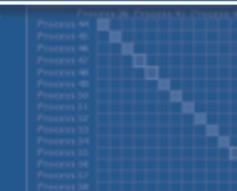




SOFTWARE



0.00 <<time step loop>>
0.00 updatedt
6.62 updateX
372.85 updateLEN
0.00 gene
0.00 <<iteration loop>>
293.65 genBC

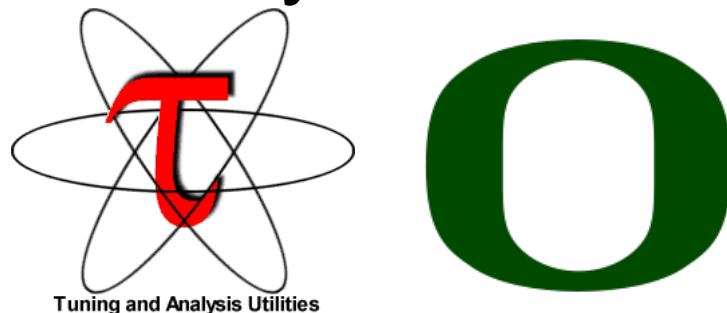


PRODUCTIVITY

FAST SOLUTIONS

- PAPI_L1_DCM
- PAPI_L1_ICM
- PAPI_L2_DCM
- PAPI_L2_ICM
- PAPI_L1_TCM
- PAPI_L2_TCM

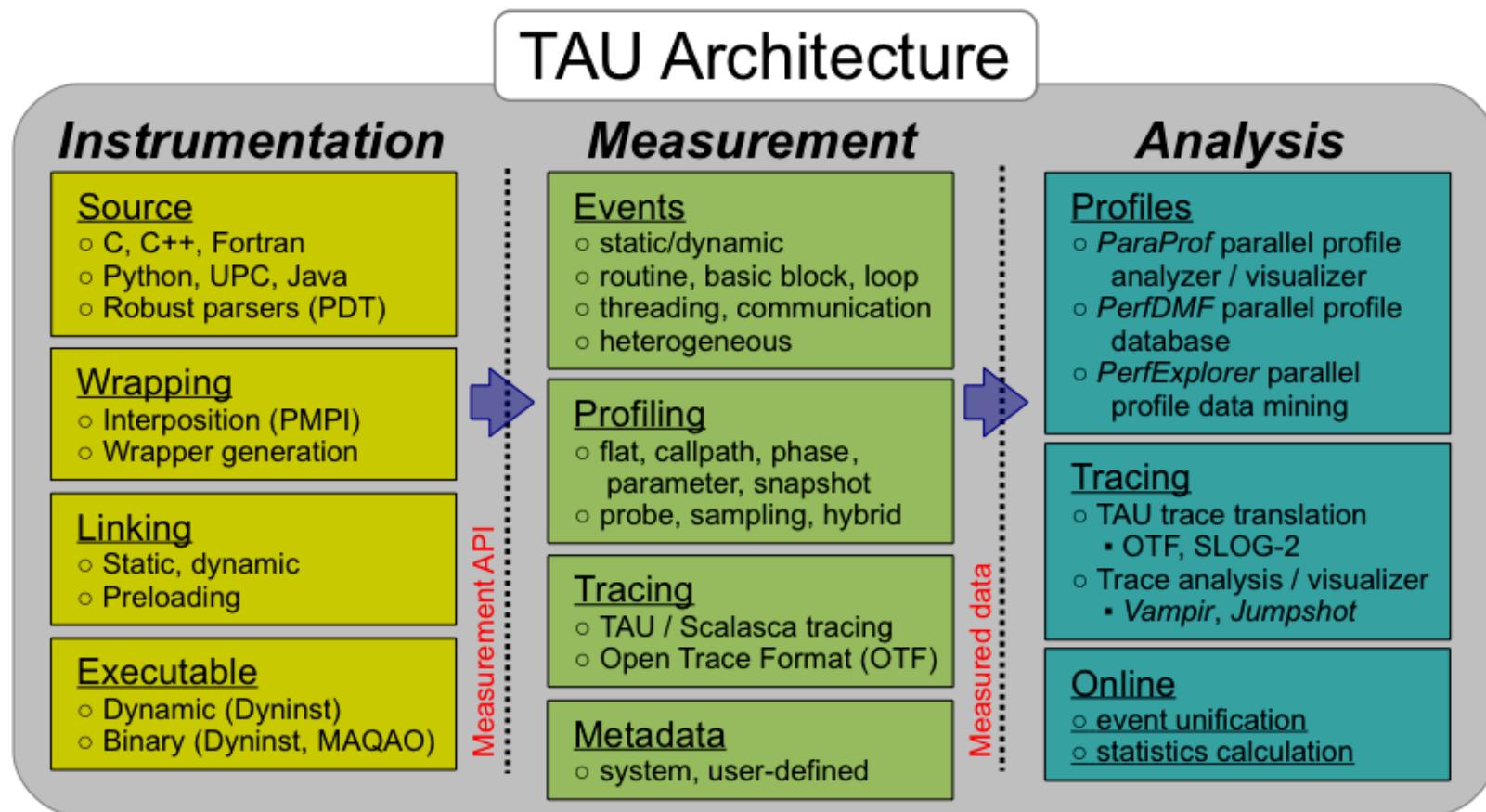
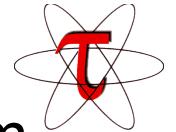
Profile Analysis with ParaProf

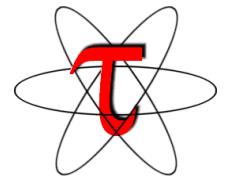


Sameer Shende
Performance Research Lab, University of Oregon

<http://TAU.uoregon.edu>

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





- Instrumentation
 - Fortran, C++, C, UPC, Java, Python, Chapel
 - Automatic instrumentation
- Measurement and analysis support
 - MPI, OpenSHMEM, ARMCI, PGAS, DMAPP
 - pthreads, OpenMP, hybrid, other thread models
 - GPU, CUDA, OpenCL, OpenACC
 - 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 (PerfDMF, TAUdb)
 - 3D profile browser

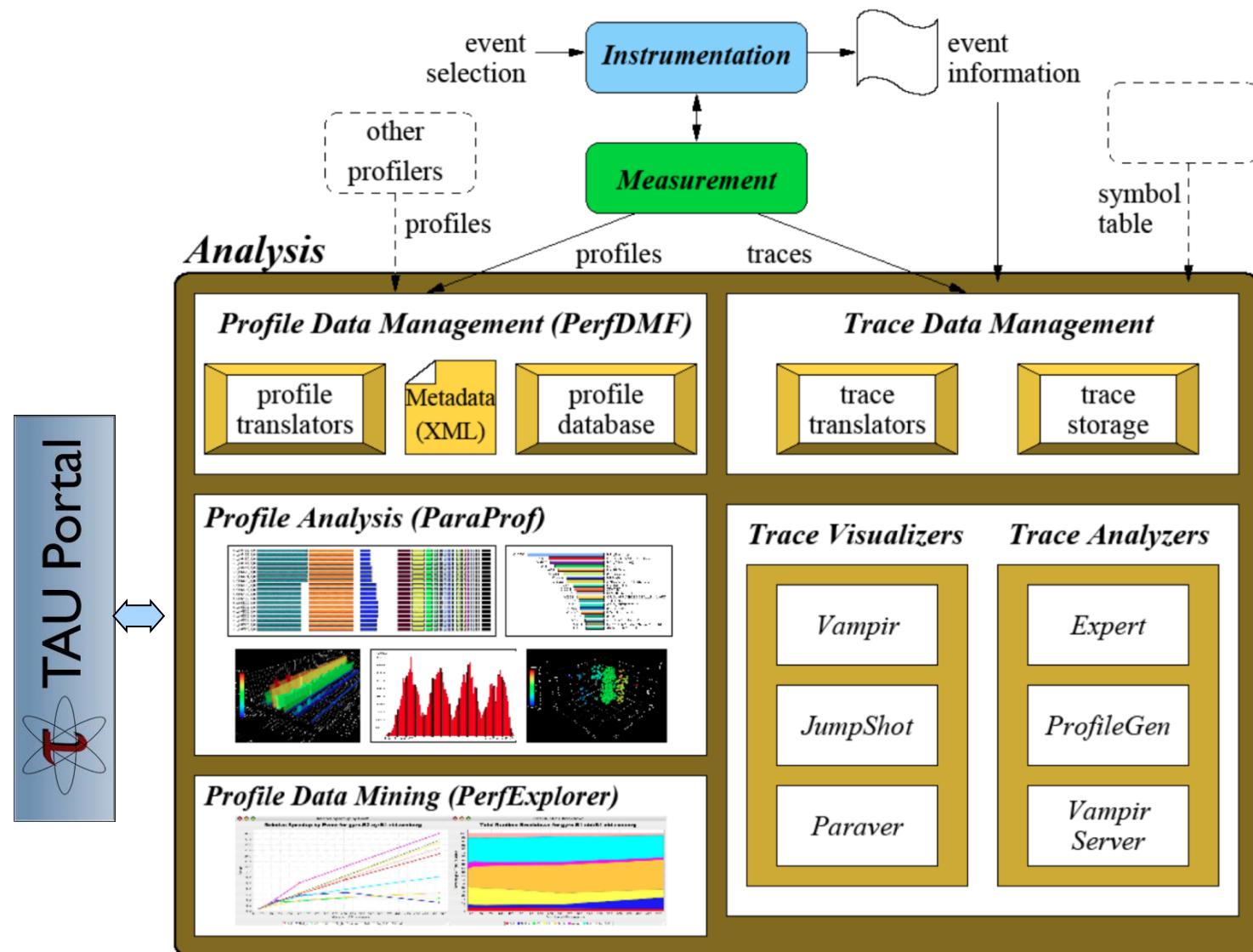
- TAU supports both sampling and direct instrumentation
- Memory debugging as well as I/O performance evaluation
- Profiling as well as tracing
- Interfaces with Score-P for more efficient measurements
- TAU's instrumentation covers:
 - Runtime library interposition (`tau_exec`)
 - Compiler-based instrumentation
 - PDT based Source level instrumentation: routine & loop
 - Event based sampling (`TAU_SAMPLING=1`)
 - Callstack unwinding with sampling (`TAU_EBS_UNWIND=1`)
 - OpenMP Tools Interface (OMPT, `tau_exec -T ompt`)
 - CUDA CUPTI, OpenCL (`tau_exec -T cupti -cupti`)

```
module use /gpfslocal/pub/vihps/UNITE/local
module load UNITE VI-HPS-TW
cd tutorial/NPB3.3-MZ-MPI
make suite
cd bin; cp ../jobscript/mds/run.tau.ll
Uncomment the first, then second run block:
# Case 2: MPI with OpenMP (OpenMP Tools Interface (OMPT))
#mpirun -np ${LOADL_TOTAL_TASKS} tau_exec -T ompt ./bt-
mz_B.4
```

llsubmit run.tau.ll

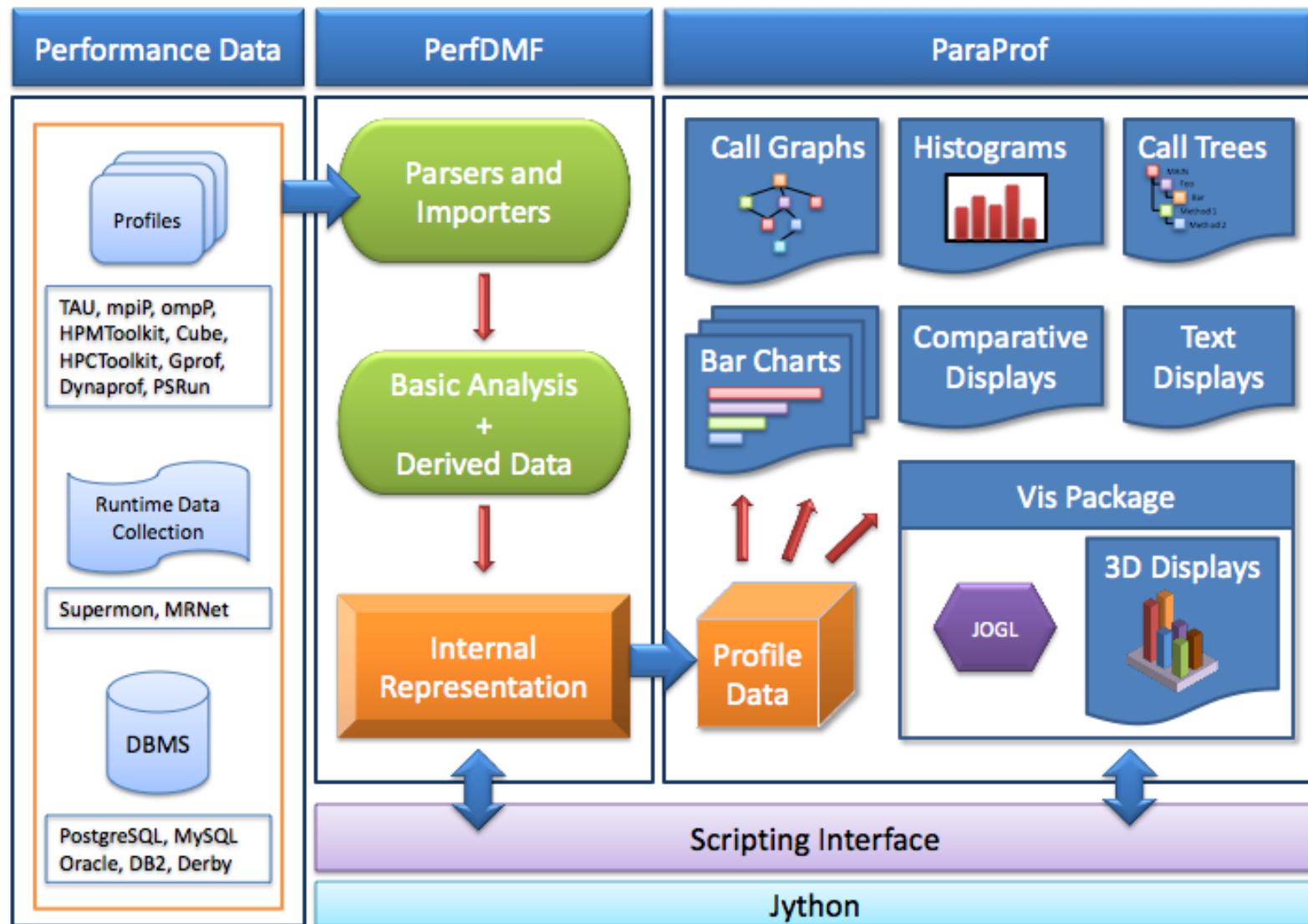
Wait and then launch after the job finishes:

paraprof (Right Click on node 0 or 1, Show Thread Statistics Table. Show Source Code on an OMPT source location. Also use paraprof on Score-P *.cubex files.)



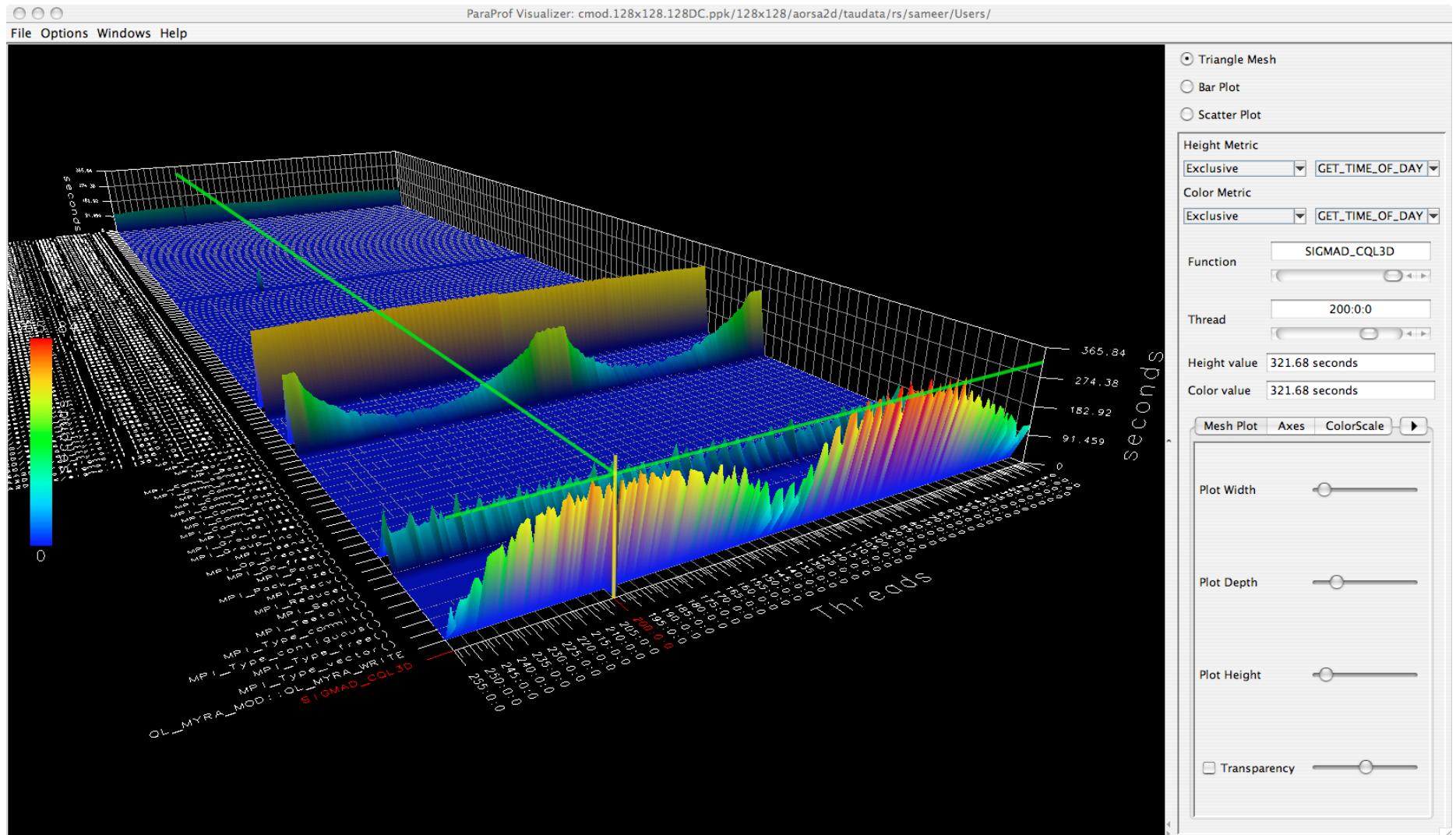
ParaProf Profile Analysis Framework

VI-HPS



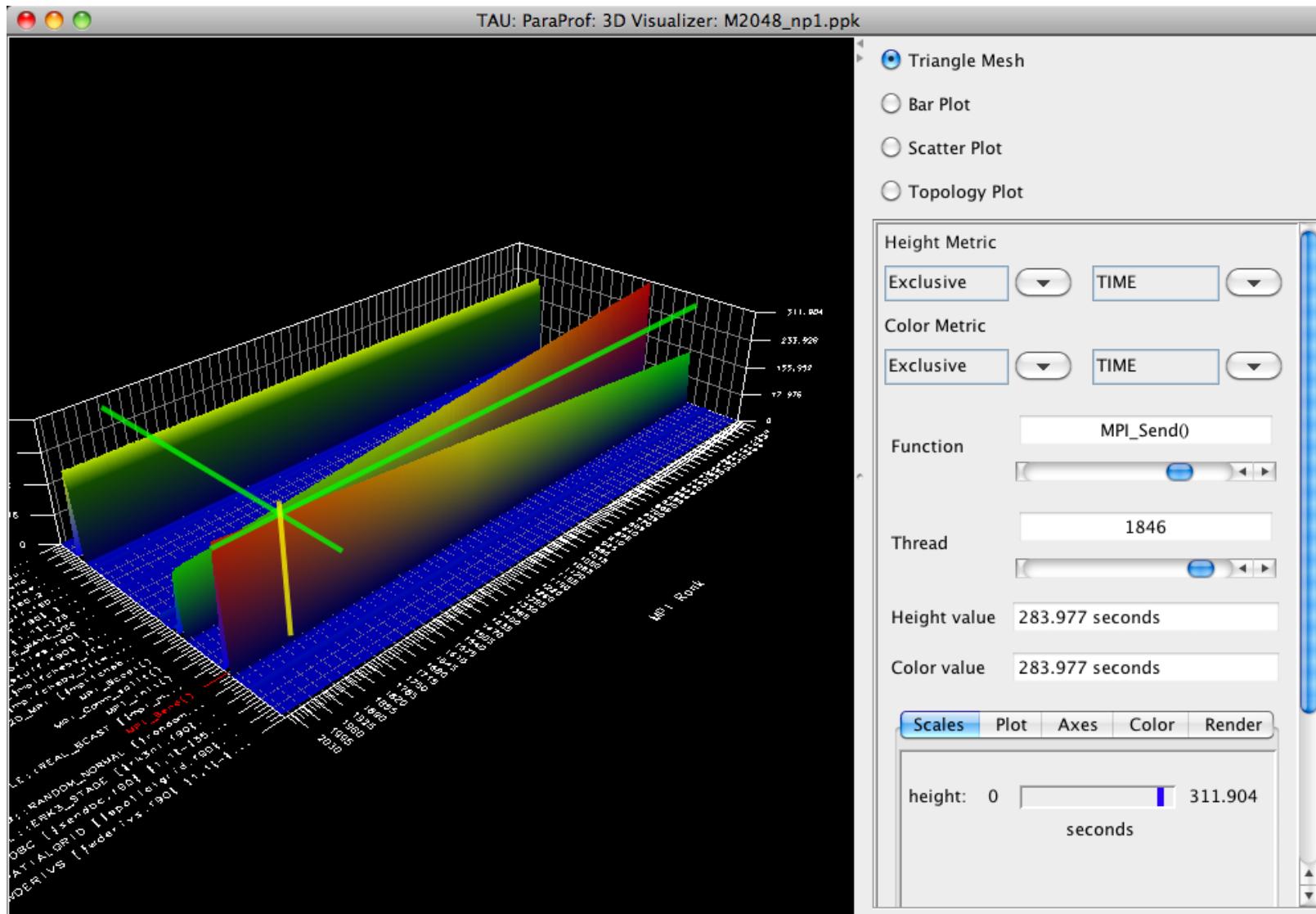
Parallel Profile Visualization: ParaProf

VI-HPS

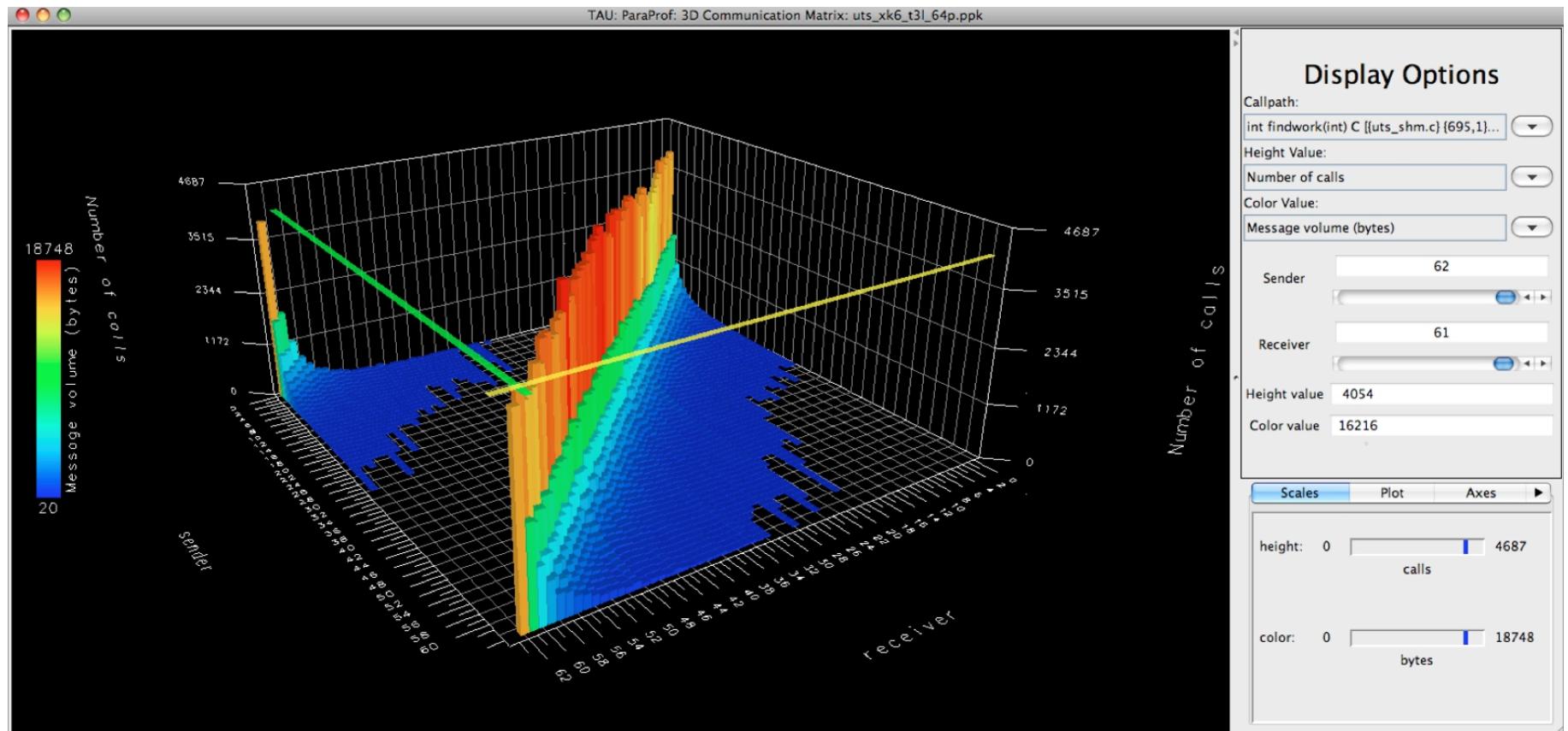


Parallel Profile Visualization: ParaProf

VI-HPS



ParaProf: 3D Communication Matrix



- The Tutorial contains Score-P experiments of BT-MZ
 - class “B“, 4 processes with 4 OpenMP threads each
 - collected on a dedicated node of the SuperMUC HPC system at Leibniz Rechenzentrum (LRZ), Munich, Germany

```
% cd  
% ls  
periscope-1.5  
README  
run.out  
scorep-20120913_1740_557443655223384  
scorep_bt-mz_B_4x4_sum  
scorep_bt-mz_B_4x4_sum+mets  
scorep_bt-mz_B_4x4_trace
```

- Start TAU's paraprof GUI with default profile report

```
% paraprof scorep-20120913_1740_557443655223384/profile.cubex  
OR  
% paraprof scorep_bt-mz_B_4x4_trace/scout.cubex
```

ParaProf: Manager Window: scout.cubex

TAU: ParaProf Manager

- □ ×

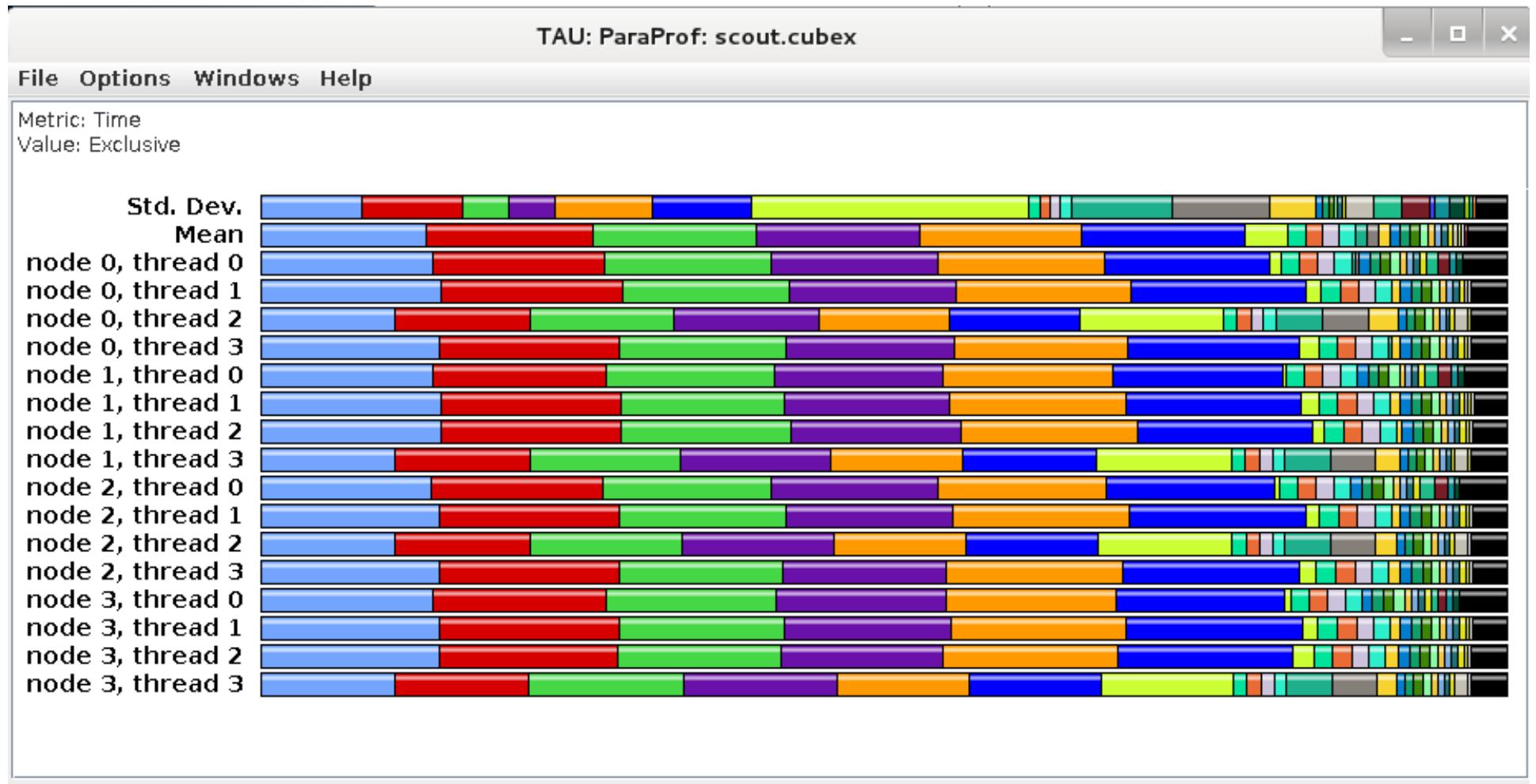
File Options Help

Applications

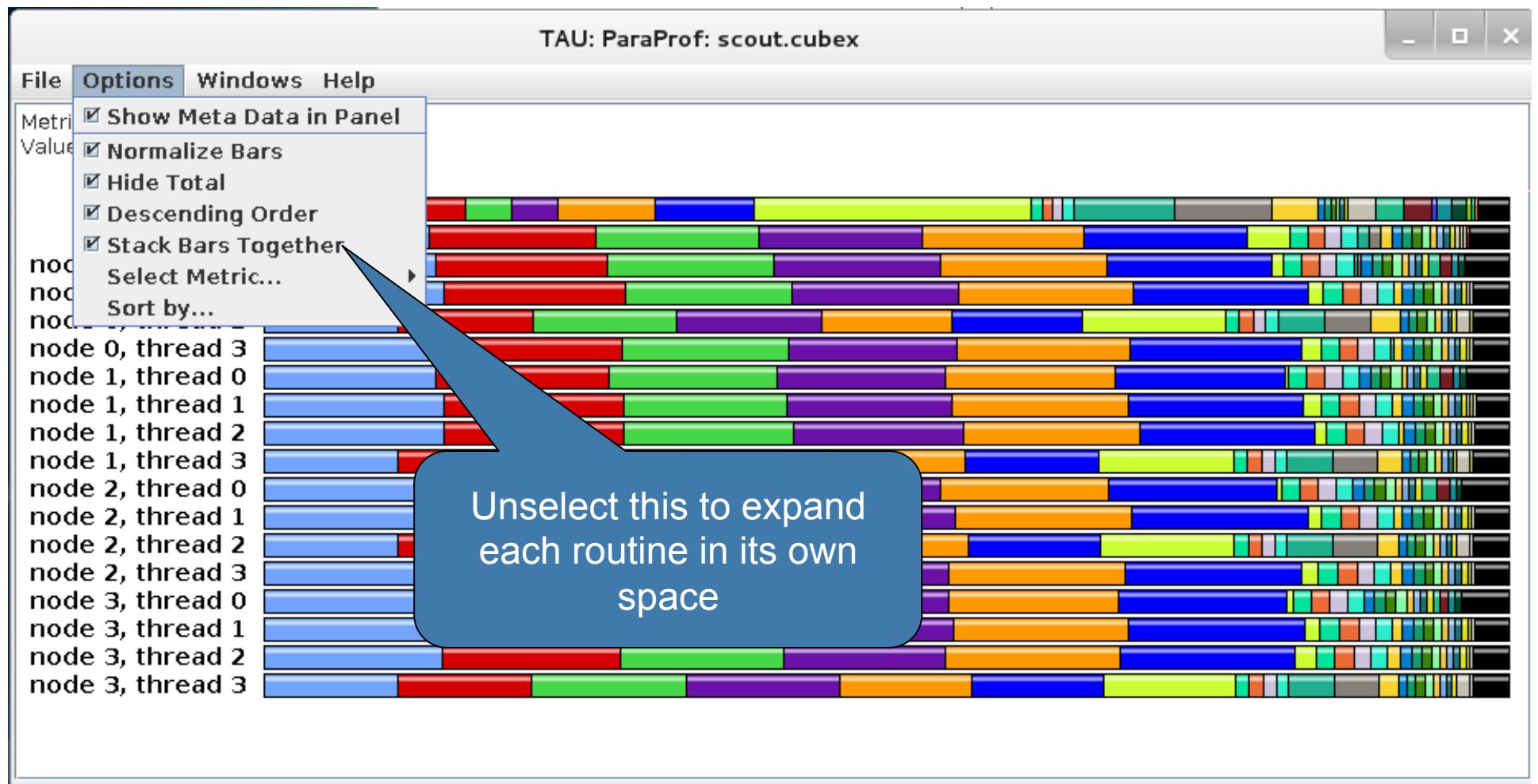
- Standard Applications
 - Default App
 - Default Exp
 - scout.cubex
 - Time
 - Wait at Barrier
 - Barrier Completion
 - Late Sender
 - Late Sender => Messages in Wrong Order
 - Late Sender => Messages in Wrong Order => Messages from different sources
 - Late Sender => Messages in Wrong Order => Messages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

Metrics in the profile

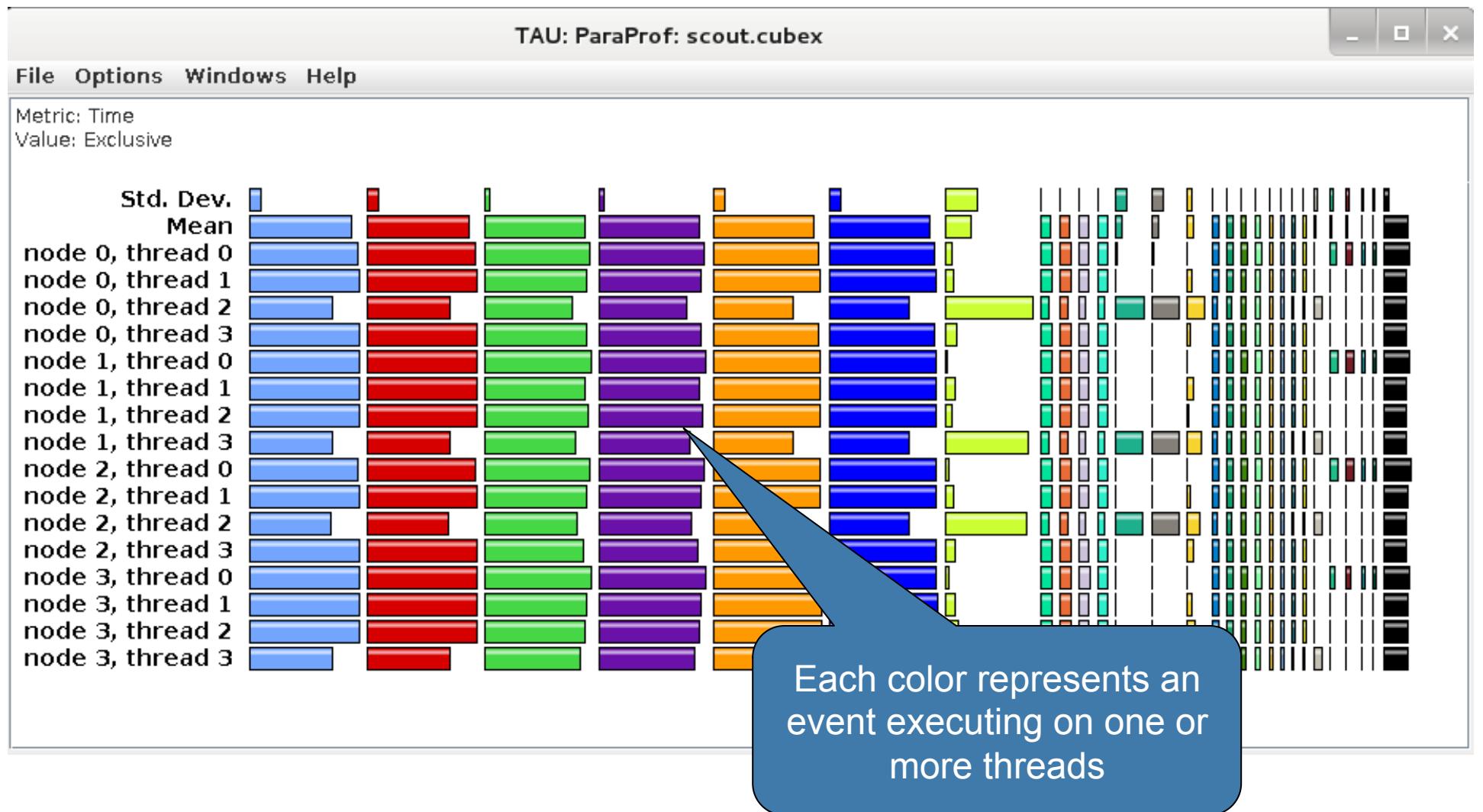
ParaProf: Main window



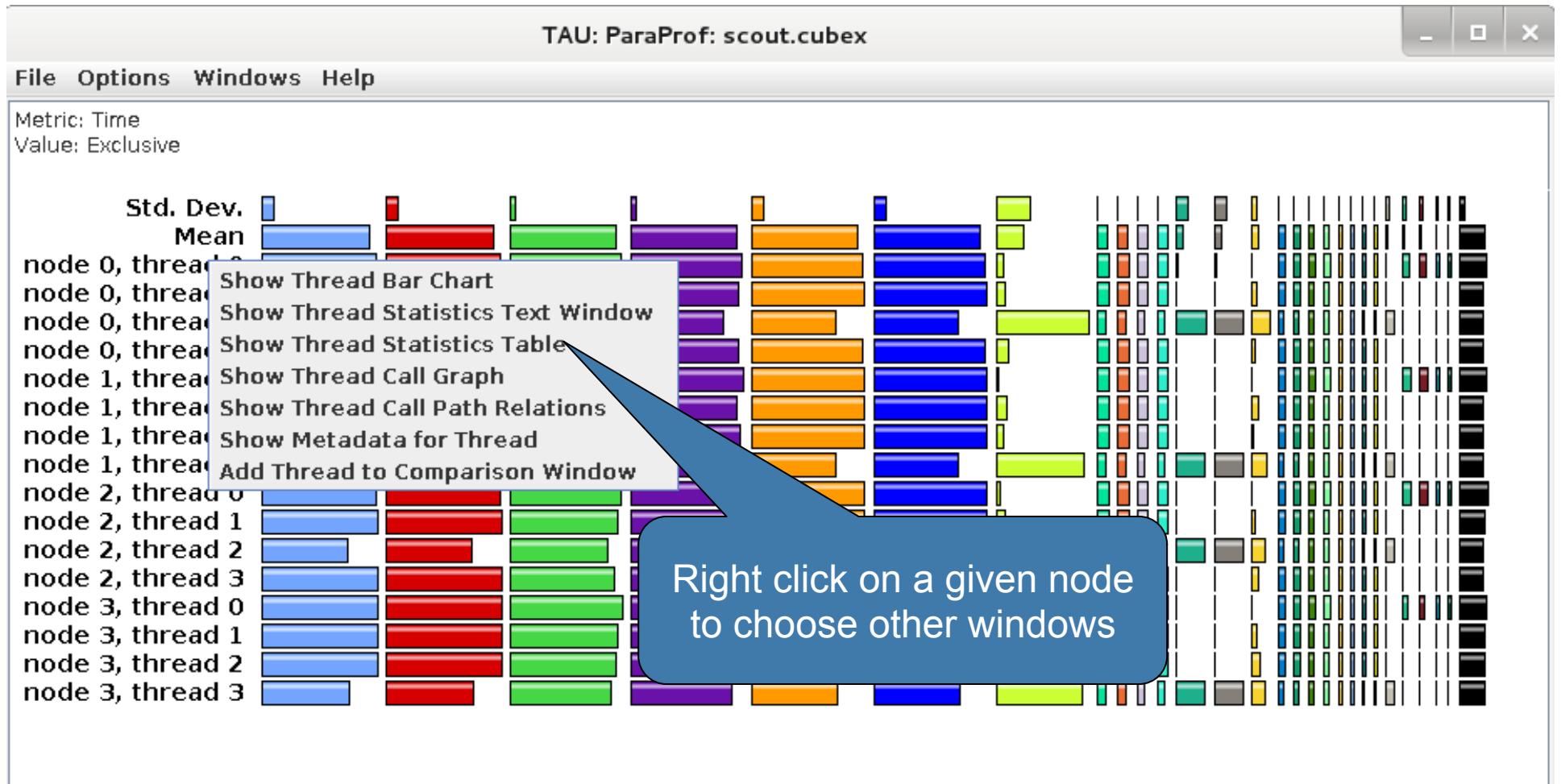
ParaProf: Options



ParaProf:



ParaProf: Windows



ParaProf: Thread Statistics Table

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

File Options Windows Help

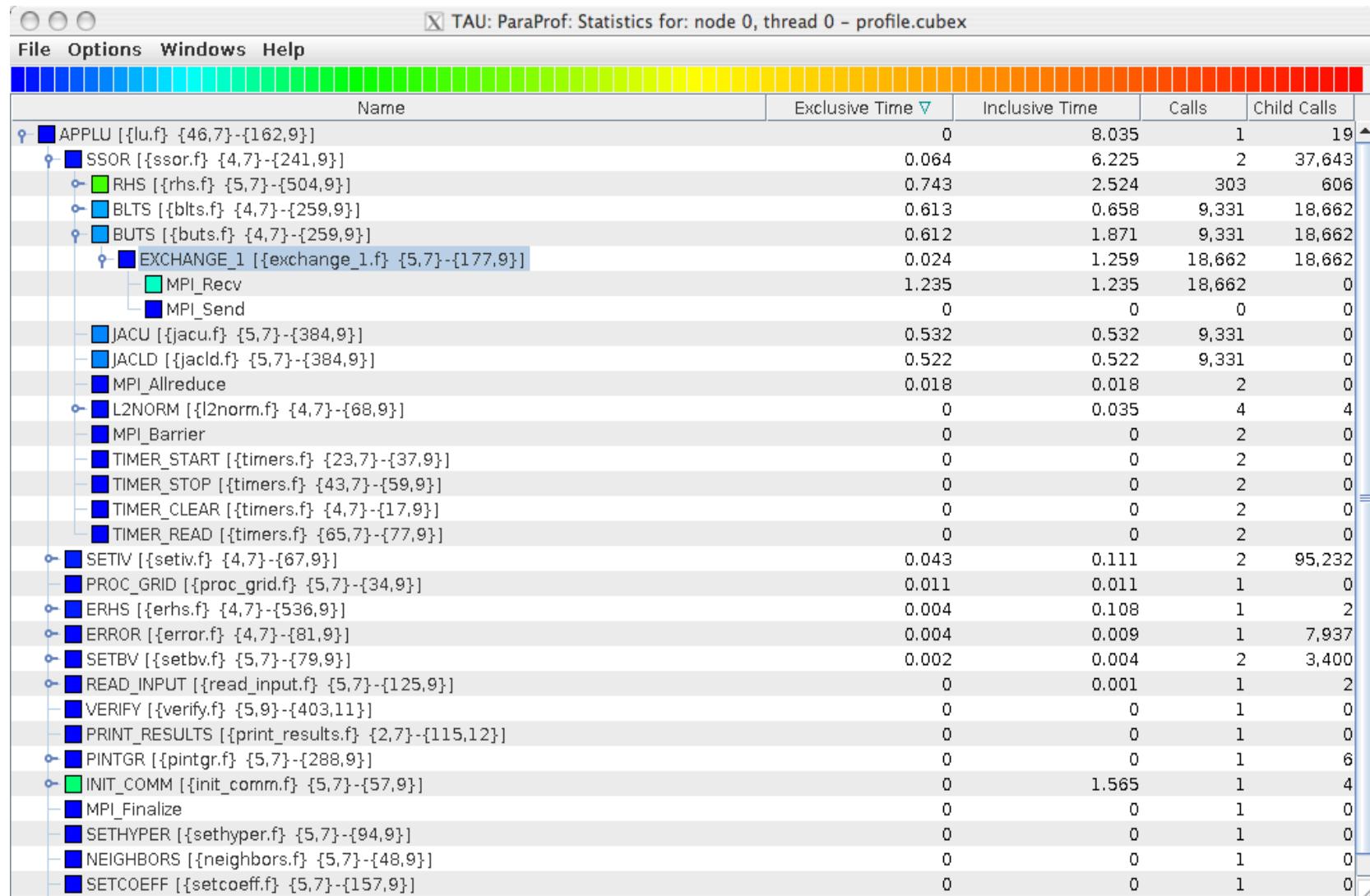
Time

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	0	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	0.228	3,232	3,232
!\$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				

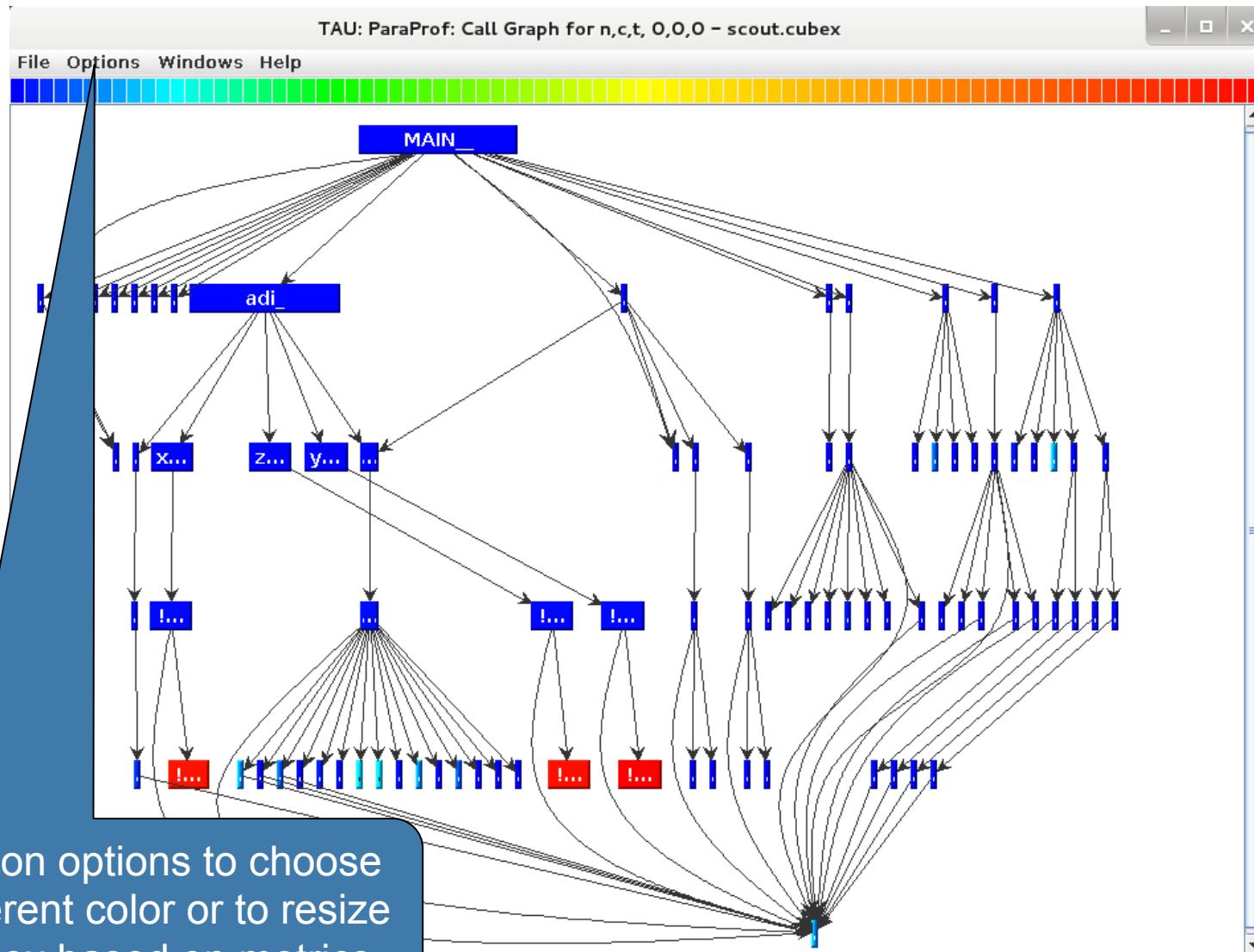
Click to sort by a given metric, drag and move to rearrange columns

Example: Score-P with TAU (LU NPB)

VI-HPS



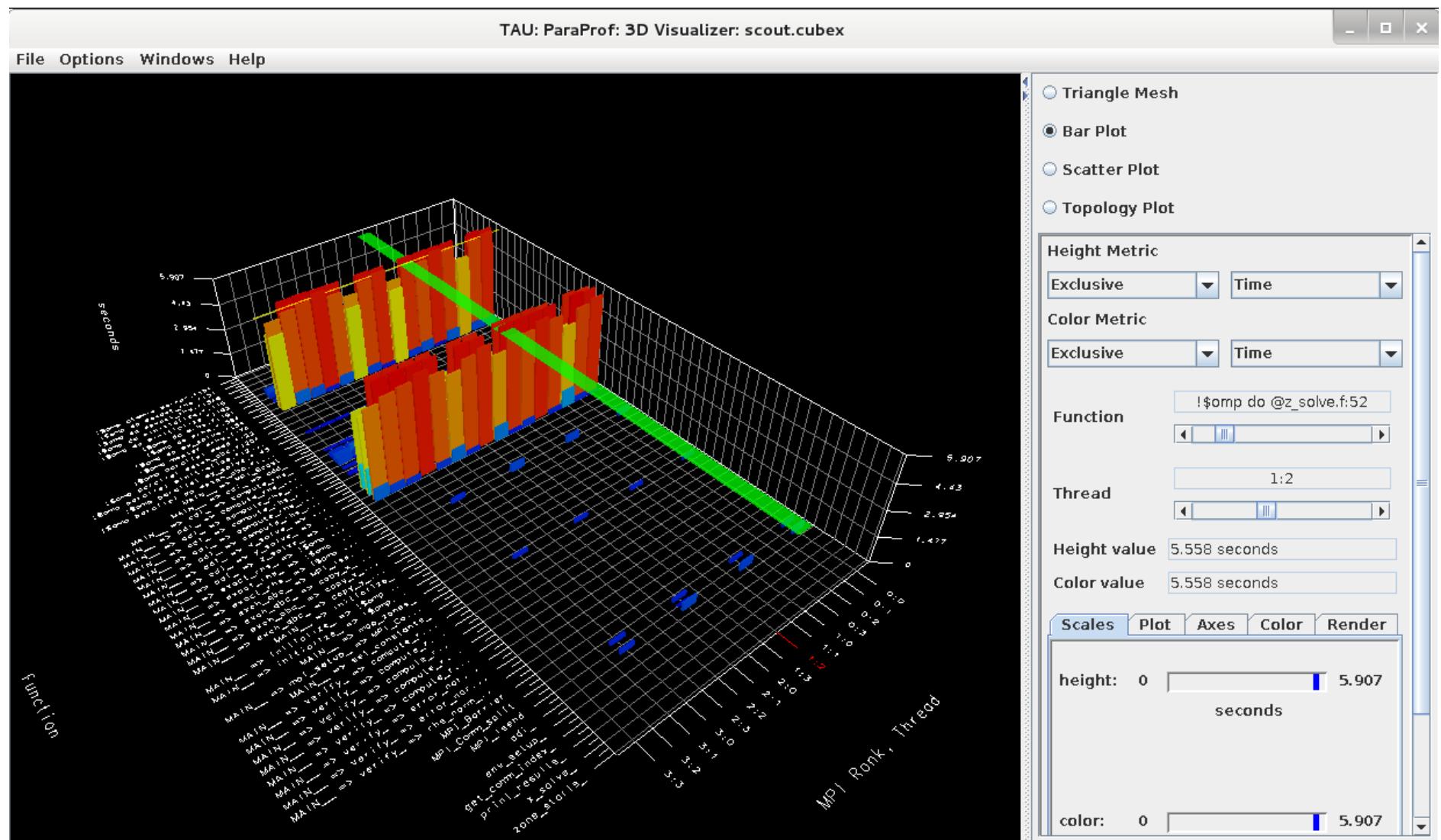
ParaProf: Thread Callgraph Window



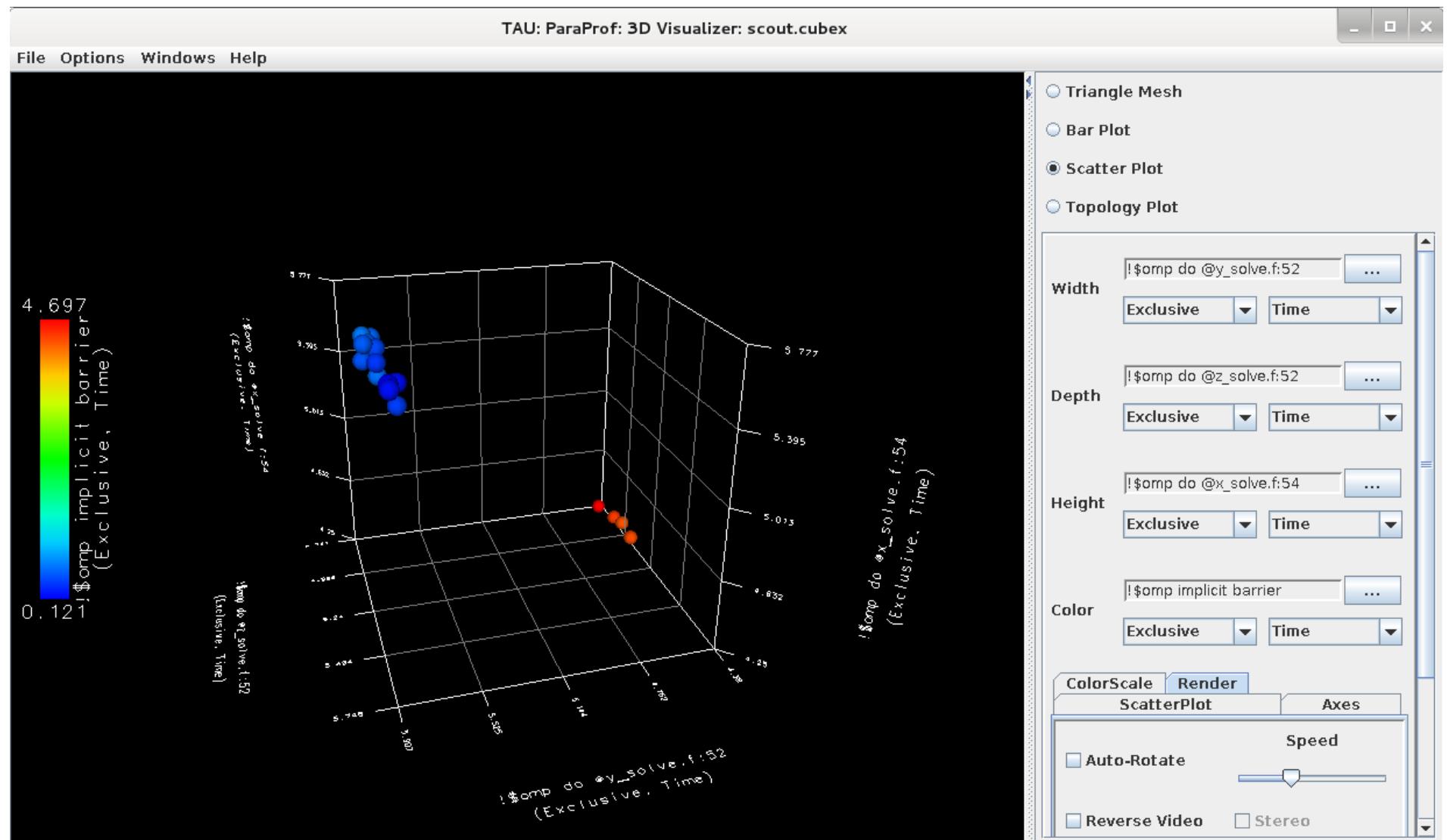
ParaProf: Callpath Thread Relations Window

TAU: ParaProf: Call Path Data n,c,t, O,O,O – 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 !\$omp do @initialize.f:50
-->	0.04	0.04	32	
-->	0.03	2.536	3232/3232	compute_rhs_
9.8E-4	0.03	2.536	3232	!\$omp parallel @rhs.f:28
0.225	9.8E-4	3232/3232	!\$omp master @rhs.f:424	
0.002	0.228	3232/3232	!\$omp do @rhs.f:62	
0.002	0.002	3232/3232	!\$omp master @rhs.f:74	
0.199	0.002	3232/3232	!\$omp master @rhs.f:293	
0.002	0.199	3232/3232	!\$omp do @rhs.f:384	
0.343	0.002	3232/3232	!\$omp master @rhs.f:183	
0.016	0.343	3232/3232	!\$omp do @rhs.f:37	
0.014	0.016	3232/3232	!\$omp do @rhs.f:372	
0.609	0.014	3232/3232	!\$omp do @rhs.f:413	
0.36	0.609	3232/3232	!\$omp do @rhs.f:191	
0.583	0.36	3232/3232	!\$omp do @rhs.f:301	
0.019	0.583	3232/3232	!\$omp do @rhs.f:80	
0.006	0.019	3232/3232	!\$omp do @rhs.f:400	
0.069	0.006	3232/51680	!\$omp implicit barrier	
0.015	0.069	3232/3232	!\$omp do @rhs.f:428	
-->	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	0.029	6432/6432	!\$omp parallel @exch_qbc.f:255
0.02	0.02	6432	!\$omp parallel do @exch_qbc.f:255	
0.013	0.013	6432/51680	!\$omp implicit barrier	

ParaProf:Windows -> 3D Visualization -> Bar Plot

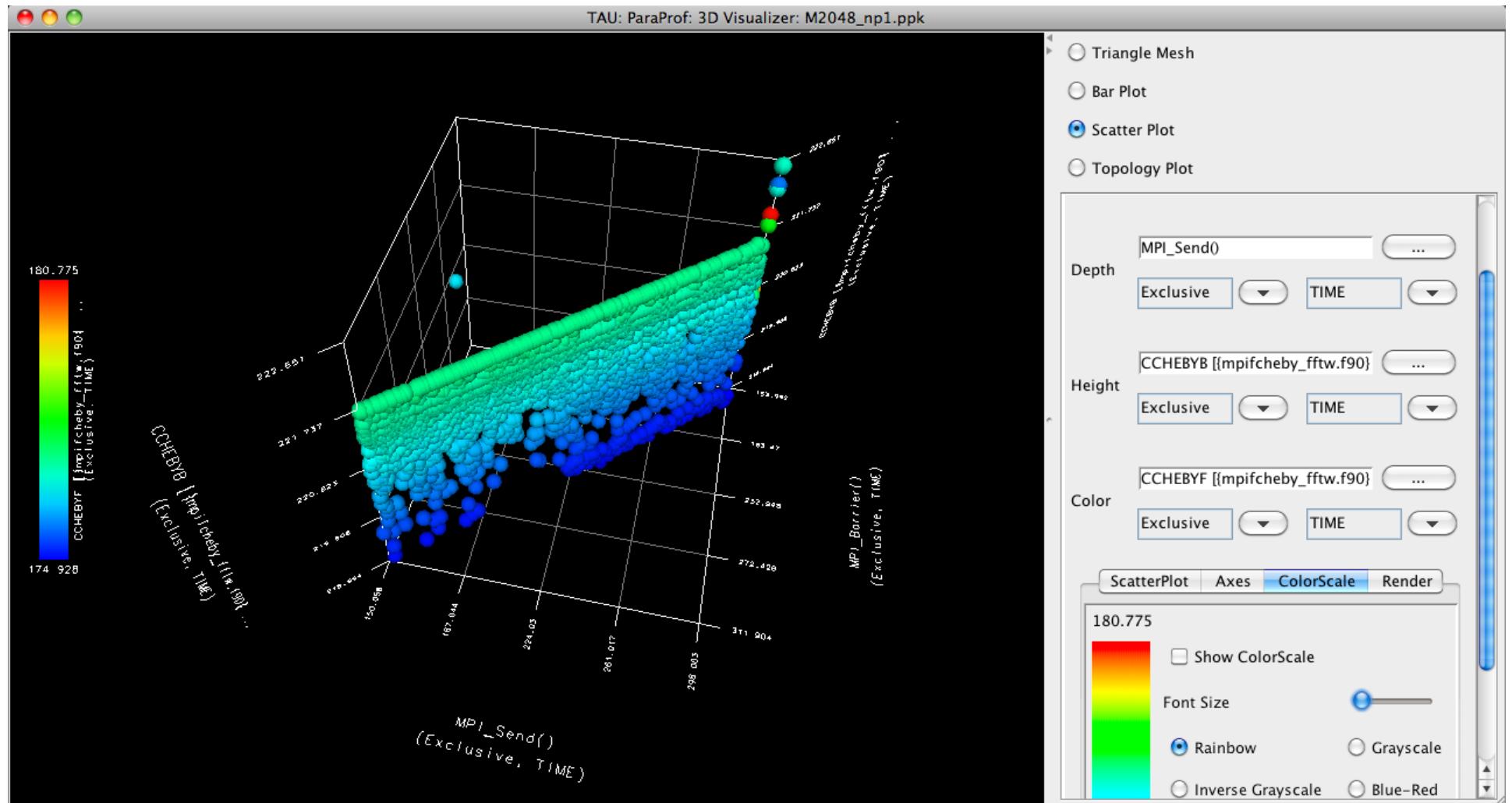


ParaProf: 3D Scatter Plot

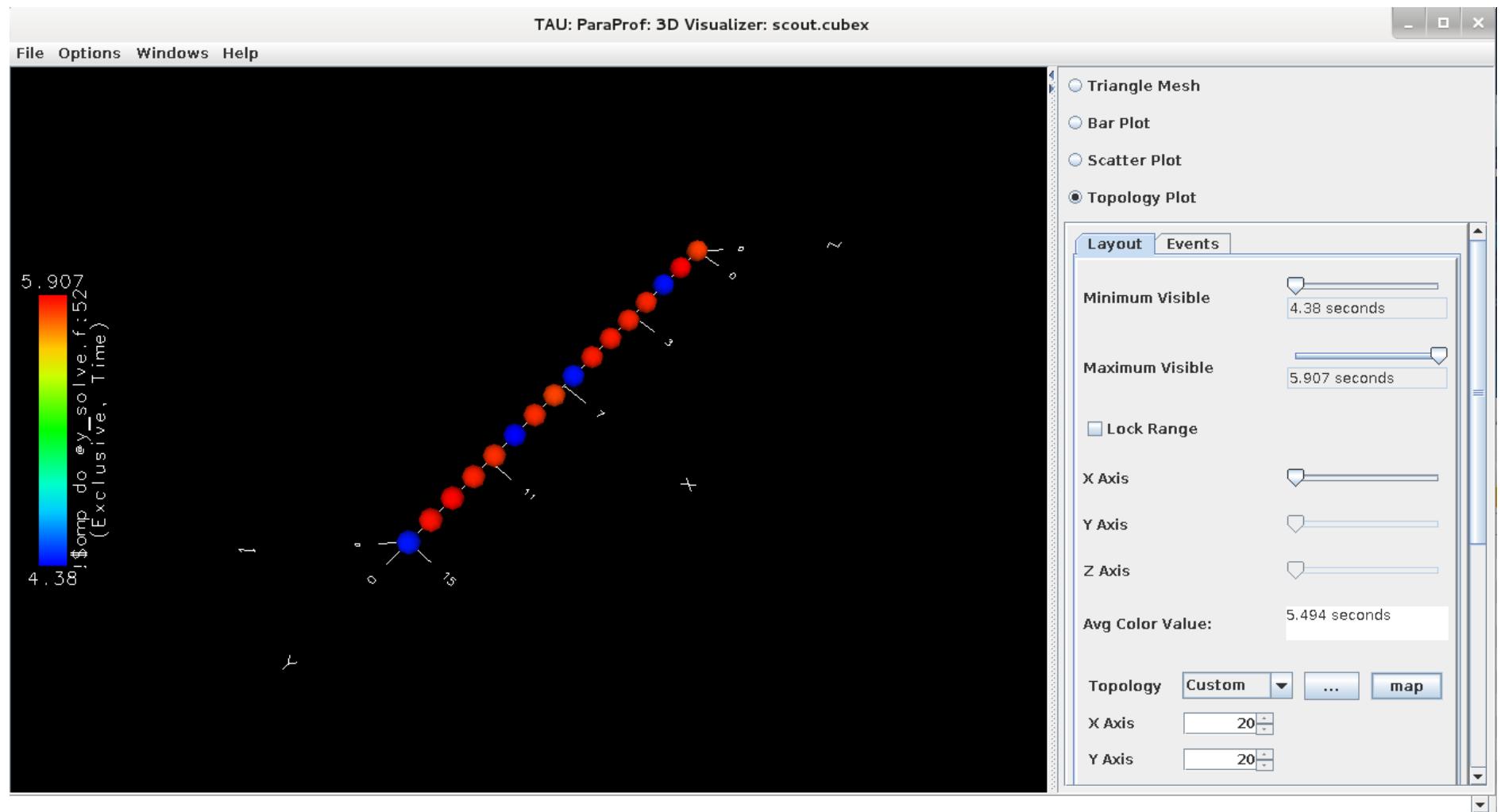


ParaProf: Scatter Plot

VI-HPS

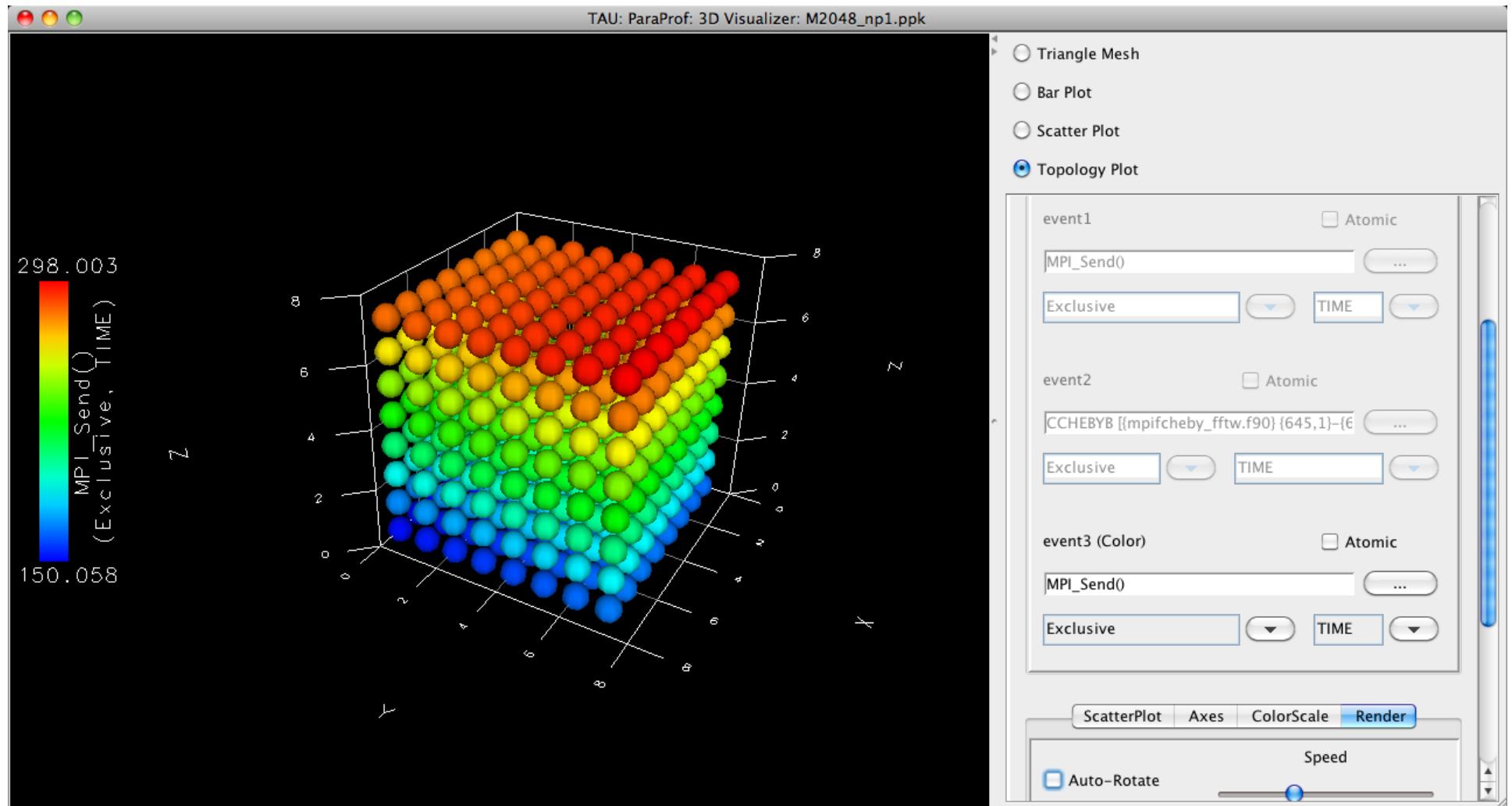


ParaProf: 3D Topology View for a Routine



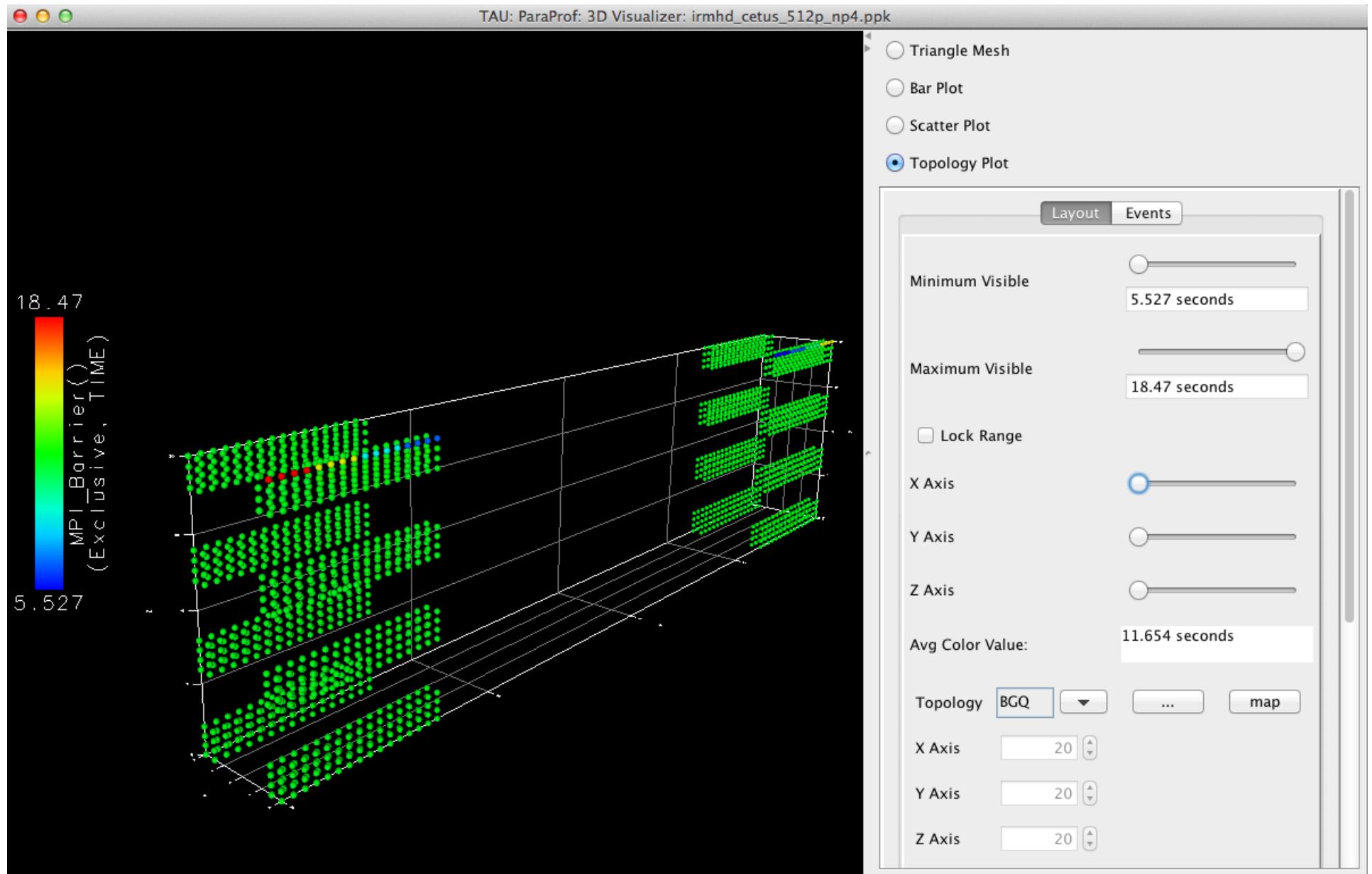
ParaProf: Topology View 3D Torus (IBM BG/P)

VI-HPS

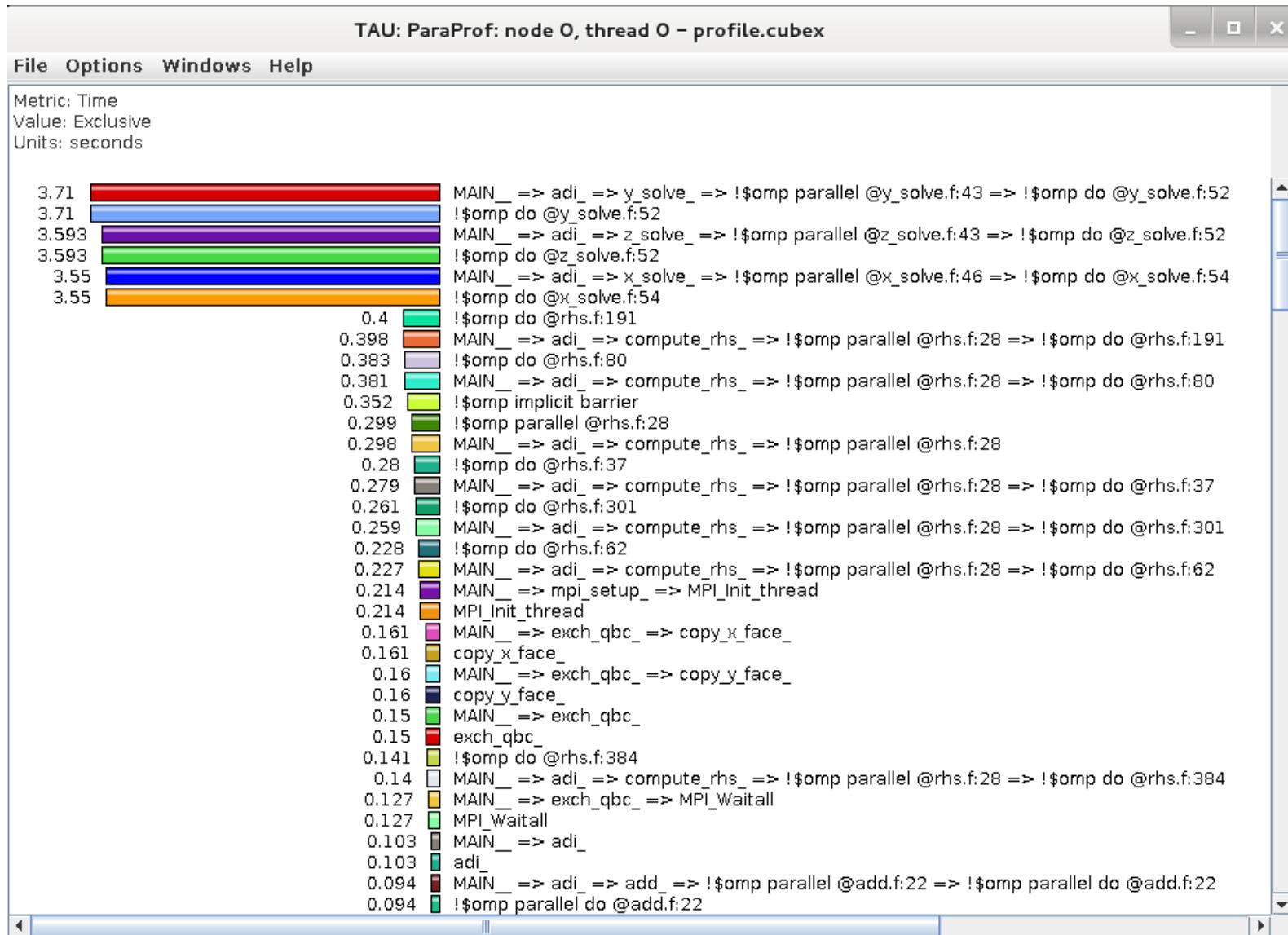


ParaProf:Topology View (6D Torus Coordinates BG/Q)

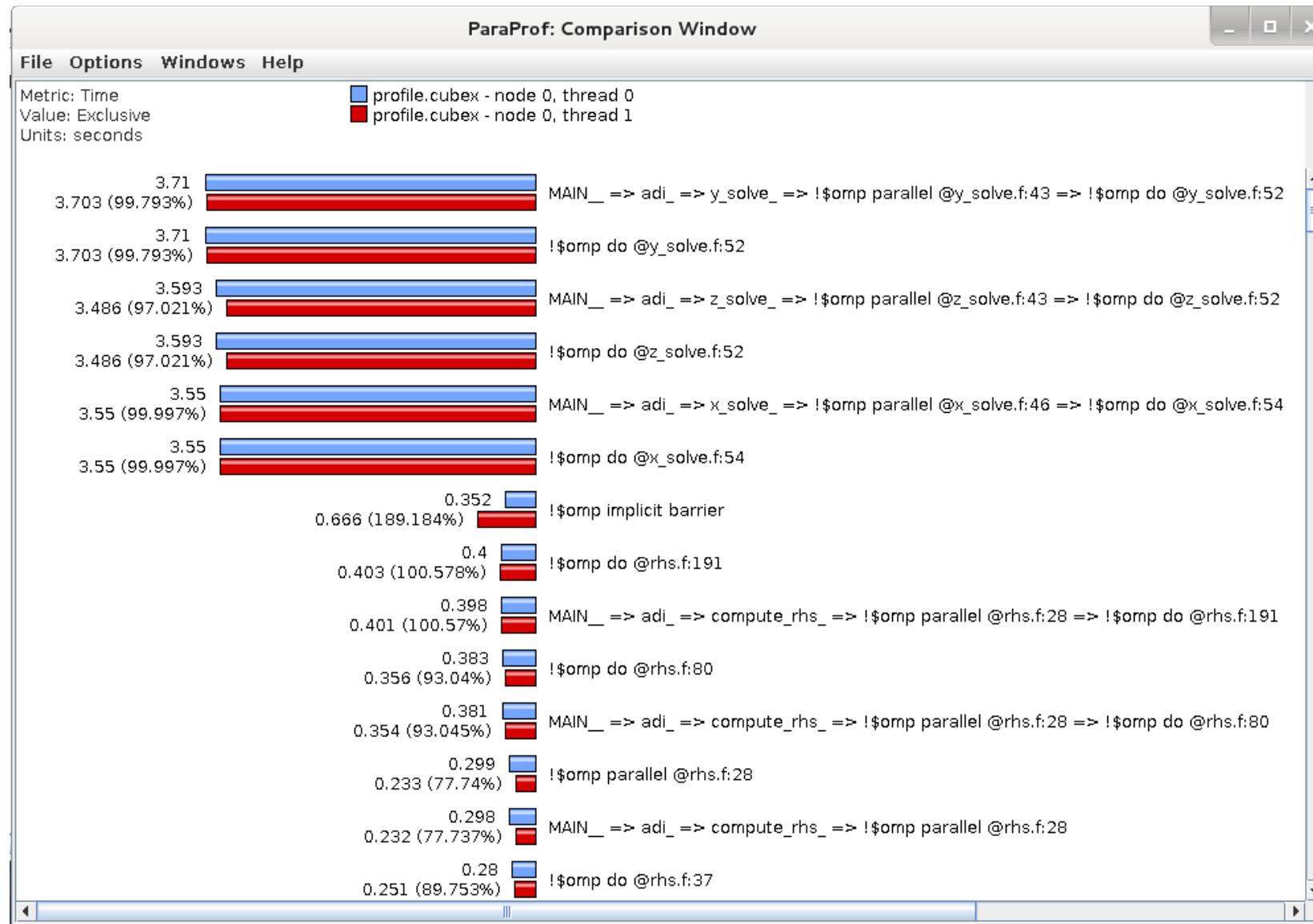
VI-HPS



ParaProf: Node View



ParaProf: Add Thread to Comparison Window



ParaProf: Score-P Profile Files, Database

TAU: ParaProf Manager

File Options Help

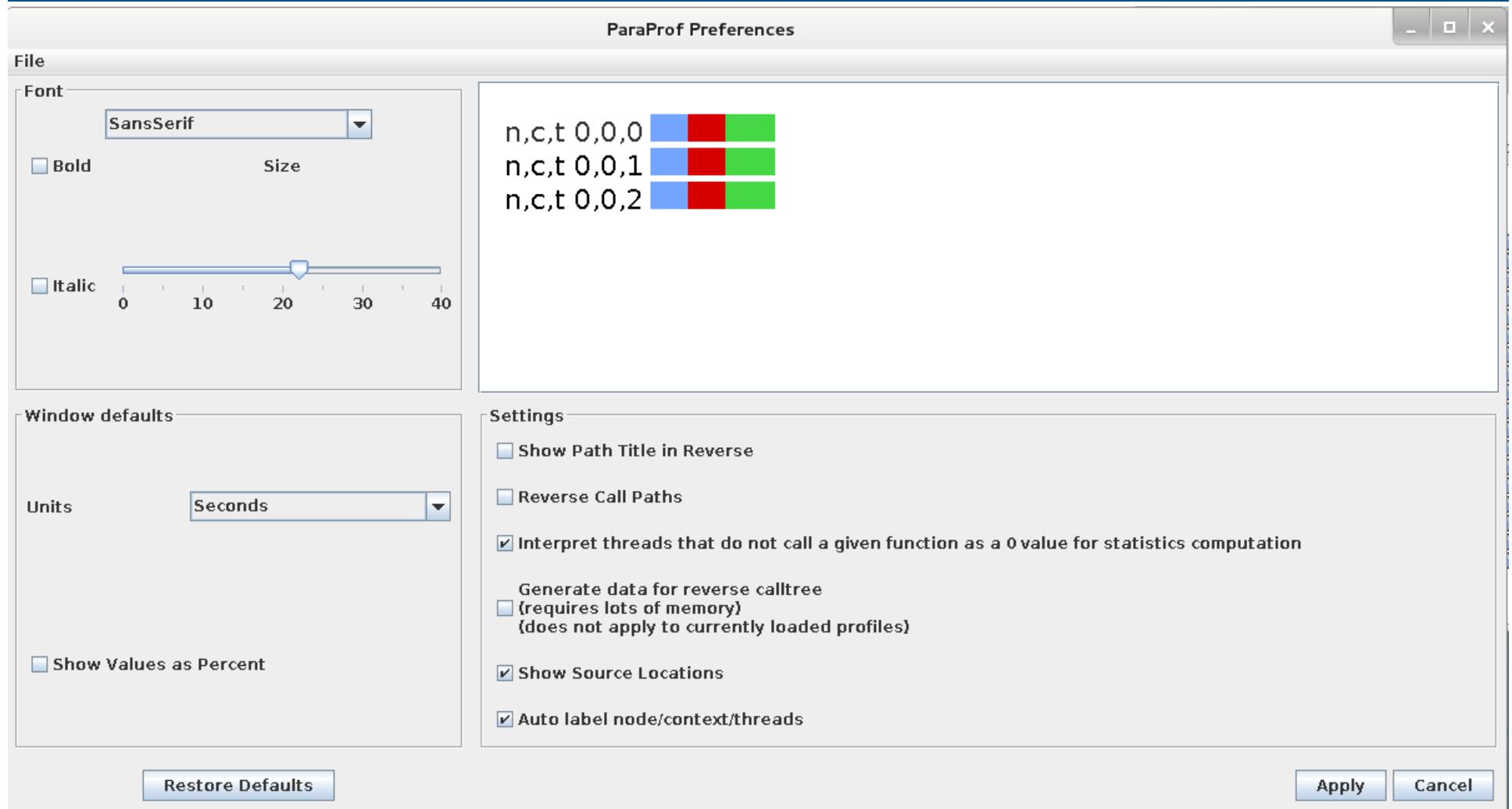
Applications

- 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_jsrss
 - ru_minflt
 - ru_majflt
 - ru_nswap
 - ru_inblock
 - ru_oublock
 - ru_msgrnd
 - ru_msgrcv
 - ru_nsignals
 - ru_nvcsrw
 - ru_nvcsrw
 - bytes_sent
 - bytes_received
- Default (jdbc:h2:/home/livetau/.ParaProf//perfdrmf;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



ParaProf: Group Changer Window

TAU: ParaProf: Group Changer: profile.cubex

Region	Current	Available
filter: <input type="text"/>	CUBE_DEFAULT	<input type="text"/> new group
<pre>!\$omp atomic @error.f:104 !\$omp atomic @error.f:51 !\$omp do @error.f:33 !\$omp do @error.f:91 !\$omp do @exact_rhs.f:147 !\$omp do @exact_rhs.f:247 !\$omp do @exact_rhs.f:31 !\$omp do @exact_rhs.f:346 !\$omp do @exact_rhs.f:46 !\$omp do @initialize.f:100 !\$omp do @initialize.f:119 !\$omp do @initialize.f:137 !\$omp do @initialize.f:156 !\$omp do @initialize.f:174 !\$omp do @initialize.f:192 !\$omp do @initialize.f:31</pre>	<input type="button" value="<--"/> <input type="button" value="-->"/>	
	CUBE_CALLPATH	

ParaProf: Options -> Derived Metric Panel

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_msgrcv
 - ru_msgrcv
 - ru_nsignals
 - ru_nvcsrw

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

