Analysis report examination with CUBE

Brian Wylie
Jülich Supercomputing Centre

CUBE

Parallel program analysis report exploration tools

- Libraries for XML report reading & writing
- Algebra utilities for report processing
- GUI for interactive analysis exploration
  - requires Qt4.6 or later

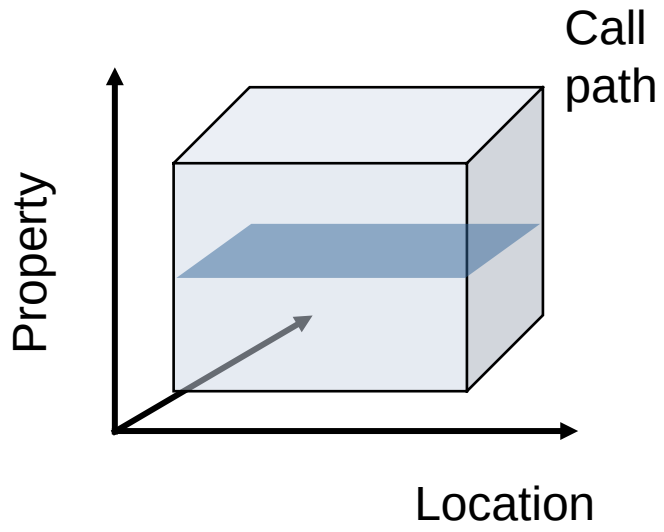
Originally developed as part of Scalasca toolset

Now available as a separate component

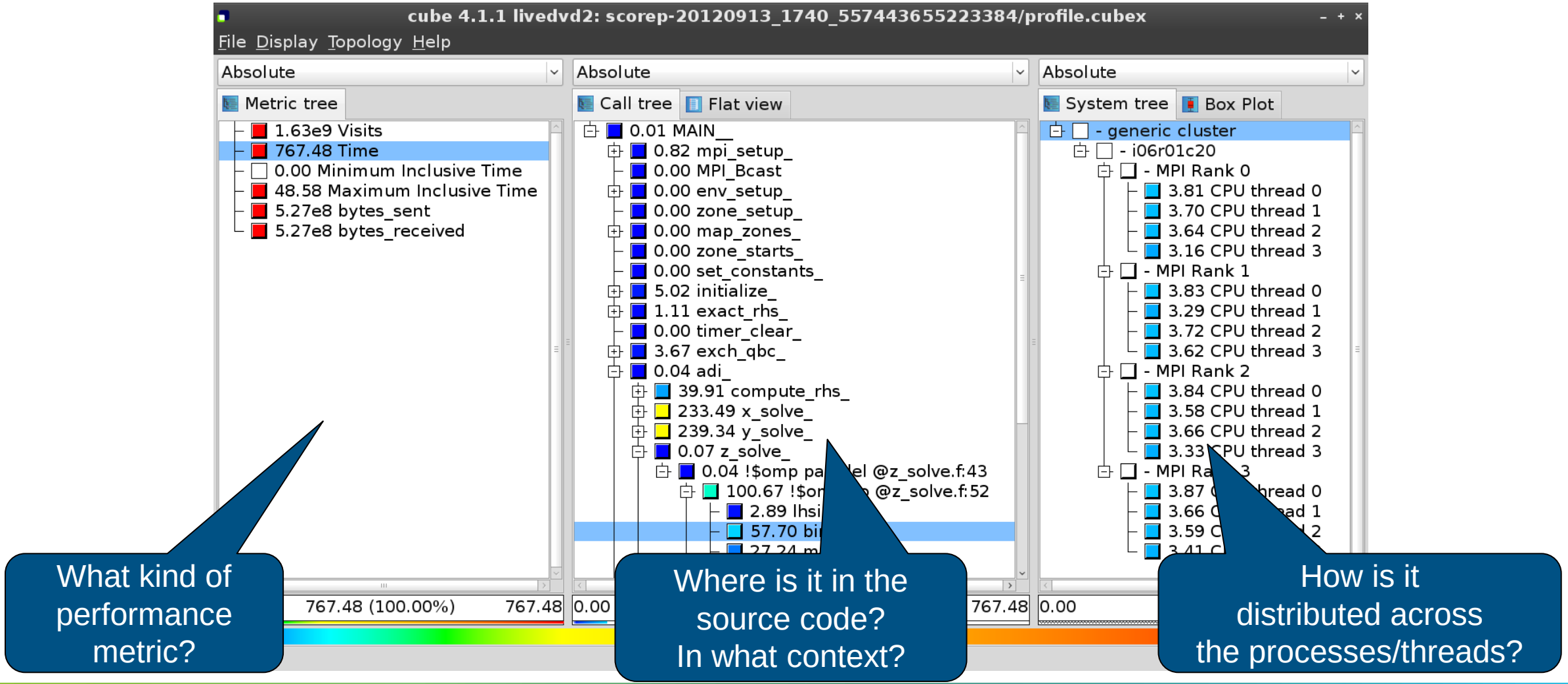
- Can be installed independently of Score-P, e.g., on laptop or desktop
- Latest release: CUBE 4.3.3 (December 2015)

Analysis presentation and exploration

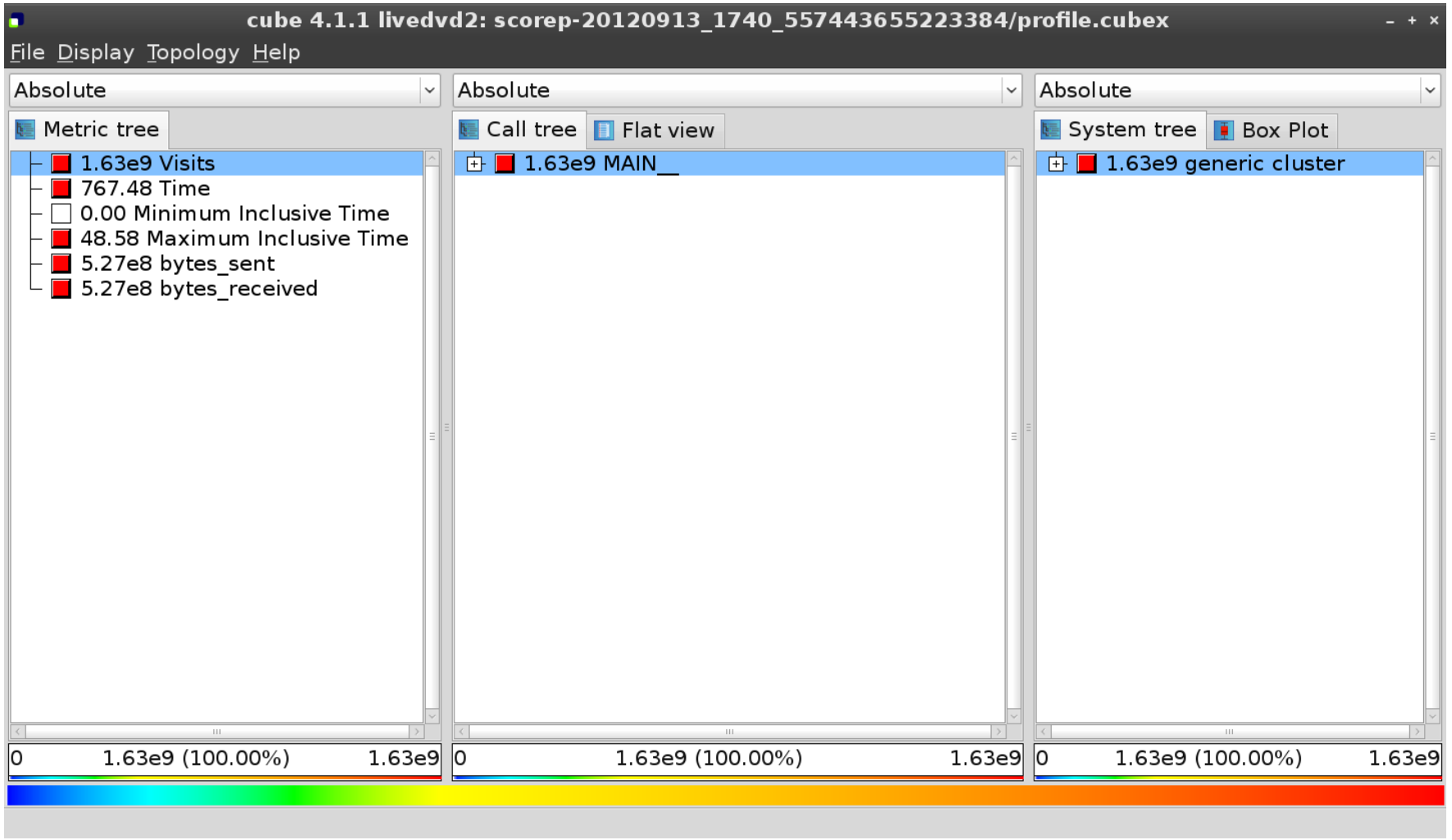
- Representation of values (severity matrix) on three hierarchical axes
  - Performance property (metric)
  - Call path (program location)
  - System location (process/thread)
- Three coupled tree browsers
- CUBE displays severities
  - As value: for precise comparison
  - As colour: for easy identification of hotspots
  - Inclusive value when closed & exclusive value when expanded
  - Customizable via display modes



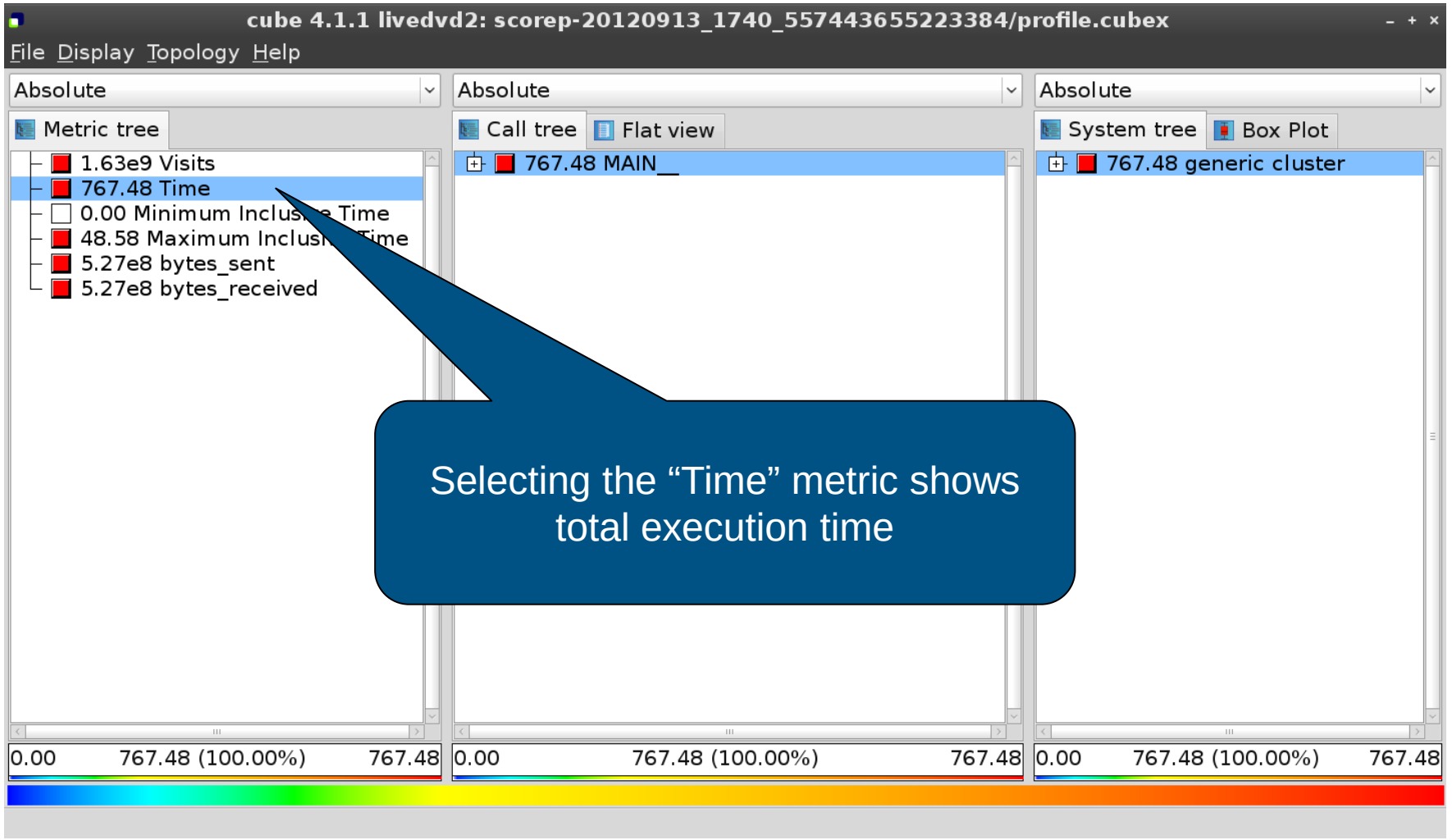
Analysis presentation



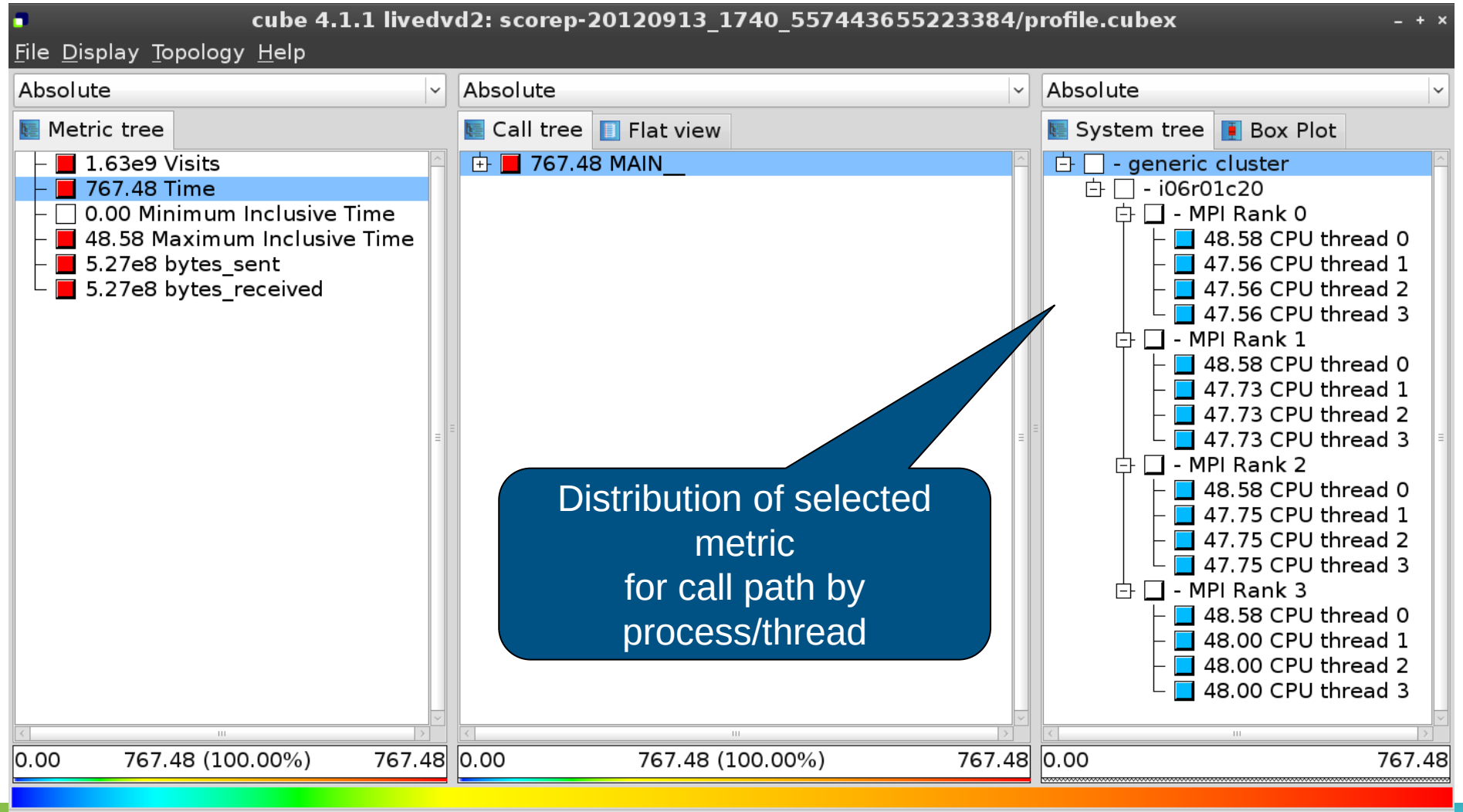
Analysis report exploration (opening view)



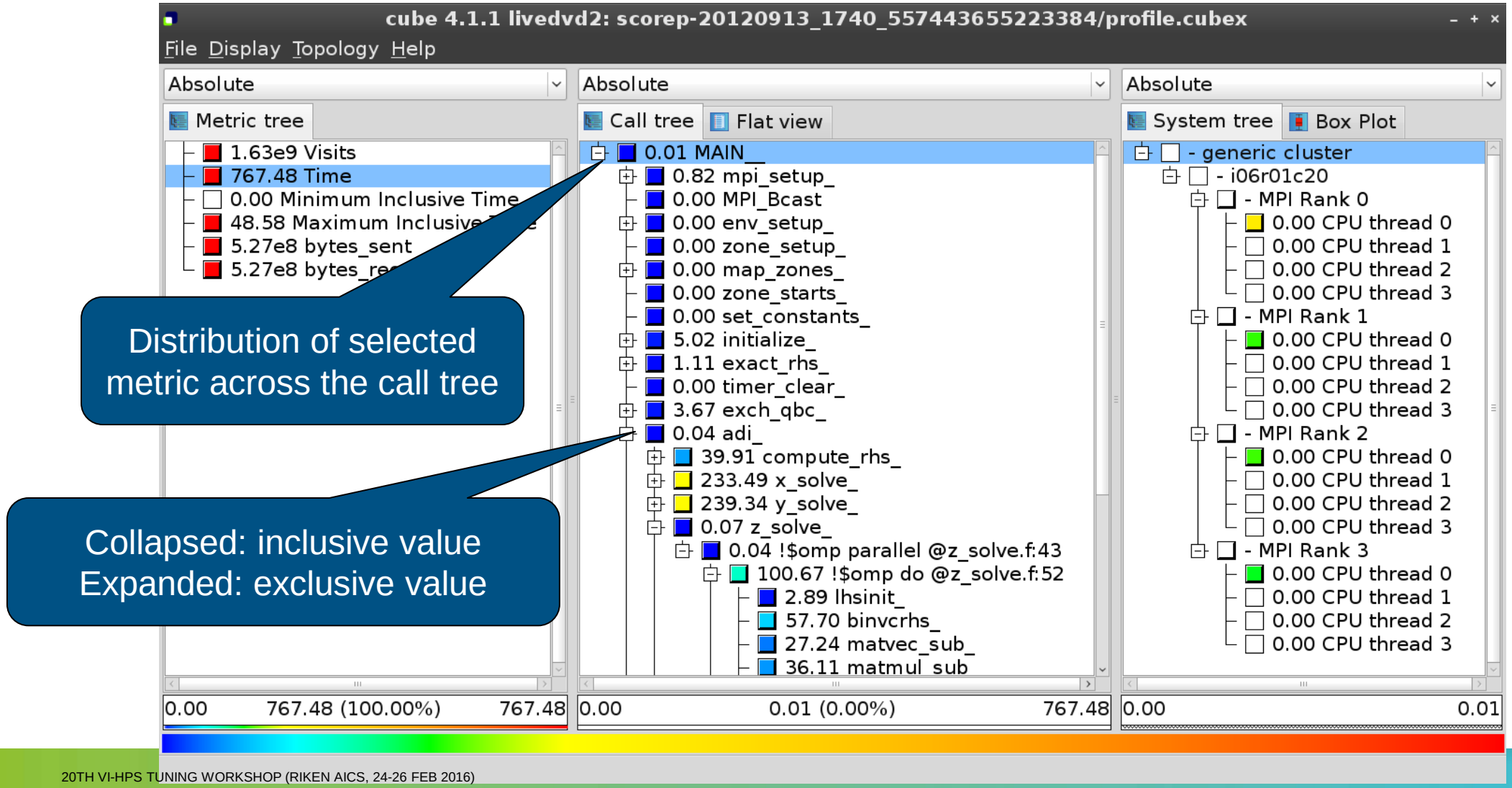
Metric selection



Expanding the system tree

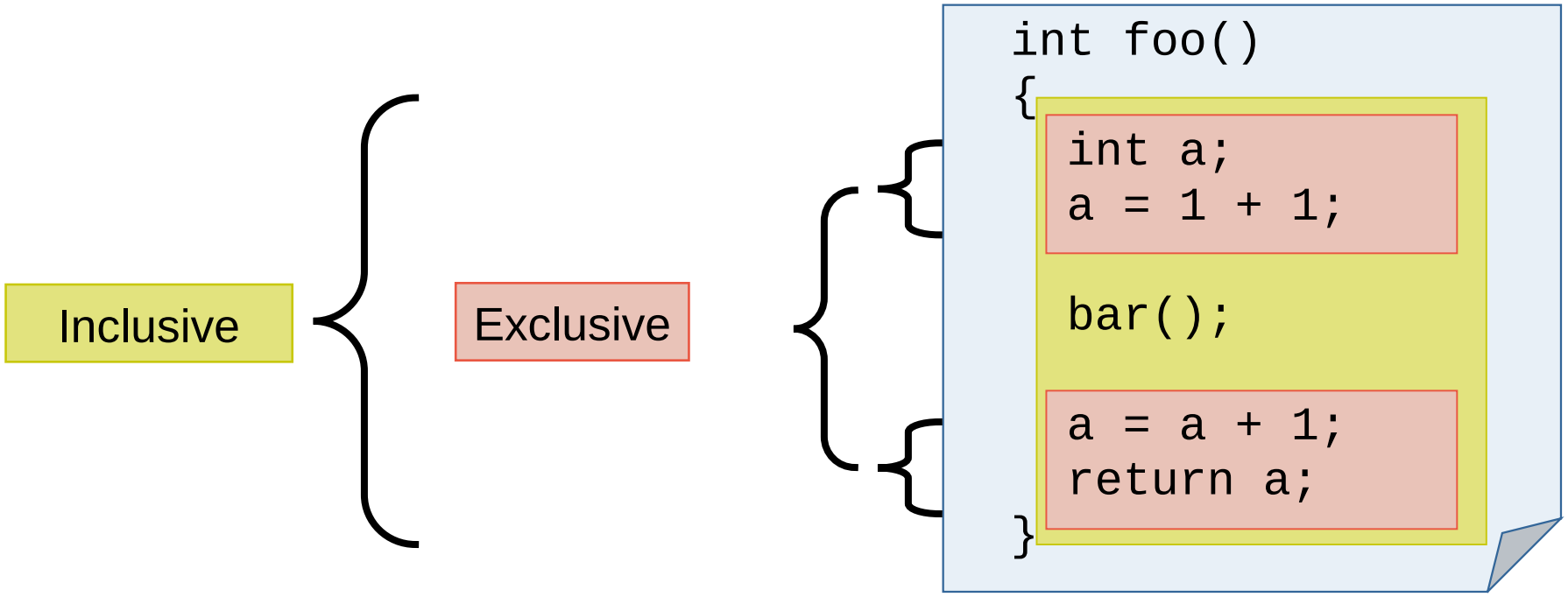


Expanding the call tree

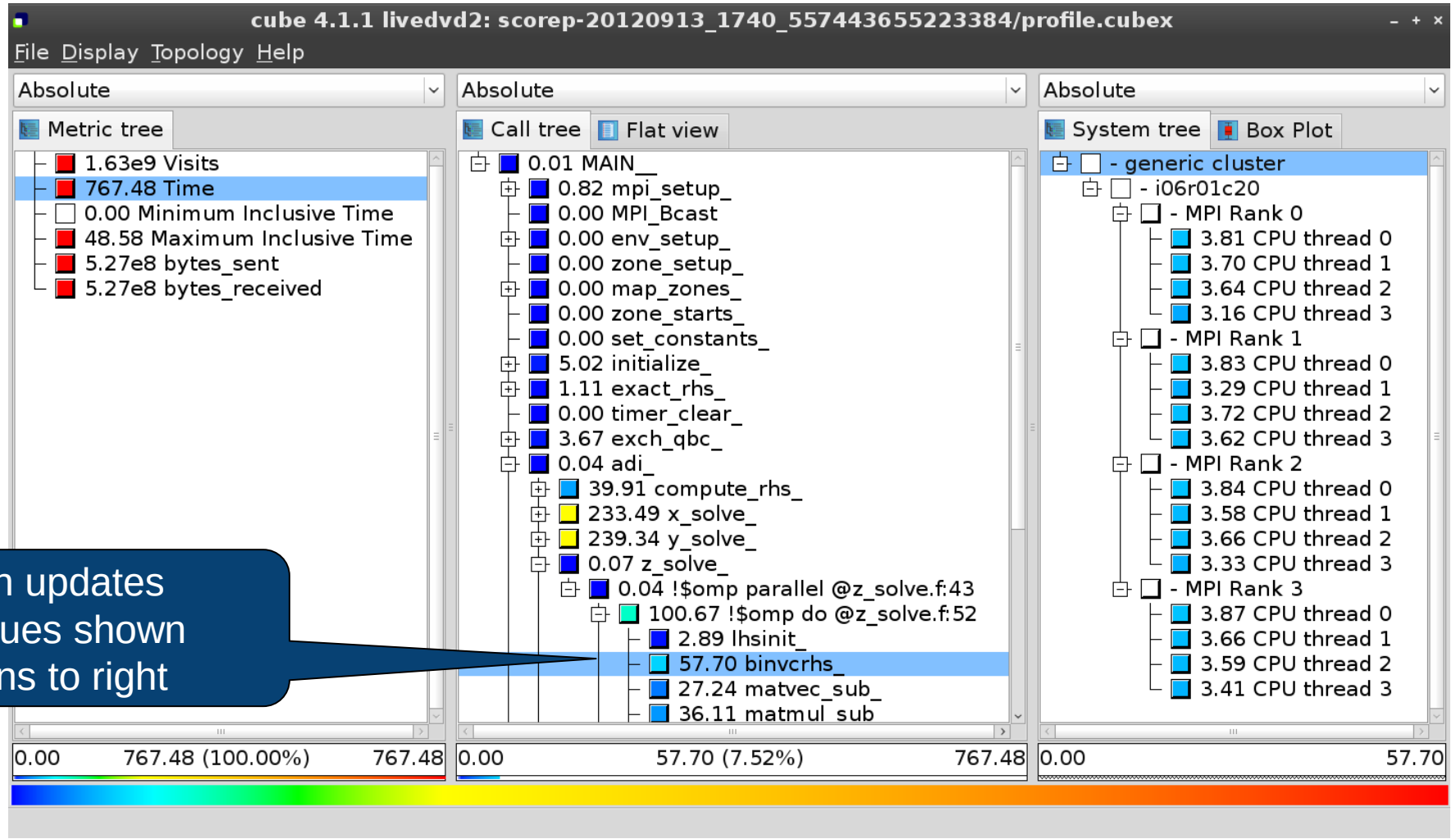


Inclusive vs. Exclusive values

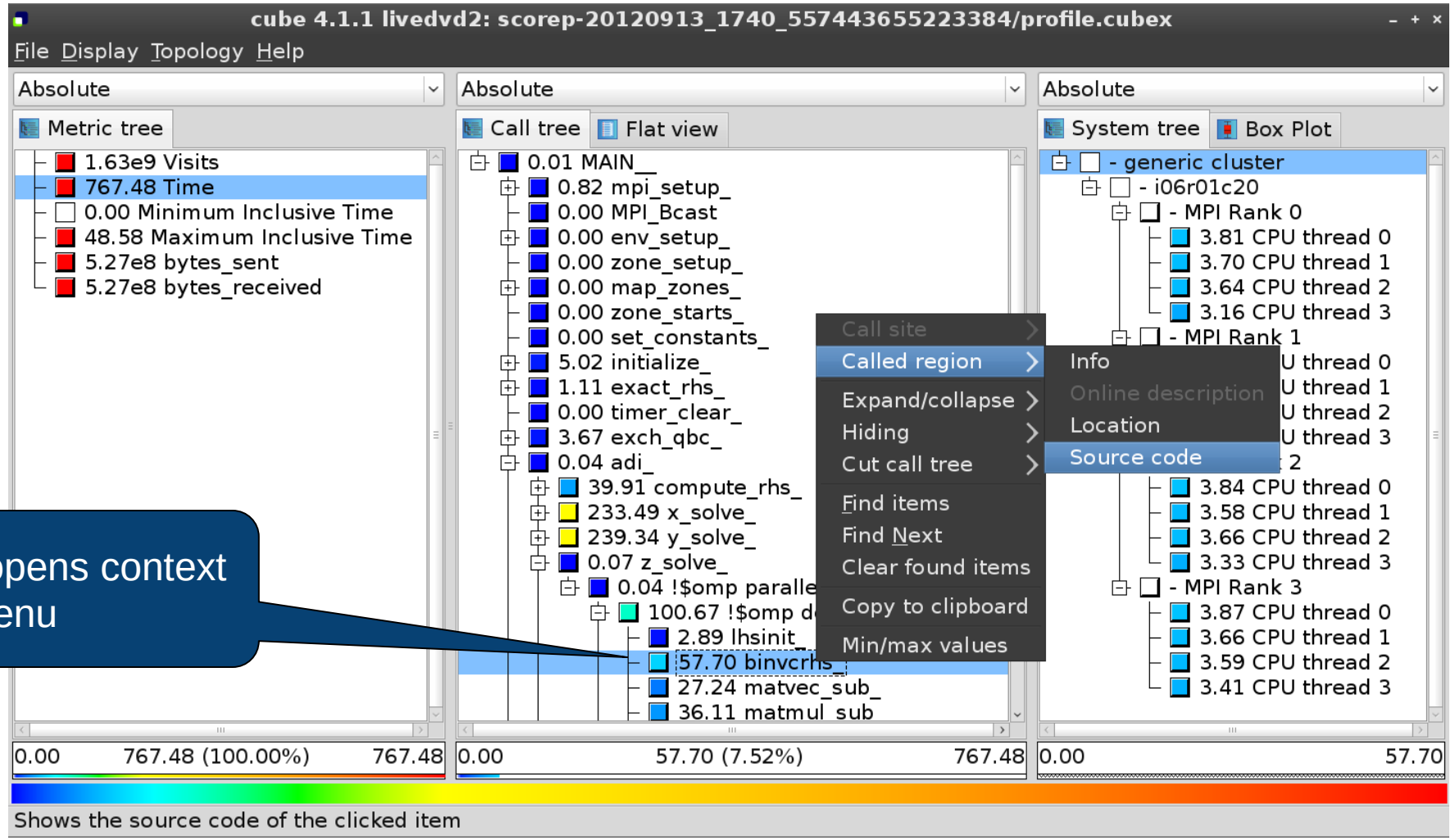
- Inclusive
  - Information of all sub-elements aggregated into single value
- Exclusive
  - Information cannot be subdivided further



Selecting a call path

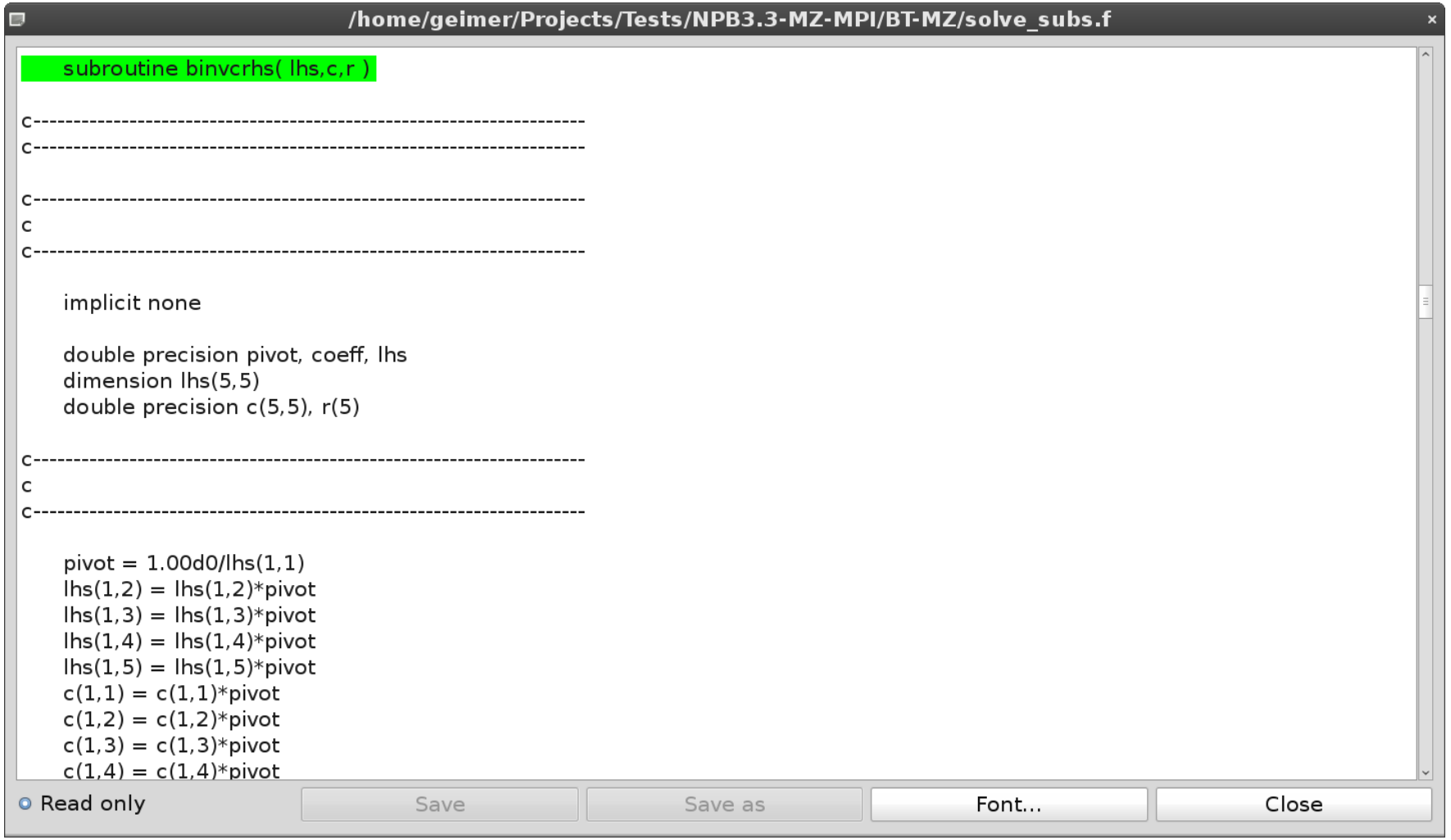


Source-code view via context menu

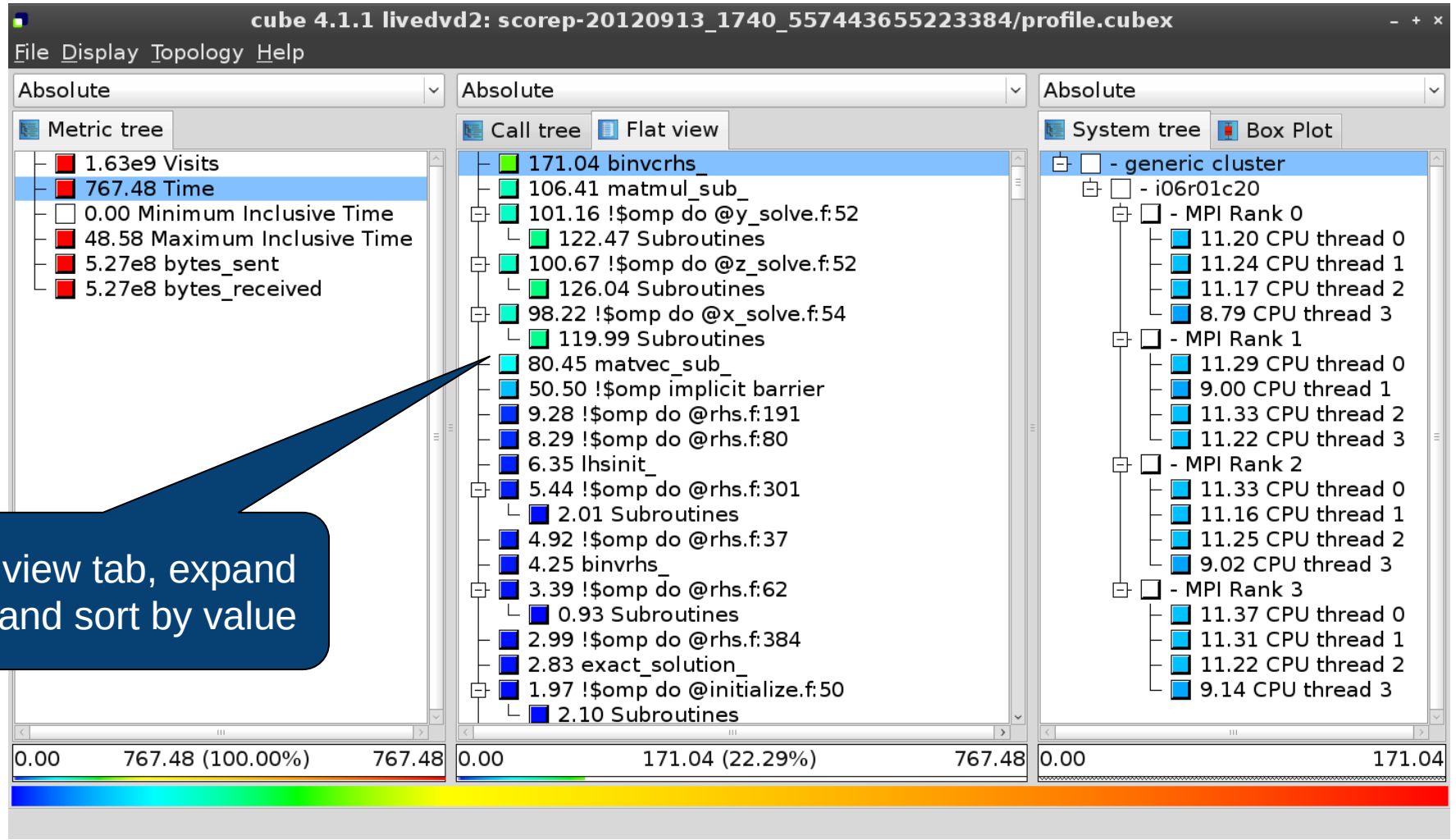


Right-click opens context menu

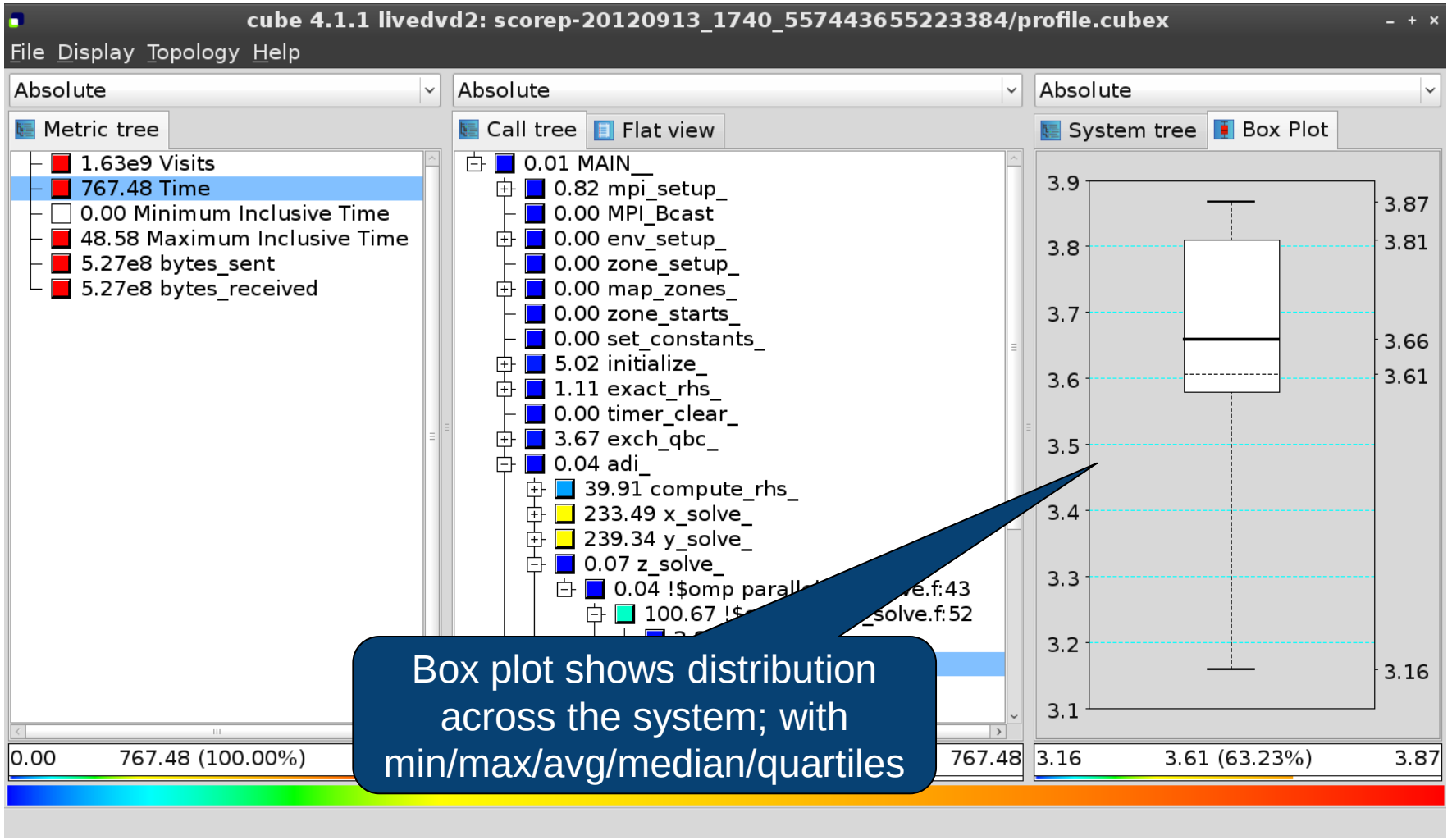
Source-code view



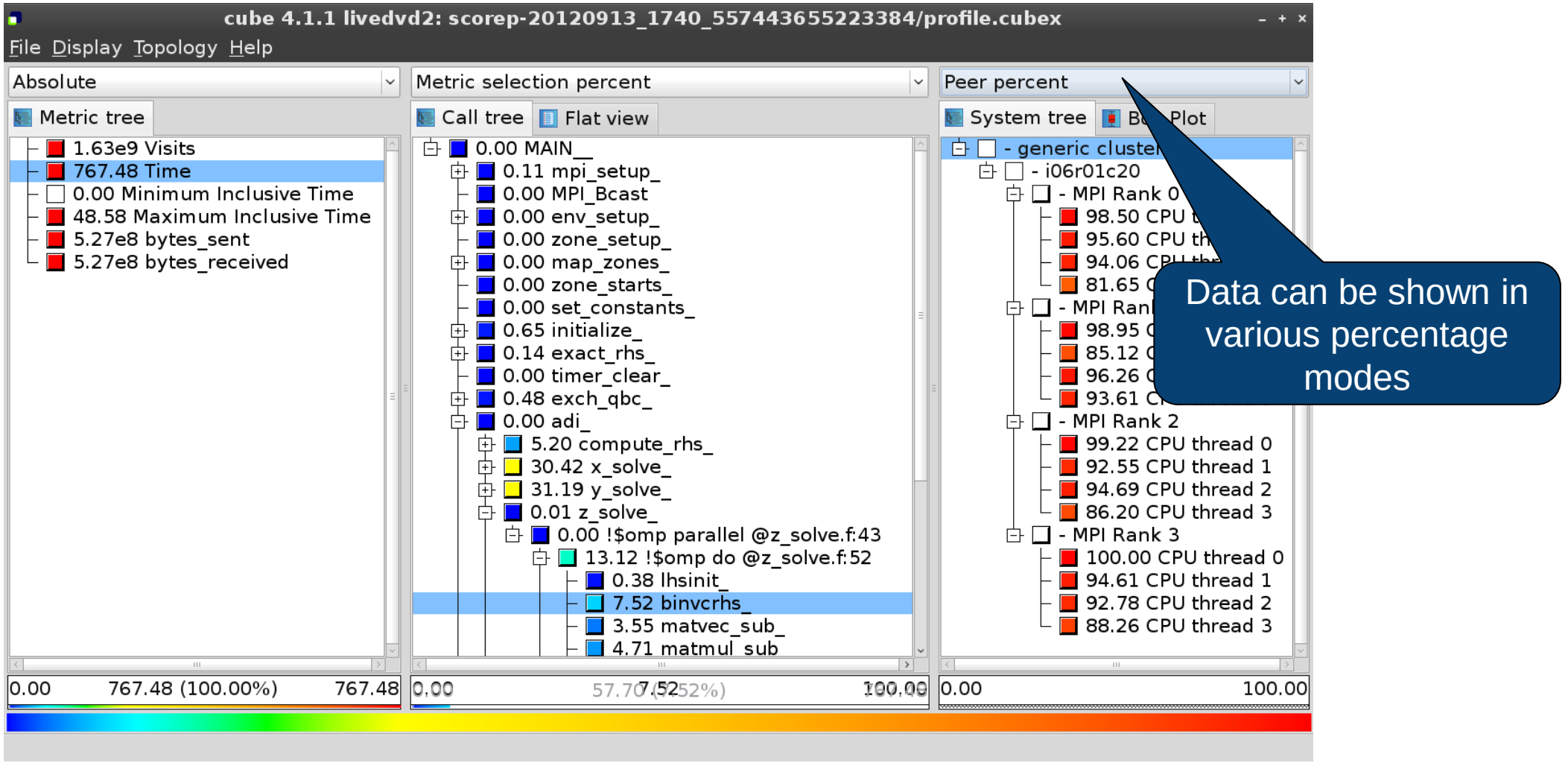
Flat profile view



Box plot view



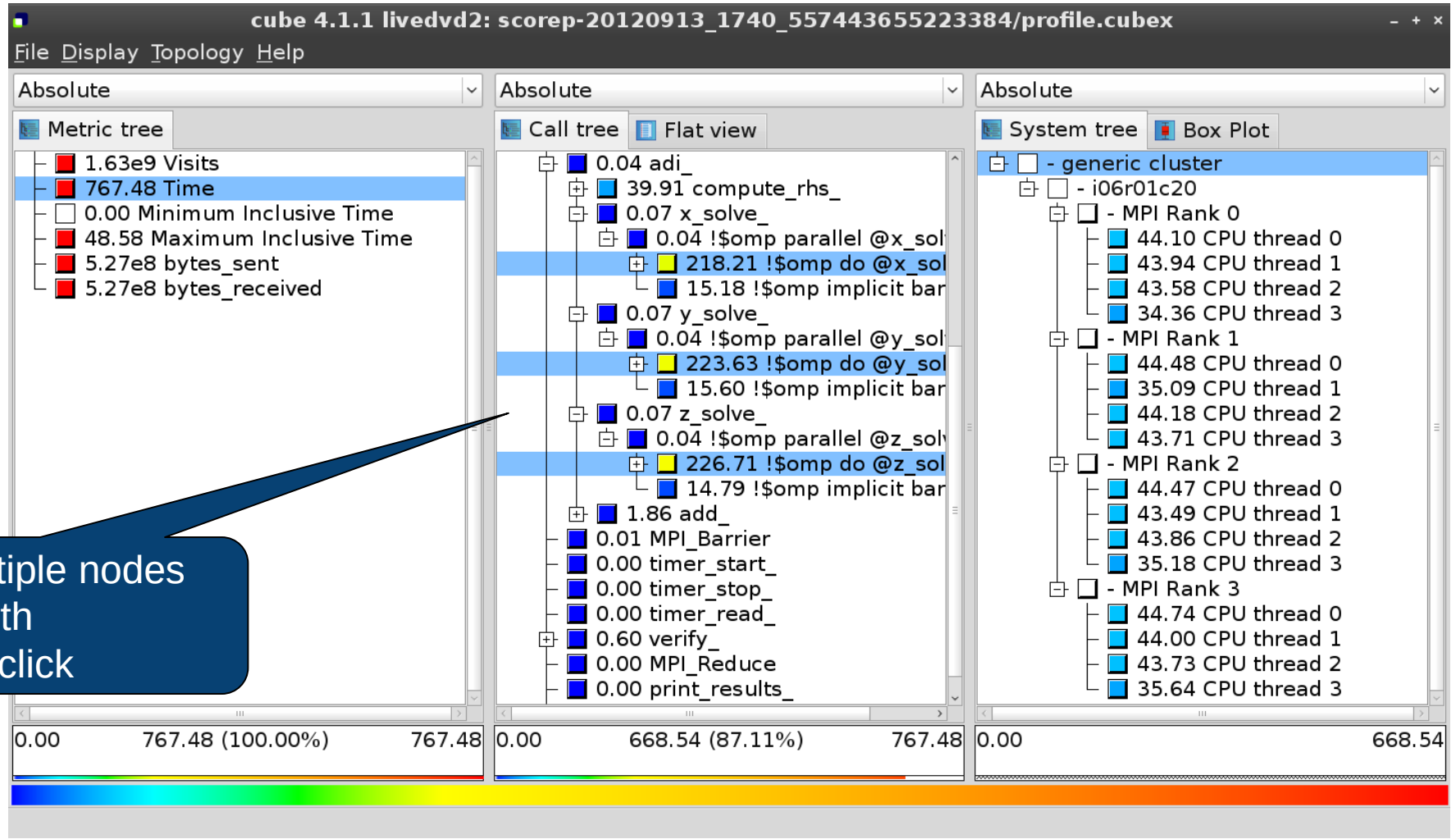
Alternative display modes



Important display modes

- Absolute
  - Absolute value shown in seconds/bytes/counts
- Selection percent
  - Value shown as percentage w.r.t. the selected node "on the left" (metric/call path)
- Peer percent (system tree only)
  - Value shown as percentage relative to the maximum peer value

Multiple selection



Select multiple nodes with Ctrl-click

Derived metrics in Cube

- Value of the derived metric is not stored, but **calculated** on-the-fly
- One defines an CubePL expression, e.g.:

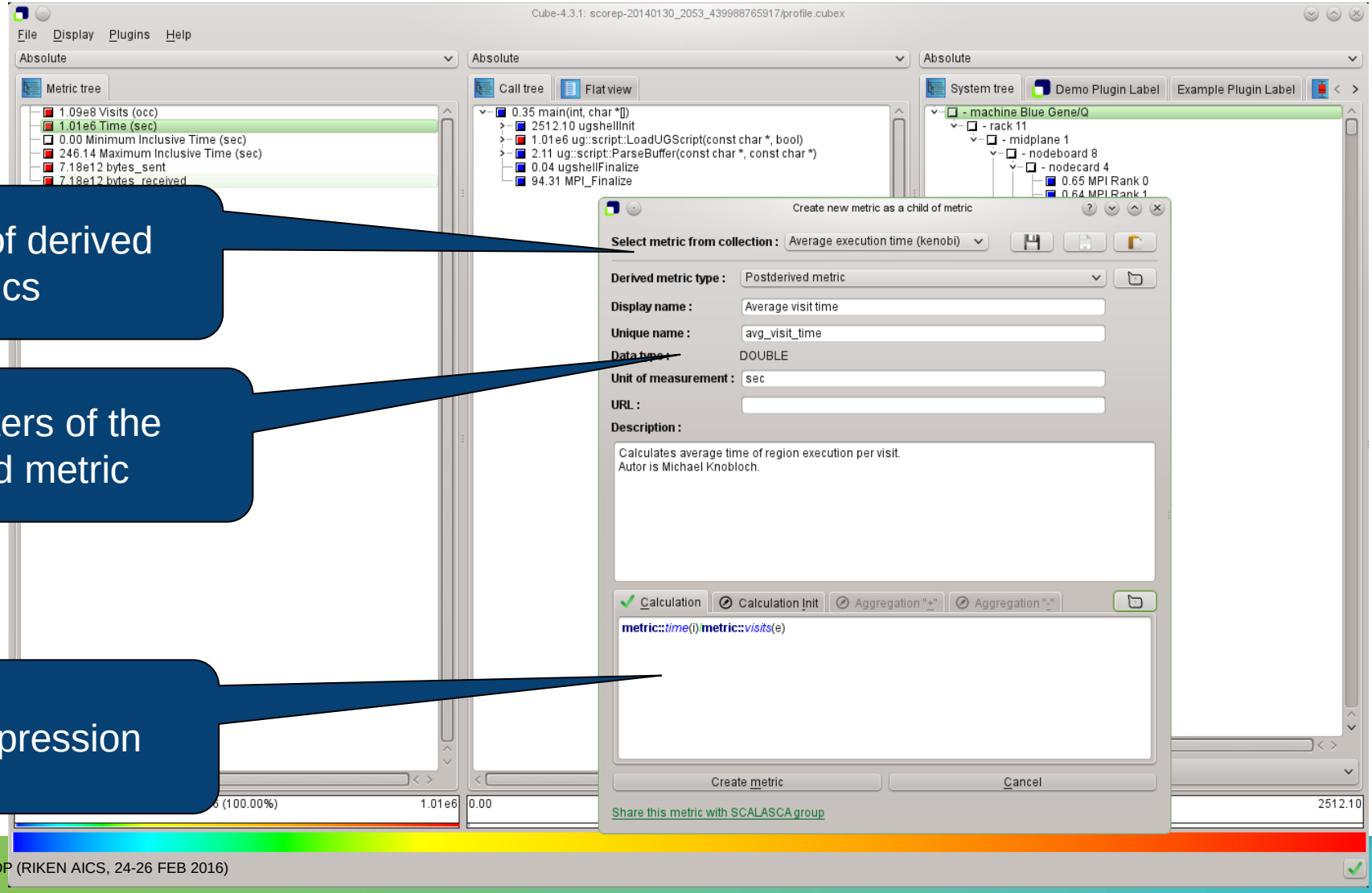
  metric::time(i) / metric::visits(e)
- Types of derived metrics:
  - **Prederived**: evaluation of the CubePL expression is done before the aggregation
  - **Postderived**: evaluation of the CubePL expression is performed after the aggregation

- Examples:
  - “Average execution time” Postderived metric with an expression:

    metric::time(i) / metric::visits(e)
  - “Number of FLOP per second” Postderived metric with an expression:

    metric::FLOP() / metric::time()

Derived metrics in Cube GUI

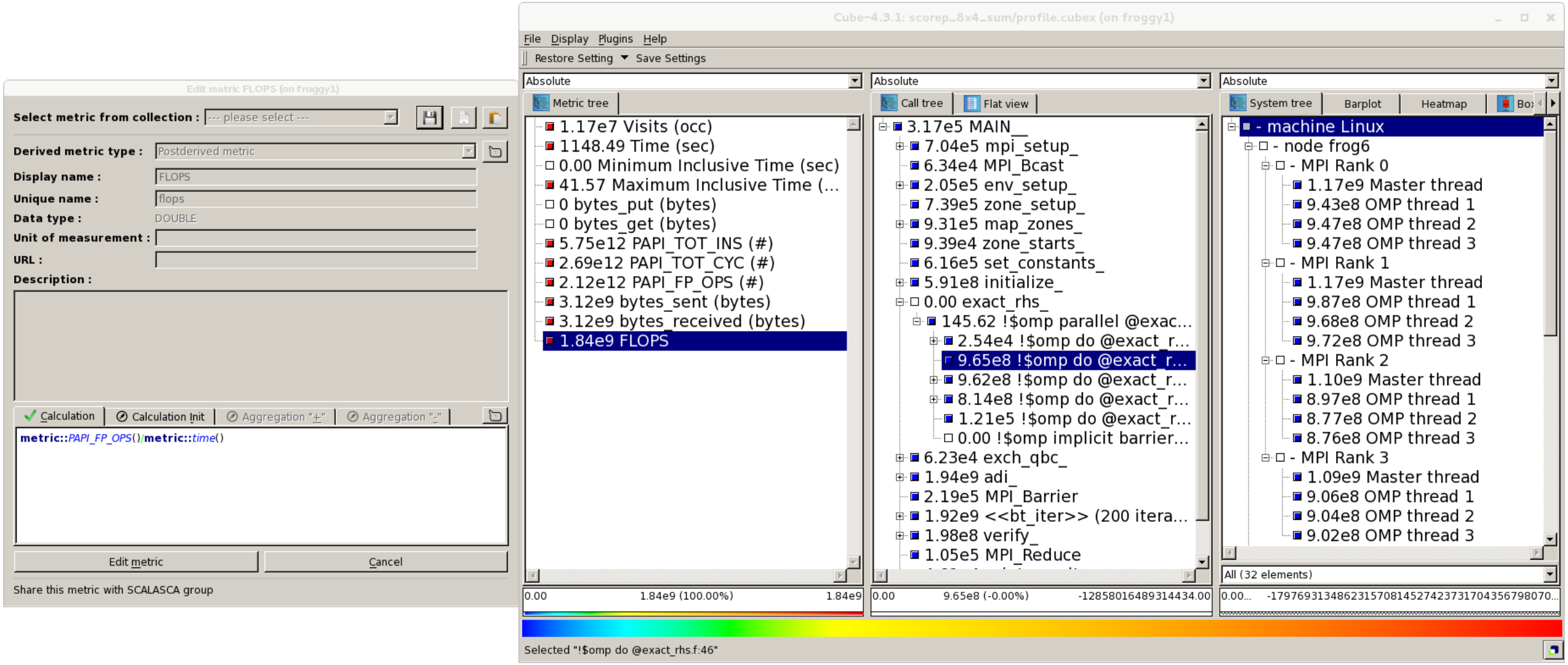


Collection of derived metrics

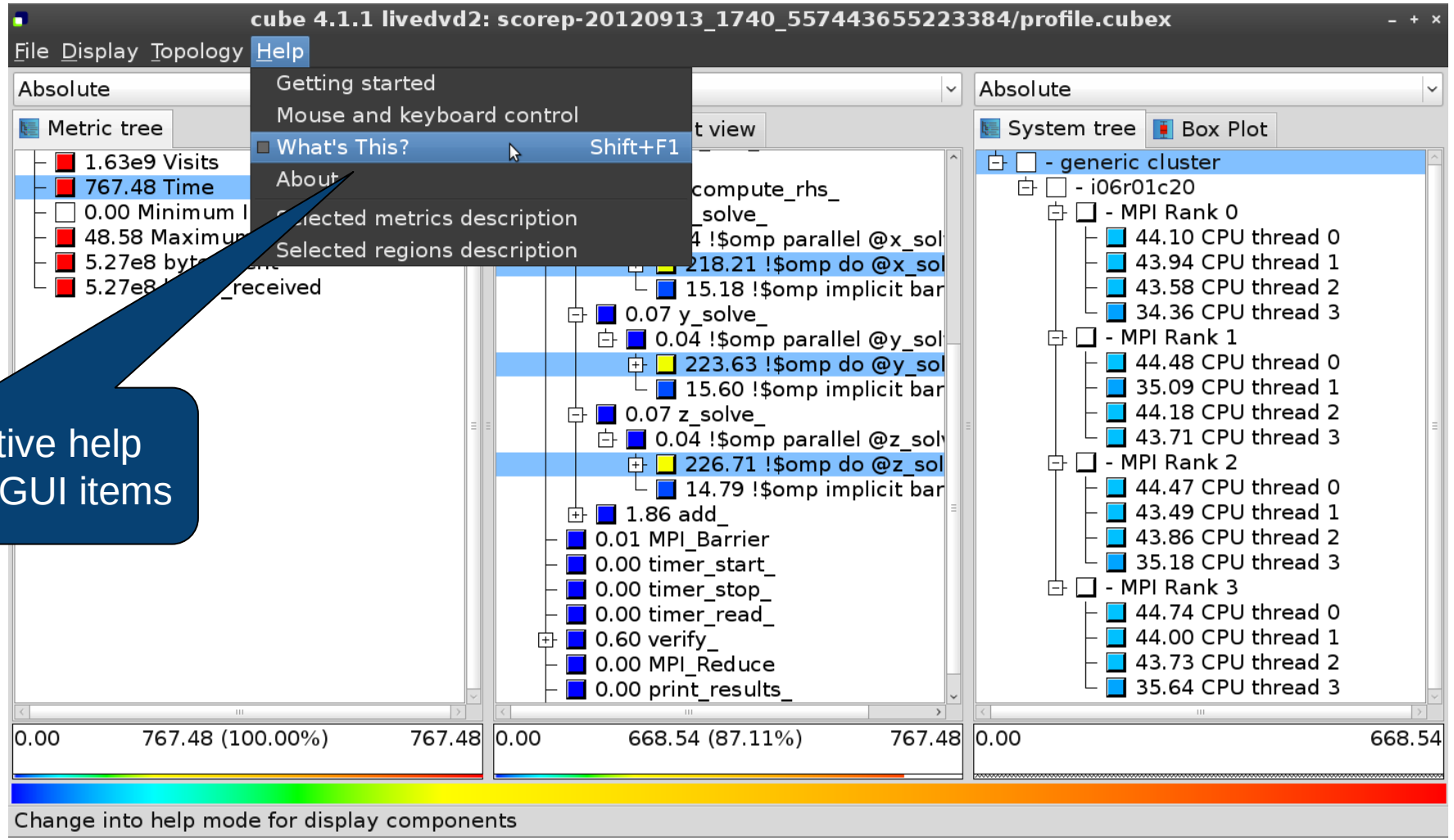
Parameters of the derived metric

CubePL expression

Example derived metric FLOPS based on PAPI_FP_OPS and time



Context-sensitive help



Context-sensitive help available for all GUI items

CUBE algebra utilities

- Extracting solver sub-tree from analysis report

```
% cube_cut  -r '<<ITERATION>>'  scorep_bt-mz_B_8x8_sum/profile.cubex
Writing cut.cubex... done.
```

- Calculating difference of two reports

```
% cube_diff  scorep_bt-mz_B_8x8_sum/profile.cubex  cut.cubex
Writing diff.cubex... done.
```

- Additional utilities for merging, calculating mean, etc.
- Default output of cube_utility is a new report utility.cubex
- Further utilities for report scoring & statistics
- Run utility with “-h” (or no arguments) for brief usage info

Loop Unrolling

- Show time dependent behavior by unrolling iterations

- Preparations:
  - Mark loops by using Score-P user instrumentation in your source code

```
SCOREP_USER_REGION_BEGIN( scorep_bt_loop, "<<bt_iter>>", SCOREP_USER_REGION_TYPE_DYNAMIC )
```

- Result in the CUBE profile:
  - Iterations shown as separate call trees

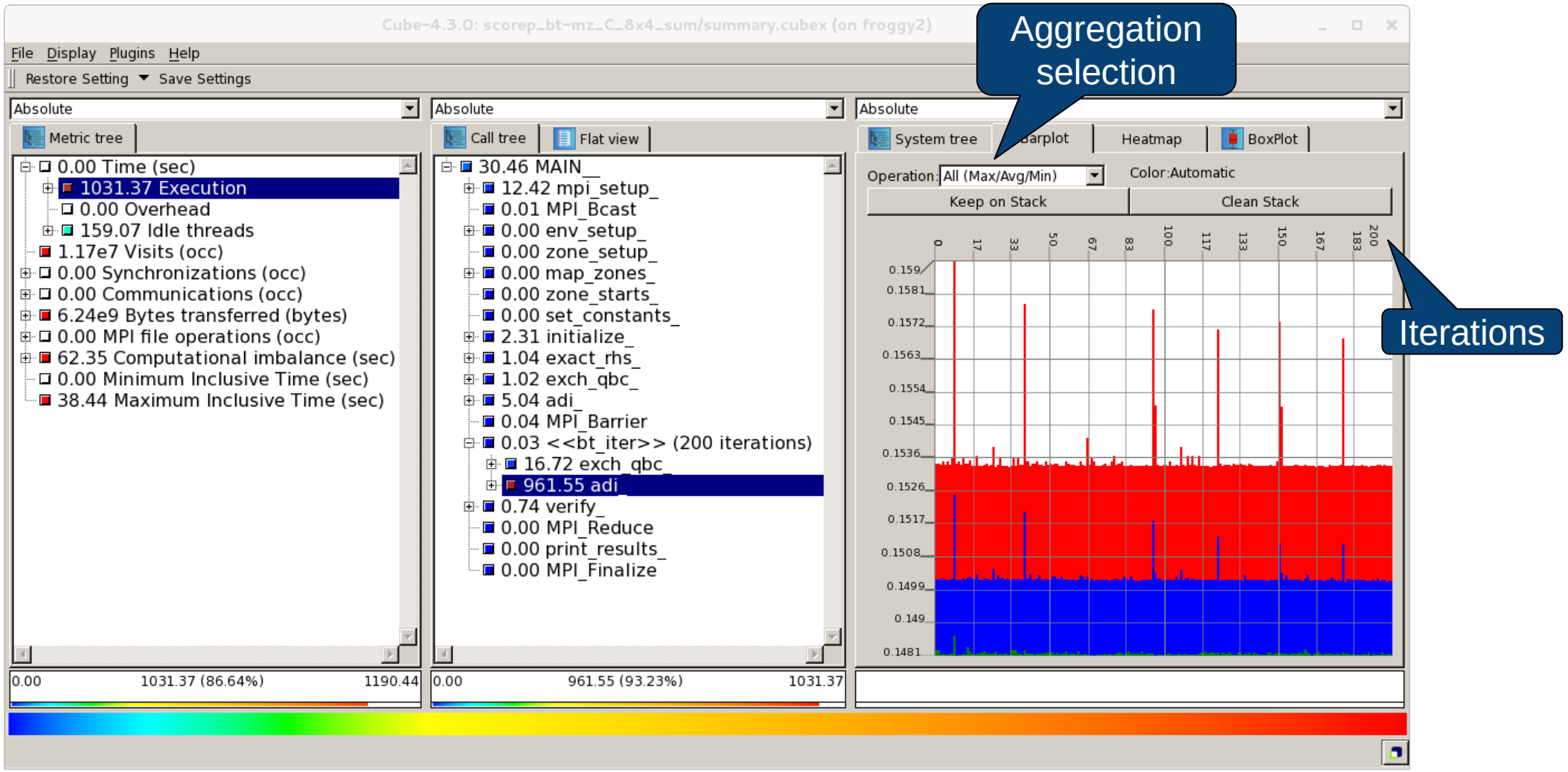
➢Useful for checking results for specific iterations

or

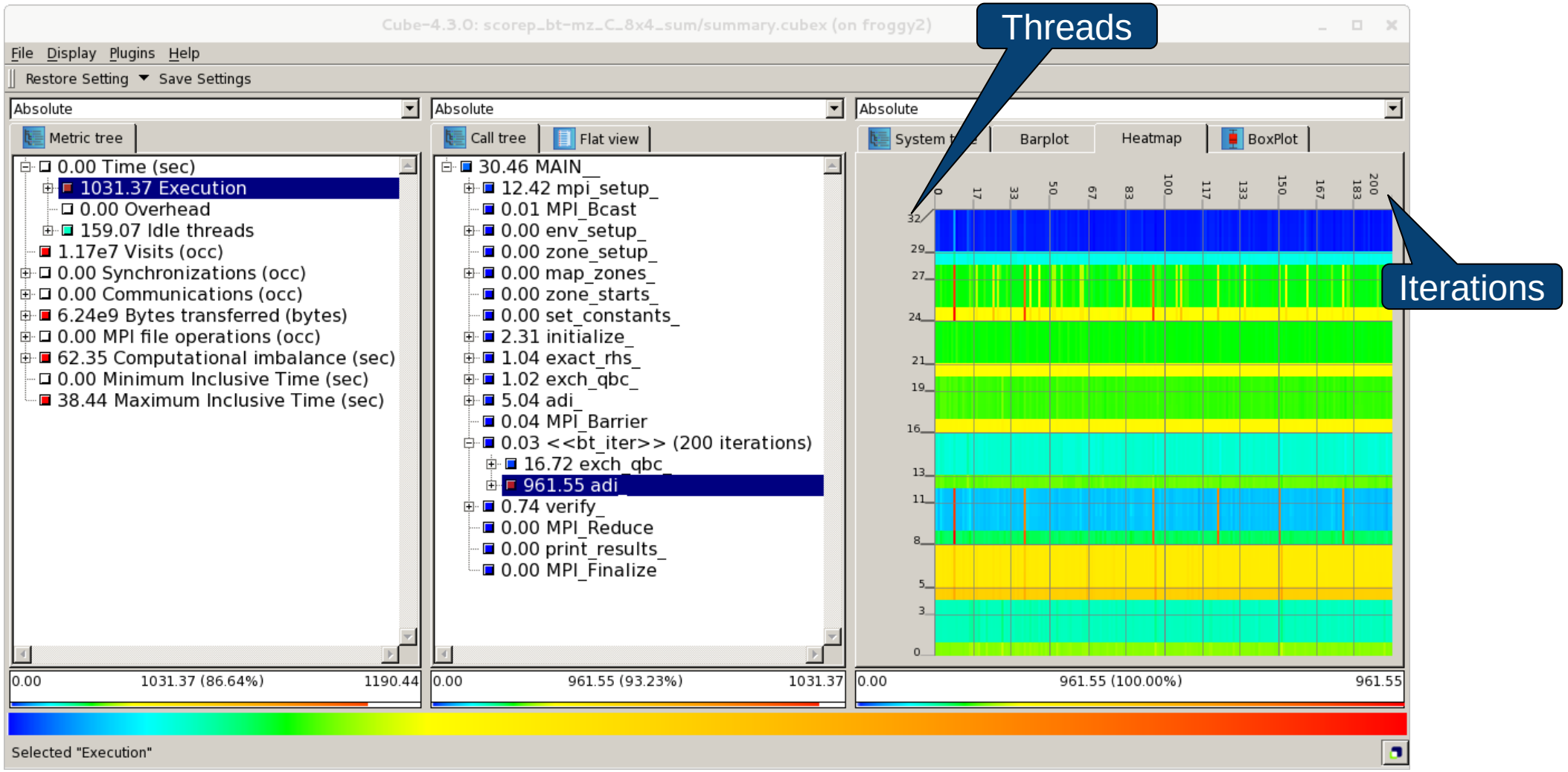
  - Select your user instrumented region and mark it as loop
  - Choose hide iterations

➢View the Barplot statistics or the (thread x iterations) Heatmap

Loop Unrolling - Barplot



Loop Unrolling – Heatmap



Further information

CUBE

- Parallel program analysis report exploration tools
  - Libraries for XML report reading & writing
  - Algebra utilities for report processing
  - GUI for interactive analysis exploration
- Available under New BSD open-source license
- Documentation & sources:
  - http://www.scalasca.org
- User guide also part of installation:
  - `cube-config --cube-dir`/share/doc/CubeGuide.pdf
- Contact:
  - mailto: scalasca@fz-juelich.de