, const void *, size_t, int, int, int, long *) C	0	0	1	0
void shmem_longlong_sum_to_all(long long *, const long long *, size_t, int, int, int, long long *, long *) C	0	0	1	0
int shmem_my_pe(void) C	0	0	9	0
void shmem_free(void *) C	0	0	8	0
int shmem_n_pes(void) C	0	0	1	0
▼ [CALLSITE] void shmem_init(void) C	0.996	0.996	2	0
▼ [CONTEXT] [CALLSITE] void shmem_init(void) C	0	0.481	1.688	0
[SAMPLE] __ioctl [{}home/abuild/rpmbuild/BUILD/glibc-2.19/misc/./sysdeps/unix/syscall-template.S] {81}	0.473	0.473	1.344	0
[SAMPLE] _pmi_smp_barrier_join [{}usr/src/packages/BUILD/cray-pmi-5.0.10/src/pmi_core/smp_barrier.c] {70}	0.006	0.006	0.281	0
[SAMPLE] Tau_lite_stop_timer [{}global/project/projectdirs/m88/jlinford/taucmdr-test/system/tau/tau-2.26.2/src/Profile/TauCapi.cpp] {}	0.002	0.002	0.047	0
[SAMPLE] _dmappi_sheap_alloc [{}home/abuild/rpmbuild/BUILD/cray-dmapp-7.1.1/src/dmapp_sheap.c] {318}	0.001	0.001	0.016	0



# Create a New Experiment

Select a new measurement to create a new experiment

```
ParaTools — ssh cori.nersc.gov — 120x17
[jlinford@nid00073 ~/workspace/openshmem17/applications/ISx/SHMEM $ tau select profile
[TAU] Created a new experiment 'cori09-ISx-profile'
[TAU] Installing TAU Performance System at
[TAU]   '/global/project/projectdirs/m88/jlinford/taucmdr-test/system/tau/./tau-2.26.2'
[TAU] Configuring TAU...
[TAU] Completed in 155.459 seconds
[TAU] Compiling and installing TAU...
[TAU] Completed in 48.596 seconds
[TAU] Checking installed files...
[TAU] Completed in 10.551 seconds
[TAU] Setting file permissions...
[TAU] Completed in 2.556 seconds
[TAU] Verifying TAU Performance System installation...
[TAU] Selected experiment 'cori09-ISx-profile'.
[TAU] Application rebuild required:
[TAU]   - source_inst changed from 'never' to 'automatic'
[jlinford@nid00073 ~/workspace/openshmem17/applications/ISx/SHMEM $
```

TAU Performance System®  
automatically reconfigured and  
recompiled.

User advised that an application rebuild is  
required to use source-based instrumentation.



# Create and Select KNL Target

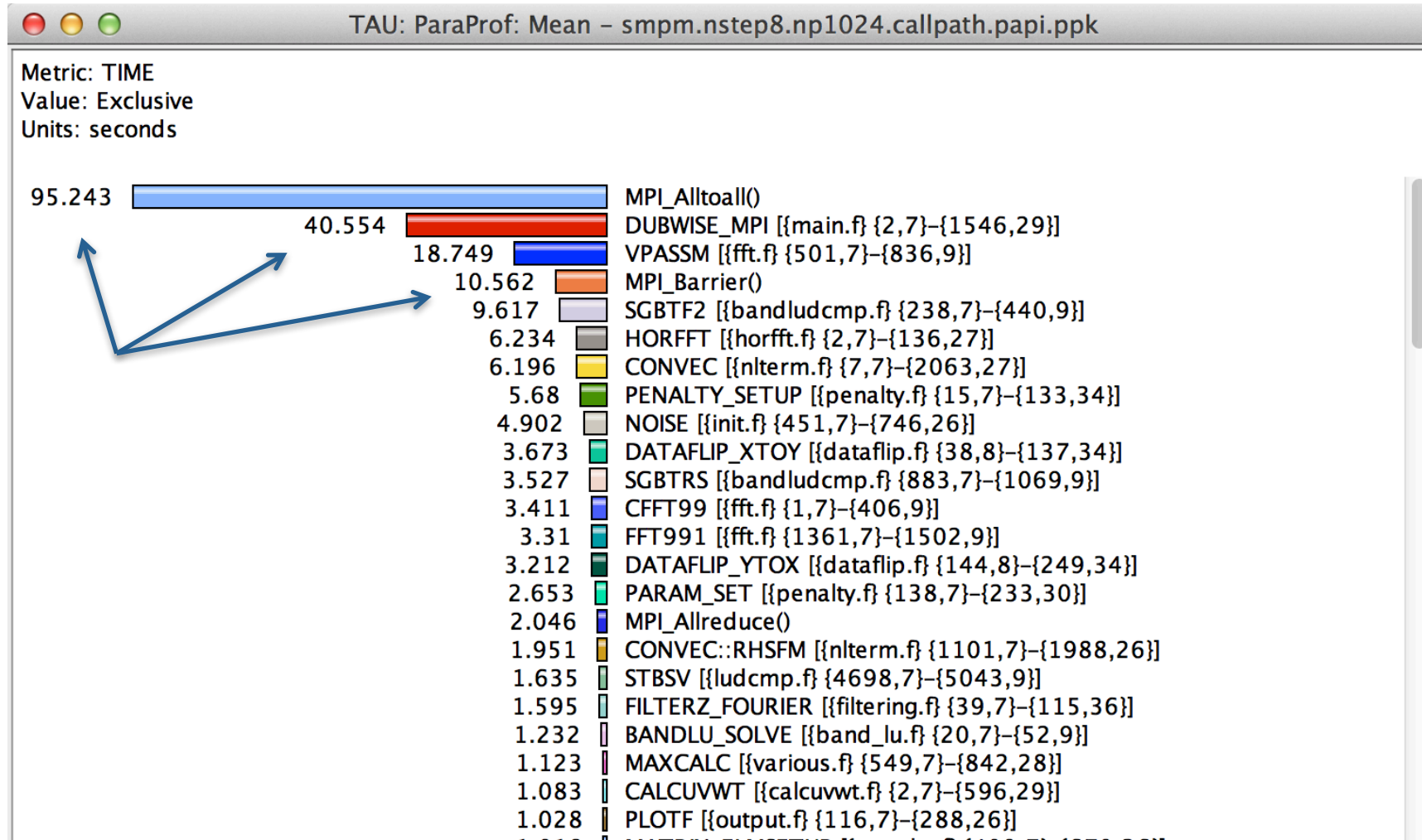
```
Terminal — ssh cori.nersc.gov — 120x35
[jlinford@cori09 ~/workspace/openshmem17/applications/ISx $ tau target copy cori09 cori.KNL --arch=KNL
[TAU] Added target 'cori.KNL' to project configuration 'ISx'.
[jlinford@cori09 ~/workspace/openshmem17/applications/ISx $ tau select cori.KNL ISx profile
[TAU] Created a new experiment 'cori.KNL-ISx-profile'
[TAU] Installing PDT to '/global/project/projectdirs/m88/jlinford/taucmdr-test/system/pdt/04860562'
[TAU] Using PDT source archive '/global/project/projectdirs/m88/jlinford/taucmdr-test/system/src/pdt.tgz'
[TAU] Checking contents of '/global/project/projectdirs/m88/jlinford/taucmdr-test/system/src/pdt.tgz'
[TAU] Completed in 8.297 seconds
[TAU] Extracting '/global/project/projectdirs/m88/jlinford/taucmdr-test/system/src/pdt.tgz' to create
[TAU]      '/dev/shm/tmpedFKyo/./pdtoolkit-3.24'
[TAU] Completed in 4.488 seconds
[TAU] Configuring PDT...
[TAU] Completed in 18.205 seconds
[TAU] Compiling PDT...
[TAU] Completed in 5.997 seconds
[TAU] Installing PDT...
[TAU] Completed in 0.116 seconds
[TAU] Checking installed files...
[TAU] Completed in 0.115 seconds
[TAU] Setting file permissions...
[TAU] Completed in 0.179 seconds
[TAU] Verifying PDT installation...
[TAU] Installing TAU Performance System at
[TAU]      '/global/project/projectdirs/m88/jlinford/taucmdr-test/system/tau/./tau-2.26.2'
[TAU] Configuring TAU...
[TAU] Completed in 18.261 seconds
[TAU] Compiling and installing TAU...
[TAU] Completed in 30.248 seconds
[TAU] Checking installed files...
[TAU] Completed in 0.215 seconds
[TAU] Setting file permissions...
[TAU] Completed in 0.484 seconds
[TAU] Verifying TAU Performance System installation...
[TAU] Selected experiment 'cori.KNL-ISx-profile'.
[jlinford@cori09 ~/workspace/openshmem17/applications/ISx $ ]
```

# Performance Data Analysis

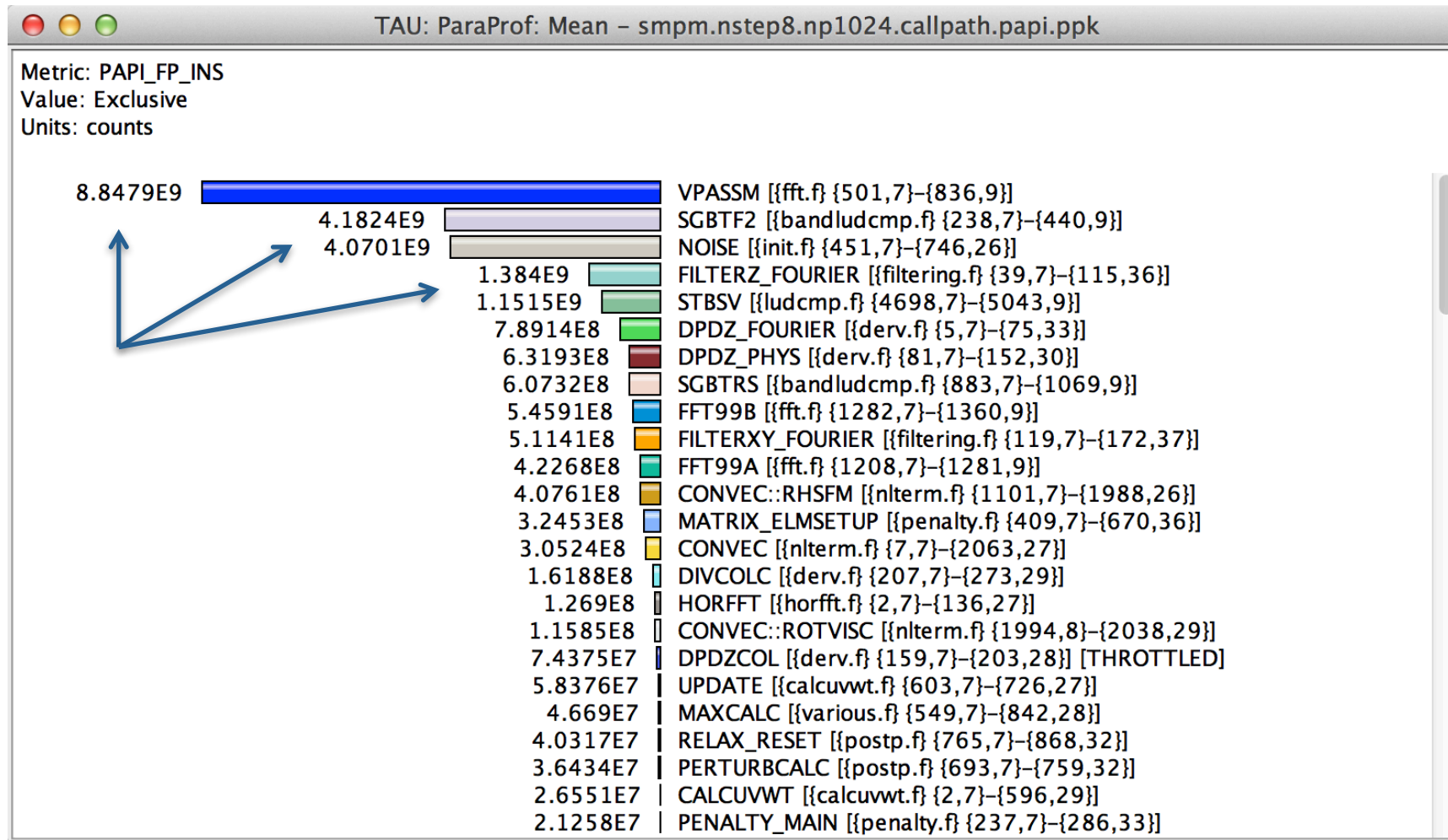


EXASCALE COMPUTING PROJECT

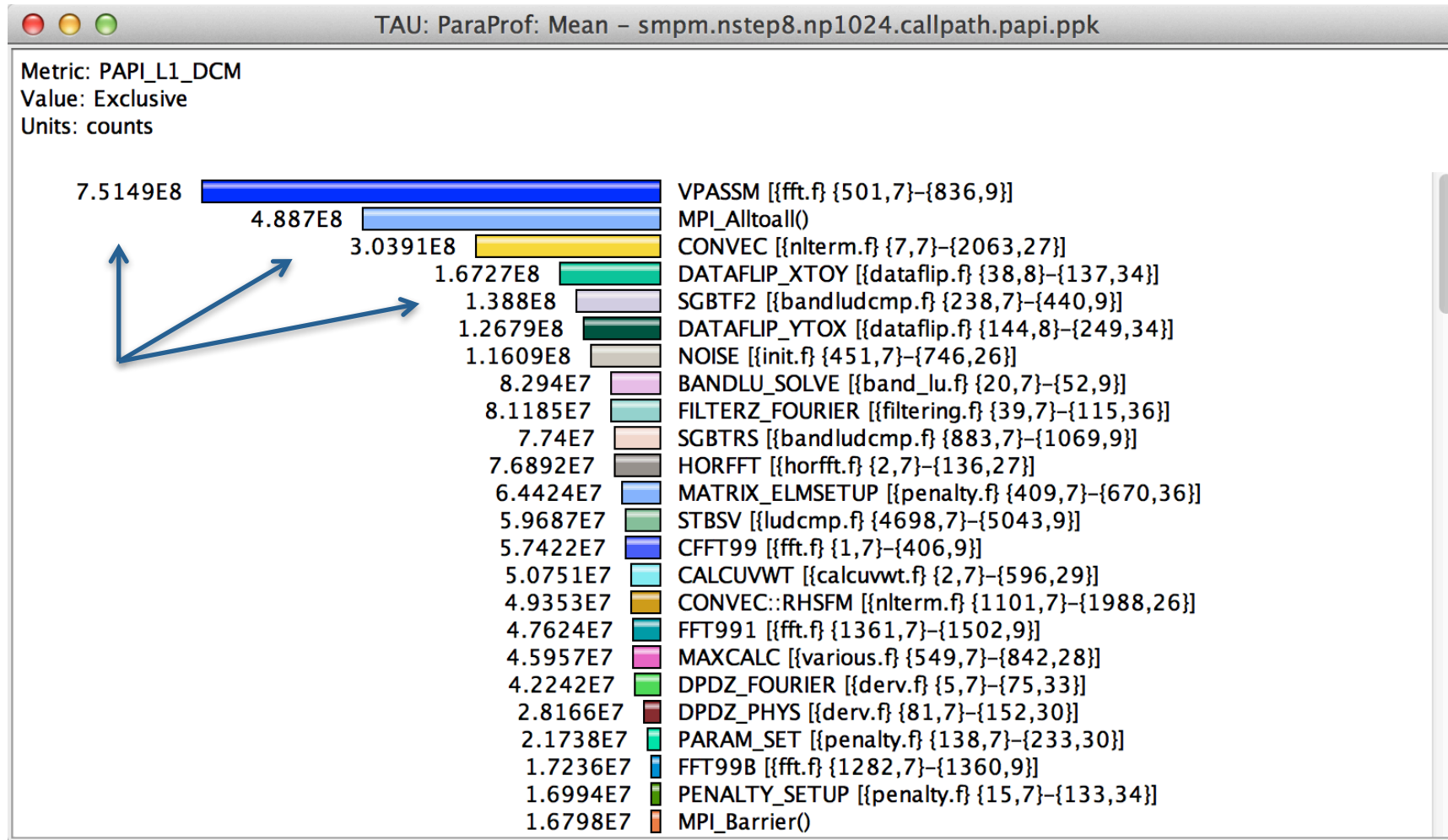
# How Much Time per Code Region?




# How Many Instructions per Code Region?



# How Many L1 or L2 Cache Misses?




# How Much Memory Does the Code Use?

TAU: ParaProf: Mean Context Events – sphere_np32_nsteps5_mem.ppk						
Name 	Total	NumSamples	MaxValue	MinValue	MeanValue	Std. Dev.
▼ .TAU application						
free size (bytes)	14,236,992.16	27,169.781	49,152	1	524.001	2,013.103
malloc size (bytes)	13,132,932	23,292	262,144	1	563.839	4,492.057
▶ MPI_Finalize()						
▼ OurMain()						
free size (bytes)	1,298,918.679	1,495.125	461,766.25	4	868.769	16,928.073
malloc size (bytes)	48,150	20	36,032	11	2,407.5	7,911.992
▼ OurMain						
free size (bytes)	3,465	9	769	32	385	260.2
malloc size (bytes)	4,314	12	769	32	359.5	240.981
▼ <module>						
free size (bytes)	293,088	449	32,564	32	652.757	1,526.875
malloc size (bytes)	311,966	493	32,564	32	632.791	1,460.941
▶ staticCFD						
▶ __init__						
▶ <module>						
Memory Utilization (heap, in KB)		849,270.344	192,825.168	0.078	147,832.141	62,621.576
Message size for all-gather	4,096	1	4,096	4,096	4,096	0
Message size for all-reduce	23,340	843	320	4	27.687	64.653
Message size for all-to-all	104	26	4	4	4	0
Message size for broadcast	24,923	206	8,788	4	120.985	860.992
Message size for reduce	8,912	8	8,788	4	1,114	2,900.511
free size (bytes)	27,417,881,391.51	413,600.719	24,025,667	1	66,290.701	199,538.234
malloc size (bytes)	27,468,709,355.914	435,669.625	24,025,667	0	63,049.402	195,561.193

High-water mark




# How Much Memory Does the Code Use?

TAU: ParaProf: Mean Context Events – sphere_np32_nsteps5_mem.ppk						
Name 	Total	NumSamples	MaxValue	MinValue	MeanValue	Std. Dev.
▼ .TAU application						
free size (bytes)	14,236,992.16	27,169.781	49,152	1	524.001	2,013.103
malloc size (bytes)	13,132,932	23,292	262,144	1	563.839	4,492.057
▶ MPI_Finalize()						
▼ OurMain()						
free size (bytes)	1,298,918.679	1,495.125	461,766.25	4	868.769	16,928.073
malloc size (bytes)	48,150	20	36,032	11	2,407.5	7,911.992
▼ OurMain						
free size (bytes)	3,465	9	769	32	385	260.2
malloc size (bytes)	4,314	12	769	32	359.5	240.981
▼ <module>						
free size (bytes)	293,088	449	32,564	32	652.757	1,526.875
malloc size (bytes)	311,966	493	32,564	32	632.791	1,460.941
▶ staticCFD						
▶ __init__						
▶ <module>						
Memory Utilization (heap, in KB)		849,270.344	192,825.168	0.078	147,832.141	62,621.576
Message size for all-gather	4,096	1	4,096	4,096	4,096	0
Message size for all-reduce	23,340	843	320	4	27.687	64.653
Message size for all-to-all	104	26	4	4	4	0
Message size for broadcast	24,923	206	8,788	4	120.985	860.992
Message size for reduce	8,912	8	8,788	4	1,114	2,900.511
free size (bytes)	27,417,881,391.51	413,600.719	24,025,667	1	66,290.701	199,538.234
malloc size (bytes)	27,468,709,355.914	435,669.625	24,025,667	0	63,049.402	195,561.193

Total allocated/deallocated

# Where is Memory Allocated / Deallocated?

TAU: ParaProf: Mean Context Events – sphere_np32_nsteps5_mem.ppk						
Name 	Total	NumSamples	MaxValue	MinValue	MeanValue	Std. Dev.
▼ .TAU application						
free size (bytes)	14,236,992.16	27,169.781	49,152	1	524.001	2,013.103
malloc size (bytes)	13,132,932	23,292	262,144	1	563.839	4,492.057
▶ MPI_Finalize()						
▼ OurMain()						
free size (bytes)	1,298,918.679	1,495.125	461,766.25	4	868.769	16,928.073
malloc size (bytes)	48,150	20	36,032	11	2,407.5	7,911.992
▼ OurMain						
free size (bytes)	3,465	9	769	32	385	260.2
malloc size (bytes)	4,314	12	769	32	359.5	240.981
▼ <module>						
free size (bytes)	293,088	449	32,564	32	652.757	1,526.875
malloc size (bytes)	311,966	493	32,564	32	632.791	1,460.941
▶ staticCFD						
▶ __init__						
▶ <module>						
Memory Utilization (heap, in KB)		849,270.344	192,825.168	0.078	147,832.141	62,621.576
Message size for all-gather	4,096	1	4,096	4,096	4,096	0
Message size for all-reduce	23,340	843	320	4	27.687	64.653
Message size for all-to-all	104	26	4	4	4	0
Message size for broadcast	24,923	206	8,788	4	120.985	860.992
Message size for reduce	8,912	8	8,788	4	1,114	2,900.511
free size (bytes)	27,417,881,391.51	413,600.719	24,025,667	1	66,290.701	199,538.234
malloc size (bytes)	27,468,709,355.914	435,669.625	24,025,667	0	63,049.402	195,561.193

Allocation / Deallocation Events



# What are the I/O Characteristics?


TAU: ParaProf: Context Events for thread: n,c,t, 1,0,0 - samarc\_obc\_4p\_iomem\_cp.ppk

Name ▾	Total	MeanValue	NumSamples	MinValue	MaxValue	Std. Dev.
▼ .TAU application						
▶ read()						
▶ fopen64()						
▶ fclose()						
▼ OurMain()						
malloc size	5,235	1,097.174	23	11	12,032	2,851.143
free size	2,707	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	1,536	219.429	7	32	464	148.122
▶ 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

# What are the I/O Characteristics?

Name 	Total	NumSamples	MaxValue	MinValue	MeanValue	Std. Dev.
▶ Incl						
▶ Initialize						
▶ LoadBodyEuler						
▶ LoadMesh						
MPI-IO Bytes Written	4,328,712	144	893,152	0	30,060.5	128,042.696
MPI-IO Write Bandwidth (MB/s)		144	196.86	0	3.421	16.87
▶ MPI_Allgatherv()						
▶ MPI_Bcast()						
▶ MPI_Comm_create()						
▶ MPI_File_close()						
▶ MPI_File_open()						
▶ MPI_File_write_all()						
▶ MPI_File_write_at()						
▶ MPI_Finalize()						
▶ MPI_Gather()						
▶ MPI_Gatherv()						

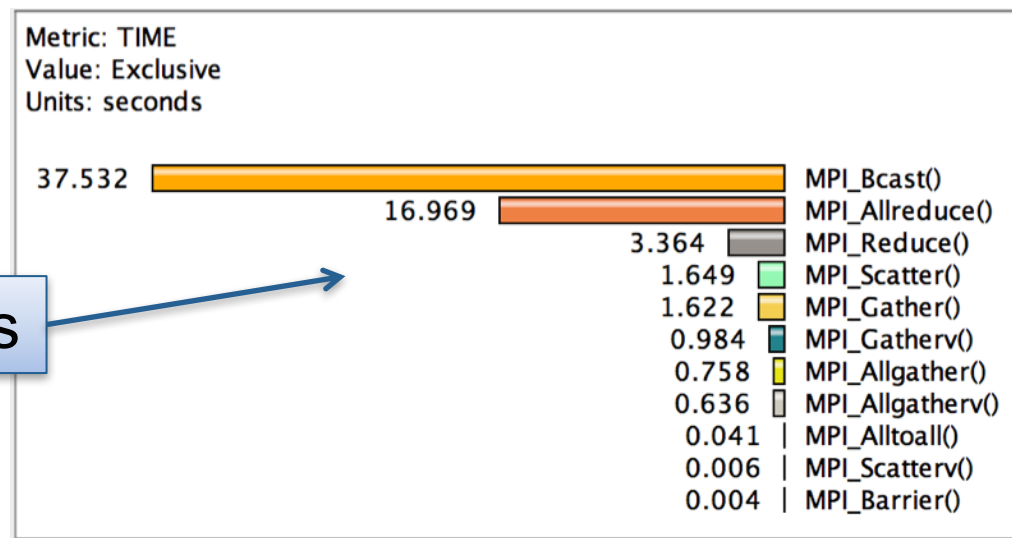
Peak MPI-IO Write Bandwidth

# How Much Time is spent in Collectives?

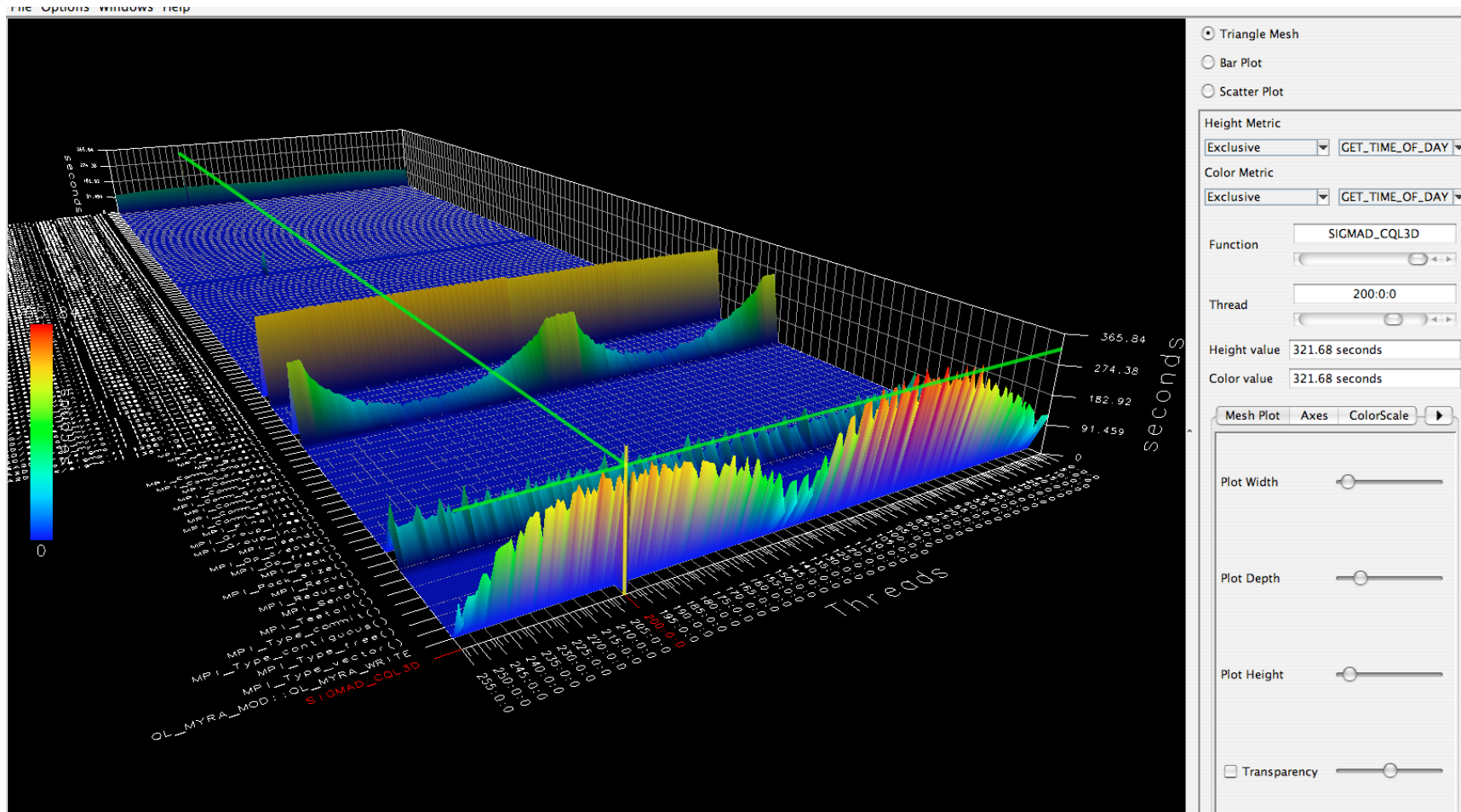
Name 	Total	Num...	MaxValue	MinValue	MeanValue	Std. Dev.
► MPI_Wait()						
► MPI_Waitall()						
Message size for all-gather	305,753,268	72	172,215,296	4	4,246,573.167	22,551,605.859
Message size for all-reduce	163,308	632	21,908	4	258.399	897.725
Message size for all-to-all	112	14	8	8	8	0
Message size for broadcast	692,208,045.5	3,346	18,117,620	0	206,876.284	1,284,673.036
Message size for gather	6,901,452.378	15.312	1,387,306.625	4	450,707.094	483,216.499
Message size for reduce	66,812	1,520	56	4	43.955	21.598
Message size for scatter	63,147.906	146	62,567.906	4	432.52	5,160.063

Message sizes

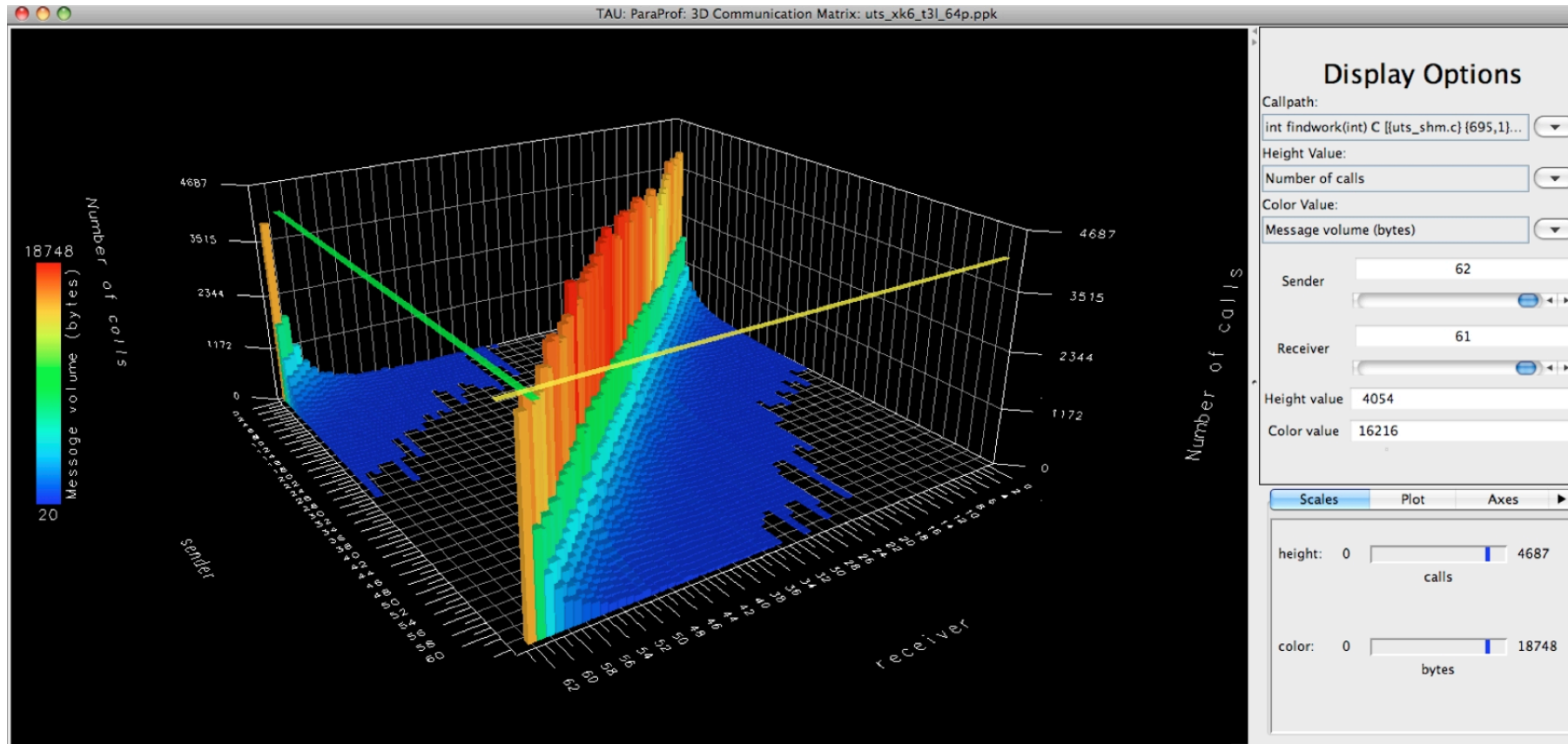
Time spent in collectives



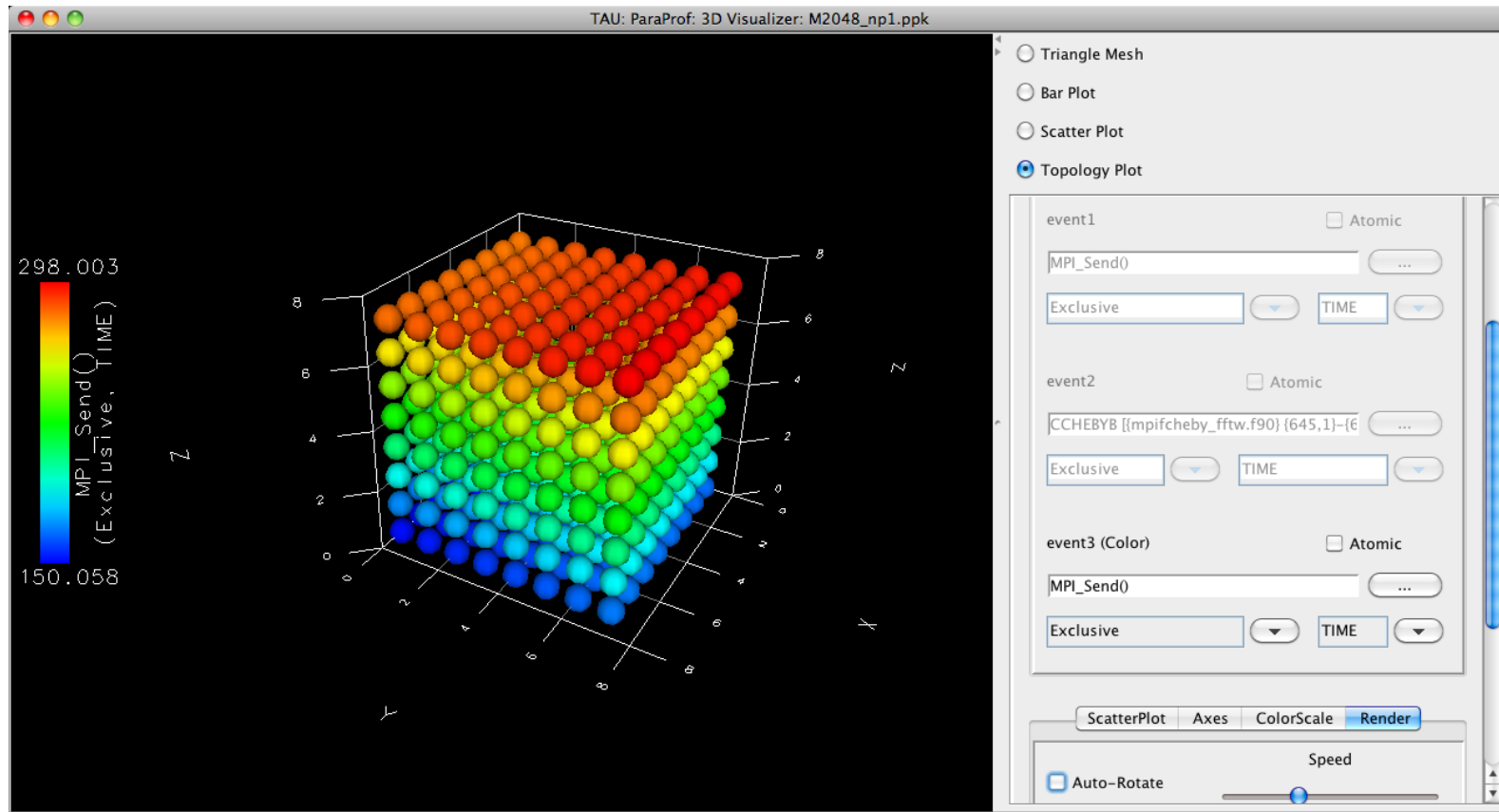
# 3D Profile Visualization



# 3D Communication Visualization

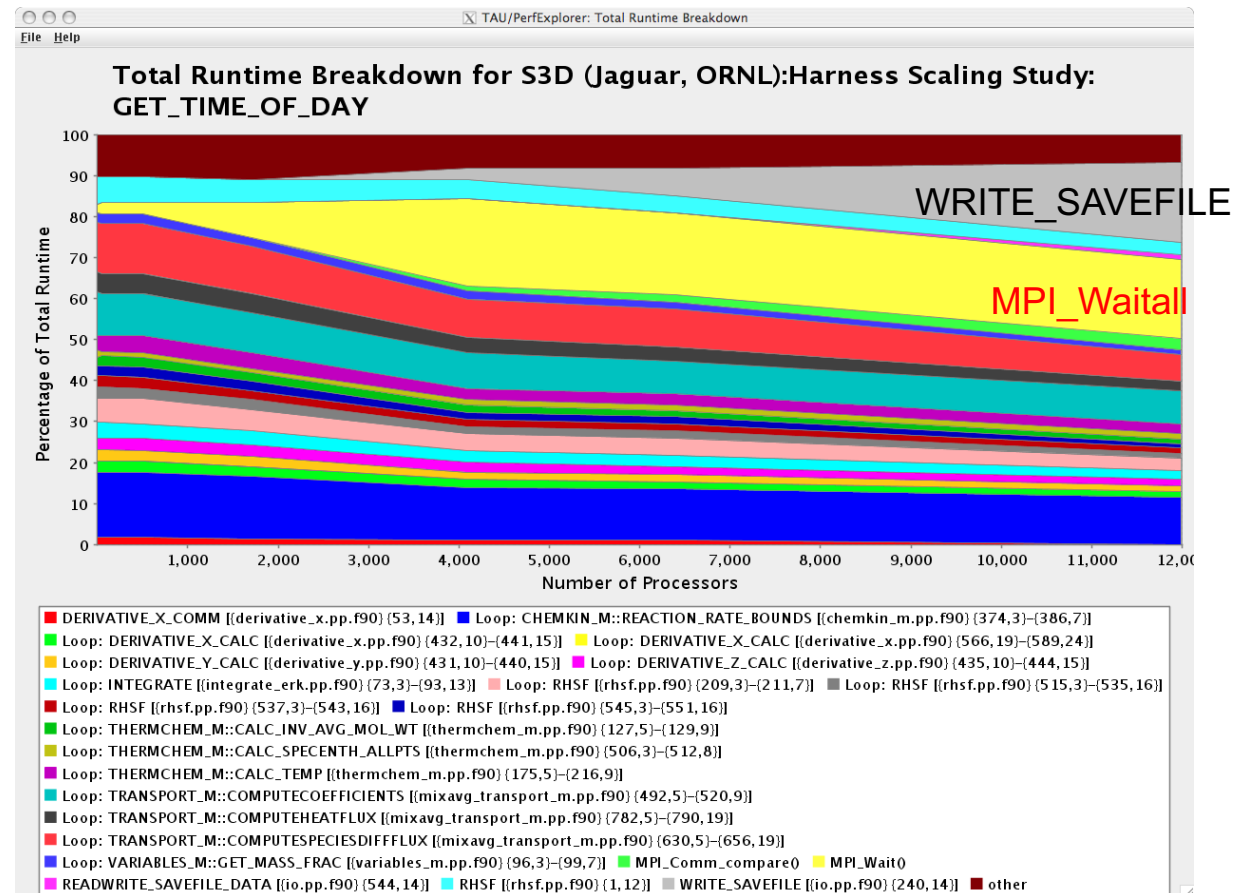


# 3D Topology Visualization

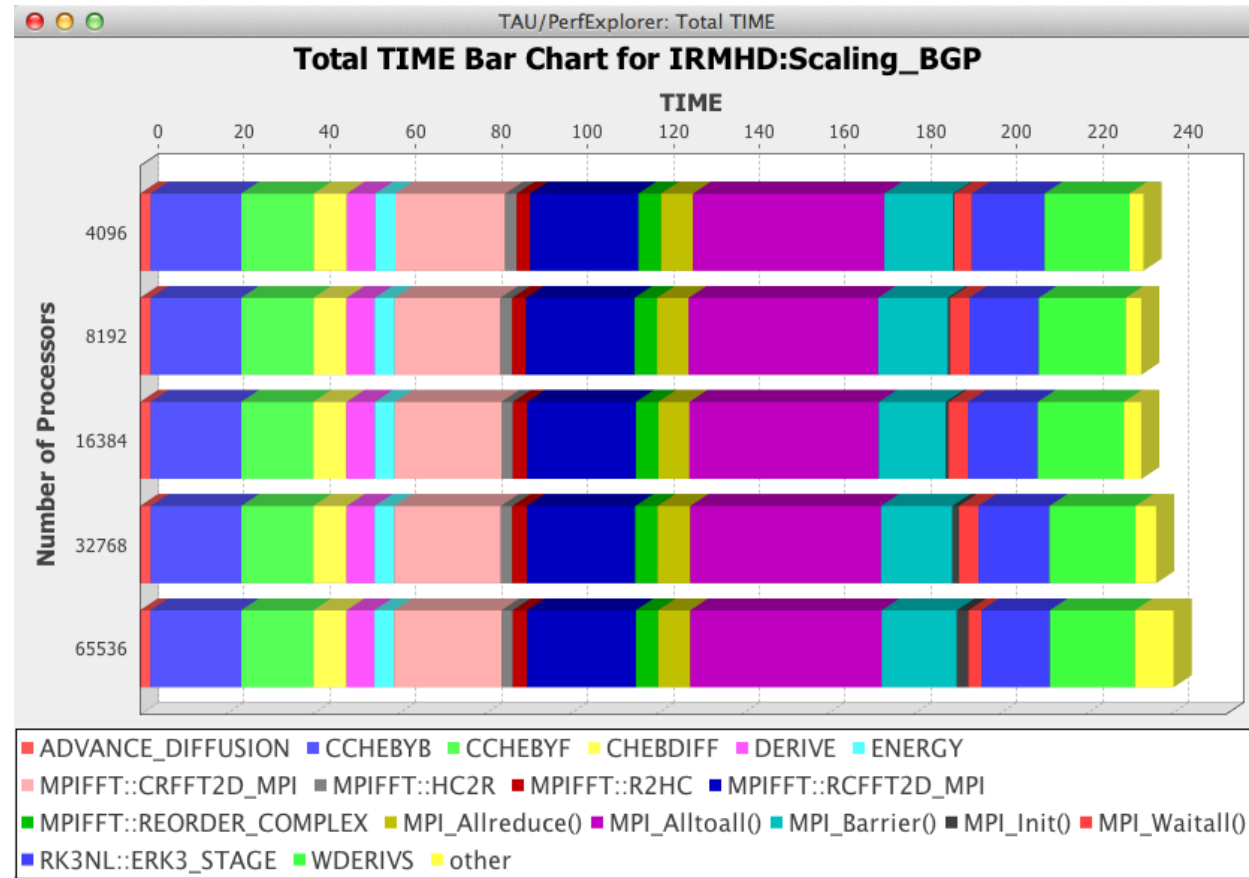




# How Does Each Routine Scale?

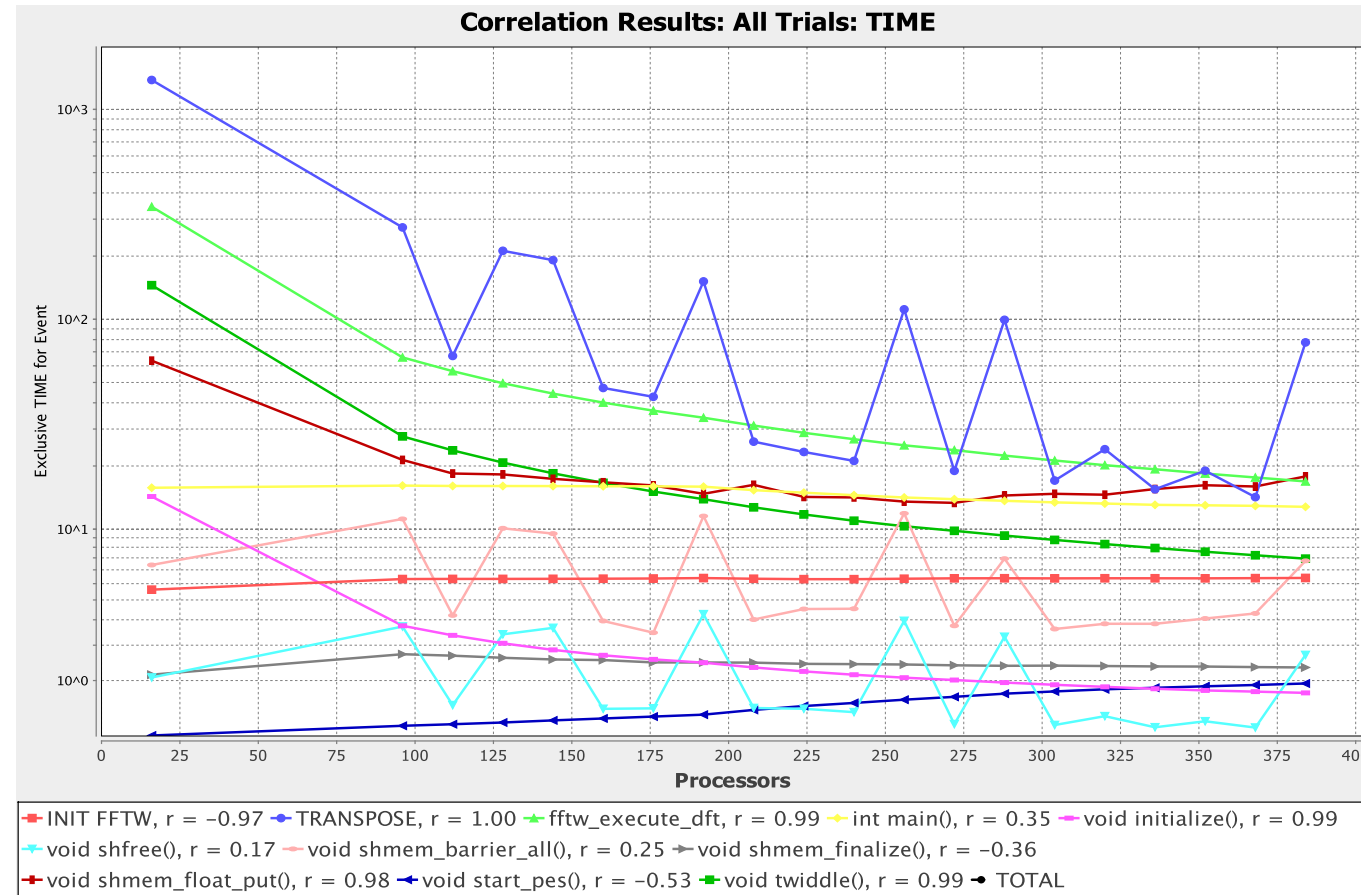


# How Does Each Routine Scale?

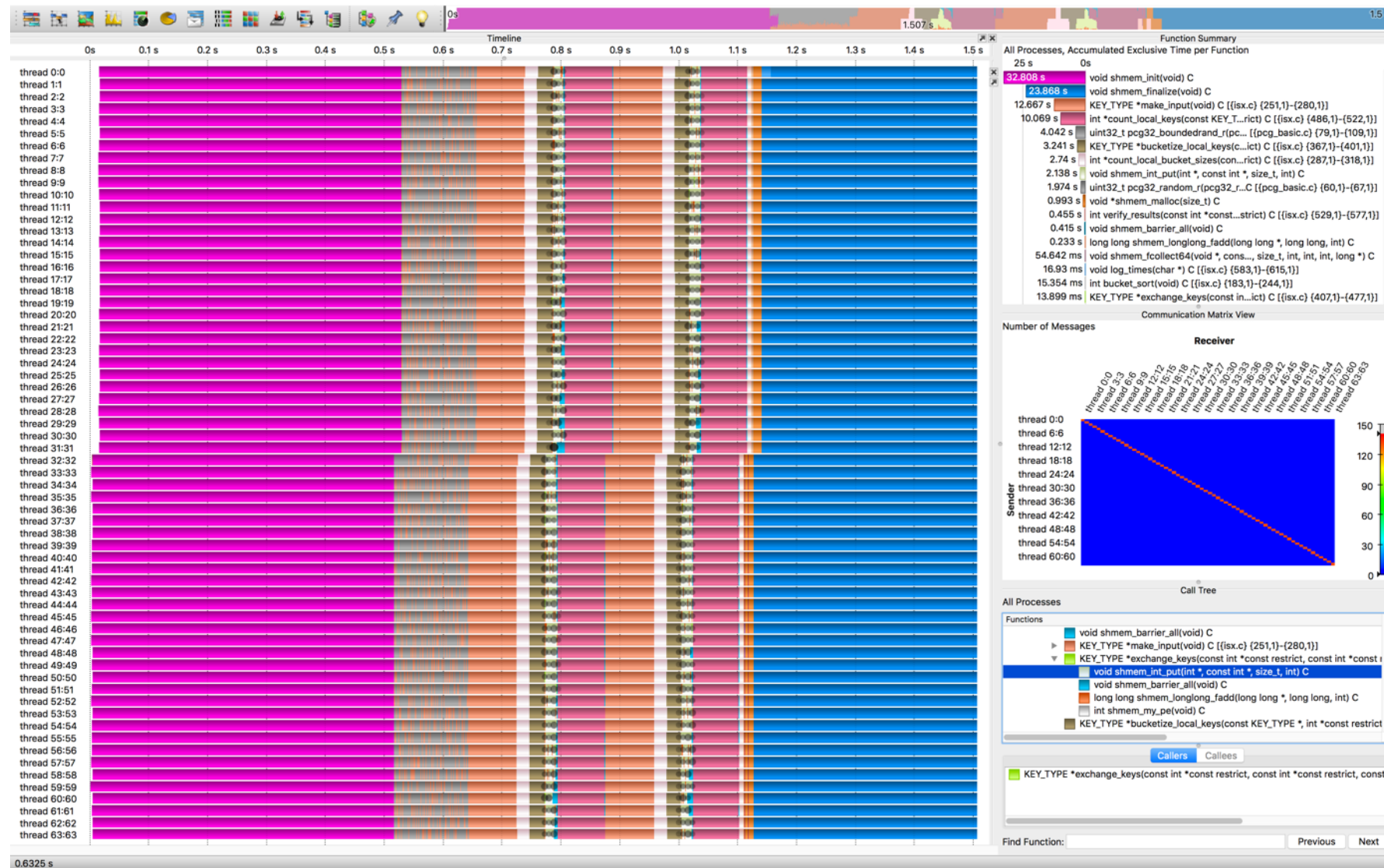




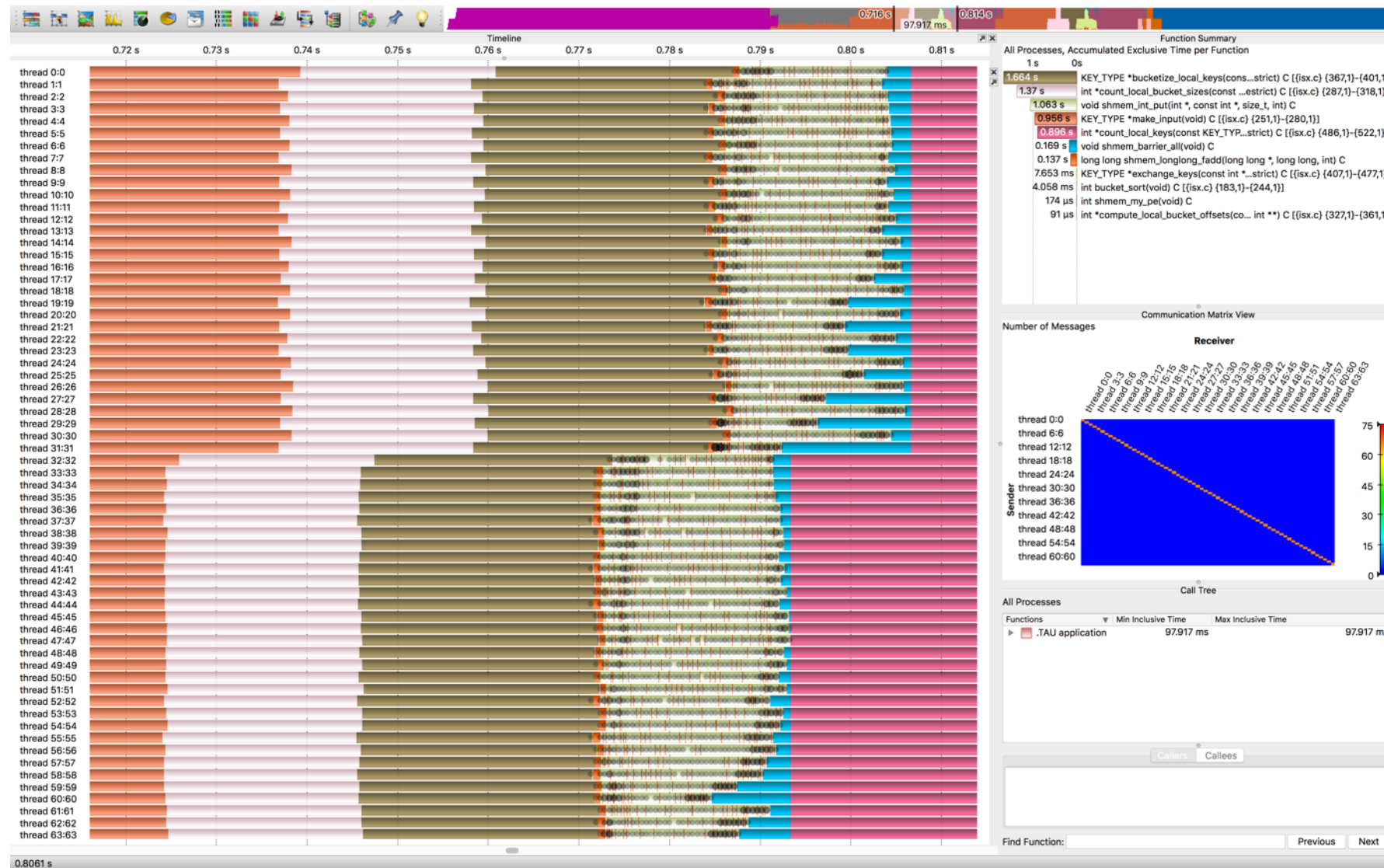
# Which Events Correlate with Runtime?



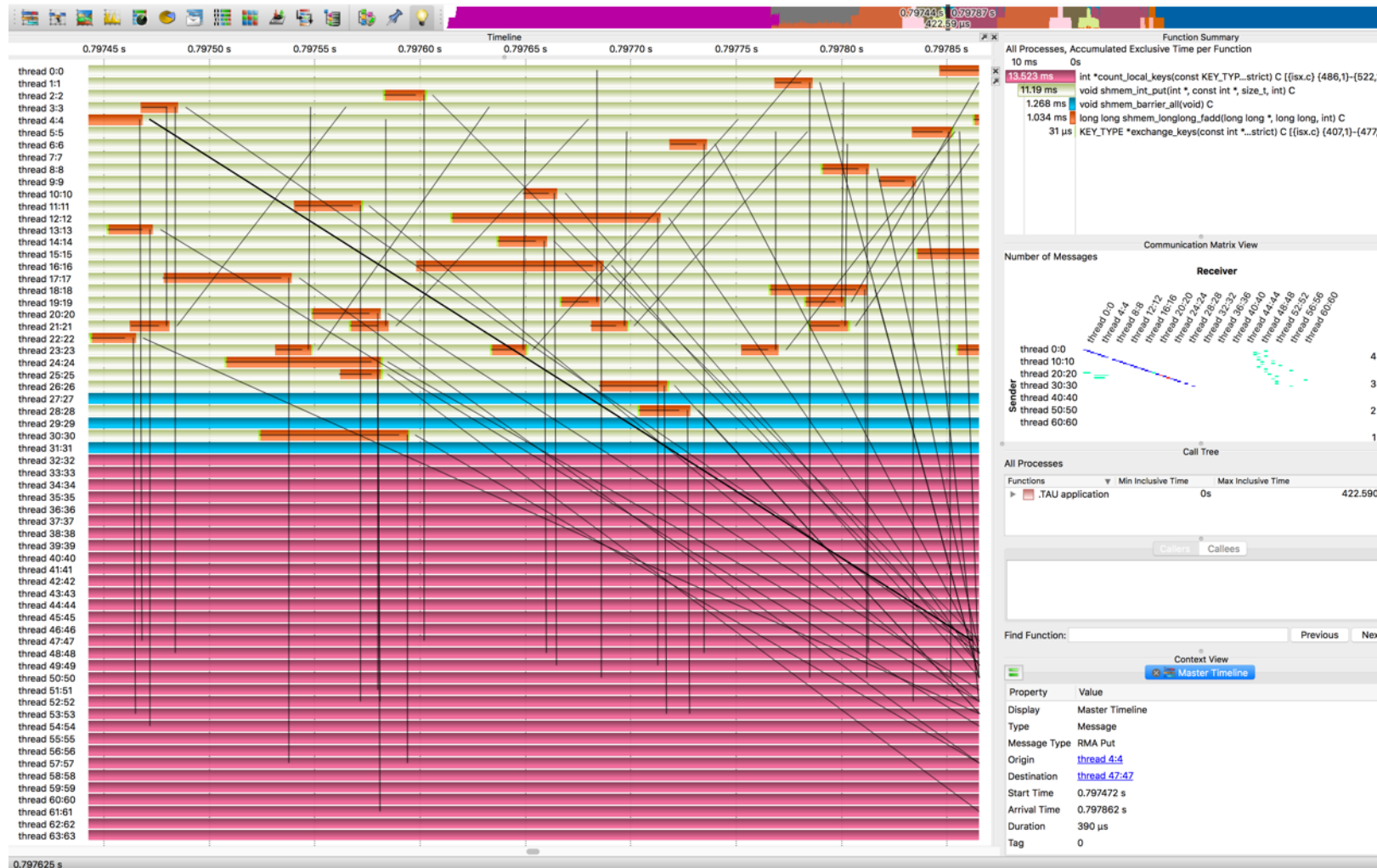
# When do events occur?



# Different Nodes, Different Timelines



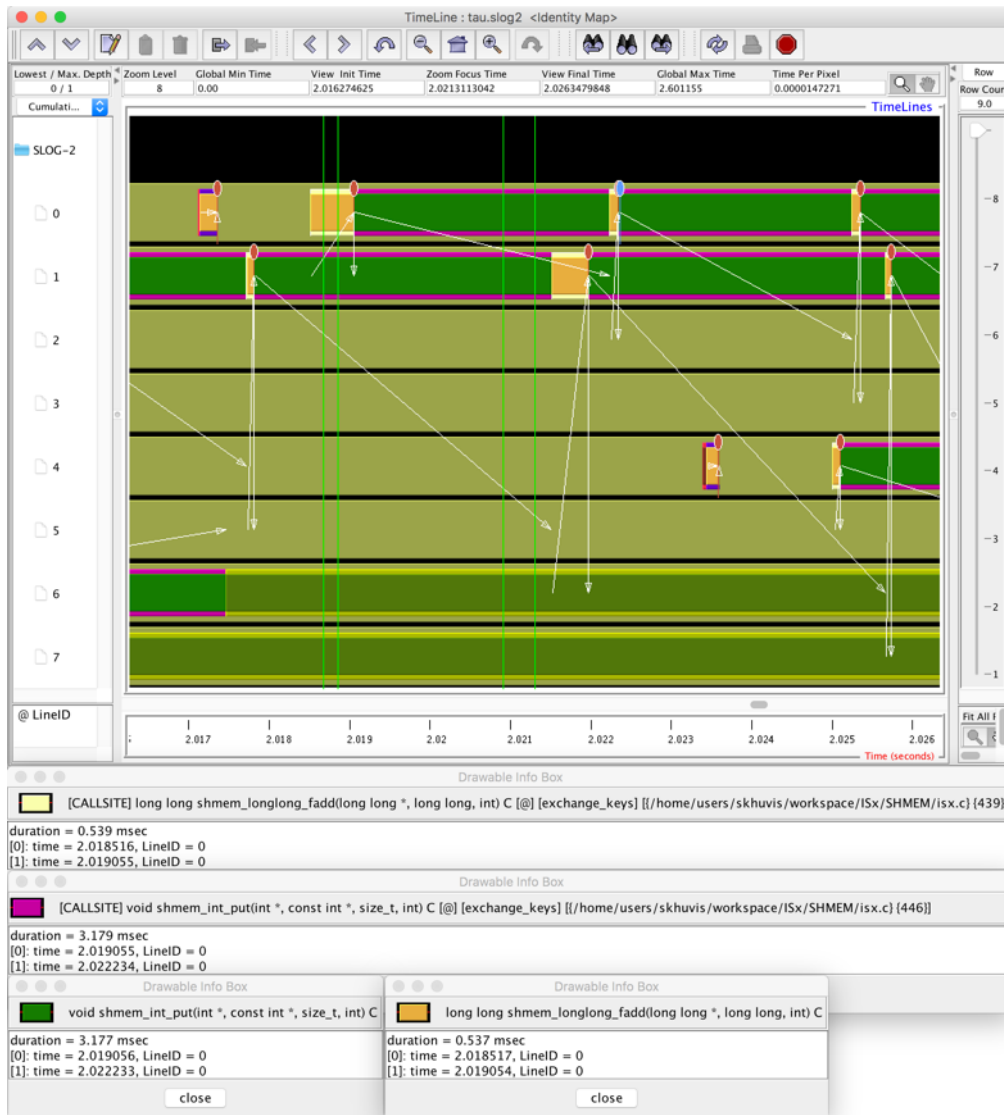
# Zoom In to View Individual Communication API Calls





# Where do Events Occur?

- Callsites differentiate calls to common functions
- Separate time spent in API routines that are called throughout the code.



# What Caused My Application to Crash?

TAU: ParaProf Manager		
Options	TrialField	Value
Standard Applications	Name	py-c++-f90-create.ppk
Default App	Application ID	0
Default Exp	Experiment ID	0
py-c++-f90-create.ppk	Trial ID	0
TIME	BACKTRACE 1	[SAMINT::timestep(double, double)] [/mnt/home/jlinford/py-c++-f90-create/SAMINT.C:77] [/mnt/home/jlinford/py-c++-f90-create/_samint.so]
	BACKTRACE 2	[samarcStep(double, double)] [/mnt/home/jlinford/py-c++-f90-create/pycintfc.C:57] [/mnt/home/jlinford/py-c++-f90-create/_samint.so]
	BACKTRACE 3	[_wrap_samarcStep] [/mnt/home/jlinford/py-c++-f90-create/samint_wrap.c:3883] [/mnt/home/jlinford/py-c++-f90-create/_samint.so]
	BACKTRACE 4	[call_function] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:4013] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so]
	BACKTRACE 5	[fast_function] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:4099] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so]
	BACKTRACE 6	[PyEval_EvalCodeEx] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:3253] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so]
	BACKTRACE 7	[PyEval_EvalCode] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:667] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so]
	BACKTRACE 8	[PyImport_ExecCodeModuleEx] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/import.c:681] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so]
	BACKTRACE 9	[load_source_module] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/import.c:1021] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so]
	BACKTRACE 10	[import_submodule] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/import.c:2596] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so]
	BACKTRACE 11	[load_next] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/import.c:2416] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so]
	BACKTRACE 12	[import_module_level] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/import.c:2137] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so]
	BACKTRACE 13	[builtin___import__] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/builtinmodule.c:49] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so]
	BACKTRACE 14	[PyObject_Call] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Objects/abstract.c:2529] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so]
	BACKTRACE 15	[PyEval_CallObjectWithKeywords] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:3882] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so]
	BACKTRACE 16	[PyEval_EvalFrameEx] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:2333] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so]
	BACKTRACE 17	[fast_function] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:4099] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so]
	BACKTRACE 18	[PyEval_EvalCodeEx] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:3253] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so]
	BACKTRACE 19	[PyEval_EvalCode] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:667] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so]
	BACKTRACE 20	[run_mod] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/pythonrun.c:1346] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so]
	BACKTRACE 21	[exec_statement] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:4746] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so]
	BACKTRACE 22	[PyEval_EvalCodeEx] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:3253] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so]
	BACKTRACE 23	[fast_function] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:4109] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so]
	BACKTRACE 24	[fast_function] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:4099] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so]
	BACKTRACE 25	[PyEval_EvalCodeEx] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:3253] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so]

# What Caused My Application to Crash?



Right-click to see source code

Metadata for file 0,0		
Name	Value	
BACKTRACE 1	[SAMINT::timestep(double, double)] [/mnt/home/jlinford/py-c++-f90-create/SAMINT::timestep.c:3883] [/mnt/home/jlinford/py-c++-f90-create/_samint.so]	<a href="#">Show Source Code</a>
BACKTRACE 2	[samarStep(double, double)] [/mnt/home/jlinford/py-c++-f90-create/pycintfc.c:3883] [/mnt/home/jlinford/py-c++-f90-create/_samint.so]	
BACKTRACE 3	[_wrap_samarStep] [/mnt/home/jlinford/py-c++-f90-create/samint_wrap.c:3883] [/mnt/home/jlinford/py-c++-f90-create/_samint.so]	
BACKTRACE 4	[call_function] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:4013] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so.1.0]	
BACKTRACE 5	[fast_function] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:4099] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so.1.0]	
BACKTRACE 6	[PyEval_EvalCodeEx] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:3253] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so.1.0]	
BACKTRACE 7	[PyEval_EvalCode] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:667] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so.1.0]	
BACKTRACE 8	[PyImport_ExecCodeModuleEx] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/import.c:681] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so.1.0]	
BACKTRACE 9	[load_source_module] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/import.c:1021] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so.1.0]	
BACKTRACE 10	[import_submodule] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/import.c:2596] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so.1.0]	
BACKTRACE 11	[load_next] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/import.c:2416] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so.1.0]	
BACKTRACE 12	[import_module_level] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/import.c:2137] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so.1.0]	
BACKTRACE 13	[builtin__import_] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/builtinmodule.c:49] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so.1.0]	
BACKTRACE 14	[PyObject_Call] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Objects/abstract.c:2529] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so.1.0]	
BACKTRACE 15	[PyEval_CallObjectWithKeywords] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:3882] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so.1.0]	
BACKTRACE 16	[PyEval_EvalFrameEx] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:2333] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so.1.0]	
BACKTRACE 17	[fast_function] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:4099] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so.1.0]	
BACKTRACE 18	[PyEval_EvalCodeEx] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:3253] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so.1.0]	
BACKTRACE 19	[PyEval_EvalCode] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:667] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so.1.0]	
BACKTRACE 20	[run_mod] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/pythonrun.c:1346] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so.1.0]	
BACKTRACE 21	[exec_statement] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:4746] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so.1.0]	
BACKTRACE 22	[PyEval_EvalCodeEx] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:3253] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so.1.0]	
BACKTRACE 23	[fast_function] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:4109] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so.1.0]	
BACKTRACE 24	[fast_function] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:4099] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so.1.0]	
BACKTRACE 25	[PyEval_EvalCodeEx] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:3253] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so.1.0]	
BACKTRACE 26	[fast_function] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:4109] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so.1.0]	
BACKTRACE 27	[PyEval_EvalCodeEx] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:3253] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so.1.0]	
BACKTRACE 28	[PyEval_EvalCode] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:667] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so.1.0]	
BACKTRACE 29	[run_mod] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/pythonrun.c:1346] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so.1.0]	
BACKTRACE 30	[PyRun_SimpleFileExFlags] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/pythonrun.c:936] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so.1.0]	
BACKTRACE 31	[Py_Main] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Modules/main.c:599] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so.1.0]	
BACKTRACE 32	[pyMPI_Main_with_communicator] [(unknown):0] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/pyMPI-2.5b0/bin/pyMPI]	
BACKTRACE 33	[main] [(unknown):0] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/pyMPI-2.5b0/bin/pyMPI]	
BACKTRACE 34	[_libc_start_main] [(unknown):0] [/lib64/libc-2.5.so]	
BACKTRACE 35	[_start] [(unknown):0] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/pyMPI-2.5b0/bin/pyMPI]	

# What Caused My Application to Crash?



```
TAU: ParaProf: Source Browser: /mnt/home/jlinford/py-c++-f90-create/SAMINT.C
File Help
65  /*
66  *****
67  *
68  * Take a timestep - advance solution from "time" to "time + dt"
69  *
70  *****
71  */
72  void SAMINT::timestep(const double time,
73                      const double dt)
74  {
75      cout << "SAMINT::timestep()" << endl;
76      timestep_(time,dt);
77      int x = 4 / (4-4);
78      cout << " x = " << x << endl;
79  }
80
81  /*
82  *****
83  *
84  * Write data to output
85  * (visit, fieldview, or overgrid - set in samarc input file)
86  *
87  *****
88  */
89  void SAMINT::writePlotData(const double time,
90                          const int step)
91  {
92      cout << "SAMINT::writePlotData()" << endl;
93  }
```

Error Highlighted in Source Browser



# Conclusion



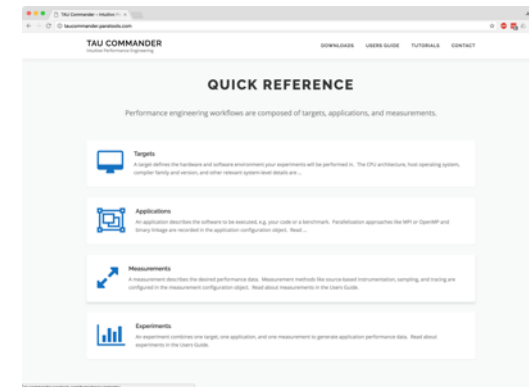
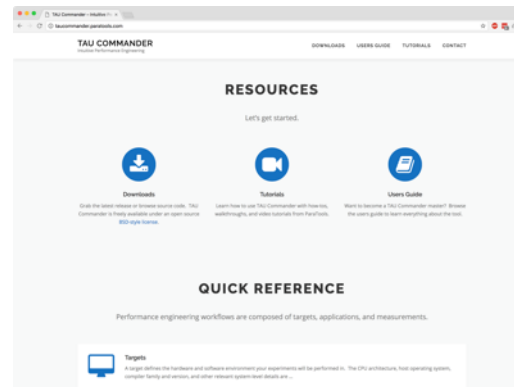
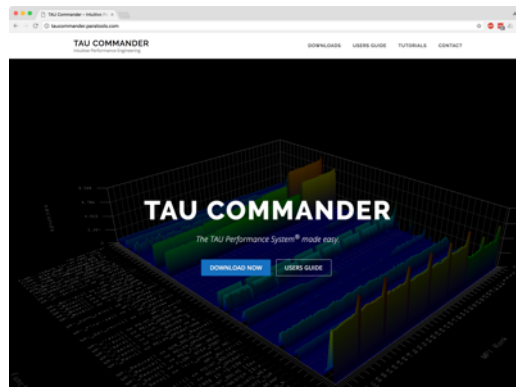
EXASCALE COMPUTING PROJECT

# Downloads

[www.taucommander.com](http://www.taucommander.com)

[www.github.com/ParaToolsInc/taucmdr](http://www.github.com/ParaToolsInc/taucmdr)

**Free, open source, BSD license**



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- HPCMP DoD PETTT Program
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  - Office of Science
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- TU Dresden
- Research Centre Jülich



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