

# VI-HPS



## Analysis report examination with CUBE

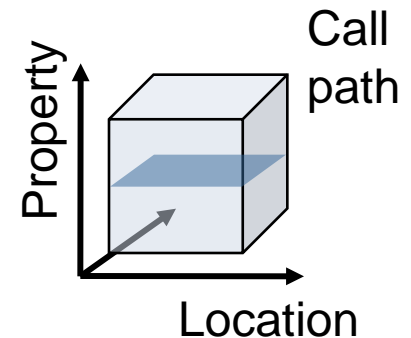
Brian Wylie

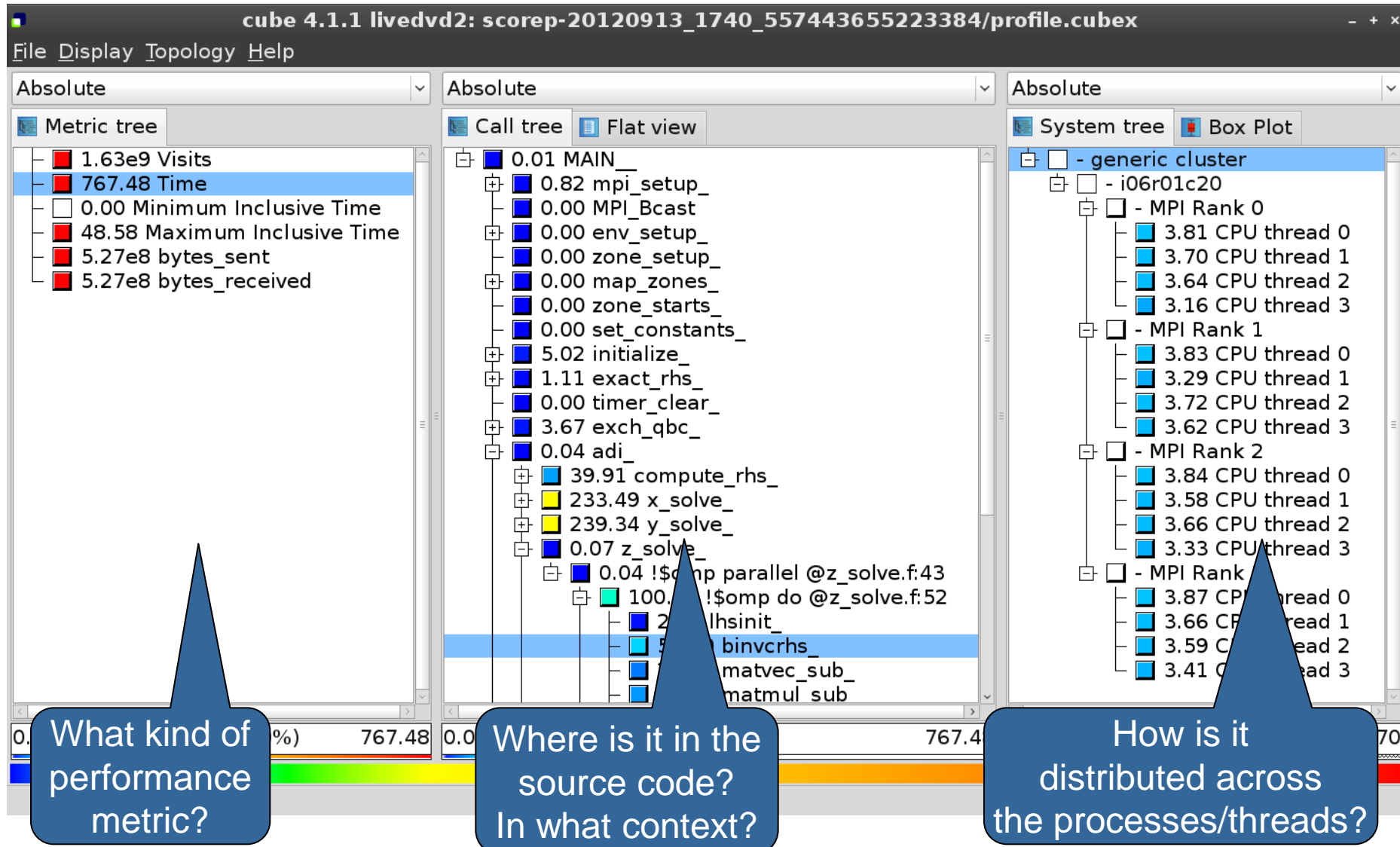
Jülich Supercomputing Centre



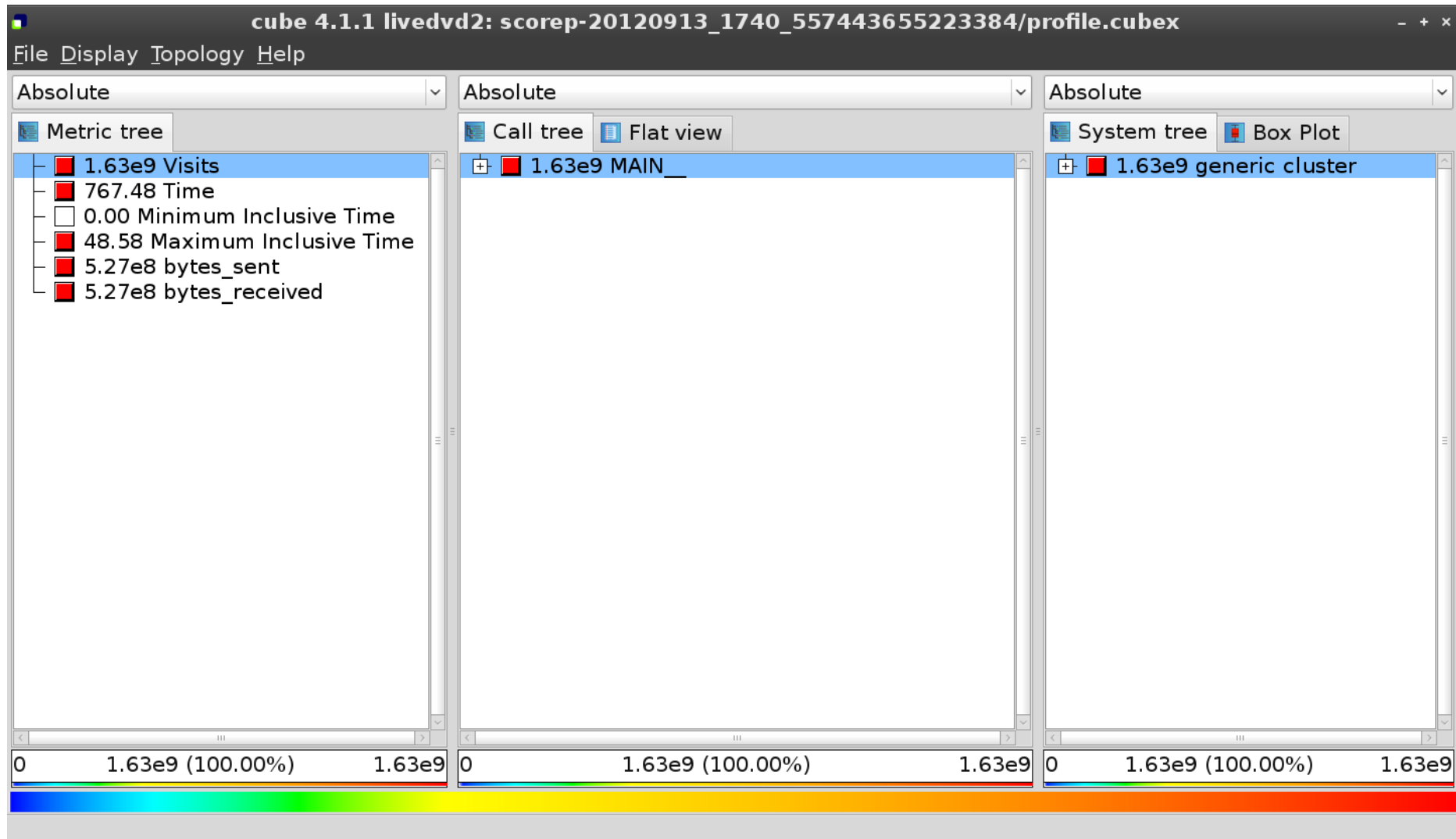
- Parallel program analysis report exploration tools
  - Libraries for XML report reading & writing
  - Algebra utilities for report processing
  - GUI for interactive analysis exploration
    - requires Qt4
- Originally developed as part of Scalasca toolset
- Now available as a separate component
  - Can be installed independently of Scalasca or Score-P, e.g., on laptop or desktop
  - Latest release: CUBE 4.2.3 (June 2014)

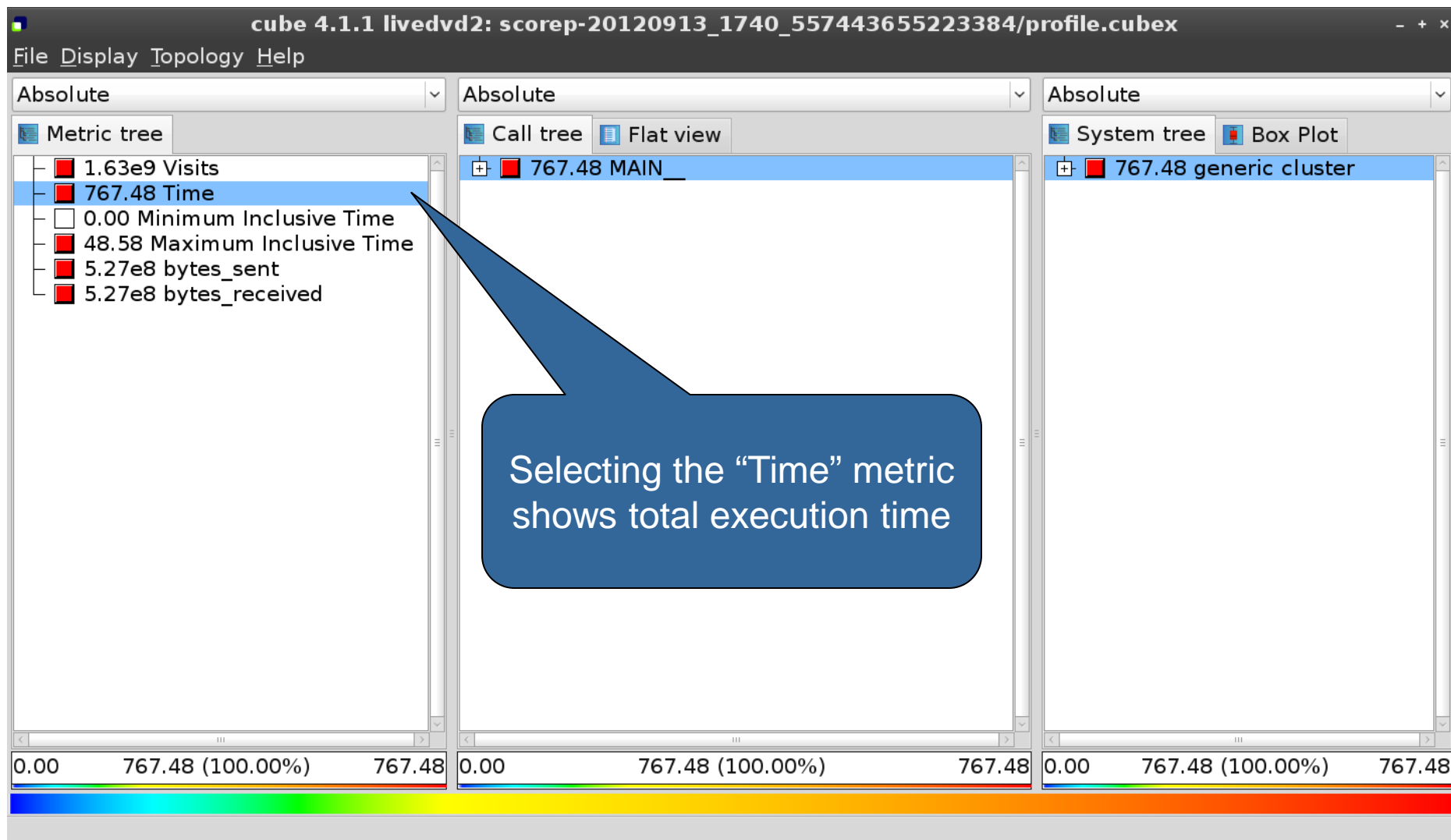
- Representation of values (severity matrix) on three hierarchical axes
  - Performance property (metric)
  - Call path (program location)
  - System location (process/thread)
- Three coupled tree browsers
- CUBE displays severities
  - As value: for precise comparison
  - As colour: for easy identification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

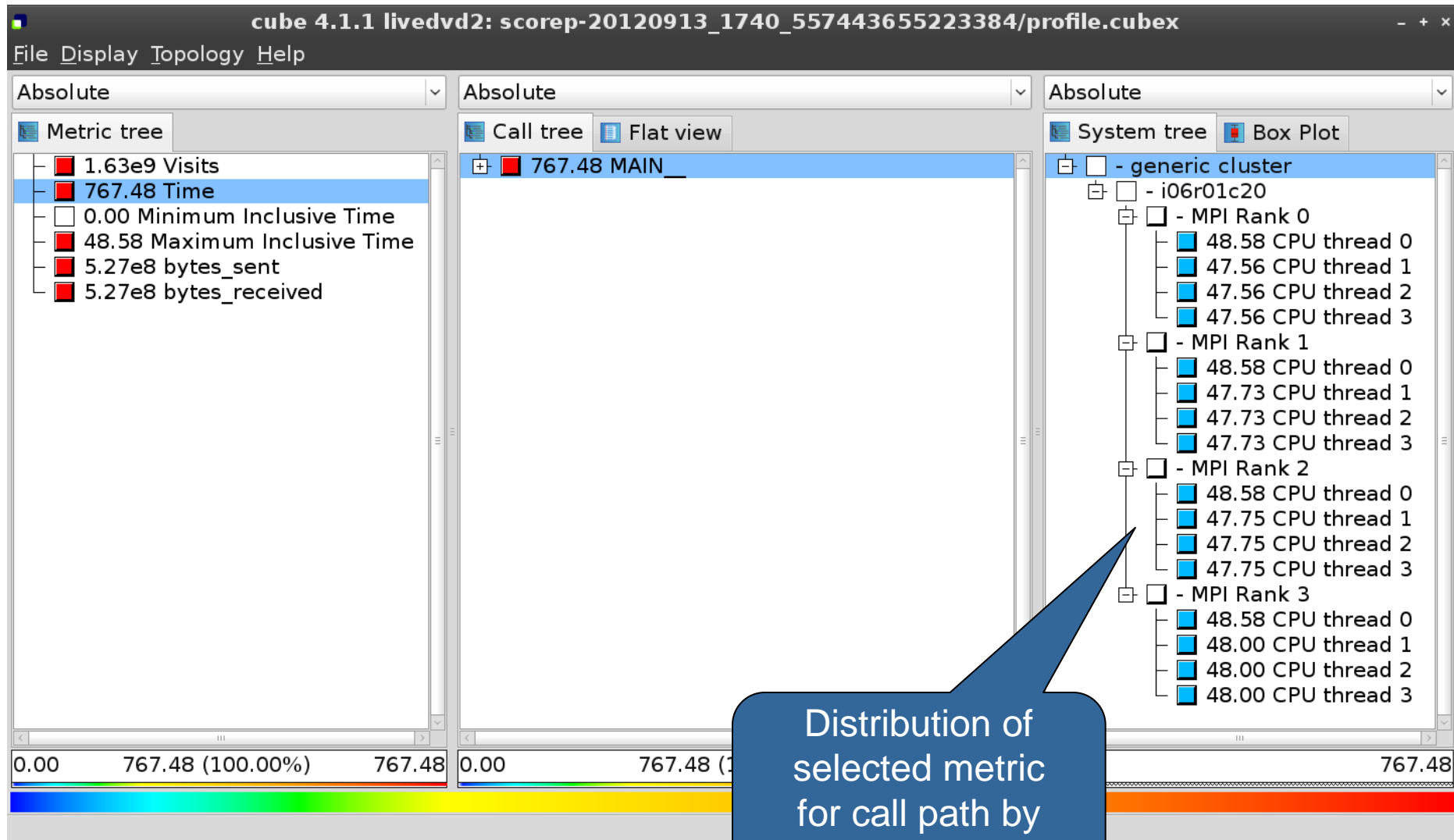




# Analysis report exploration (opening view)







**Metric tree**

- 1.63e9 Visits
- 767.48 Time
- 0.00 Minimum Inclusive Time
- 48.58 Maximum Inclusive Time
- 5.27e8 bytes\_sent
- 5.27e8 bytes\_received

**Call tree**

- 0.01 MAIN\_ (Collapsed: inclusive value)
  - 0.82 mpi\_setup\_ (Expanded: exclusive value)
  - 0.00 MPI\_Bcast
  - 0.00 env\_setup\_
  - 0.00 zone\_setup\_
  - 0.00 map\_zones\_
  - 0.00 zone\_starts\_
  - 0.00 set\_constants\_
  - 5.02 initialize\_
  - 1.11 exact\_rhs\_
  - 0.00 timer\_clear\_
  - 3.67 exch\_qbc\_
  - 0.04 adi\_
    - 39.91 compute\_rhs\_
    - 233.49 x\_solve\_
    - 239.34 y\_solve\_
    - 0.07 z\_solve\_
      - 0.04 !\$omp parallel @z\_solve.f:43
        - 100.67 !\$omp do @z\_solve.f:52
          - 2.89 lhsinit\_
          - 57.70 binvcrhs\_
          - 27.24 matvec\_sub\_
          - 36.11 matmul sub

0.01 (0.00%) 767.48

**System tree**

- generic cluster
  - i06r01c20
    - MPI Rank 0
      - 0.00 CPU thread 0
      - 0.00 CPU thread 1
      - 0.00 CPU thread 2
      - 0.00 CPU thread 3
    - MPI Rank 1
      - 0.00 CPU thread 0
      - 0.00 CPU thread 1
      - 0.00 CPU thread 2
      - 0.00 CPU thread 3
    - MPI Rank 2
      - 0.00 CPU thread 0
      - 0.00 CPU thread 1
      - 0.00 CPU thread 2
      - 0.00 CPU thread 3
    - MPI Rank 3
      - 0.00 CPU thread 0
      - 0.00 CPU thread 1
      - 0.00 CPU thread 2
      - 0.00 CPU thread 3

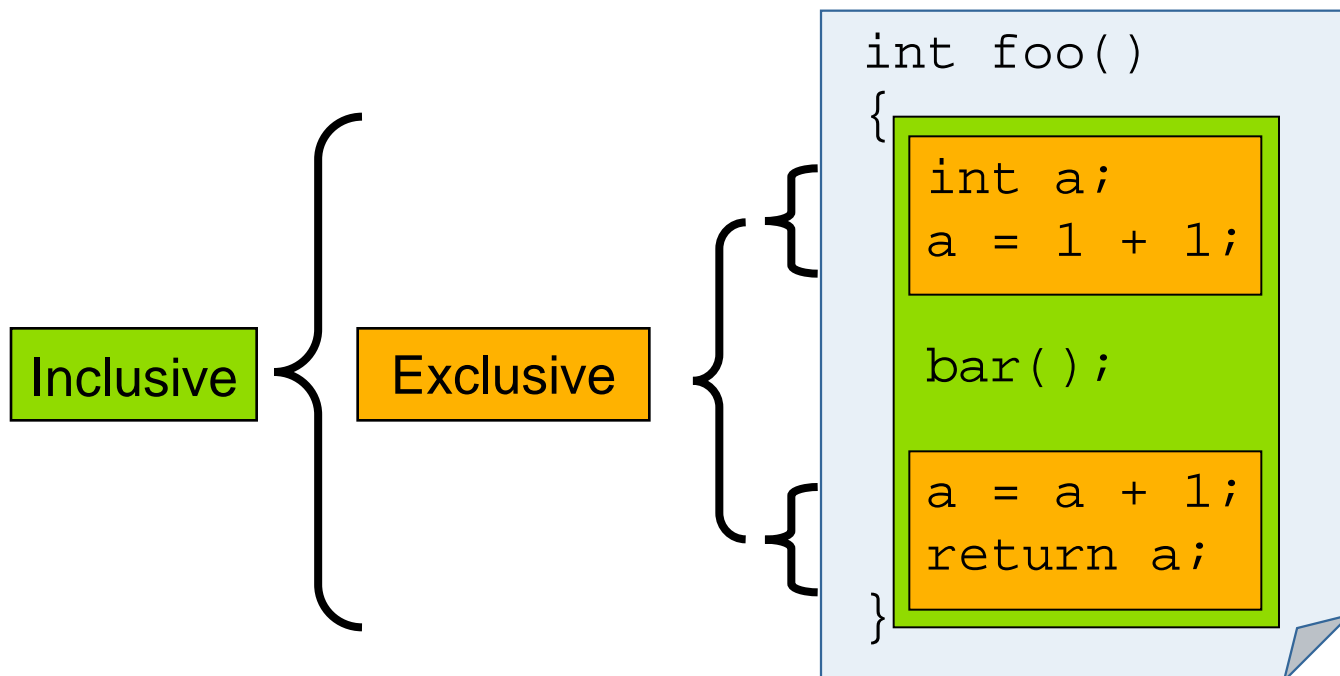
0.00 0.01

**Callouts:**

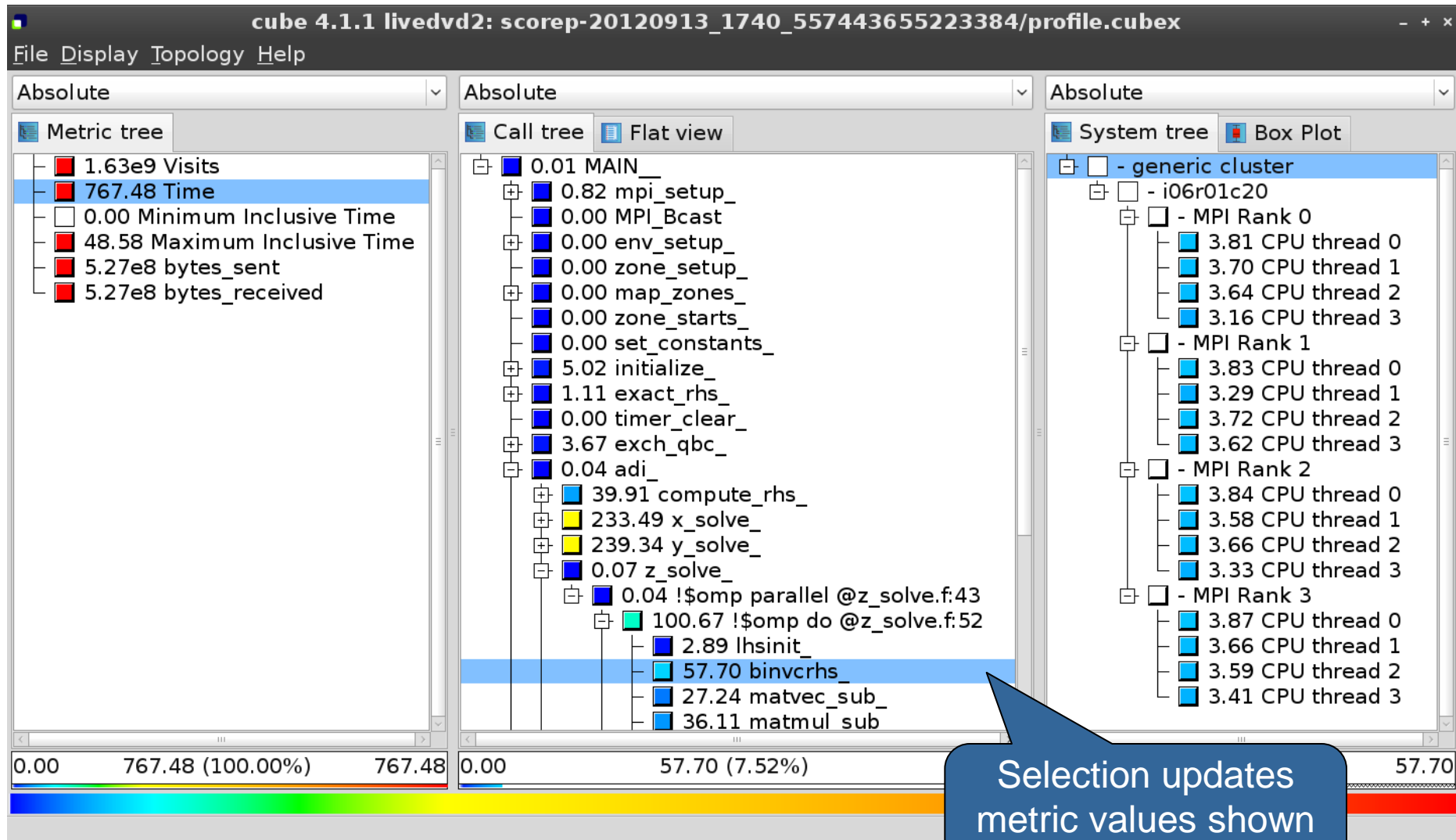
- Distribution of selected metric across the call tree
- Collapsed: inclusive value
- Expanded: exclusive value



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



# Selecting a call path



The screenshot shows the 'cube 4.1.1 livedvd2' interface with three main panels: 'Metric tree', 'Call tree', and 'System tree'. The 'Call tree' panel is in 'Call tree' view and shows a hierarchical tree of function calls. A context menu is open over the '57.70 binvcrhs' node, with 'Source code' selected. A blue callout bubble points to the context menu with the text 'Right-click opens context menu'. The bottom of the interface shows a progress bar and a status bar with the text 'Shows the source code of the clicked item'.

cube 4.1.1 livedvd2: scorep-20120913\_1740\_557443655223384/profile.cubex

File Display Topology Help

Absolute Absolute Absolute

Metric tree Call tree Flat view System tree Box Plot

1.63e9 Visits  
767.48 Time  
0.00 Minimum Inclusive Time  
48.58 Maximum Inclusive Time  
5.27e8 bytes\_sent  
5.27e8 bytes\_received

0.01 MAIN\_  
0.82 mpi\_setup\_  
0.00 MPI\_Bcast  
0.00 env\_setup\_  
0.00 zone\_setup\_  
0.00 map\_zones\_  
0.00 zone\_starts\_  
0.00 set\_constants\_  
5.02 initialize\_  
1.11 exact\_rhs\_  
0.00 timer\_clear\_  
3.67 exch\_qbc\_  
0.04 adi\_  
39.91 compute\_rhs\_  
233.49 x\_solve\_  
239.34 y\_solve\_  
0.07 z\_solve\_  
0.04 !\$omp parallel  
100.67 !\$omp do  
2.89 lhsinit\_  
57.70 binvcrhs  
27.24 atvec\_sub\_  
matmul sub

- generic cluster  
- i06r01c20  
- MPI Rank 0  
3.81 CPU thread 0  
3.70 CPU thread 1  
3.64 CPU thread 2  
3.16 CPU thread 3  
- MPI Rank 1  
3.84 CPU thread 0  
3.58 CPU thread 1  
3.66 CPU thread 2  
3.33 CPU thread 3  
- MPI Rank 3  
3.87 CPU thread 0  
3.66 CPU thread 1  
3.59 CPU thread 2  
3.41 CPU thread 3

0.00 767.48 (100.00%) 767.48 767.48 0.00 57.70

Shows the source code of the clicked item

Right-click opens context menu

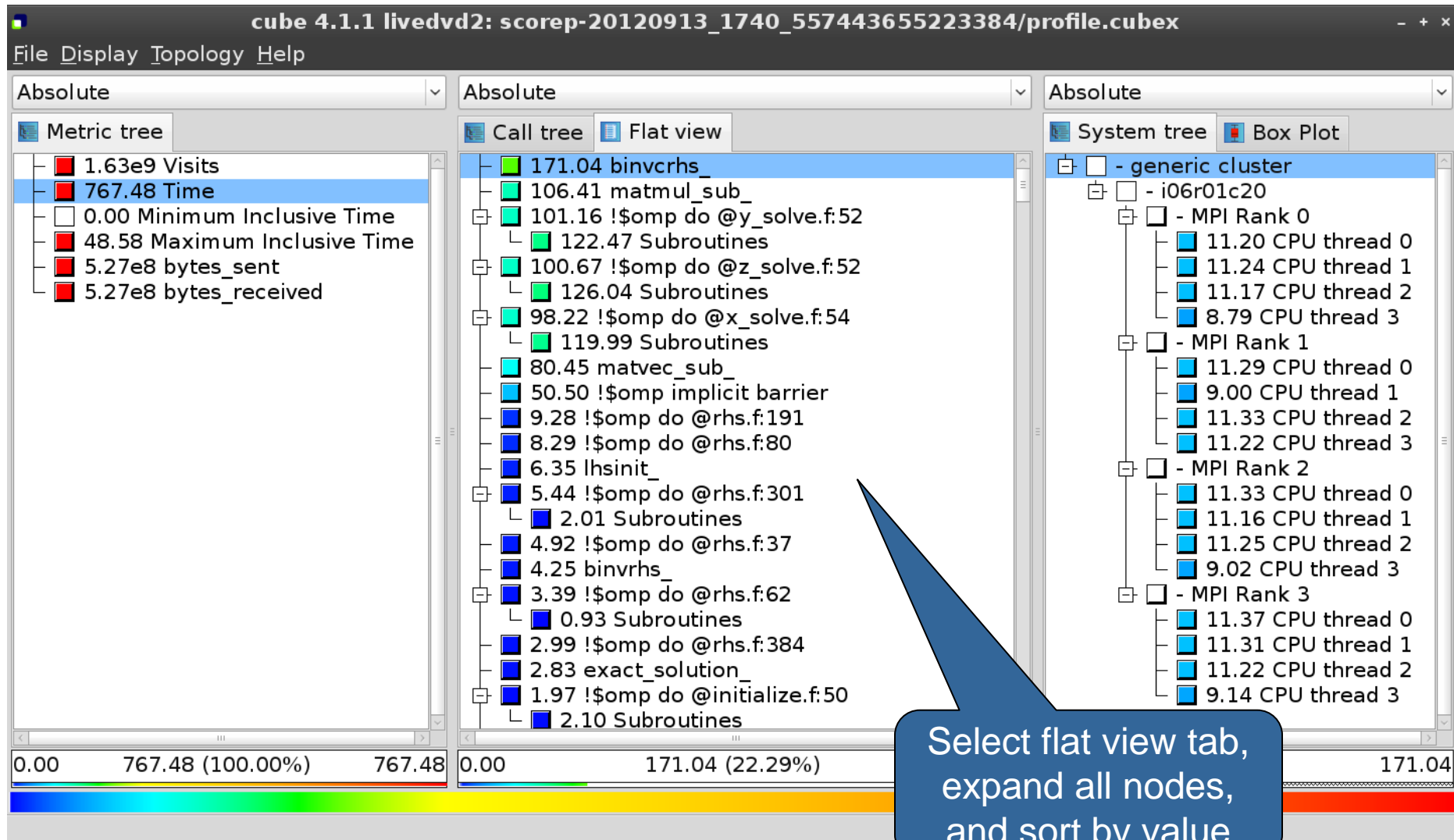
```
subroutine binvrhs( lhs,c,r )
-----
-----
-----
c
-----
-----

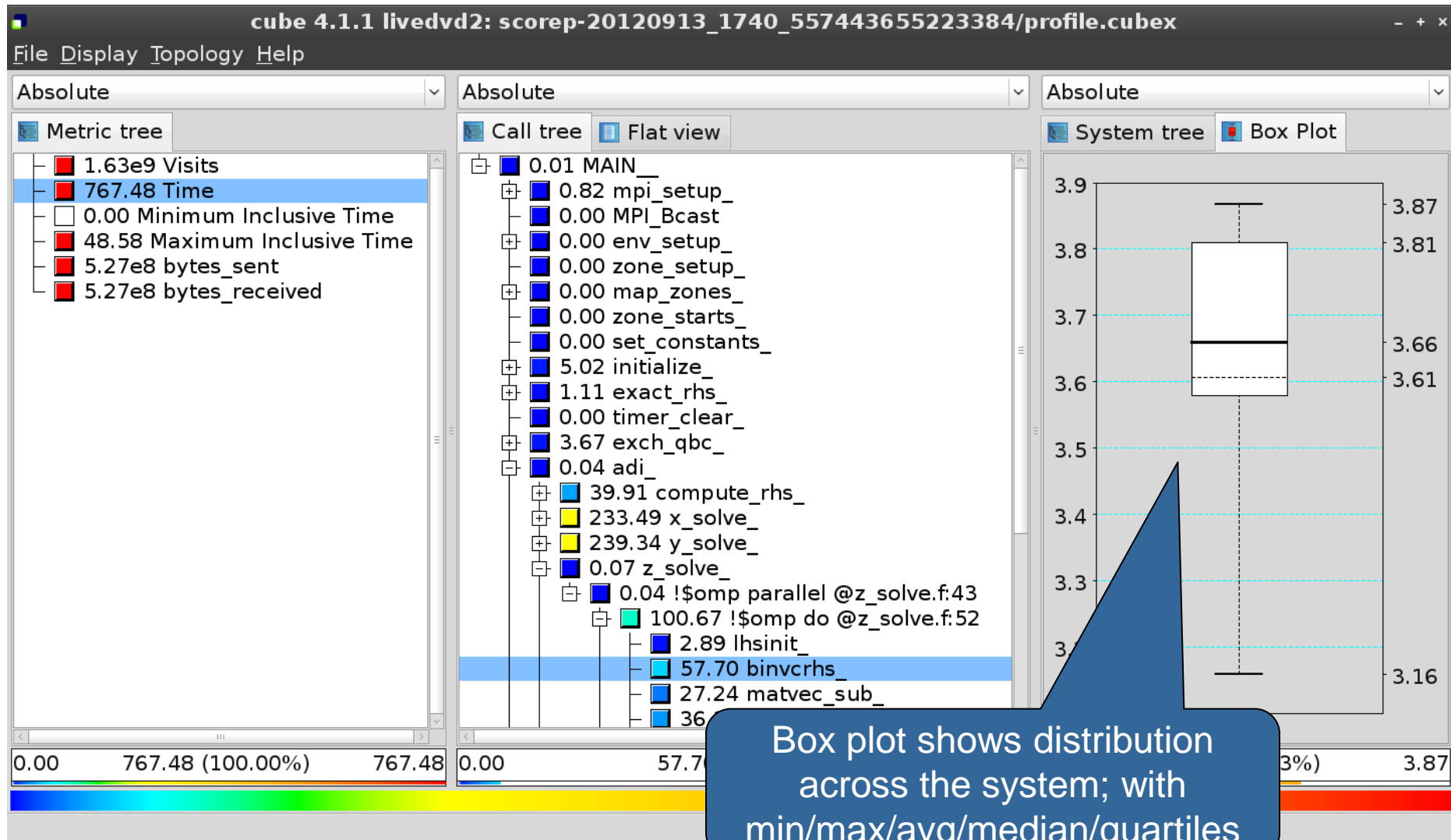
implicit none

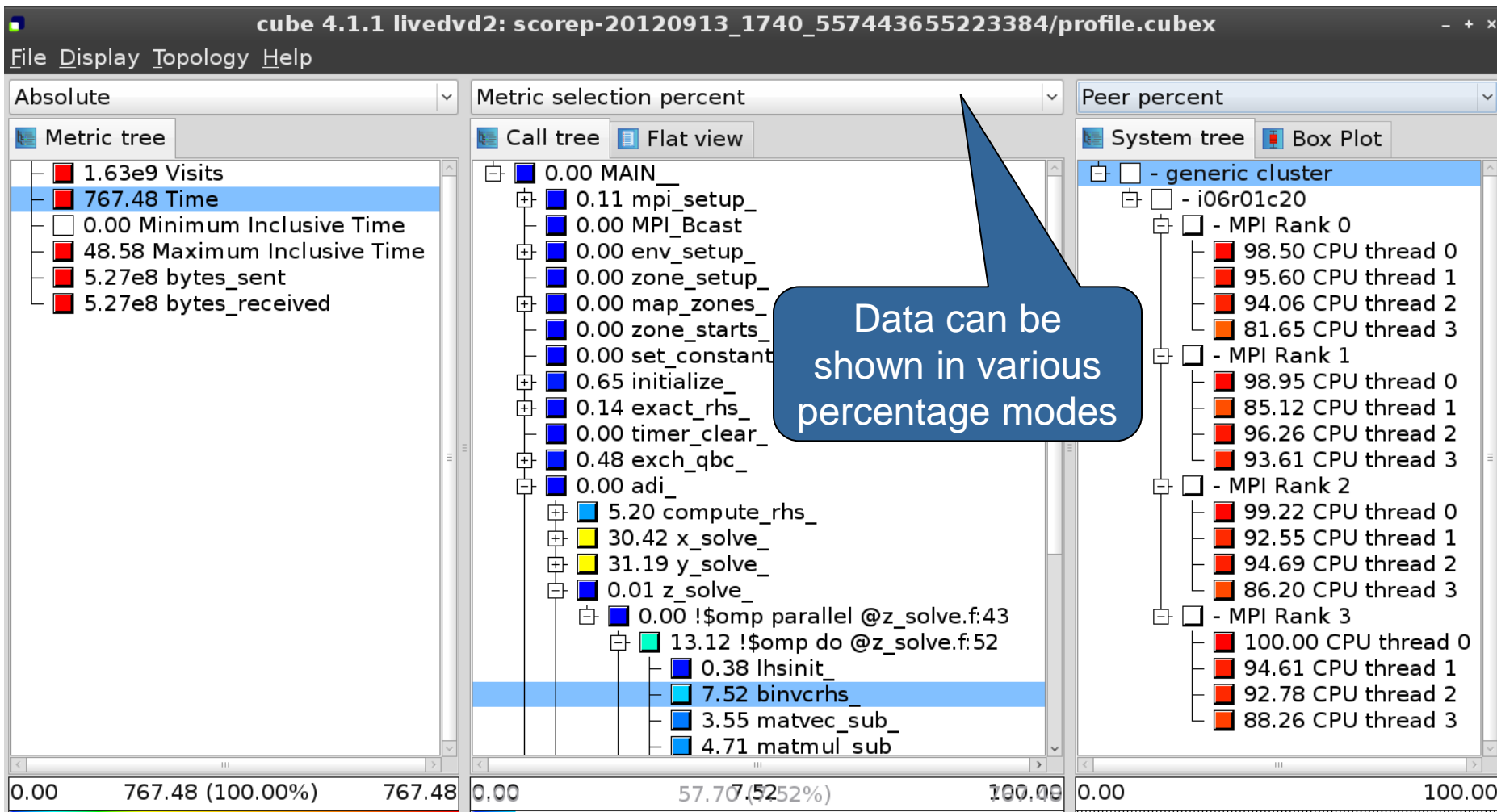
double precision pivot, coeff, lhs
dimension lhs(5,5)
double precision c(5,5), r(5)

-----
-----
-----

pivot = 1.00d0/lhs(1,1)
lhs(1,2) = lhs(1,2)*pivot
lhs(1,3) = lhs(1,3)*pivot
lhs(1,4) = lhs(1,4)*pivot
lhs(1,5) = lhs(1,5)*pivot
c(1,1) = c(1,1)*pivot
c(1,2) = c(1,2)*pivot
c(1,3) = c(1,3)*pivot
c(1,4) = c(1,4)*pivot
```







- 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

The screenshot displays the cube 4.1.1 livevd2 interface with three panels:

- Metric tree:** Shows various performance metrics. The '767.48 Time' node is selected.
- Call tree:** Shows a hierarchical view of function calls. Several nodes are selected, including '218.21 !\$omp do @x\_sol', '223.63 !\$omp do @y\_sol', and '226.71 !\$omp do @z\_sol'. A blue callout bubble points to this panel with the text 'Select multiple nodes with Ctrl-click'.
- System tree:** Shows a hierarchical view of the system tree, including MPI Ranks and CPU threads.

At the bottom of the interface, there are three progress bars corresponding to the panels, showing values like 0.00, 767.48 (100.00%), 767.48, 0.00, 48, and 0.00, 668.54.

The screenshot shows the 'cube 4.1.1' application window with the title 'scorep-20120913\_1740\_557443655223384/profile.cubex'. The 'Help' menu is open, and the 'What's This?' option is selected, which is highlighted with a blue callout bubble containing the text 'Context-sensitive help available for all GUI items'. The 'What's This?' menu item has a keyboard shortcut 'Shift+F1' next to it. The background shows a performance analysis interface with three panels: 'Metric tree', 'System tree', and a central data view. The 'Metric tree' on the left lists metrics such as '1.63e9 Visits', '767.48 Time', and '0.00 Minimum'. The 'System tree' on the right shows a hierarchical view of the system, including 'generic cluster', 'i06r01c20', and four MPI Ranks, each with its own set of CPU threads. The central data view shows a tree of performance metrics with values and units, such as '218.21 !\$omp do @x\_sol' and '223.63 !\$omp do @y\_sol'. At the bottom, there are three progress bars and a status bar that reads 'Change into help mode for display components'.

- Extracting solver sub-tree from analysis report

```
% cube_cut -r '<<ITERATION>>' scorep_bt-mz_W_4x4_sum/profile.cubex  
Writing cut.cubex... done.
```

- Calculating difference of two reports

```
% cube_diff scorep_bt-mz_W_4x4_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

- 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](mailto:scalasca@fz-juelich.de)

