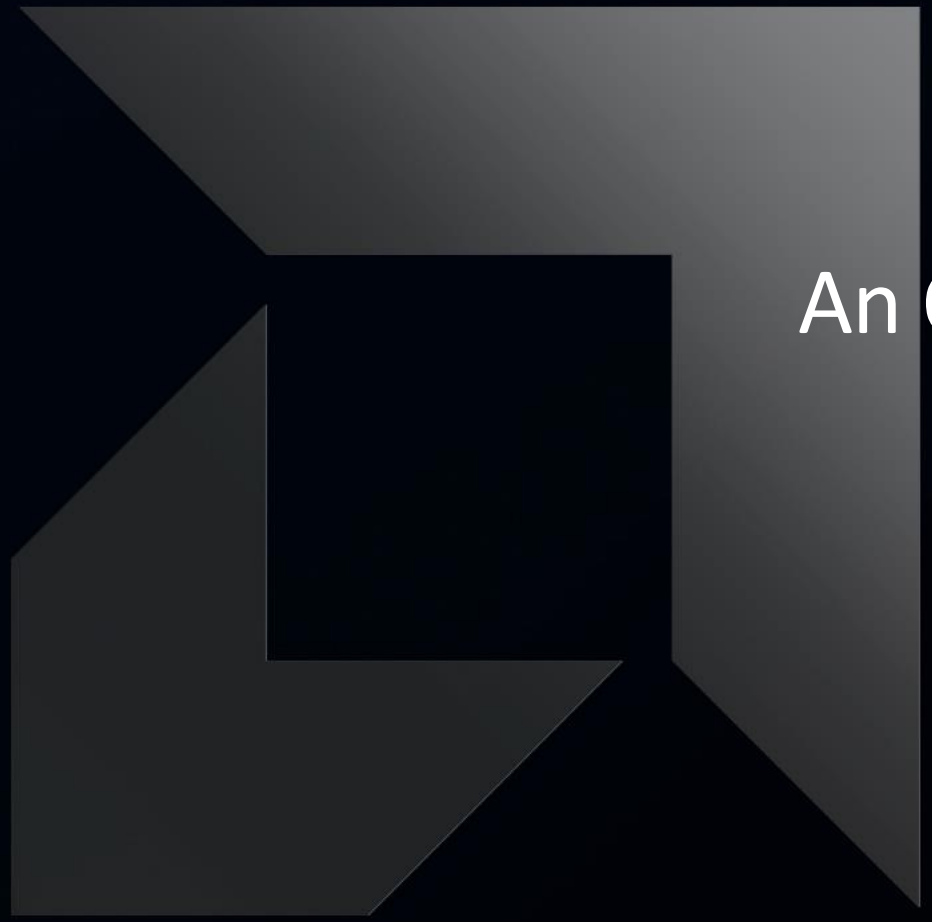

ROC-profiler and debugger:
An Overview of AMD ROCm™ Tools

ATPESC 2022 – Tools Track

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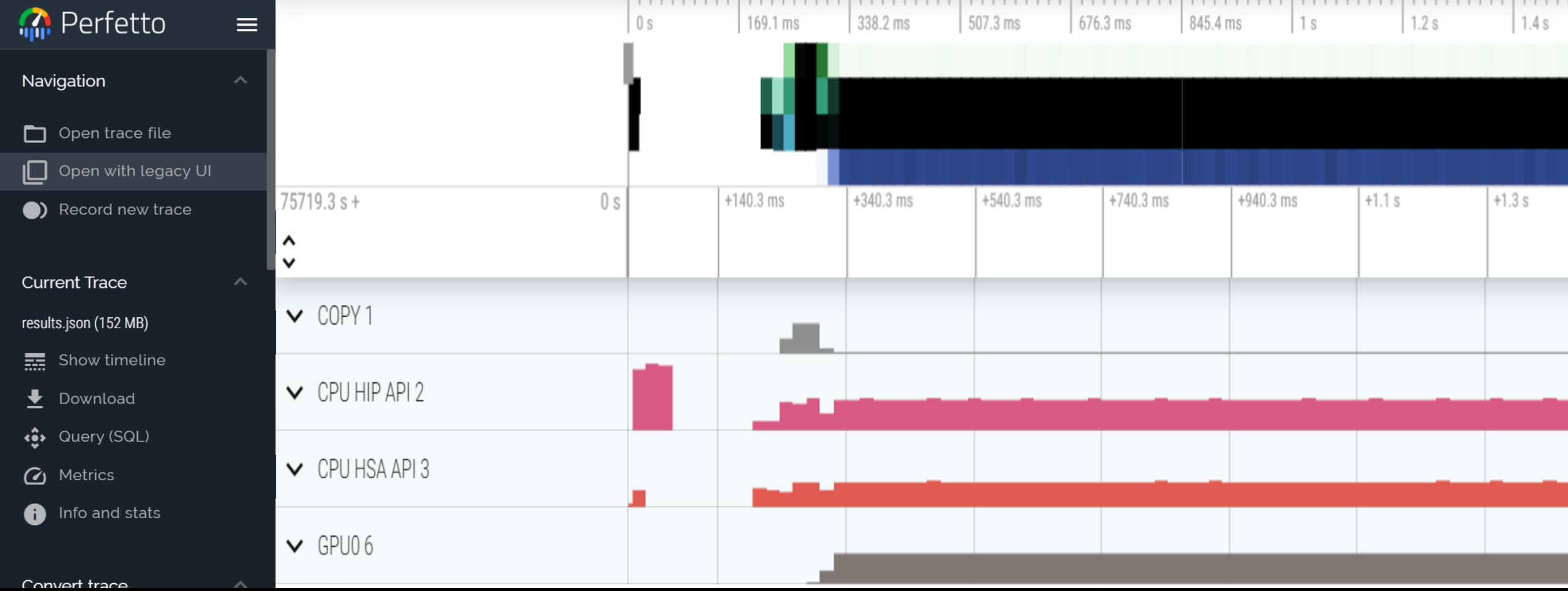
AMD
together we advance_

Agenda

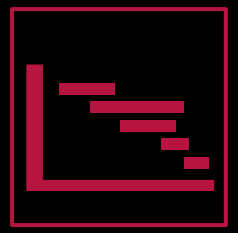
1. Profiling
2. Debugging



AMD

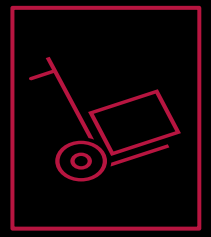
Profiling

AMD GPU Profiling



ROC-profiler (or simply rocprof) is the command line front-end for AMD GPU profiling library

- Repo: https://github.com/ROCm-Developer-Tools/rocprofiler

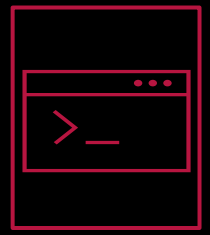


Provided in the ROCm releases

rocprof contains the central components allowing the collection of application tracing and counter collection

- Under constant development

The output of rocprof can be visualized using the chrome browser with chrome tracing or Perfetto



*More information can be found in the official ROCm documentation

Getting started with rocprof

To get help:

- `$ /opt/rocm/bin/rocprof -h`

Useful housekeeping flags:

- `--timestamp <on|off>` : turn on/off gpu kernel timestamps
- `--basenames <on|off>` : turn on/off truncating gpu kernel names (i.e., removing template parameters and argument types)
- `-o <output csv file>` : Direct counter information to a particular file name
- `-d <data directory>` : Send profiling data to a particular directory
- `-t <temporary directory>` : Change the directory where data files typically created in /tmp are placed. This allows you to save these temporary files

Flags directing rocprofiler activity:

- `-i <input.txt|.xml>` : specify an input file (note the output files will be named input.*)
- `--hsa-trace` : to trace GPU Kernels, host HSA events and HIP memory copies.
- `--hip-trace` : to trace HIP API calls
- `--roctx-trace` : to trace roctx markers

Advanced usage

- `-m <metric file>` : Allows the user to define and collect custom metrics. See rocprofiler/test/tool/*.xml on GitHub for examples

Collecting information about the kernels with rocprof

```
/opt/rocm/bin/rocprof --stats --basenames on <app with args>
```

- 2 .csv files generated
- results.csv : information per each call of kernel
- results.stats.csv : statistics grouped by each kernel

Contents of results.stats.csv

"Name",	"Calls",	"TotalDurationNs",	"AverageNs",	"Percentage"
"LocalLaplacianKernel",	1000,	817737586,	817737,	40.908259879301134
"JacobiIterationKernel",	1000,	699515425,	699515,	34.994060790890174
"NormKernel1",	1001,	454737348,	454283,	22.748756969583884
"HaloLaplacianKernel",	1000,	14561933,	14561,	0.7284773865206329
"NormKernel2",	1001,	12395374,	12382,	0.620092789636225
"__amd_rocclr_fillBufferAligned.kd",	1,	7040,	7040,	0.00035218406794656007

Identify “hottest” kernels that consume the most time.

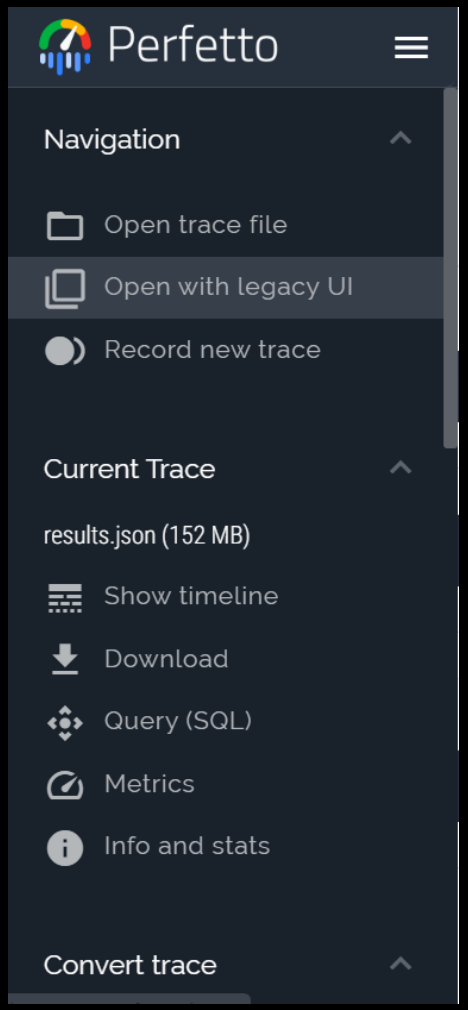
Collecting traces with rocprof

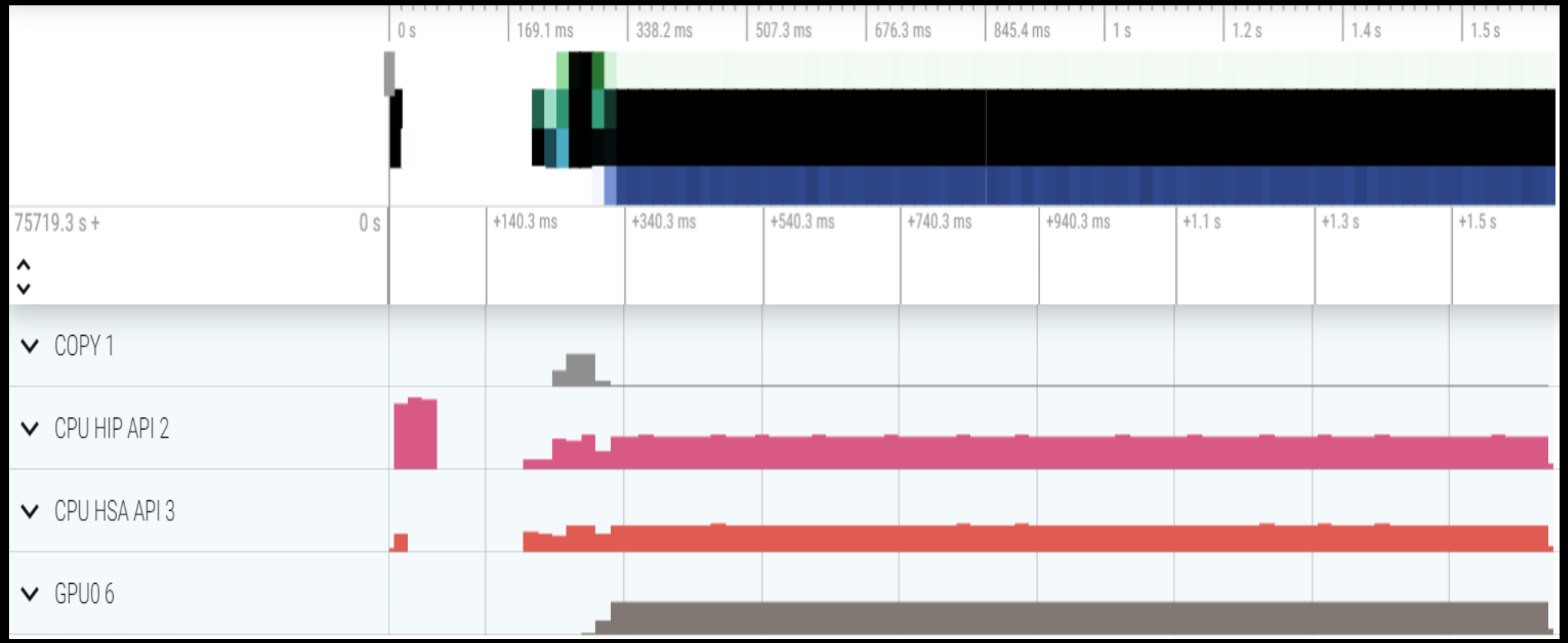
rocprof can collect a variety of trace event types and generate timelines in JSON format for use with chrome-tracing or Perfetto

Multiple modes like --hip-trace and --has-trace can be combined

Trace Event	rocprof Trace Mode
HIP API call	--hip-trace
GPU Kernels	--hip-trace
Host <-> Device Memory copies	--hip-trace
CPU HSA Calls	--hsa-trace
User code markers	--roctx-trace

Collecting and visualizing application traces with rocprof





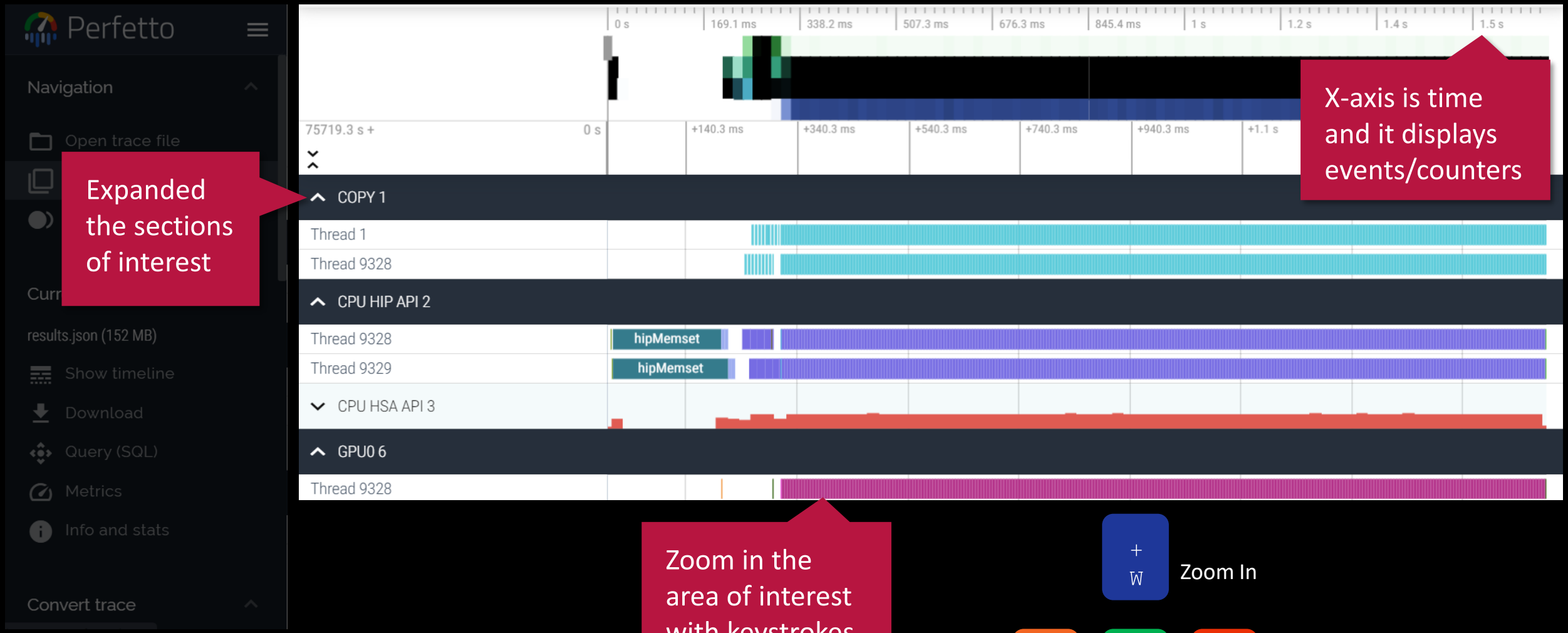

```
$ rocprof --hsa-trace --hip-trace <app with arguments>
```

This will output a .json file that can be visualized using the chrome browser and Perfetto

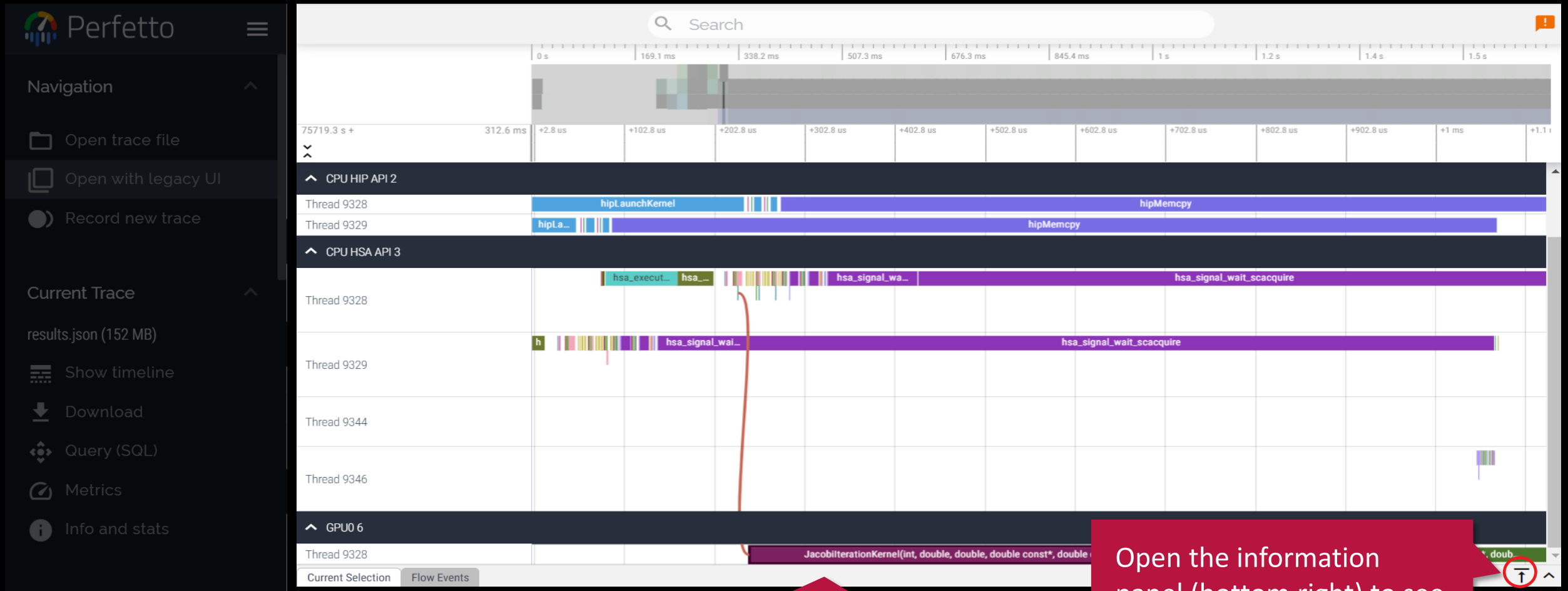
Go to https://ui.perfetto.dev/ and then load the .json file

- The trace will display HIP calls, copies, hsa signals, and kernel calls

Collecting and visualizing application traces with rocprof



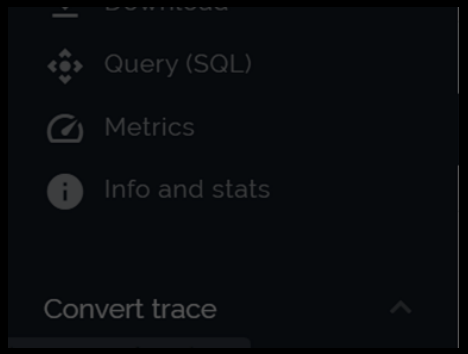
Collecting and visualizing application traces with rocprof

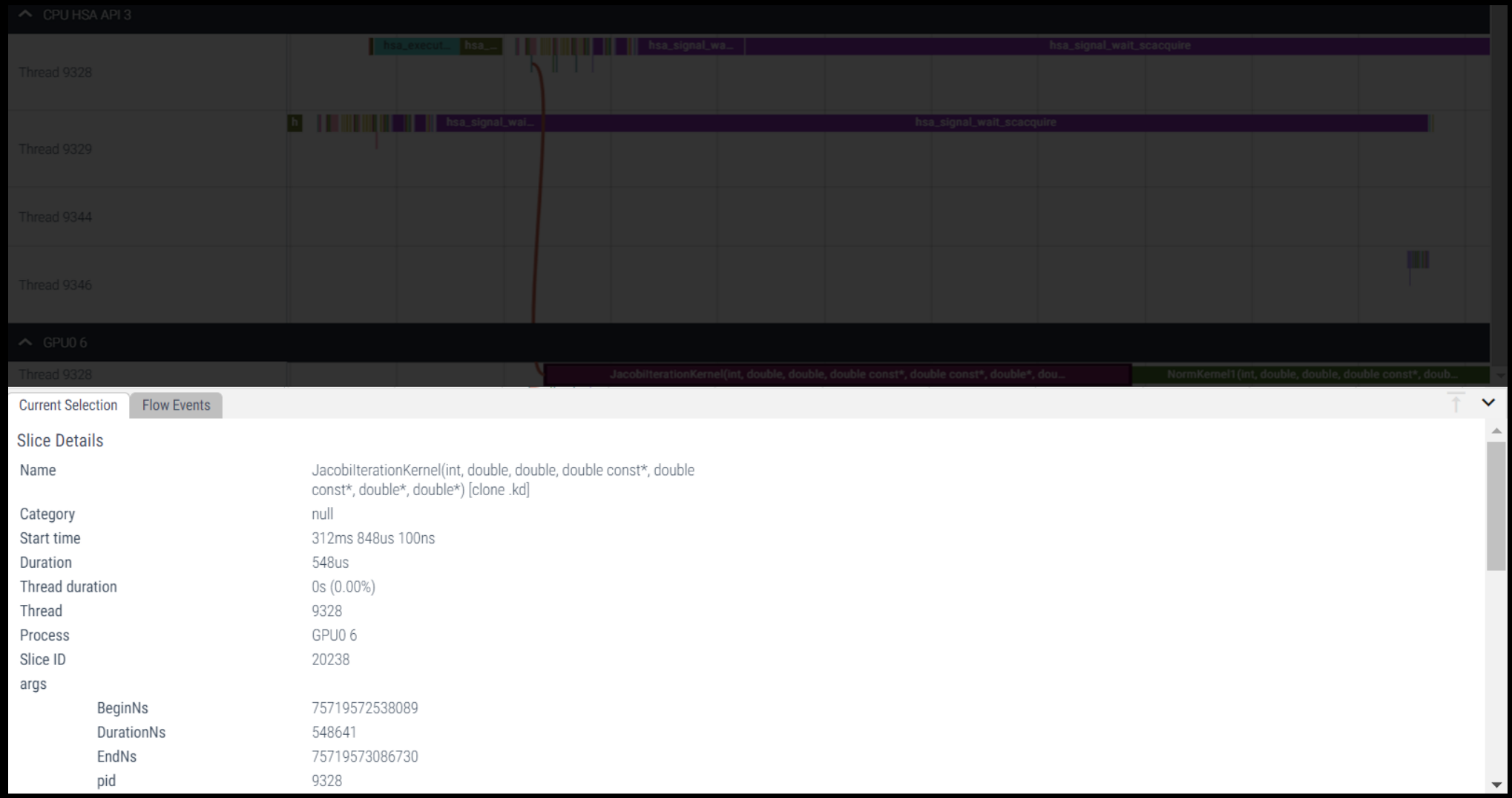


Zoom and select the kernel to see the link to HSA call that enables the kernel

Open the information panel (bottom right) to see details of the kernel

Collecting and visualizing application traces with rocprof





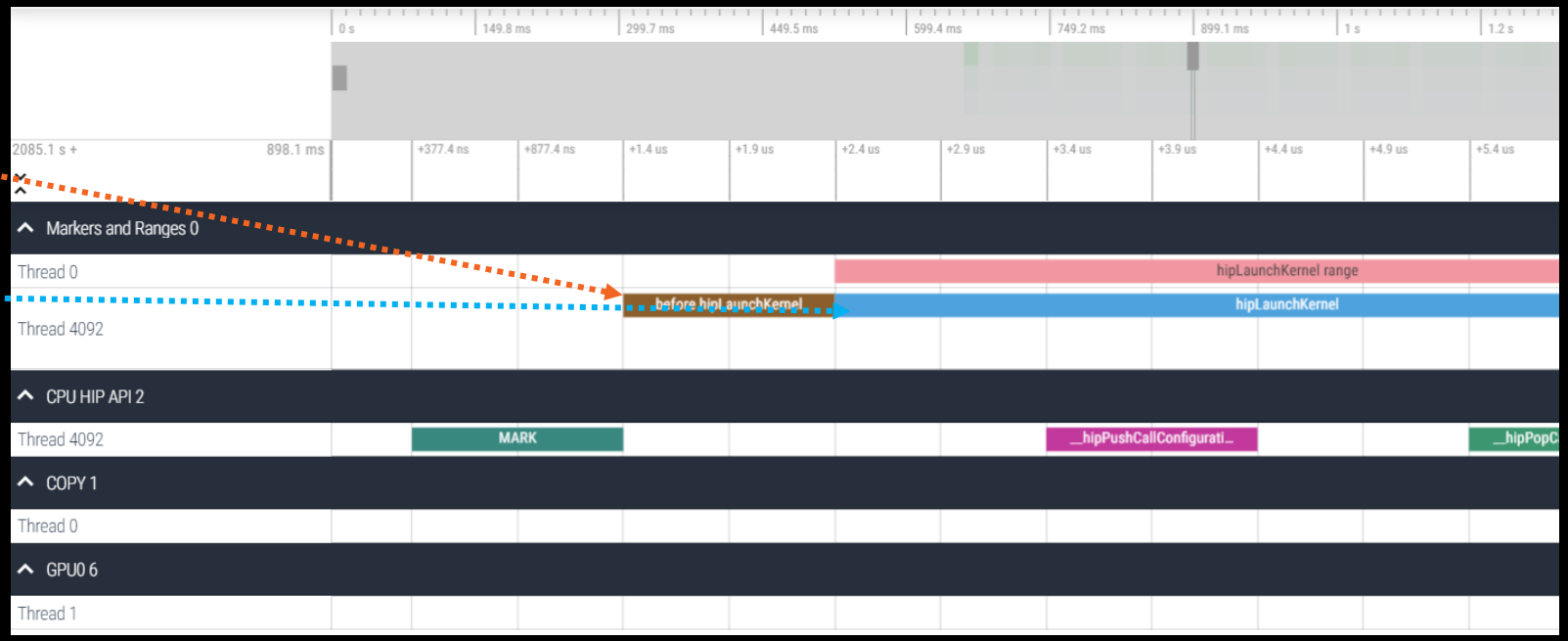
Collecting application traces with user-code markers

```
/opt/rocm/bin/rocprof --hip-trace --roctx-trace <app with args>
```

- MatrixTranspose.cpp example on roctracer GitHub page for sample usage

Code snippet

```
roctracer_mark("before HIP LaunchKernel");
...
roctxMark("before hipLaunchKernel");
int rangeId =
roctxRangeStart("hipLaunchKernel range");
...
roctxRangePush("hipLaunchKernel");
hipLaunchKernelGGL(MatrixTranspose,…);
roctracer_mark("after HIP LaunchKernel");
roctxMark("after hipLaunchKernel");
```



Collecting hardware counters with rocprof

Collect a number of hardware counters and derived counters

- `$/opt/rocm/bin/rocprof --list-basic`
- `$/opt/rocm/bin/rocprof --list-derived`

Specify counters in a counter file. For example:

- `$/opt/rocm/bin/rocprof -i my_counters.txt <app with args>`
- `$cat my_counters.txt`

```
pmc: Wavefronts VALUInsts VFetchInsts VWriteInsts VALUUtilization VALUBusy WriteSize
pmc: SALUInsts SFetchInsts LDSInsts FlatLDSInsts GDSInsts SALUBusy FetchSize
pmc: L2CacheHit MemUnitBusy MemUnitStalled WriteUnitStalled ALUStalledByLDS LDSBankConflict
...
```

- A limited number of counters can be collected during a specific pass of code
  - Each line in the counter file will be collected in one pass
  - You will receive an error suggesting alternative counter ordering if you have too many / conflicting counters on one line
- A `.csv` file will be created by this command containing all the requested counters

Commonly used counters

VALUUtilization	• The percentage of ALUs active in a wave. Low VALUUtilization is likely due to high divergence or a poorly sized grid
VALUBusy	• The percentage of GPUTime the vector ALU instructions are processed. Can be thought of as something like compute utilization
FetchSize	• The total kilobytes fetched from global memory
WriteSize	• The total kilobytes written to global memory
L2CacheHit	• The percentage of fetch, write, atomic, and other instructions that hit the data in L2 cache
MemUnitBusy	• The percentage of GPUTime the memory unit is active. The result includes the stall time
MemUnitStalled	• The percentage of GPUTime the memory unit is stalled
WriteUnitStalled	• The percentage of GPUTime the write unit is stalled
Full list at	• https://github.com/ROCm-Developer-Tools/rocprofiler/blob/amd-master/test/tool/metrics.xml

Performance counters tips and tricks

GPU Hardware counters are global

- Kernel dispatches are serialized to ensure that only one dispatch is ever in flight
- It is recommended that no other applications are running that use the GPU when collecting performance counters

Use "`--basenames on`" which will report only kernel names, leaving off kernel arguments.

How do you time a kernel's duration?

- `$rocprof --timestamps on -i my_counters.txt <app with args>`
- This produces four times: DispatchNs, BeginNs, EndNs, and CompleteNs
- Closest thing to a kernel duration: EndNs - BeginNs
- If you run with `--stats` the resultant results file will automatically include a column that calculates kernel duration
  - Note: the duration is aggregated over repeated calls to the same kernel

Collecting counters and traces

on multiple MPI ranks

- rocprof can collect counters and traces for multiple MPI ranks.
- Say you want to profile an application usually called like this:

```
mpiexec -np <n> <app with args>
```

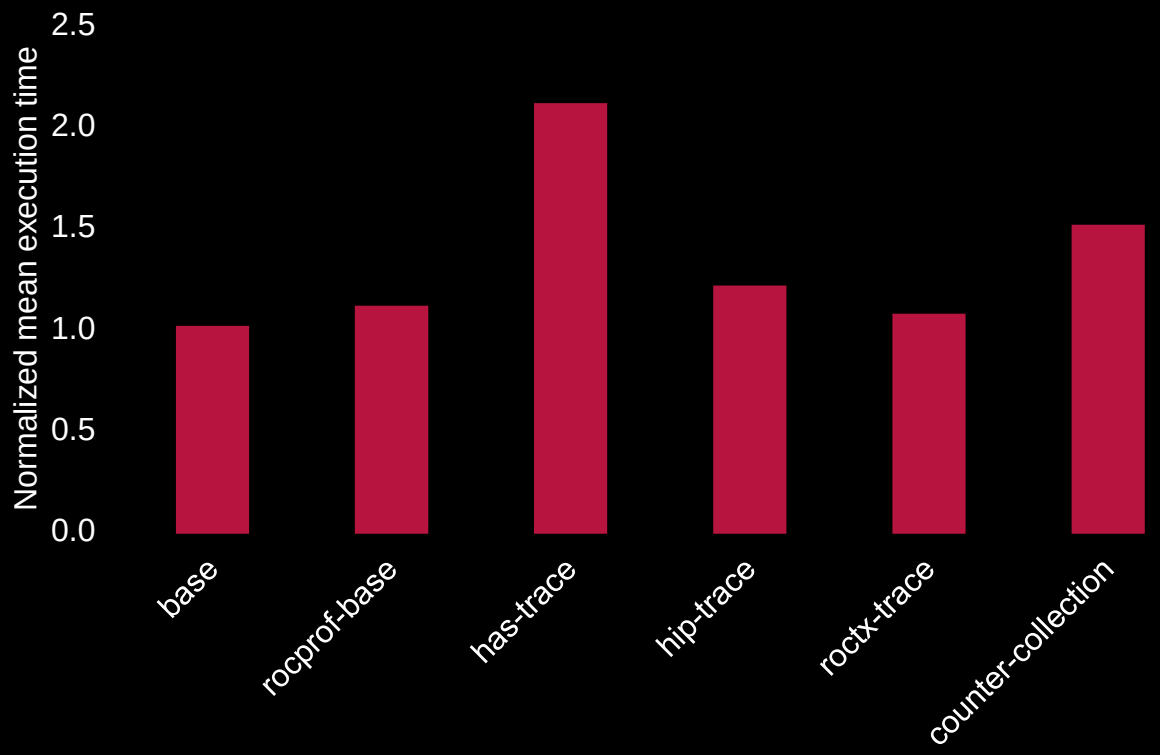
- Then invoke the profiler by executing:

```
mpiexec -np <n> rocprof --hip-trace <app with args>
```

- This will produce a single unified CSV file for all ranks
- Multi-node profiling currently isn't supported

Profiling overhead

Simple estimation of profiling overhead, obtained via wall-clock timing of entire application run via Linux ‘time’ utility:



Debugger

saxpy : cgdb — Konsole

File Edit View Bookmarks Settings Help

```
1  #include <hip/hip_runtime.h>
2
3  __constant__ float a = 1.0f;
4
5  __global__
6  void saxpy(int n, float const* x, int incx, float* y, int incy)
7  {
8      int i = blockDim.x*blockIdx.x + threadIdx.x;
9      if (i < n)
10         y[i] += a*x[i];
11 }
12
13 int main()
14 {
15     int n = 256;
16     std::size_t size = sizeof(float)*n;
17
18     float* d_x;
19     float* d_y;
20     hipMalloc(&d_x, size);
21     hipMalloc(&d_y, size);
22
23     int num_groups = 2;
24     int group_size = 128;
25     saxpy<<<num_groups, group_size>>>(n, d_x, 1, d_y, 1);
26     hipDeviceSynchronize();
/mnt/shared/codes/saxpy/saxpy.hip.cpp
```

```
[35;1mGNU gdb (rocm-rel-4.5-56) 11.1[m
Copyright (C) 2021 Free Software Foundation, Inc.
License GPLv3+: GNU GPL version 3 or later <http://gnu.org/licenses/gpl.html>
This is free software: you are free to change and redistribute it.
There is NO WARRANTY, to the extent permitted by law.
Type "show copying" and "show warranty" for details.
This GDB was configured as "x86_64-pc-linux-gnu".
Type "show configuration" for configuration details.
For bug reporting instructions, please see:
<https://github.com/ROCm-Developer-Tools/ROCgdb/issues>.
Find the GDB manual and other documentation resources online at:
    <http://www.gnu.org/software/gdb/documentation/>.

For help, type "help".
Type "apropos word" to search for commands related to "word"...
Reading symbols from [32m./saxpy[m...
[?2004h(gdb)
```

Intro to ROCgdb

What is ROCgdb, from the tin:

> The ROCm Debugger (ROCgdb) is the ROCm source-level debugger for Linux, based on the GNU Debugger (GDB). It enables heterogenous debugging on the ROCm platform of an x86-based host architecture along with AMD GPU architectures supported by the AMD Debugger API Library (ROCdbgapi). The AMD Debugger API Library (ROCdbgapi) is included with the ROCm release.
>
> The current ROCm Debugger (ROCgdb) is an initial prototype that focuses on source line debugging and does not provide symbolic variable debugging capabilities. The user guide presents features and commands that may be implemented in future versions.

Preparing the code for the debugger

Use any optimization level you like,

For example: `-O3`

Have ROCm load code objects at initialization:

```
export HIP_ENABLE_DEFERRED_LOADING=0
```

Add the flags:

–ggdb

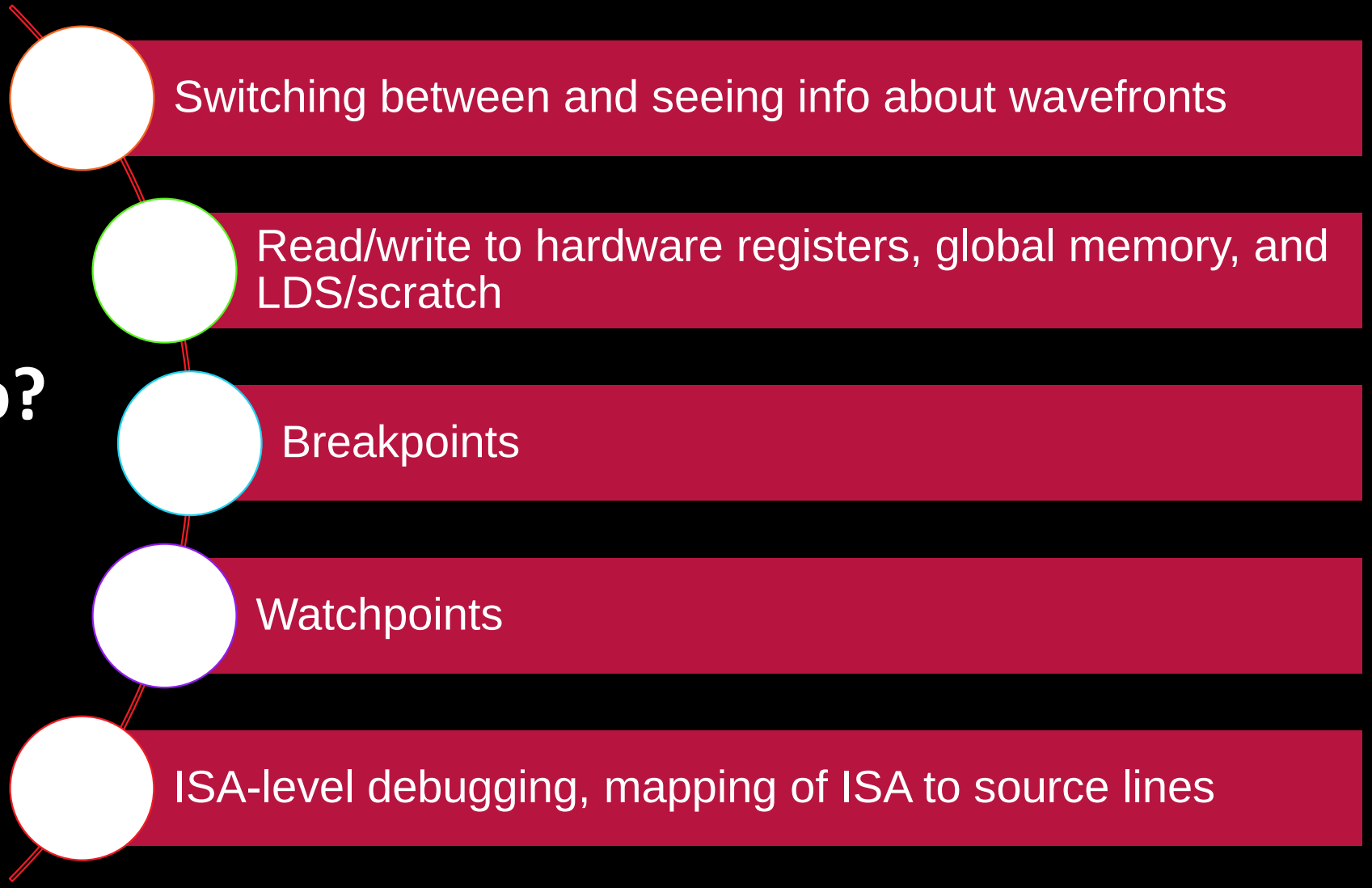
Optionally print even more useful information on API calls

```
export AMD_LOG_LEVEL=3
```

Example of what the compile options may look like…

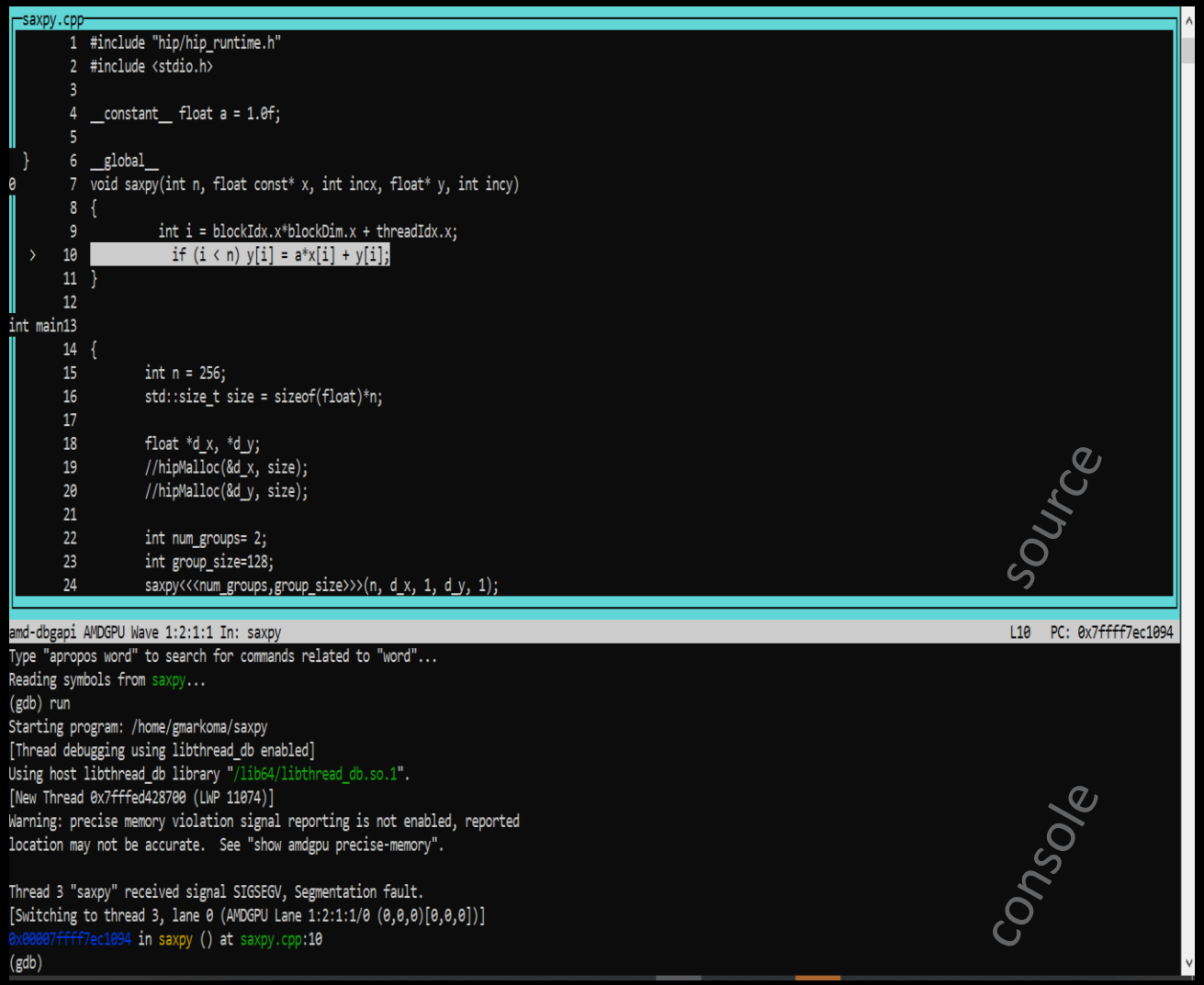
mpic++ -I/usr/lib/x86_64-linux-gnu/openmpi/include/openmpi –L/usr/lib/x86_64-linux-gnu/openmpi/include -pthread –O3 –g **–ggdb** –fPIC –std=c++11 \ –march=native –Wall –I/opt/rocm/roctracer/include –I"/opt/rocm-4.2.0/hip/include" -I"/opt/rocm/llvm/bin/../lib/clang/12.0.0" –I/opt/rocm/hsa/include –I/opt/rocm/roctracer/include –c JacobiSetup.cpp -o JacobiSetup.o

What can it do?

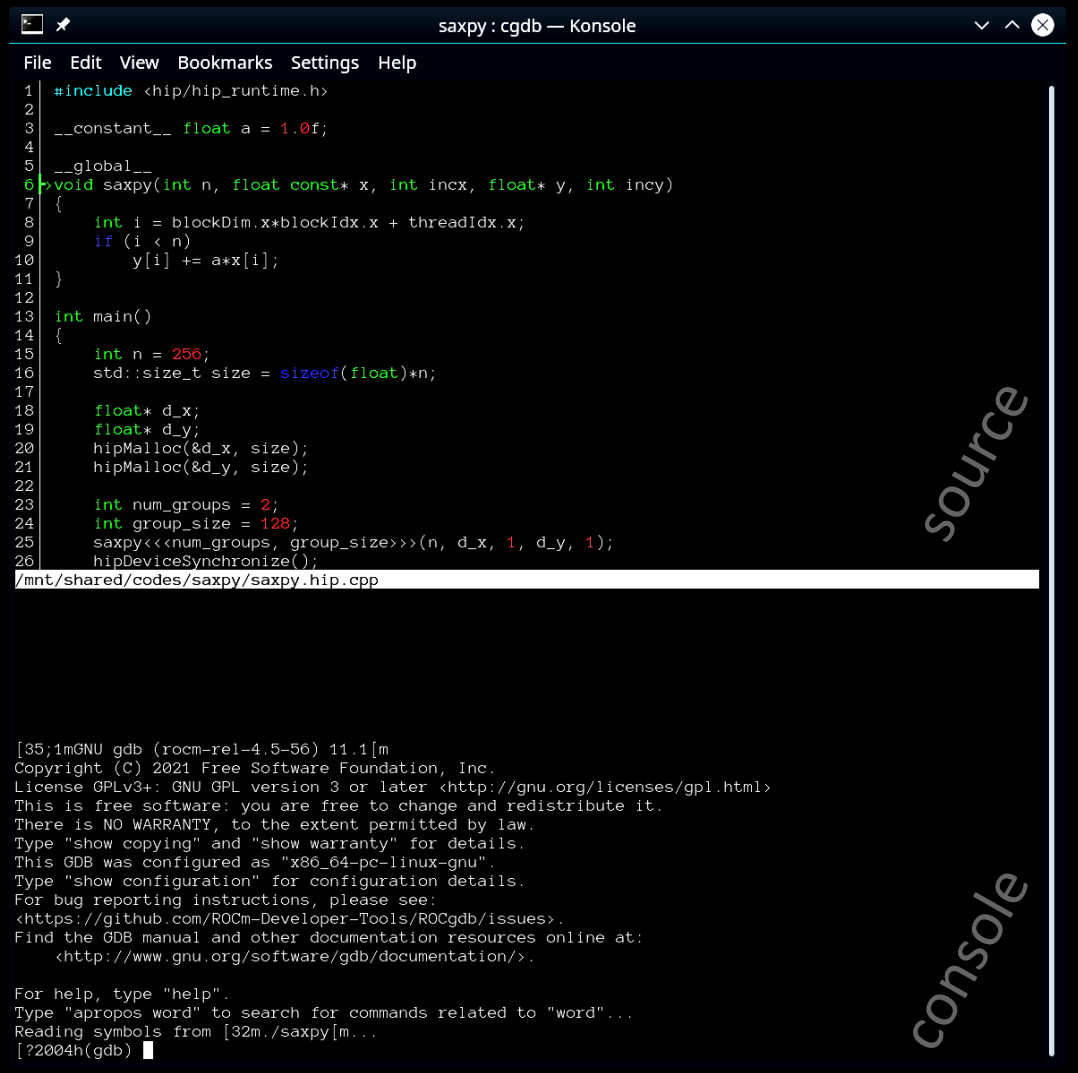


Using a “GUI” with rocgdb

`rocgdb -tui <app>`

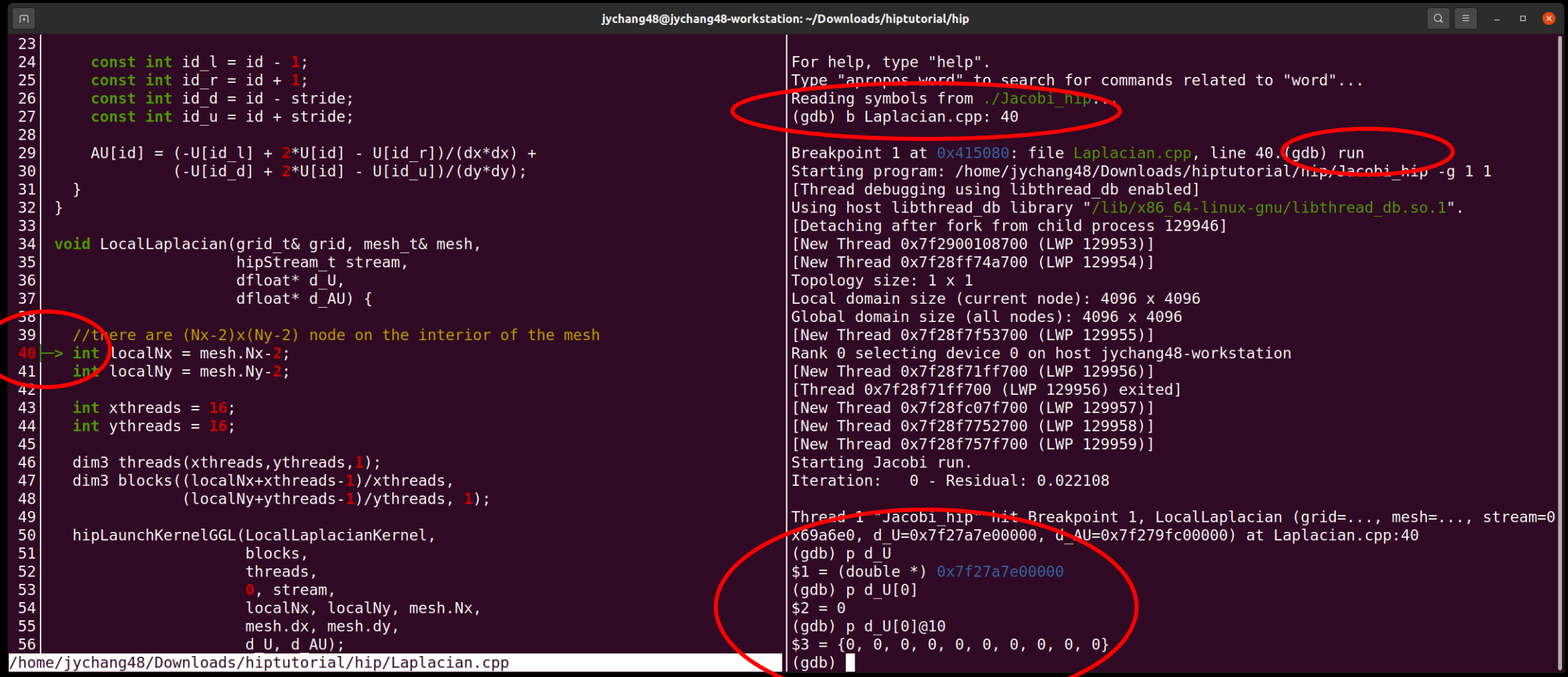


`cgdb -d rocgdb <app>`



Setting a breakpoint in host code

Here we setup a breakpoint in the host code. We can inspect the device pointer and its values:



Setting a breakpoint in device kernel

Invoke ‘b’ or ‘break’ to the device kernel of interest:

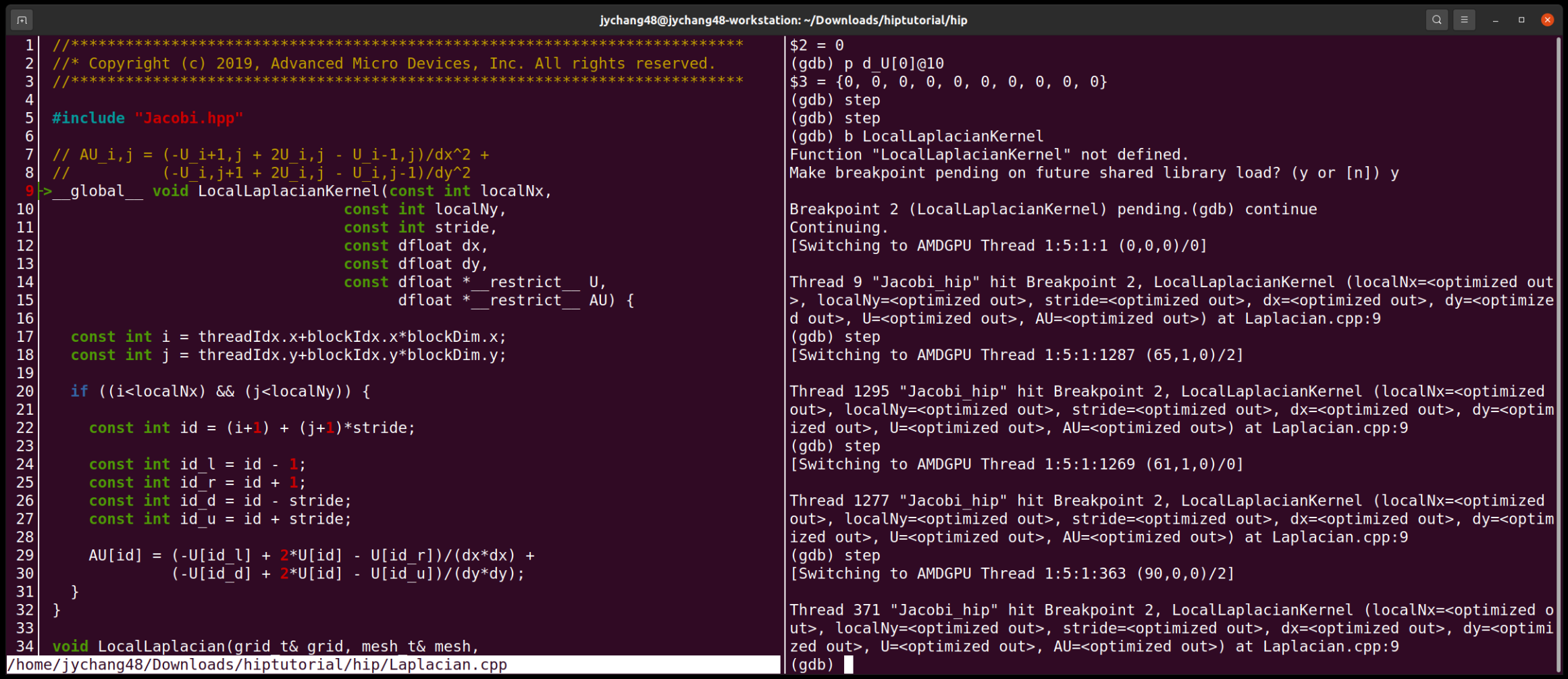
jychang48@jychang48-workstation: ~/Downloads/hiptutorial/hip

```
1  //************************************************************************
2  //* Copyright (c) 2019, Advanced Micro Devices, Inc. All rights reserved.
3  //************************************************************************
4
5  #include "Jacobi.hpp"
6
7  // AU_i,j = (-U_i+1,j + 2U_i,j - U_i-1,j)/dx^2 +
8  //          (-U_i,j+1 + 2U_i,j - U_i,j-1)/dy^2
9  __global__ void LocalLaplacianKernel(const int localNx,
10                                      const int localNy,
11                                      const int stride,
12                                      const dfloat dx,
13                                      const dfloat dy,
14                                      const dfloat *__restrict__ U,
15                                            dfloat *__restrict__ AU) {
16
17   const int i = threadIdx.x+blockIdx.x*blockDim.x;
18   const int j = threadIdx.y+blockIdx.y*blockDim.y;
19
20   if ((i<localNx) && (j<localNy)) {
21
22     const int id = (i+1) + (j+1)*stride;
23
24     const int id_l = id - 1;
25     const int id_r = id + 1;
26     const int id_d = id - stride;
27     const int id_u = id + stride;
28
29     AU[id] = (-U[id_l] + 2*U[id] - U[id_r])/(dx*dx) +
30              (-U[id_d] + 2*U[id] - U[id_u])/(dy*dy);
31   }
32 }
33
34 void LocalLaplacian(grid_t& grid, mesh_t& mesh,
/home/jychang48/Downloads/hiptutorial/hip/Laplacian.cpp
```

```
Topology size: 1 x 1
Local domain size (current node): 4096 x 4096
Global domain size (all nodes): 4096 x 4096
[New Thread 0x7f28f7f53700 (LWP 129955)]
Rank 0 selecting device 0 on host jychang48-workstation
[New Thread 0x7f28f71ff700 (LWP 129956)]
[Thread 0x7f28f71ff700 (LWP 129956) exited]
[New Thread 0x7f28fc07f700 (LWP 129957)]
[New Thread 0x7f28f7752700 (LWP 129958)]
[New Thread 0x7f28f757f700 (LWP 129959)]
Starting Jacobi run.
Iteration:   0 - Residual: 0.022108

Thread 1 "Jacobi_hip" hit Breakpoint 1, LocalLaplacian (grid=..., mesh=..., stream=0
x69a6e0, d_U=0x7f27a7e00000, d_AU=0x7f279fc00000) at Laplacian.cpp:40
(gdb) p d_U
$1 = (double *) 0x7f27a7e00000
(gdb) p d_U[0]
$2 = 0
(gdb) p d_U[0]@10
$3 = {0, 0, 0, 0, 0, 0, 0, 0, 0, 0}
(gdb) step
(gdb) step
(gdb) b LocalLaplacianKernel
Function "LocalLaplacianKernel" not defined.
Make breakpoint pending on future shared library load? (y or [n]) y

Breakpoint 2 (LocalLaplacianKernel) pending.(gdb) continue
Continuing.
[Switching to AMDGPU Thread 1:5:1:1 (0,0,0)/0]

Thread 9 "Jacobi_hip" hit Breakpoint 2, LocalLaplacianKernel (localNx=<optimized out
>, localNy=<optimized out>, stride=<optimized out>, dx=<optimized out>, dy=<optimize
d out>, U=<optimized out>, AU=<optimized out>) at Laplacian.cpp:9
(gdb)
```

Examine switching context to new thread

What happens when you type ‘step’? Another thread hit the same breakpoint!
GDB will switch context to the new thread:



Examine switching context to new thread

AMDGPU Thread agent-id:queue-id:dispatch-num:wave-id **(work-group-z,work-group-y,work-group-x)/work-group-thread-index**

```
[Switching to AMDGPU Thread 1:5:1:1 (0,0,0)/0]

Thread 9 "Jacobi_hip" hit Breakpoint 2, LocalLaplacianKernel (localNx=<optimized out
>, localNy=<optimized out>, stride=<optimized out>, dx=<optimized out>, dy=<optimize
d out>, U=<optimized out>, AU=<optimized out>) at Laplacian.cpp:9
```

agent-id	queue-id	dispatch-num	wave-id	(z, y, x)
Agent Target ID	Queue Target ID	Dispatch Target ID – how many kernels have been launched	Wavefront ID – index of wavefront of kernel	work-group/block index

Examine the ISA with rocgdb using cgdb

Using cgdb, type
ESC -> :set dis -> ENTER

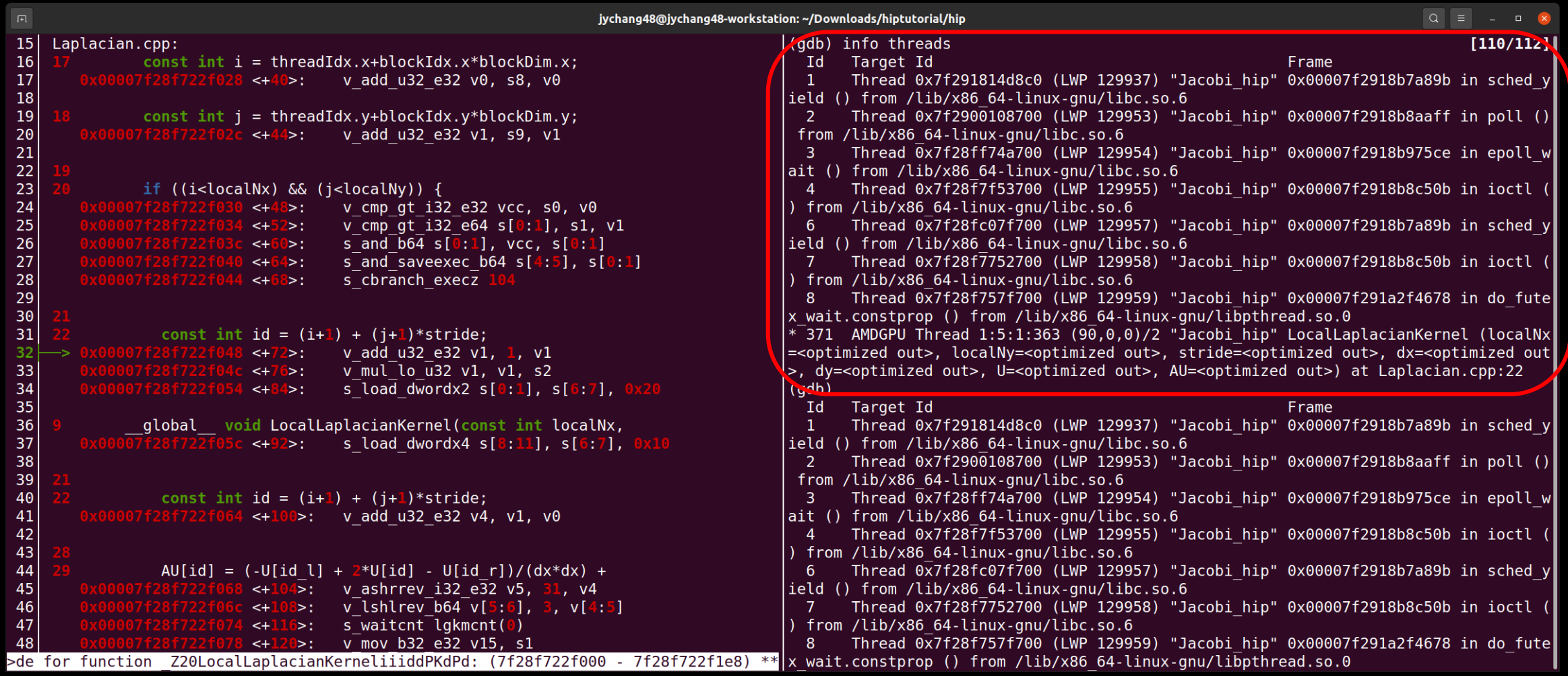
jychang48@jychang48-workstation: ~/Downloads/hiptutorial/hip

```
 3  9        __global__ void LocalLaplacianKernel(const int localNx,
 4     0x00007f28f722f000 <+0>:     s_load_dwordx4 s[0:3], s[6:7], 0x0
 5
 6  /opt/rocm-4.2.0/hip/include/hip/amd_detail/hip_runtime.h:
 7  232         return __ockl_get_local_size(x);
 8     0x00007f28f722f008 <+8>:     s_load_dword s10, s[4:5], 0x4
 9     0x00007f28f722f010 <+16>:    s_waitcnt lgkmcnt(0)
10     0x00007f28f722f014 <+20>:    s_lshr_b32 s3, s10, 16
11     0x00007f28f722f018 <+24>:    s_and_b32 s4, s10, 0xffff
12     0x00007f28f722f020 <+32>:    s_mul_i32 s8, s8, s4
13     0x00007f28f722f024 <+36>:    s_mul_i32 s9, s9, s3
14
15 Laplacian.cpp:
16 17        const int i = threadIdx.x+blockIdx.x*blockDim.x;
17     0x00007f28f722f028 <+40>:    v_add_u32_e32 v0, s8, v0
18
19 18        const int j = threadIdx.y+blockIdx.y*blockDim.y;
20 ---> 0x00007f28f722f02c <+44>:    v_add_u32_e32 v1, s9, v1
21
22 19
23 20        if ((i<localNx) && (j<localNy)) {
24     0x00007f28f722f030 <+48>:    v_cmp_gt_i32_e32 vcc, s0, v0
25     0x00007f28f722f034 <+52>:    v_cmp_gt_i32_e64 s[0:1], s1, v1
26     0x00007f28f722f03c <+60>:    s_and_b64 s[0:1], vcc, s[0:1]
27     0x00007f28f722f040 <+64>:    s_and_saveexec_b64 s[4:5], s[0:1]
28     0x00007f28f722f044 <+68>:    s_cbranch_execz 104
29
30 21
31 22          const int id = (i+1) + (j+1)*stride;
32     0x00007f28f722f048 <+72>:    v_add_u32_e32 v1, 1, v1
33     0x00007f28f722f04c <+76>:    v_mul_lo_u32 v1, v1, s2
34     0x00007f28f722f054 <+84>:    s_load_dwordx2 s[0:1], s[6:7], 0x20
35
36 9        __global__ void LocalLaplacianKernel(const int localNx,
>de for function _Z20LocalLaplacianKerneliiiddPKdPd: (7f28f722f000 - 7f28f722f1e8) **
```

```
Make breakpoint pending on future shared library load? (y or [n]) y

Breakpoint 2 (LocalLaplacianKernel) pending.(gdb) continue
Continuing.
[Switching to AMDGPU Thread 1:5:1:1 (0,0,0)/0]

Thread 9 "Jacobi_hip" hit Breakpoint 2, LocalLaplacianKernel (localNx=<optimized out
>, localNy=<optimized out>, stride=<optimized out>, dx=<optimized out>, dy=<optimize
d out>, U=<optimized out>, AU=<optimized out>) at Laplacian.cpp:9
(gdb) step
[Switching to AMDGPU Thread 1:5:1:1287 (65,1,0)/2]

Thread 1295 "Jacobi_hip" hit Breakpoint 2, LocalLaplacianKernel (localNx=<optimized
out>, localNy=<optimized out>, stride=<optimized out>, dx=<optimized out>, dy=<optim
ized out>, U=<optimized out>, AU=<optimized out>) at Laplacian.cpp:9
(gdb) step
[Switching to AMDGPU Thread 1:5:1:1269 (61,1,0)/0]

Thread 1277 "Jacobi_hip" hit Breakpoint 2, LocalLaplacianKernel (localNx=<optimized
out>, localNy=<optimized out>, stride=<optimized out>, dx=<optimized out>, dy=<optim
ized out>, U=<optimized out>, AU=<optimized out>) at Laplacian.cpp:9
(gdb) step
[Switching to AMDGPU Thread 1:5:1:363 (90,0,0)/2]

Thread 371 "Jacobi_hip" hit Breakpoint 2, LocalLaplacianKernel (localNx=<optimized o
ut>, localNy=<optimized out>, stride=<optimized out>, dx=<optimized out>, dy=<optimi
zed out>, U=<optimized out>, AU=<optimized out>) at Laplacian.cpp:9
(gdb) disable 2
(gdb) step
(gdb) stepi
0x00007f28f722f010 in __HIP_BlockDim::operator() (this=<optimized out>, x=<optimized
 out>) at /opt/rocm-4.2.0/hip/include/hip/amd_detail/hip_runtime.h:232
(gdb) step
(gdb) step
(gdb)
```

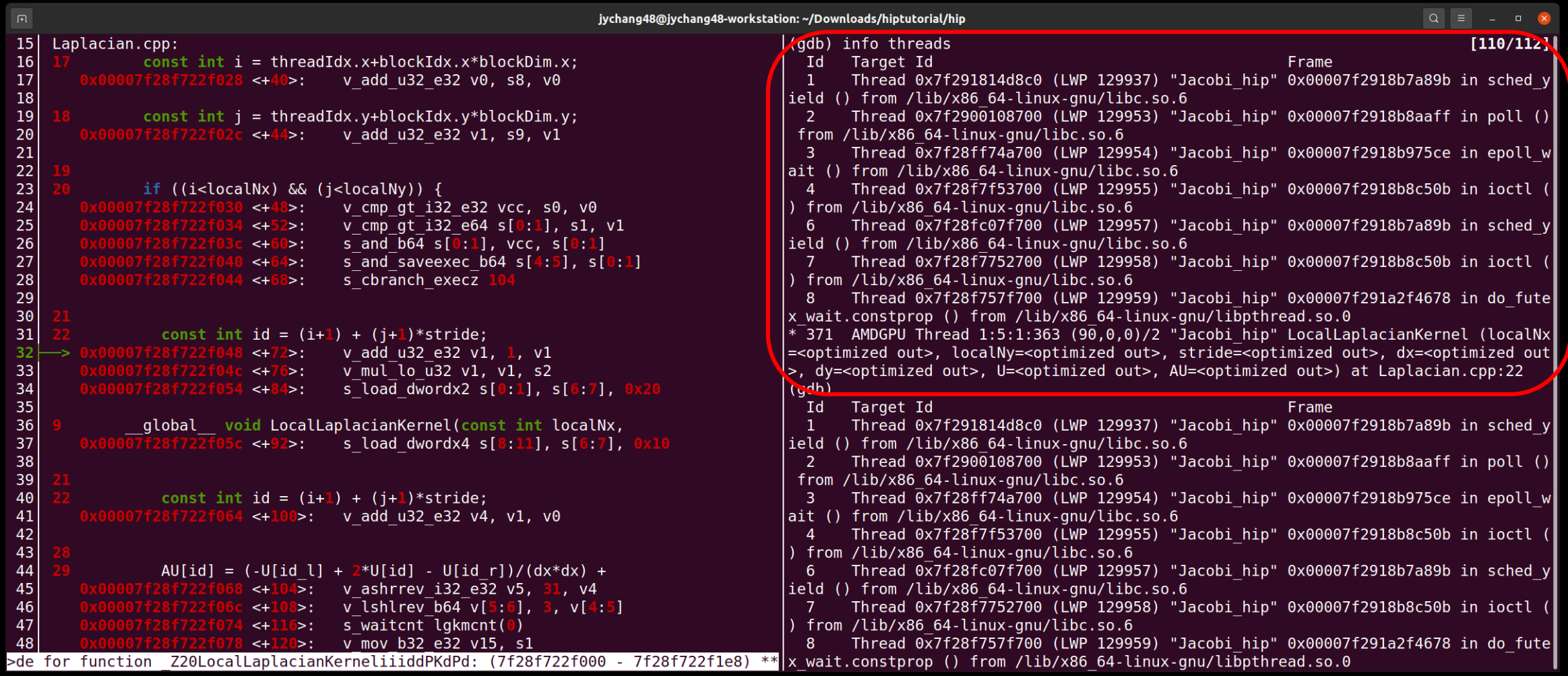
Switching wavefronts

Use info threads to see the location of both host threads and GPU wavefronts



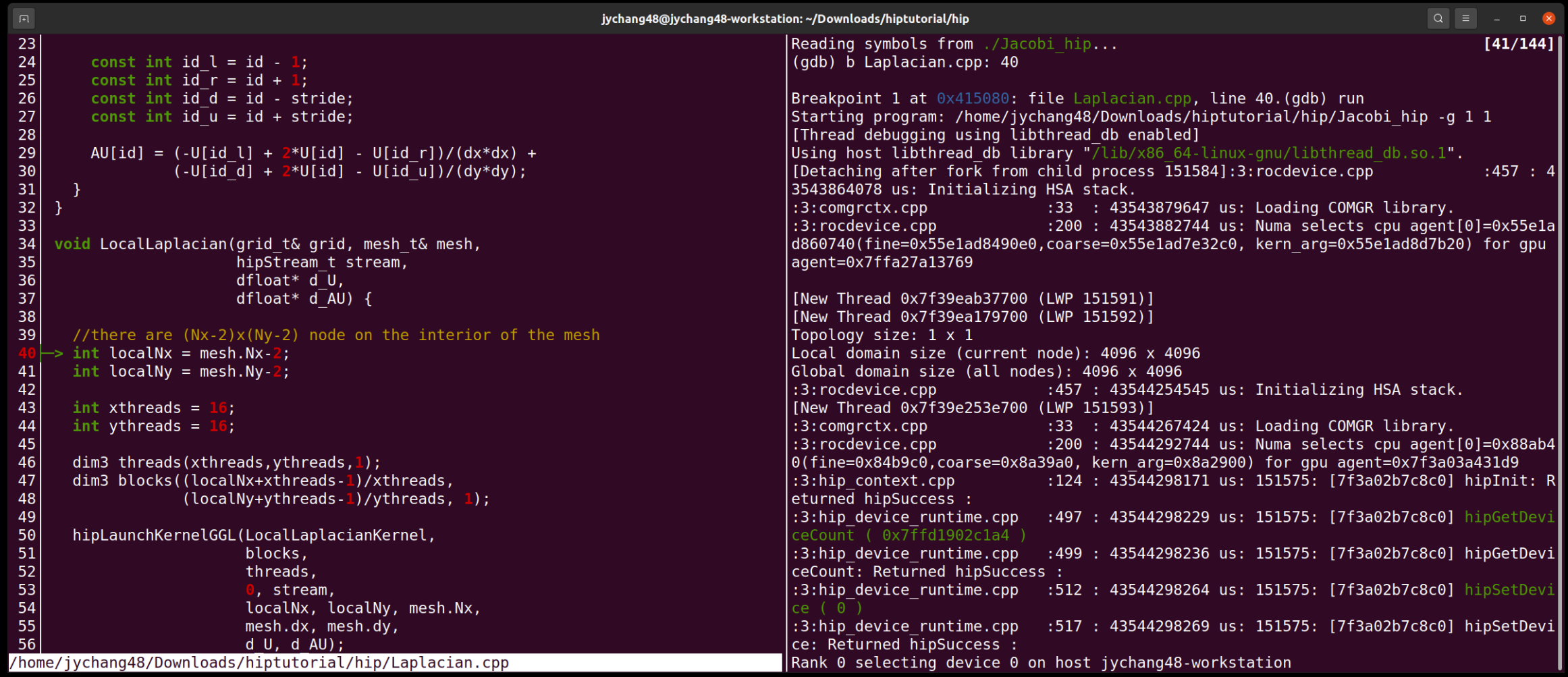
Switching wavefronts

Or use `thread <tid>` to examine one particular thread



Other tips and tricks with rocgdb

Use `export AMD_LOG_LEVEL=3` to print all API calls and more happening



Other tips and tricks with rocgdb

Use `export AMD_LOG_LEVEL=3` to print all API calls and more happening

jychang48@jychang48-workstation: ~/Downloads/hiptutorial/hip

```
23
24      const int id_l = id - 1;
25      const int id_r = id + 1;
26      const int id_d = id - stride;
27      const int id_u = id + stride;
28
29      AU[id] = (-U[id_l] + 2*U[id] - U[id_r])/(dx*dx) +
30               (-U[id_d] + 2*U[id] - U[id_u])/(dy*dy);
31    }
32  }
33
34  void LocalLaplacian(grid_t& grid, mesh_t& mesh,
35                      hipStream_t stream,
36                      dfloat* d_U,
37                      dfloat* d_AU) {
38
39    //there are (Nx-2)x(Ny-2) node on the interior of the mesh
40--> int localNx = mesh.Nx-2;
41    int localNy = mesh.Ny-2;
42
43    int xthreads = 16;
44    int ythreads = 16;
45
46    dim3 threads(xthreads,ythreads,1);
47    dim3 blocks((localNx+xthreads-1)/xthreads,
48                (localNy+ythreads-1)/ythreads, 1);
49
50    hipLaunchKernelGGL(LocalLaplacianKernel,
51                       blocks,
52                       threads,
53                       0, stream,
54                       localNx, localNy, mesh.Nx,
55                       mesh.dx, mesh.dy,
56                       d_U, d_AU);
/home/jychang48/Downloads/hiptutorial/hip/Laplacian.cpp
```

```
Rank 0 selecting device 0 on host jychang48-workstation                    [61/144]
:3:hip_memory.cpp           :289 : 43544298319 us: 151575: [7f3a02b7c8c0] hipHostMal
loc ( 0x7ffd1902c6f8, 131072, 0 )
:3:hip_memory.cpp           :318 : 43544298463 us: 151575: [7f3a02b7c8c0] hipHostMal
loc: Returned hipSuccess : 0x7f39e85c0000: duration: 144 us
:3:hip_memory.cpp           :289 : 43544298473 us: 151575: [7f3a02b7c8c0] hipHostMal
loc ( 0x7ffd1902c700, 131072, 0 )
:3:hip_memory.cpp           :318 : 43544298589 us: 151575: [7f3a02b7c8c0] hipHostMal
loc: Returned hipSuccess : 0x7f39e8580000: duration: 116 us
:3:hip_memory.cpp           :283 : 43544298607 us: 151575: [7f3a02b7c8c0] hipMalloc
( 0x7ffd1902c708, 131072 )
:3:rocdevice.cpp            :2065: 43544298694 us: device=0x8d2890, freeMem_ = 0xfef
e0000
:3:hip_memory.cpp           :285 : 43544298702 us: 151575: [7f3a02b7c8c0] hipMalloc:
 Returned hipSuccess : 0x7f39e1a00000: duration: 95 us
:3:hip_memory.cpp           :1877: 43544298712 us: 151575: [7f3a02b7c8c0] hipMemset
( 0x7f39e1a00000, 0, 131072 )
:3:rocdevice.cpp            :2566: 43544299081 us: number of allocated hardware queu
es with low priority: 0, with normal priority: 0, with high priority: 0, maximum per
 priority is: 4
[New Thread 0x7f39e19ff700 (LWP 151594)]
[Thread 0x7f39e19ff700 (LWP 151594) exited]
[New Thread 0x7f39e857f700 (LWP 151595)]
:3:rocdevice.cpp            :2638: 43544316233 us: created hardware queue 0x7f39e88c
6000 with size 1024 with priority 1, cooperative: 0
:3:devprogram.cpp           :2463: 43544489762 us: Using Code Object V4.
:3:rocvirtual.cpp           :572 : 43544495580 us: !    arg1: uint* bufUInt = ptr:0x
7f39e1a00000 obj:[0x7f39e1a00000-0x7f39e1a20000] threadId : 7f39e857f700

:3:rocvirtual.cpp           :572 : 43544495588 us: !    arg2: uchar* pattern = ptr:0
x7f39e876e080 obj:[0x7f39e876e000-0x7f39e876f000] threadId : 7f39e857f700

:3:rocvirtual.cpp           :2521: 43544495591 us: [7f39e857f700]!      ShaderName :
 __amd_rocclr_fillBuffer
```

Other tips and tricks with rocgdb

Use `i th` to see a list of all active host threads. Currently viewing thread 1 (default)

jychang48@jychang48-workstation: ~/Downloads/hiptutorial/hip

```
23
24      const int id_l = id - 1;
25      const int id_r = id + 1;
26      const int id_d = id - stride;
27      const int id_u = id + stride;
28
29      AU[id] = (-U[id_l] + 2*U[id] - U[id_r])/(dx*dx) +
30               (-U[id_d] + 2*U[id] - U[id_u])/(dy*dy);
31    }
32  }
33
34  void LocalLaplacian(grid_t& grid, mesh_t& mesh,
35                      hipStream_t stream,
36                      dfloat* d_U,
37                      dfloat* d_AU) {
38
39    //there are (Nx-2)x(Ny-2) node on the interior of the mesh
40--> int localNx = mesh.Nx-2;
41    int localNy = mesh.Ny-2;
42
43    int xthreads = 16;
44    int ythreads = 16;
45
46    dim3 threads(xthreads,ythreads,1);
47    dim3 blocks((localNx+xthreads-1)/xthreads,
48                (localNy+ythreads-1)/ythreads, 1);
49
50    hipLaunchKernelGGL(LocalLaplacianKernel,
51                       blocks,
52                       threads,
53                       0, stream,
54                       localNx, localNy, mesh.Nx,
55                       mesh.dx, mesh.dy,
56                       d_U, d_AU);
/home/jychang48/Downloads/hiptutorial/hip/Laplacian.cpp
```

```
:3:rocvirtual.cpp           :2521: 43544718546 us: [7f39e8446700]!      ShaderName :
 _Z11NormKernel2iPKdPd

:3:hip_memory.cpp           :331 : 43544719486 us: 151575: [7f3a02b7c8c0] hipMemcpy:
 Returned hipSuccess : : duration: 957 us
Iteration:    0 - Residual: 0.022108
:3:hip_device_runtime.cpp   :458 : 43544719507 us: 151575: [7f3a02b7c8c0] hipDeviceS
ynchronize (  )
:3:hip_device_runtime.cpp   :470 : 43544719512 us: 151575: [7f3a02b7c8c0] hipDeviceS
ynchronize: Returned hipSuccess :
:3:hip_event.cpp            :310 : 43544719523 us: 151575: [7f3a02b7c8c0] hipEventRe
cord ( event:0x948d00, stream:0x789710 )
:3:hip_event.cpp            :352 : 43544719530 us: 151575: [7f3a02b7c8c0] hipEventRe
cord: Returned hipSuccess :

Thread 1 "Jacobi_hip" hit Breakpoint 1, LocalLaplacian (grid=..., mesh=..., stream=0
x789710, d_U=0x7f3893e00000, d_AU=0x7f388bc00000) at Laplacian.cpp:40
(gdb) i th
  Id   Target Id                                          Frame
* 1    Thread 0x7f3a02b7c8c0 (LWP 151575) "Jacobi_hip" LocalLaplacian (grid=..., mes
h=..., stream=0x789710, d_U=0x7f3893e00000, d_AU=0x7f388bc00000) at Laplacian.cpp:40
  2    Thread 0x7f39eab37700 (LWP 151591) "Jacobi_hip" 0x00007f3a035b9aff in poll ()
 from /lib/x86_64-linux-gnu/libc.so.6
  3    Thread 0x7f39ea179700 (LWP 151592) "Jacobi_hip" 0x00007f3a035c65ce in epoll_w
ait () from /lib/x86_64-linux-gnu/libc.so.6
  4    Thread 0x7f39e253e700 (LWP 151593) "Jacobi_hip" 0x00007f3a035bb50b in ioctl (
) from /lib/x86_64-linux-gnu/libc.so.6
  6    Thread 0x7f39e857f700 (LWP 151595) "Jacobi_hip" 0x00007f3a04d23678 in do_fute
x_wait.constprop () from /lib/x86_64-linux-gnu/libpthread.so.0
  7    Thread 0x7f39e8446700 (LWP 151596) "Jacobi_hip" 0x00007f3a04d23678 in do_fute
x_wait.constprop () from /lib/x86_64-linux-gnu/libpthread.so.0
  8    Thread 0x7f39e827f700 (LWP 151597) "Jacobi_hip" 0x00007f3a04d23678 in do_fute
x_wait.constprop () from /lib/x86_64-linux-gnu/libpthread.so.0
(gdb)
```

And more…

ROCgdb has several other features and capabilities not covered in this presentation.
See the following for much more:

https://docs.amd.com/bundle/ROCDebugger-User-Guide-v5.2/page/index.html
/opt/rocm-5.2.0/share/doc/rocgdb/rocannotate.pdf
/opt/rocm-5.2.0/share/doc/rocgdb/rocgdb.pdf
/opt/rocm-5.2.0/share/doc/rocgdb/rocrefcard.pdf
/opt/rocm-5.2.0/share/doc/rocgdb/rocstabs.pdf

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