Understanding Temporal Dynamics of Parallel Codes

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SciDAC Scientific Discovery through Advanced Computing

`http://hpctoolkit.org`

RICE

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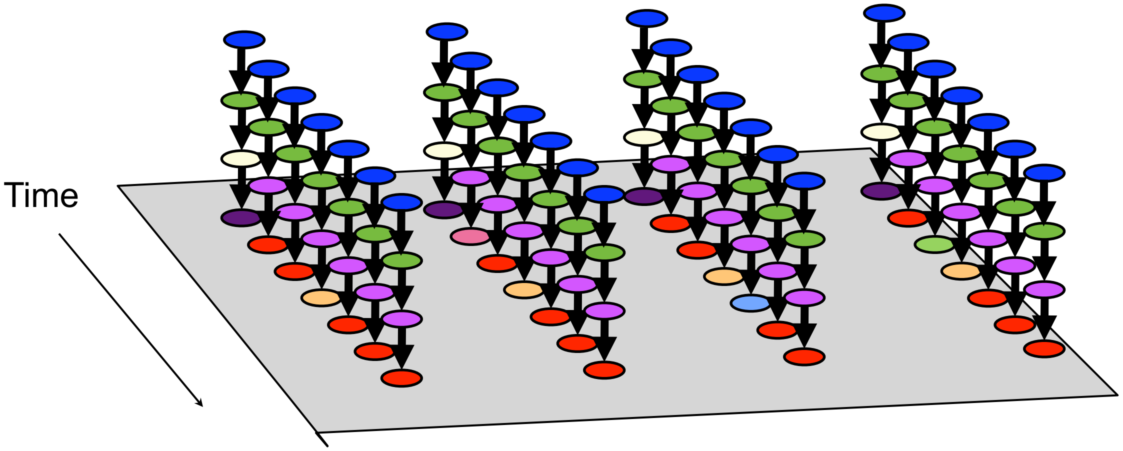
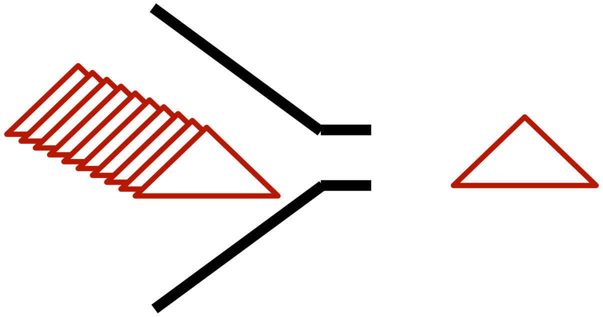
Understanding Temporal Behavior

- Profiling compresses out the temporal dimension
  - result: transient behavior, e.g. serialization, is invisible in profiles
- What can we do? Trace call path samples



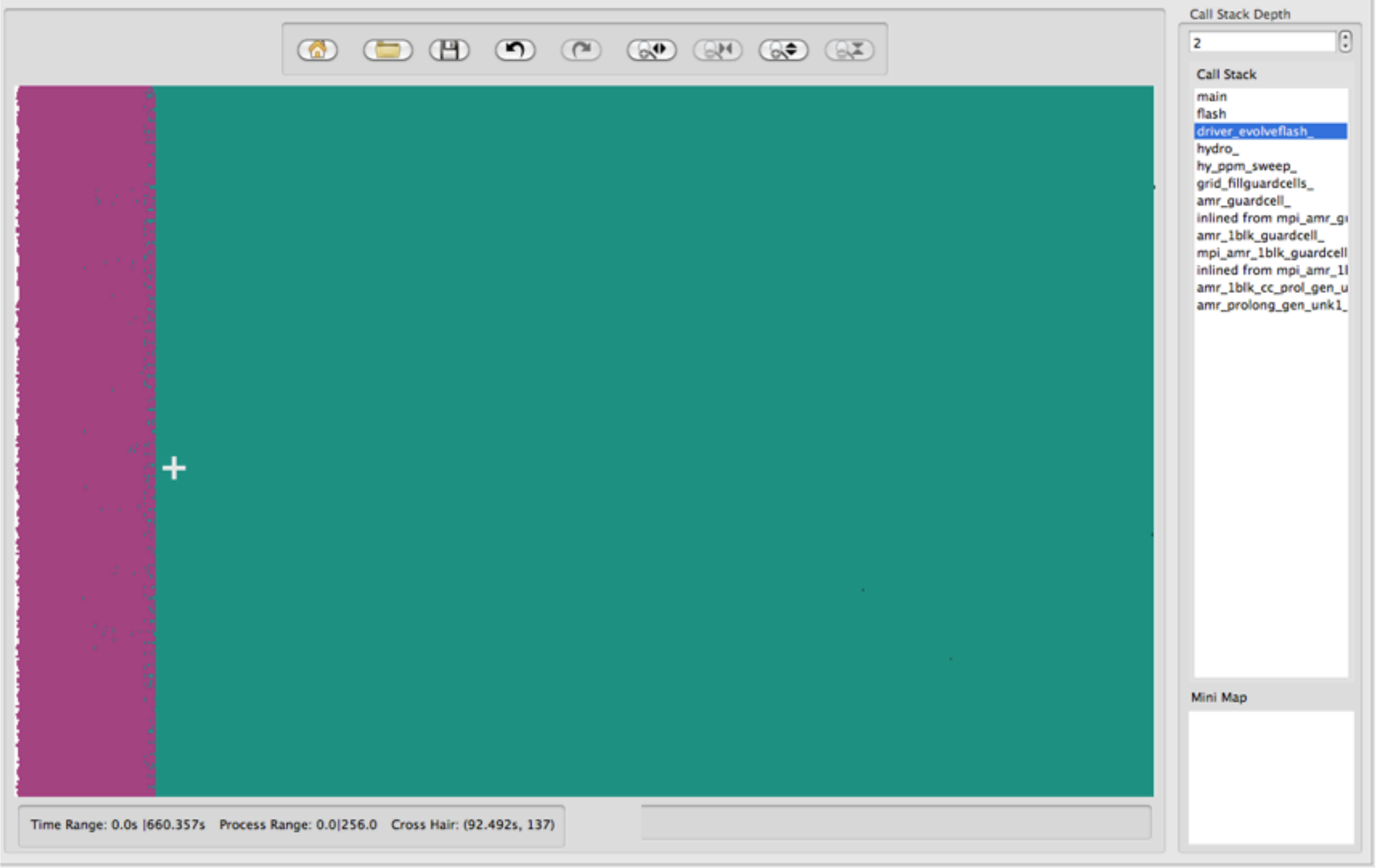
Key Steps

- Measurement
  - collect a CCT per process and/or thread using sampling
  - collect a trace of <node id, timestamp> pairs
    - note: arrange for one node-id per procedure
- Post processing
  - combine the CCTs into a canonical CCT
  - renumber all traces for consistency using canonical CCT



- Visualization
  - assign colors to procedures based on labeled nodes in CCT
  - only read in trace records you need to color the display's pixels
  - views
    - space-time view: call stack trace for all threads at depth d
    - depth view: call stack trace for an individual thread at all levels

Flash White Dwarf Collapse on 256 Cores

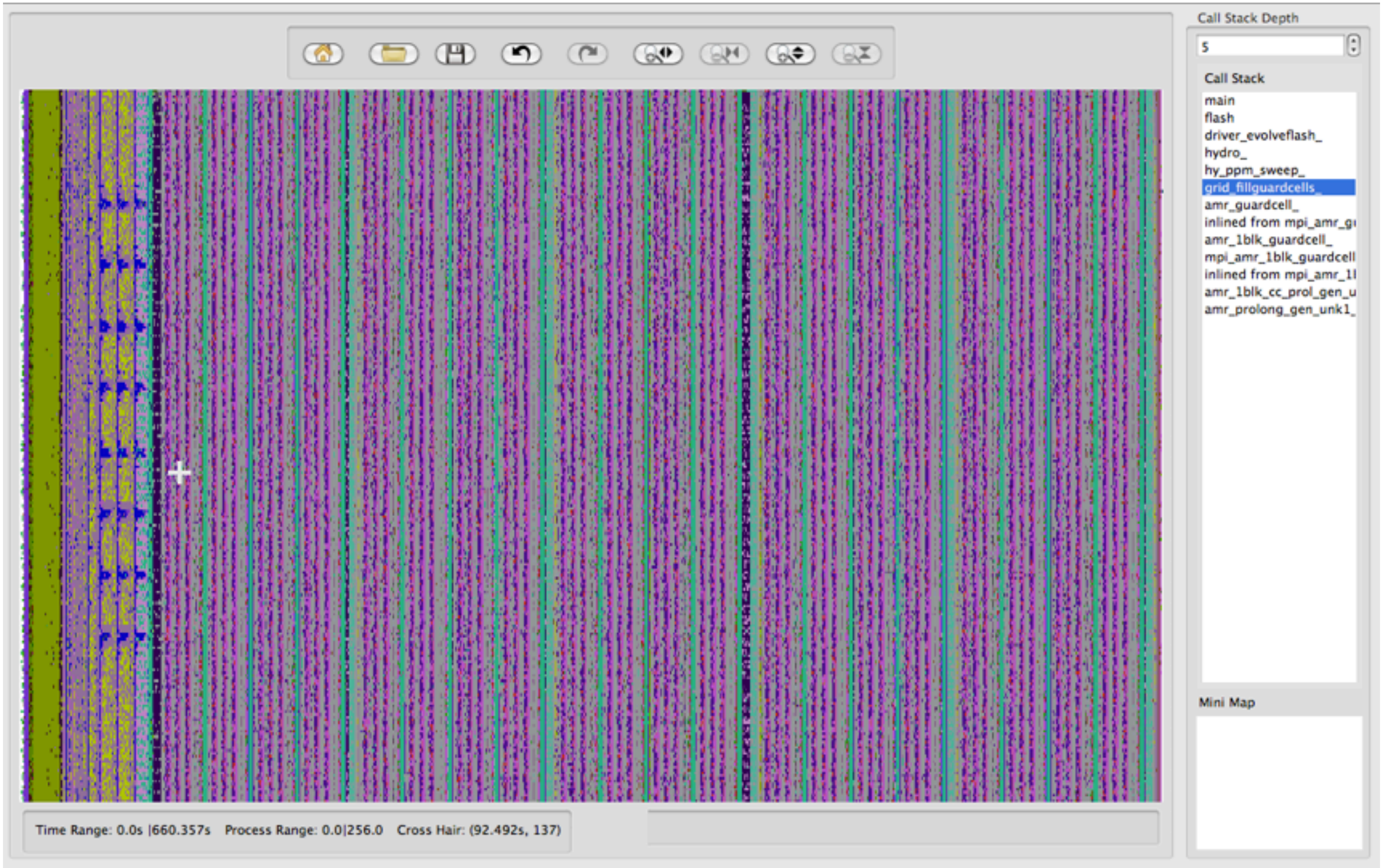


main
flash
driver_evolveflash_
hydro_
hy_ppm_sweep_
grid_fillguardcells_
amr_guardcell_
inlined from mpi_amr_gu
amr_1blk_guardcell_
mpi_amr_1blk_guardcell
inlined from mpi_amr_1l
amr_1blk_cc_prol_gen_u
amr_prolong_gen_unk1_

Time Range: 0.0s |660.357s   Process Range: 0.0|256.0   Cross Hair: (92.492s, 137)

Full execution at call stack depth 2

Flash White Dwarf Collapse on 256 Cores



Call Stack Depth

5

Call Stack

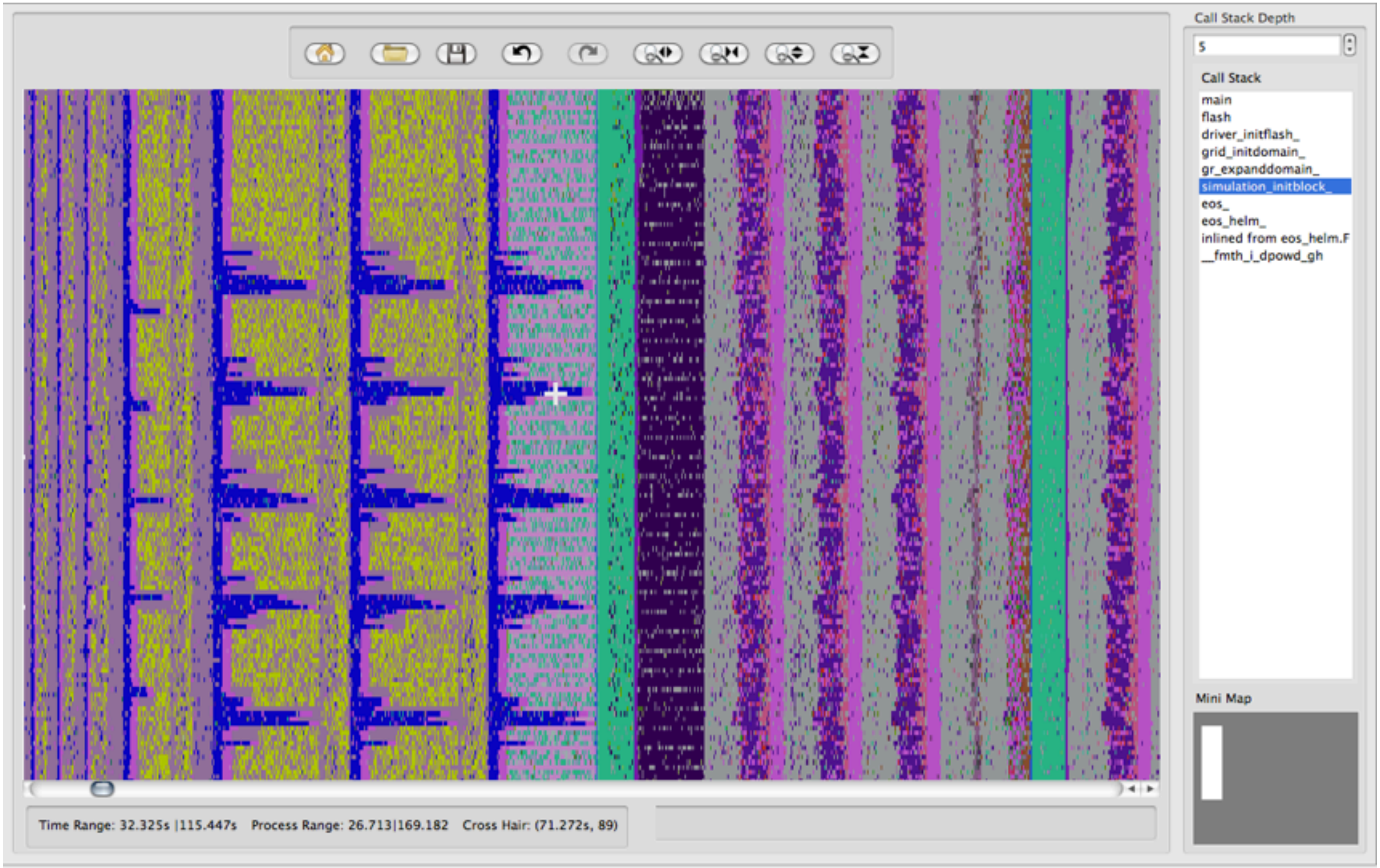
main
flash
driver_evolveflash_
hydro_
hy_ppm_sweep_
grid_fillguardcells_
amr_guardcell_
inlined from mpi_amr_g
amr_1blk_guardcell_
mpi_amr_1blk_guardcell
inlined from mpi_amr_1l
amr_1blk_cc_prol_gen_u
amr_prolong_gen_unk1_

Mini Map

Time Range: 0.0s |660.357s   Process Range: 0.0|256.0   Cross Hair: (92.492s, 137)

Full execution at call stack depth 5

Flash White Dwarf Collapse on 256 Cores



Call Stack Depth

5

Call Stack

main
flash
driver_initflash_
grid_initdomain_
gr_expanddomain_
simulation_initblock_
eos_
eos_helm_
inlined from eos_helm.F
__fmth_i_dpowd_gh

Time Range: 32.325s |115.447s   Process Range: 26.713|169.182   Cross Hair: (71.272s, 89)

Execution detail at call stack depth 5