



**Barcelona  
Supercomputing  
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*Centro Nacional de Supercomputación*



# BRAVAS

## Towards a Portable GPU Profiler

**Okke van Eck**

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May 19th, 2026

# How do we profile?

CPU | GPU





# How do we profile?

CPU | GPU

```
<?xml version='1.0'?>

<trace enabled="yes"
  home="/cvmfs/software.eessi.io/..."
  initial-mode="detail" type="paraver"
>
  <mpi enabled="no">
    <counters enabled="yes" />
    <comm-calls enabled="yes" />
  </mpi>

  <openmp enabled="yes" omp="no">
    <locks enabled="no" />
    <taskloop enabled="no" />
    <counters enabled="yes" />
  </openmp>

  <!-- XML Follows -->
</trace>
```

Choose the type of tracing:

- detail: detailed information of the tracing
- bursts: summarized information of the tracing

Trace the MPI calls

Trace OpenMP events



# How do we profile?

CPU | GPU

```
<counters enabled="yes">
  <cpu enabled="yes" starting-set-distribution="1">
    <set enabled="yes" domain="all" changeat-time="0">
      PAPI_TOT_INS,PAPI_TOT_CYC,PAPI_L1_DCM,PAPI_L2_DCM,PAPI_L3_DCM
    </set>
    <set enabled="yes" domain="all" changeat-time="5s">
      PAPI_TOT_INS,PAPI_TOT_CYC,PAPI_L1_DCM
      <sampling enabled="yes" period="1000000000">PAPI_TOT_CYC</sampling>
    </set>
    <set enabled="yes" domain="user" changeat-globalops="5">
      PAPI_TOT_INS,PAPI_TOT_CYC,PAPI_FP_INS
    </set>
  </cpu>
  <network enabled="yes" />
  <resource-usage enabled="yes" />
</counters>

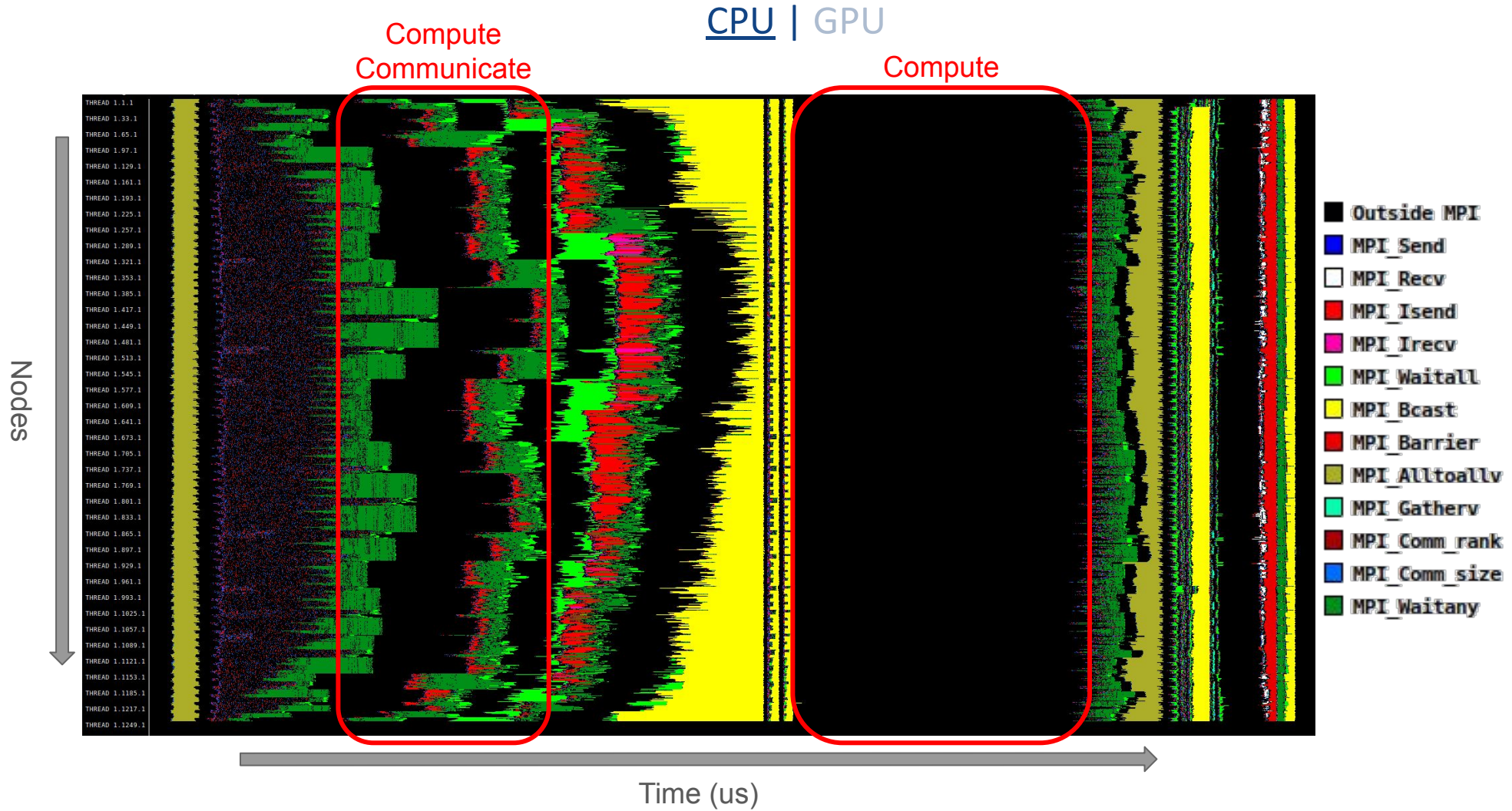
<!-- XML Follows -->
```

Select the enabled hardware counters:

- PAPI\_TOT\_INS: total instructions
- PAPI\_TOT\_CYC: total cycles
- PAPI\_L1\_DCM: total L1 data cache misses



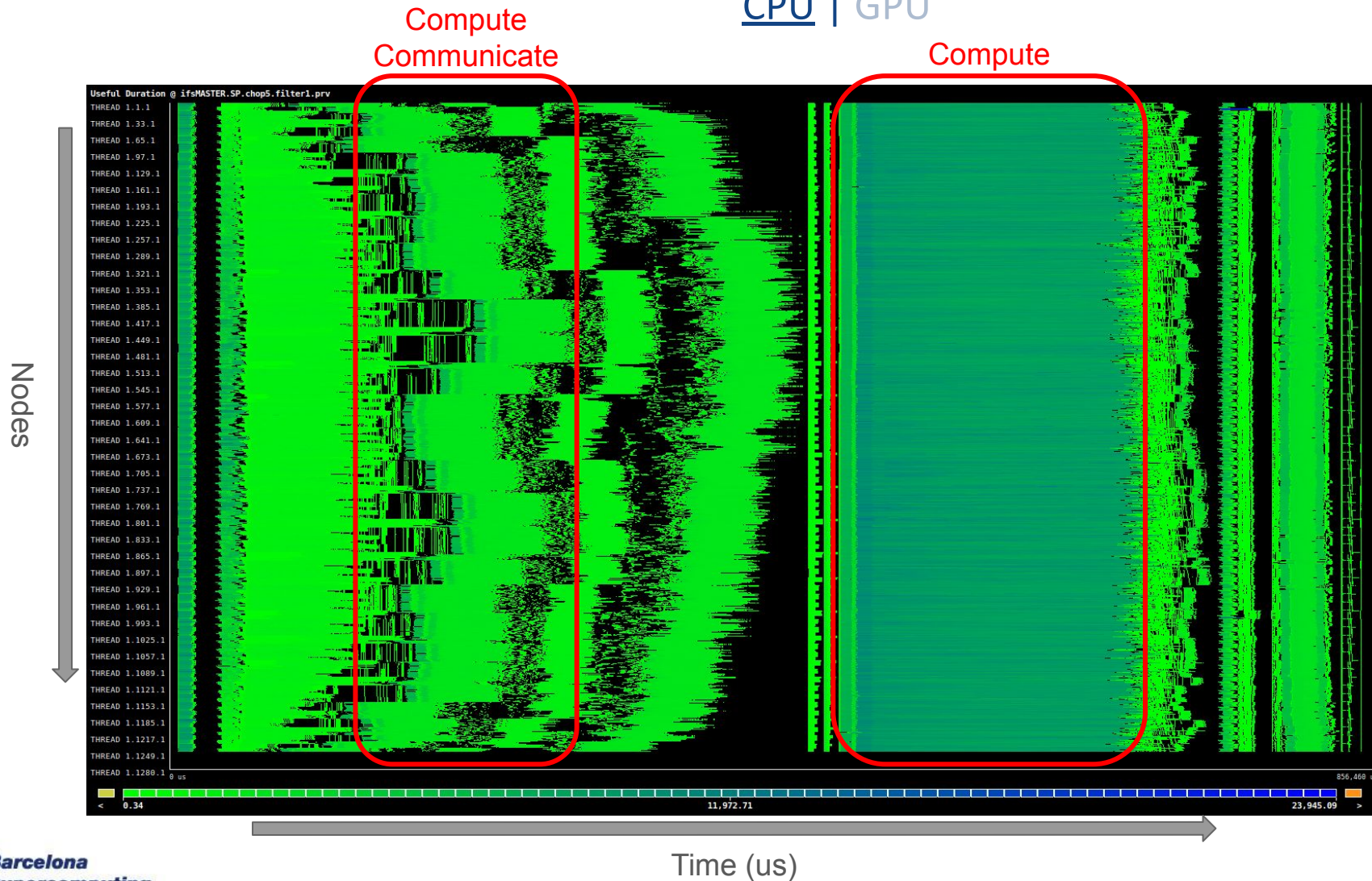
# How do we profile?





# How do we profile?

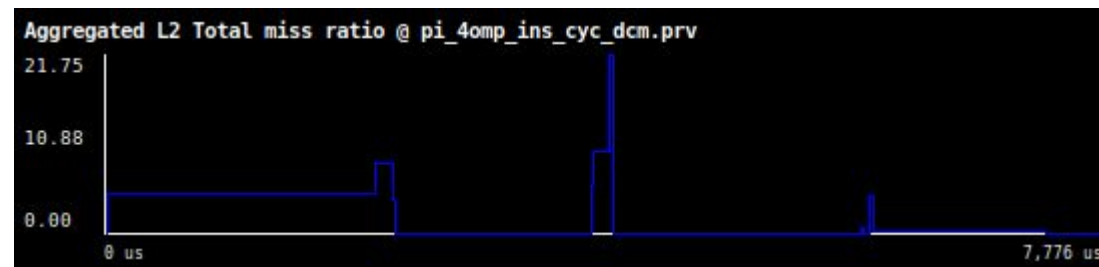
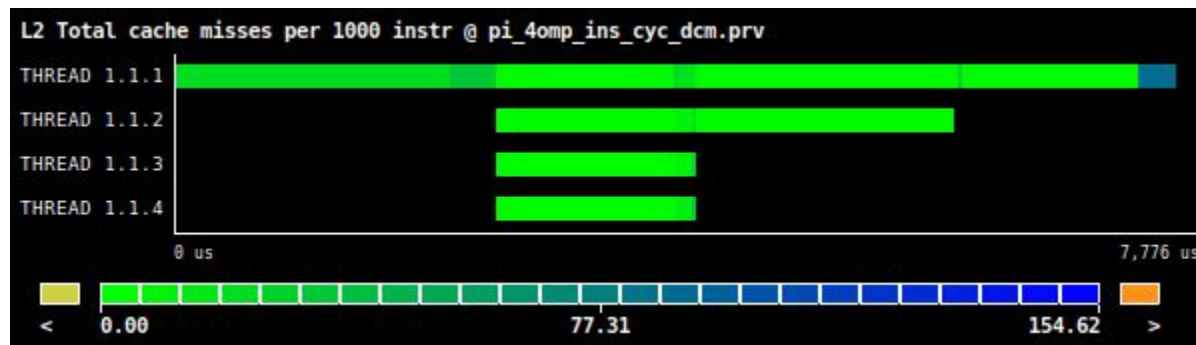
CPU | GPU





# How do we profile?

CPU | GPU





# How do we profile?

CPU | GPU

We don't have something *that portable* for GPUs..



# How do we profile?

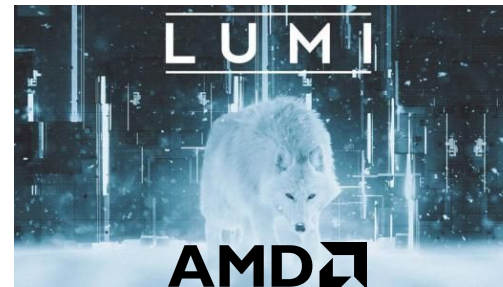
CPU | GPU





# How do we profile?

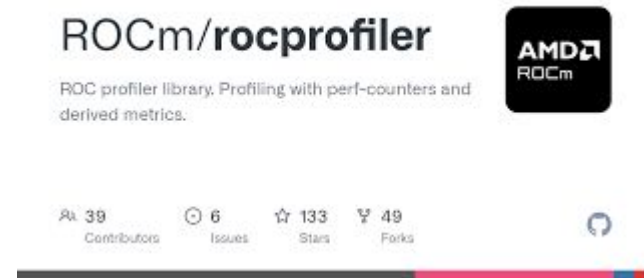
CPU | GPU





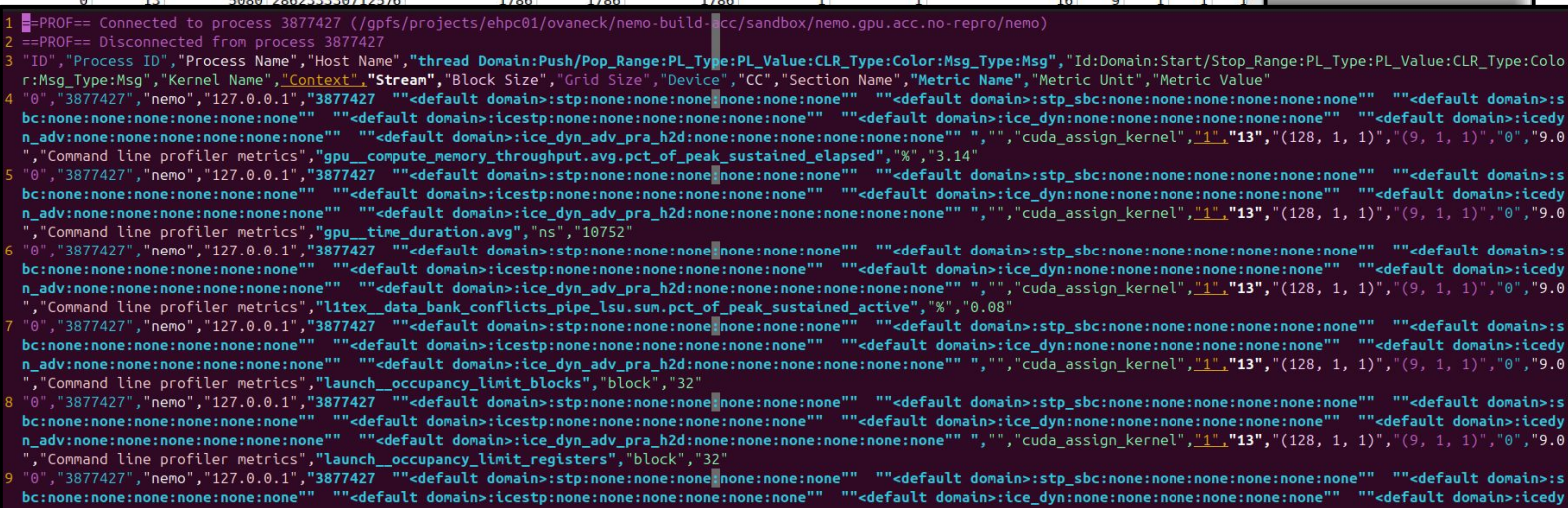
# How do we profile?

CPU | GPU





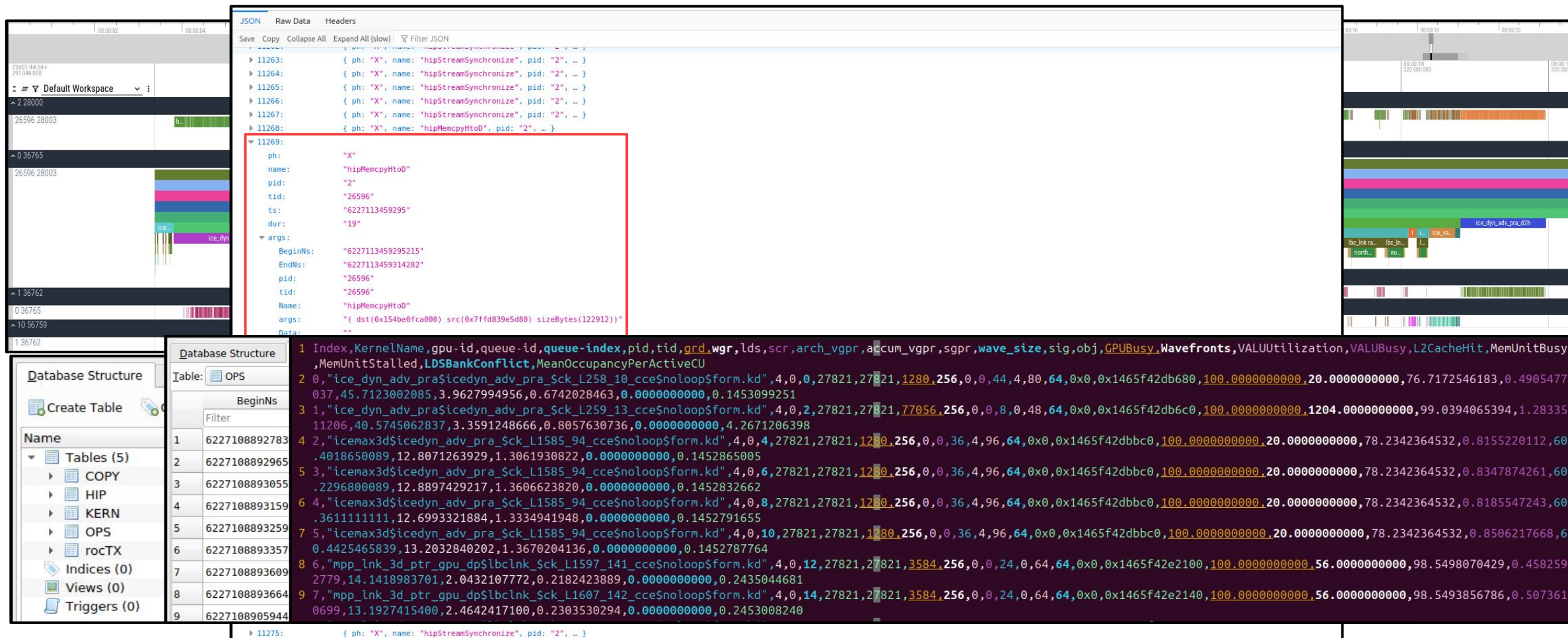
## CPU | GPU





# How do we profile?

CPU | GPU





# How do we profile?

CPU | GPU



Portability gap:

- Different applications for collecting performance metrics
- Different output formats to analyze
- Different hardware constructs



# How do we profile?

CPU | GPU



Portability gap:

- Different applications for collecting performance metrics
- Different output formats to analyze
- Different hardware constructs

Indicator gap:

- No big red arrow with "your problem is here"



# Why BRAVAS?

CPU | GPU



Portability solutions:

- Single user interface for profiling various applications
  - Flat learning curve
- Single output format for analysis
  - Generalization of hardware constructs



# Why BRAVAS?

CPU | GPU



Portability solutions:

- Single user interface for profiling various applications
  - Flat learning curve
- Single output format for analysis
  - Generalization of hardware constructs

Indicator solution:

- Quickly identify performance problems

# Design Overview

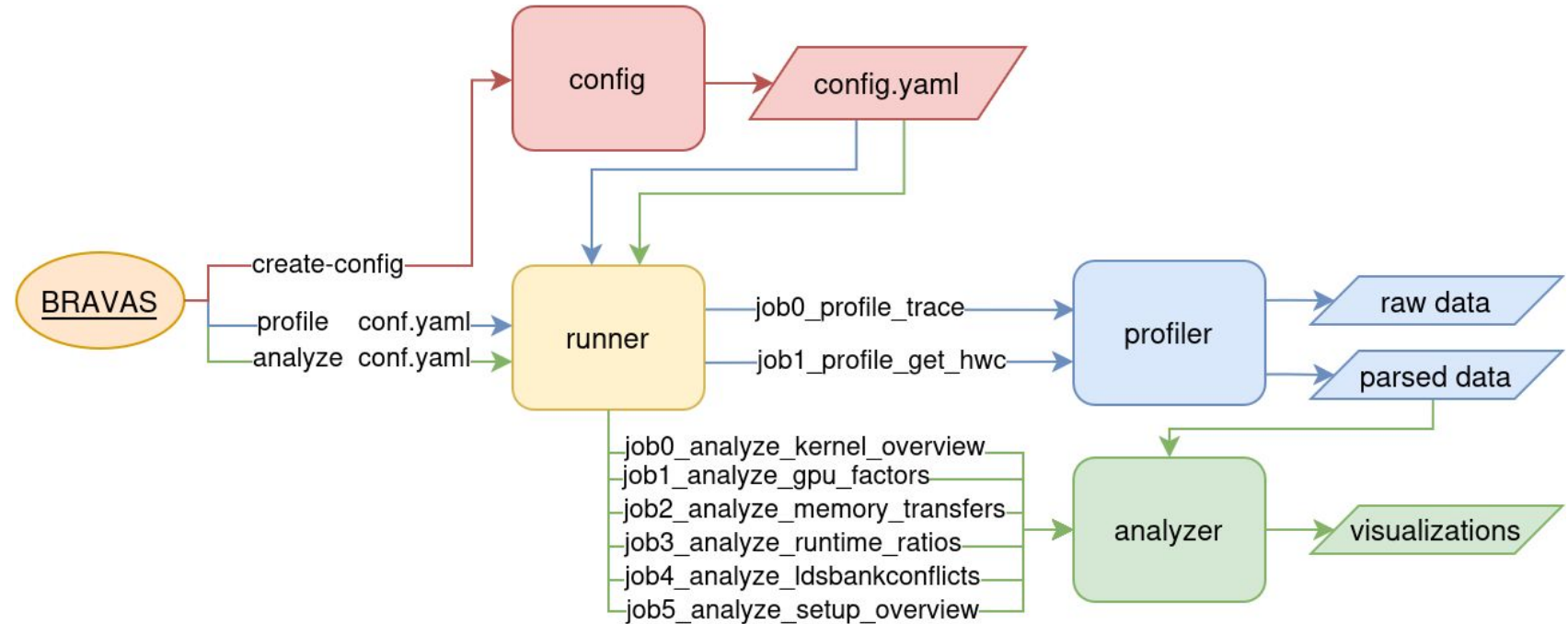


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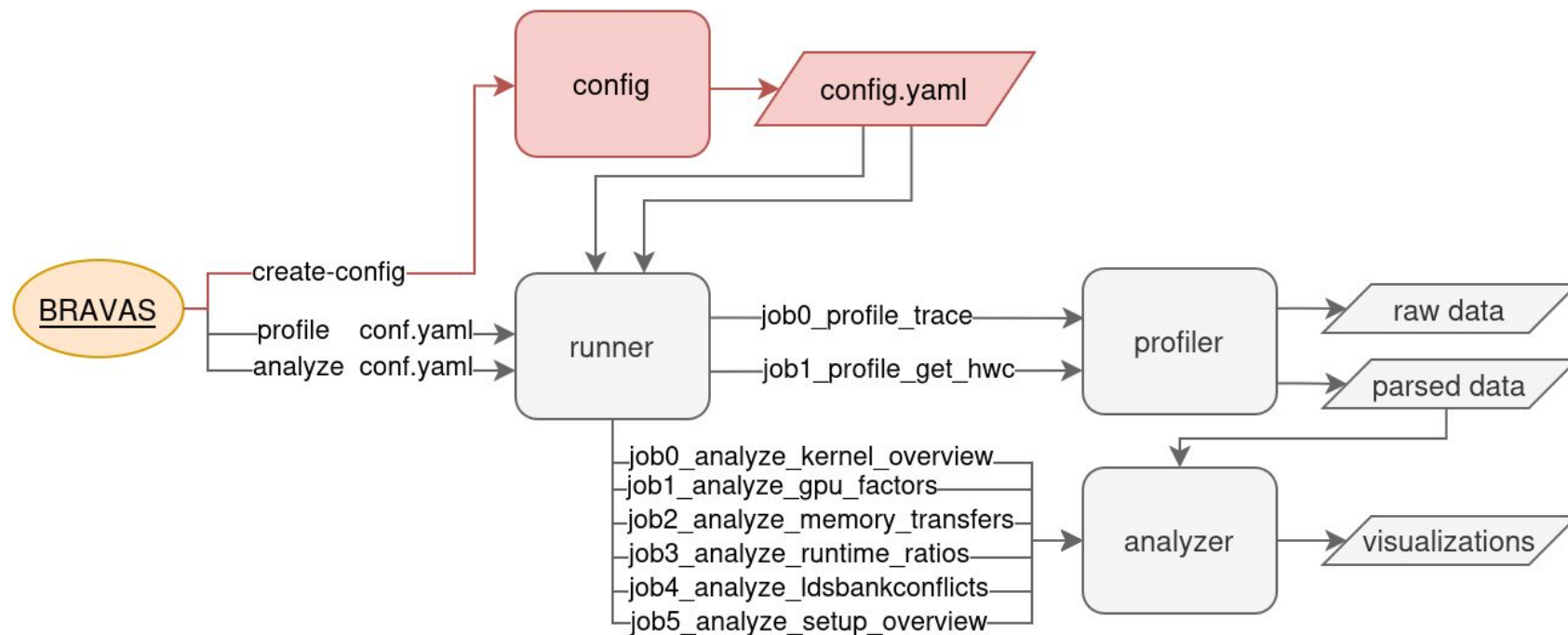


# Design Overview





# Design Overview



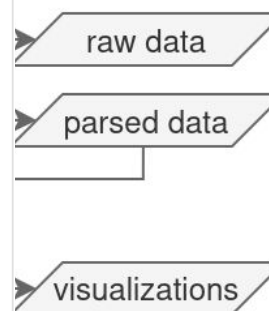


# Design Overview



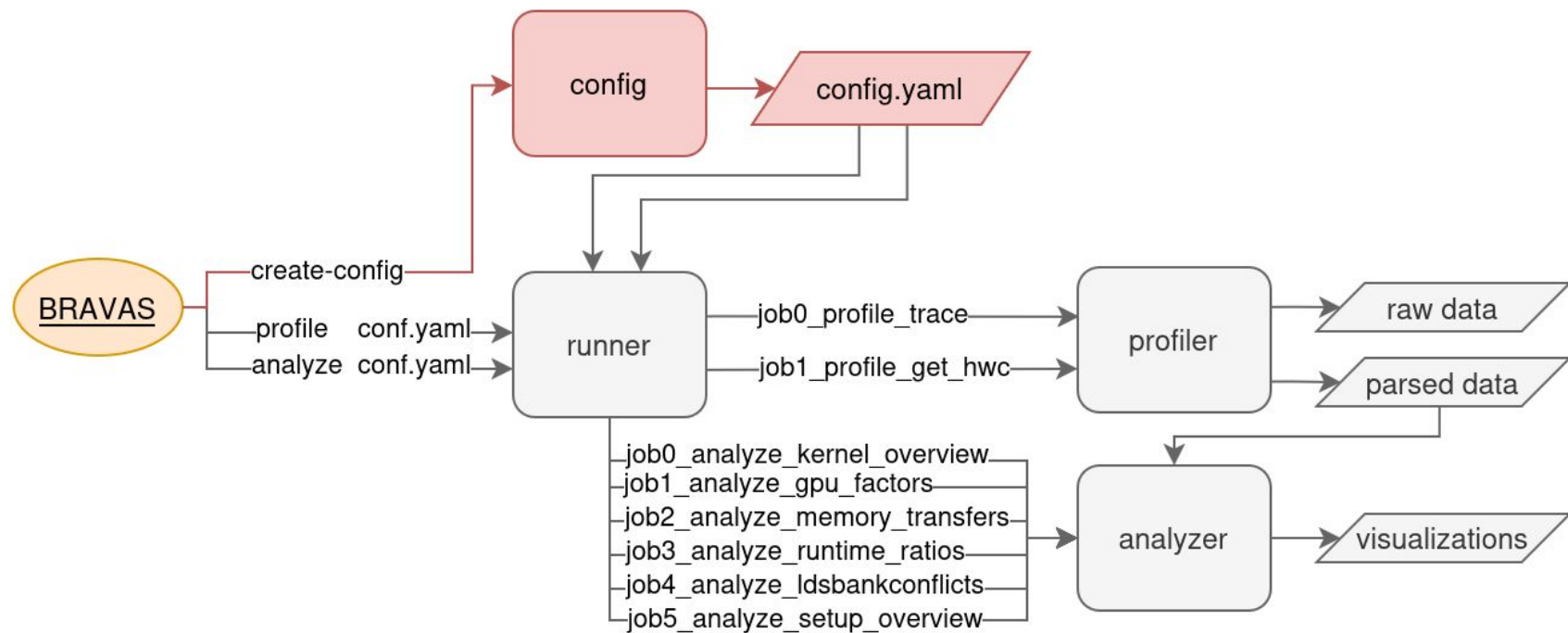
```
1 profile:
2   # Application setup.
3   application:
4     # Output directory for this experiment.
5     outdir: None
6     # Path to the application binary.
7     binary: None
8     # Environment file to load before executing any jobs.
9     env: ""
10    # Wrapper script to wrap each binary execution with.
11    wrapper: ""
12    # Fixed arguments for the binary.
13    fixed_args: ""
14    # Variable arguments for the binary.
15    var_args: ""
16
17    # Experimental setup options.
18    options:
19      arg_mode: zip
20      repeats: 1
21      trace_markers: ""
```

```
59 analyze:
60   # The results folder name in the outdir to perform the analysis on.
61   # By default the latest timestamp will be used.
62   res_folder: ""
63
64   # Create a table with all kernels, their calls, and duration stats.
65   # Options for value:
66   #   none: do not create the table
67   #   basic: create the table without coloring
68   #   colored: create the table and color rows
69   kernel_overview: none
70
71   # Create a GPU Factors overview for each provided kernel.
72   gpu_factors: ""
73
74   # Create a runtime scaling figure or table for the given nodes.
75   # Options for value:
76   #   none: do not create a scaling overview
77   #   figure: create a figure with the runtimes
78   #   table: create a table with the runtimes
79   #   figure table: create a figure and a table with the runtimes
80   runtime_scaling: none
81
82   # Create an energy scaling figure or table for the given nodes.
83   # Options for value:
84   #   none: do not create a scaling overview
85   #   figure: create a figure with the performance per watt
86   #   table: create a table with the performance per watt
87   #   figure table: create a figure and a table with the performance per watt
88   energy_scaling: none
89
90   # Create figures with memory transfers against bytes transferred.
91   # Options for value:
92   #   none: do not create figures
93   #   aggregated: create a figure per setup with aggregated values for all ranks
94   #   setups: create a figure containing aggregated values for all setups
95   #   List[int]: create a figure per setup containing aggregated values for the
96   #               provided ranks
97   #   all: create a figure per setup containing values for all ranks
98   memory_transfers: none
99
100  # Create a table with statistics on memory transfers.
101  setup_overview: false
```



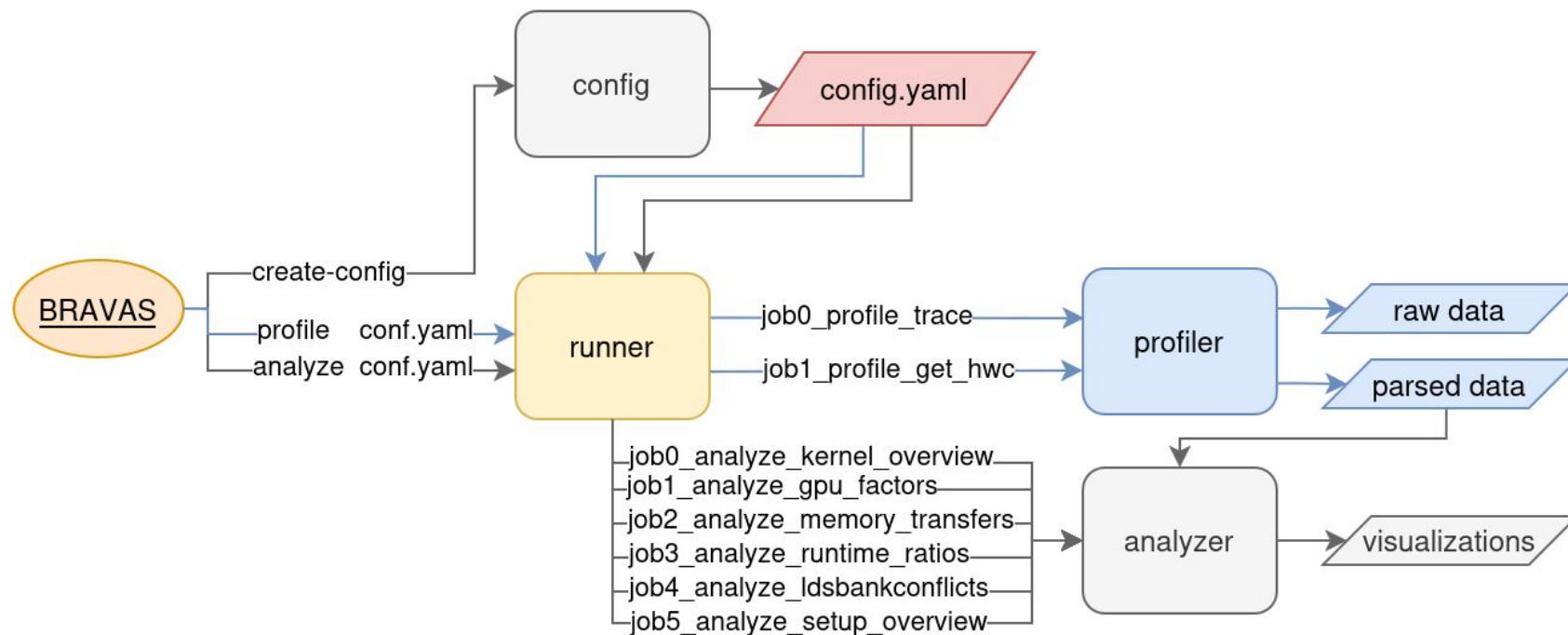


# Design Overview



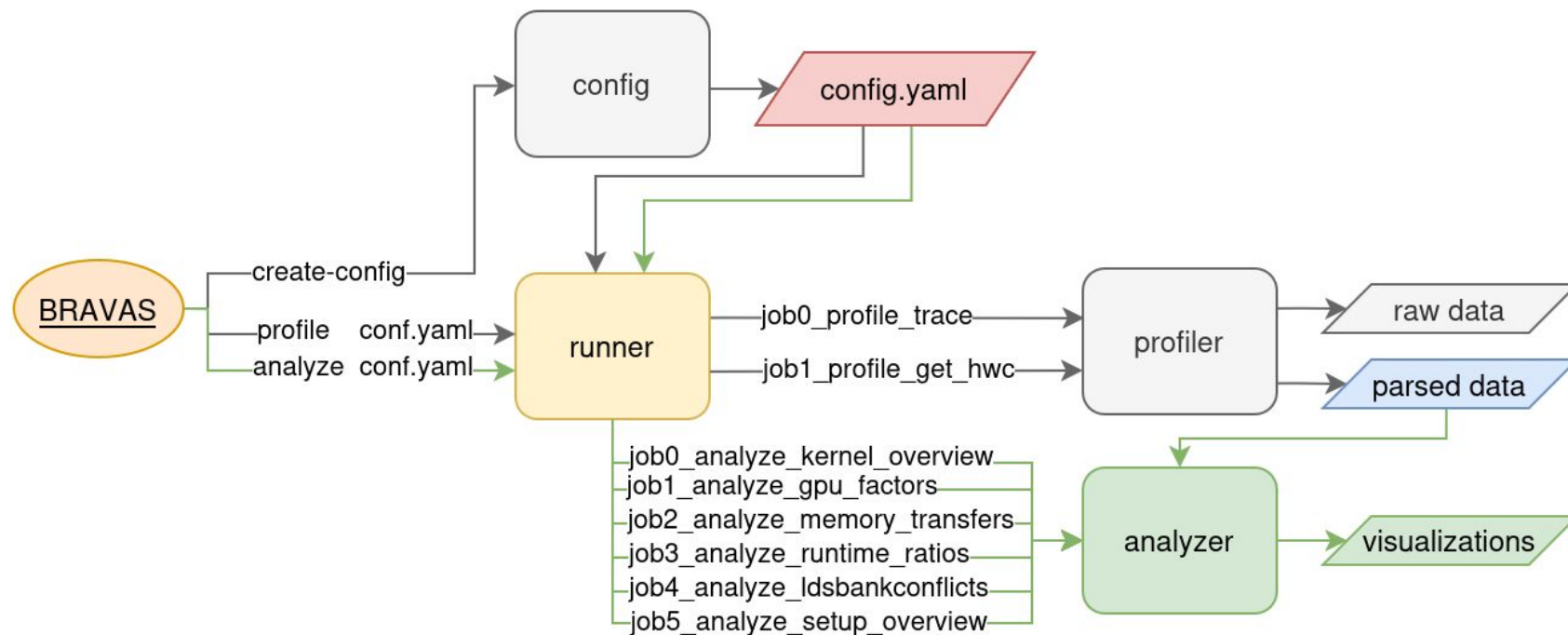


# Design Overview





# Design Overview



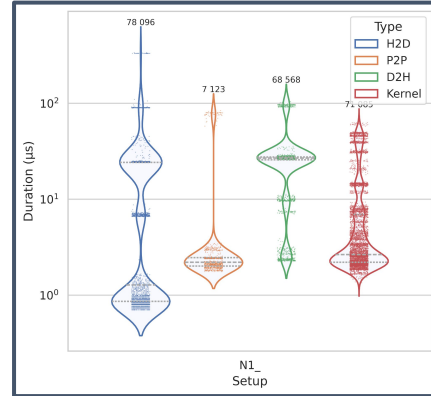


# Design Overview

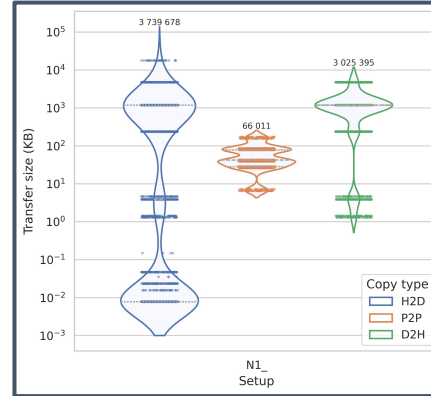
## Setup Overview

|                       | N1_      |
|-----------------------|----------|
| Unique kernels (#)    | 79       |
| Kernel call count (#) | 8 592    |
| Kernel time (μs)      | 71 085   |
| H2D count (#)         | 6 232    |
| D2H count (#)         | 3 664    |
| H2D time (μs)         | 85 218   |
| D2H time (μs)         | 75 690   |
| H2D size (MB)         | 3 716.49 |
| D2H size (MB)         | 3 018.95 |

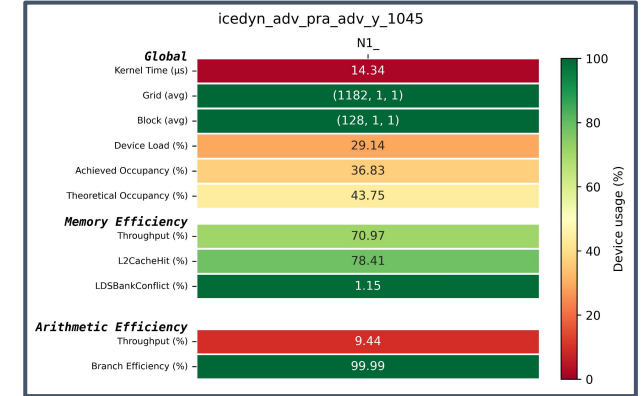
## Runtimes per Setup



## Memory Transfer Sizes per Setup



## GPU Factors



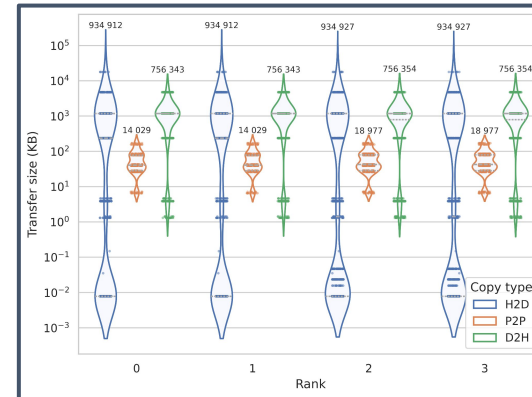
## Kernel Time

| KernelName                            | Calls | TotalDurationUs | AverageUs | Percentage |
|---------------------------------------|-------|-----------------|-----------|------------|
| icedyn_adv_pra_adv_y_883              | 416   | 19 749.58       | 47.47     | 27.78      |
| icedyn_adv_pra_adv_x_667              | 416   | 14 654.4        | 35.23     | 20.62      |
| cuda_assign_kernel                    | 1 920 | 7 083.02        | 3.69      | 9.96       |
| icedyn_adv_pra_adv_y_1045             | 416   | 5 967.31        | 14.34     | 8.39       |
| icedyn_adv_pra_ice_dyn_adv_pra_543    | 32    | 1 943.71        | 60.74     | 2.73       |
| lbcnfd_lbc_nfd_nogather_3d_gpu_dp_939 | 832   | 1 693.41        | 2.04      | 2.38       |
| icedyn_adv_pra_ice_dyn_adv_pra_505    | 32    | 1 369.28        | 42.79     | 1.93       |
| lbcnfd_mpp_nfd_3d_ptr_gpu_dp_3117     | 96    | 978.75          | 10.2      | 1.38       |
| lbcnfd_mpp_nfd_3d_ptr_gpu_dp_3210     | 96    | 886.4           | 9.23      | 1.25       |
| lbcnfd_mpp_nfd_3d_ptr_gpu_dp_3188     | 96    | 852.42          | 8.88      | 1.2        |
| icedyn_adv_pra_ice_dyn_adv_pra_360    | 32    | 804.99          | 25.16     | 1.13       |
| icevar_ice_var_zapneg_689             | 160   | 724.0           | 4.52      | 1.02       |
| icedyn_adv_pra_hbig_1101              | 32    | 705.82          | 22.06     | 0.99       |
| icedyn_adv_pra_ice_dyn_adv_pra_331    | 32    | 665.37          | 20.79     | 0.94       |
| icedyn_adv_pra_hbig_1158              | 32    | 627.36          | 19.6      | 0.88       |
| ...                                   | ...   | ...             | ...       | ...        |

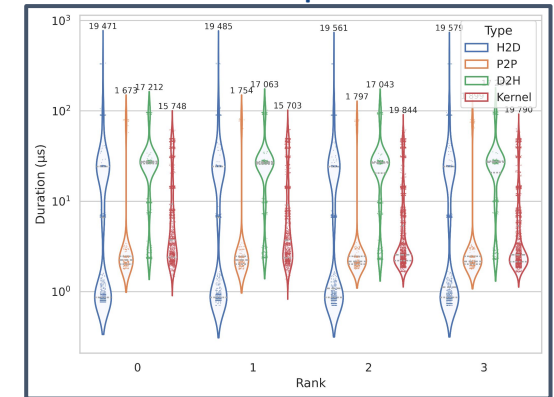
## LDS Bank Conflicts

| Rank | KernelName                | LDSBankConflict |
|------|---------------------------|-----------------|
| 0    | icedyn_adv_pra_adv_x_667  | 1.63            |
| 0    | icedyn_adv_pra_adv_y_883  | 1.6             |
| 0    | icedyn_adv_pra_adv_y_1045 | 1.17            |
| 0    | cuda_assign_kernel        | 0.06            |
| 1    | icedyn_adv_pra_adv_x_667  | 1.62            |
| 1    | icedyn_adv_pra_adv_y_883  | 1.58            |
| 1    | icedyn_adv_pra_adv_y_1045 | 1.15            |
| 1    | cuda_assign_kernel        | 0.07            |
| 2    | icedyn_adv_pra_adv_x_667  | 1.62            |
| 2    | icedyn_adv_pra_adv_y_883  | 1.6             |
| 2    | icedyn_adv_pra_adv_y_1045 | 1.16            |
| 2    | cuda_assign_kernel        | 0.03            |
| 3    | icedyn_adv_pra_adv_x_667  | 1.64            |
| 3    | icedyn_adv_pra_adv_y_883  | 1.6             |
| 3    | icedyn_adv_pra_adv_y_1045 | 1.12            |
| 3    | cuda_assign_kernel        | 0.03            |
| ...  | ...                       | ...             |

## Memory Transfer Sizes per Rank

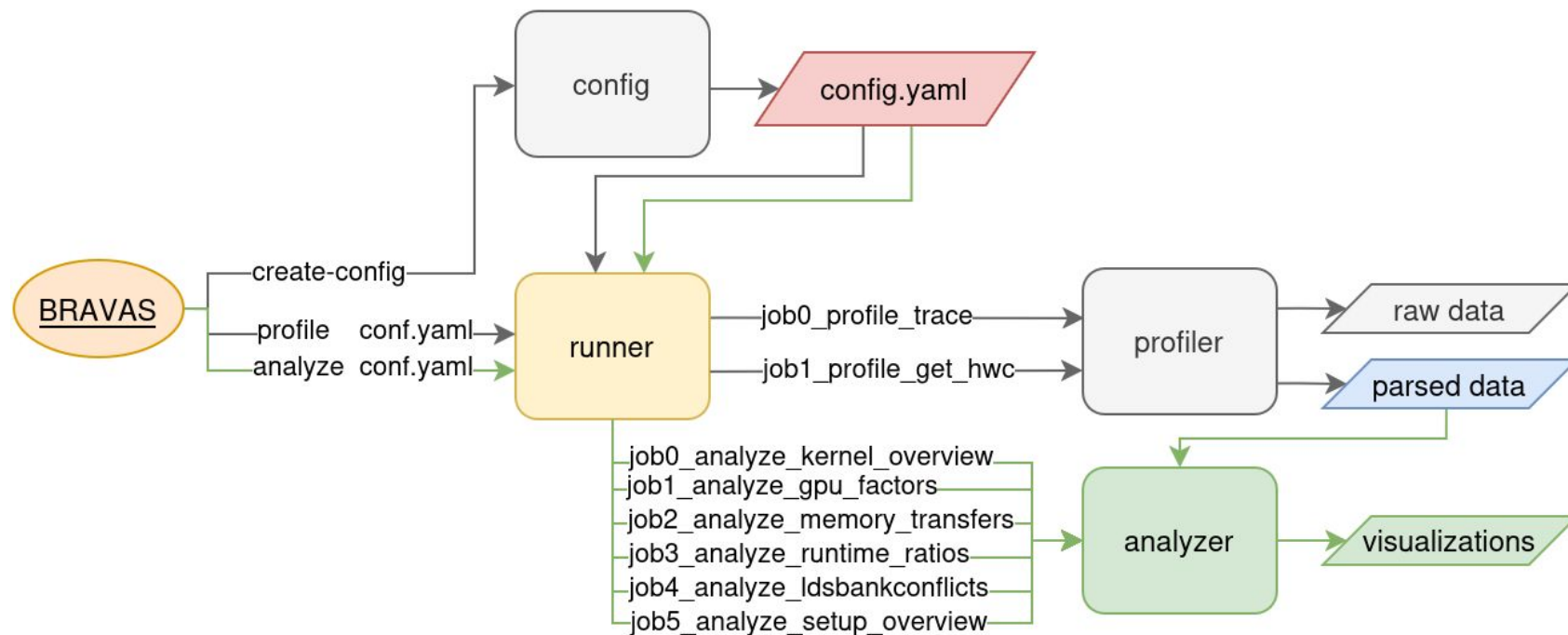


## Runtimes per Rank



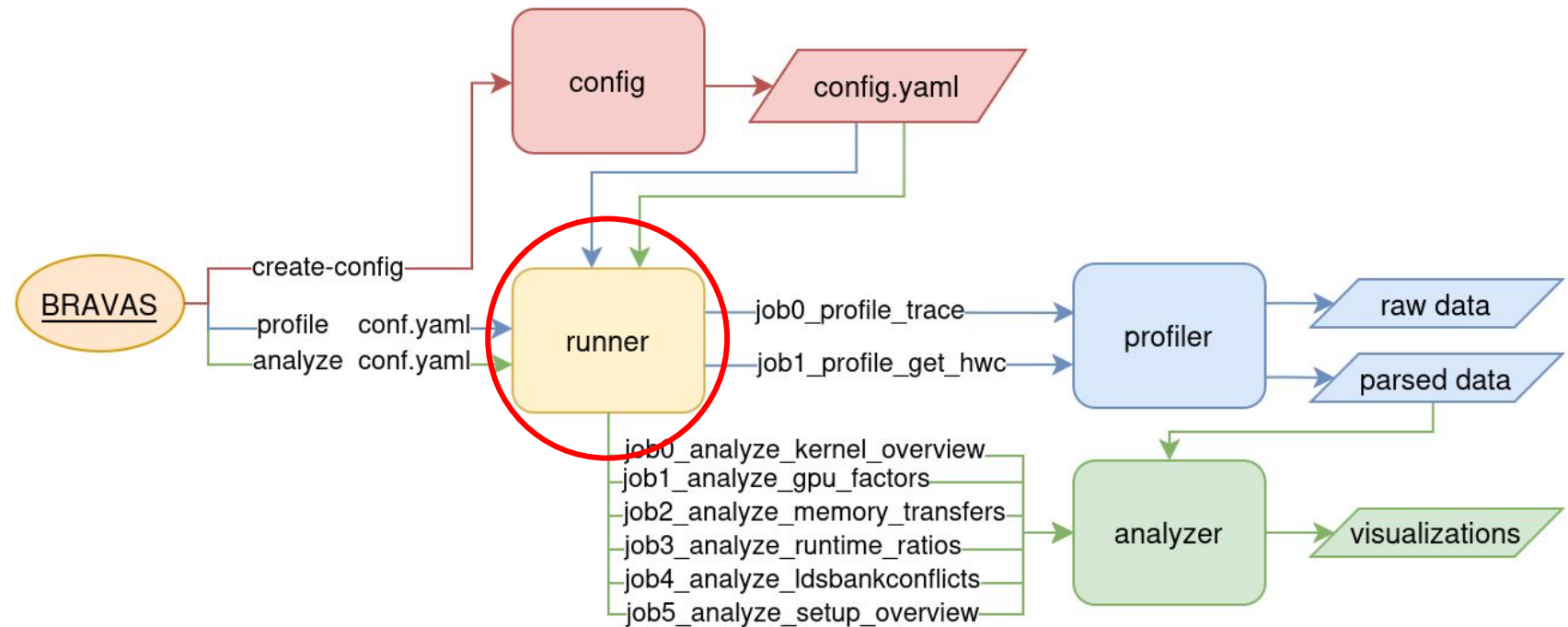


# Design Overview





# Design Overview





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May 19th, 2026

# Ocean model: OpenMP vs OpenACC on MN5 & LUMI



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# Ocean model

create-config | trace | make cut | profile & analyze



# Ocean model

[create-config](#) | [trace](#) | [make cut](#) | [profile & analyze](#)

bravas.py **create-config** config.yaml

```
1  profile:
2  # Application setup.
3  application:
4  # Output directory for this experiment.
5  outdir: "./bravas_outdir"
6  # Path to the application binary.
7  binary: "./nemo"
8  # Environment file to load before executing any jobs.
9  env: ""
10
11 # Experimental setup options.
12 options:
13   arg_mode: zip
14   repeats: 1
15   trace_markers: ""
16
17 # Execution setup.
18 runner:
19   # Runner mode: 'job', 'mpi', or 'submit'.
20   mode: job
21   # Job name.
22   job_name: "bravas"
```



# Ocean model

[create-config](#) | [trace](#) | [make cut](#) | [profile & analyze](#)

bravas.py **create-config** config.yaml

```
24 analyze:
25 # The results folder name in the outdir to perform the analysis on.
26 # By default the latest timestamp will be used.
27 res_folder: ""
28
29 # Create a table with all kernels, their calls, and duration stats.
30 # Options for value:
31 #   none: do not create the table
32 #   basic: create the table without coloring
33 #   colored: create the table and color rows
34 kernel_overview: colored
35
36 # Create a GPU Factors overview for each provided kernel.
37 gpu_factors: "yes"
38
39 # Create a runtime scaling figure or table for the given nodes.
40 # Options for value:
41 #   none: do not create a scaling overview
42 #   figure: create a figure with the runtimes
43 #   table: create a table with the runtimes
44 #   figure_table: create a figure and a table with the runtimes
45 runtime_scaling: none
46
47 # Create an energy scaling figure or table for the given nodes.
48 # Options for value:
49 #   none: do not create a scaling overview
50 #   figure: create a figure with the performance per watt
51 #   table: create a table with the performance per watt
52 #   figure_table: create a figure and a table with the performance per watt
53 energy_scaling: none
```

```
55 # Create figures with memory transfers against bytes transferred.
56 # Options for value:
57 #   none: do not create figures
58 #   aggregated: create a figure per setup with aggregated values for all ranks
59 #   setups: create a figure containing aggregated values for all setups
60 #   List[int]: create a figure per setup containing aggregated values for the
61 #               provided ranks
62 #   all: create a figure per setup containing values for all ranks
63 memory_transfers:
64 - aggregated
65 - setups
66 - all
67
68 # Create an overview of kernel and memory operations.
69 setup_overview: true
70
71 # Create figures with the GPU kernel time and cumulative memory times.
72 # Options for value:
73 #   none: do not create figures
74 #   aggregated: create a figure per setup with aggregated values for all ranks
75 #   setups: create a figure containing aggregated values for all setups
76 #   List[int]: create a figure per setup containing aggregated values for the
77 #               provided ranks
78 #   all: create a figure per setup containing values for all ranks
79 runtime_ratios:
80 - aggregated
81 - setups
82 - all
83
84 # Create a table with kernels that have LDSBankConflicts.
85 ldsbankconflicts: true
```



# Ocean model

[create-config](#) | [trace](#) | [make cut](#) | [profile & analyze](#)

bravas.py **create-config** config.yaml

```
24 analyze:
25 # The results folder name in the outdir to perform the analysis on.
26 # By default the latest timestamp will be used.
27 res_folder: ""
28
29 # Create a table with all kernels, their calls, and duration stats.
30 # Options for value:
31 # none: do not create the table
32 # basic: create the table without coloring
33 # colored: create the table and color rows
34 kernel_overview: colored ←
35
36 # Create a GPU Factors overview for each provided kernel.
37 gpu_factors: "yes" ←
38
39 # Create a runtime scaling figure or table for the given nodes.
40 # Options for value:
41 # none: do not create a scaling overview
42 # figure: create a figure with the runtimes
43 # table: create a table with the runtimes
44 # figure_table: create a figure and a table with the runtimes
45 runtime_scaling: none ✗
46
47 # Create an energy scaling figure or table for the given nodes.
48 # Options for value:
49 # none: do not create a scaling overview
50 # figure: create a figure with the performance per watt
51 # table: create a table with the performance per watt
52 # figure_table: create a figure and a table with the performance per watt
53 energy_scaling: none ✗
```

```
55 # Create figures with memory transfers against bytes transferred.
56 # Options for value:
57 # none: do not create figures
58 # aggregated: create a figure per setup with aggregated values for all ranks
59 # setups: create a figure containing aggregated values for all setups
60 # List[int]: create a figure per setup containing aggregated values for the
61 # provided ranks
62 # all: create a figure per setup containing values for all ranks
63 memory_transfers: ←
64 - aggregated
65 - setups
66 - all
67
68 # Create an overview of kernel and memory operations.
69 setup_overview: true ←
70
71 # Create figures with the GPU kernel time and cumulative memory times.
72 # Options for value:
73 # none: do not create figures
74 # aggregated: create a figure per setup with aggregated values for all ranks
75 # setups: create a figure containing aggregated values for all setups
76 # List[int]: create a figure per setup containing aggregated values for the
77 # provided ranks
78 # all: create a figure per setup containing values for all ranks
79 runtime_ratios: ←
80 - aggregated
81 - setups
82 - all
83
84 # Create a table with kernels that have LDSBankConflicts.
85 ldsbankconflicts: true ←
```



# Ocean model

create-config | trace | make cut | profile & analyze

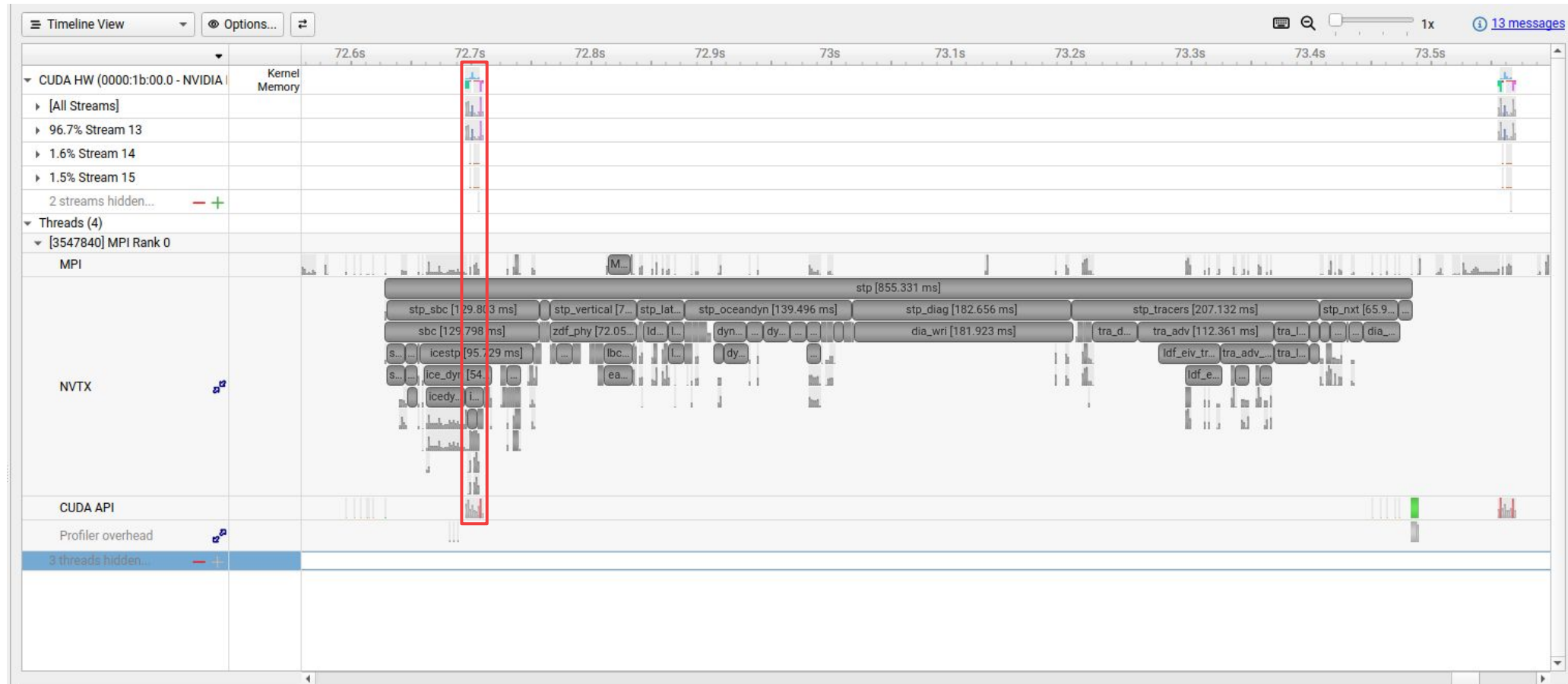
bravas.py **profile** -j 0 config.yaml



# Ocean model

create-config | [trace](#) | make cut | profile & analyze

bravas.py [profile](#) -j 0 config.yaml

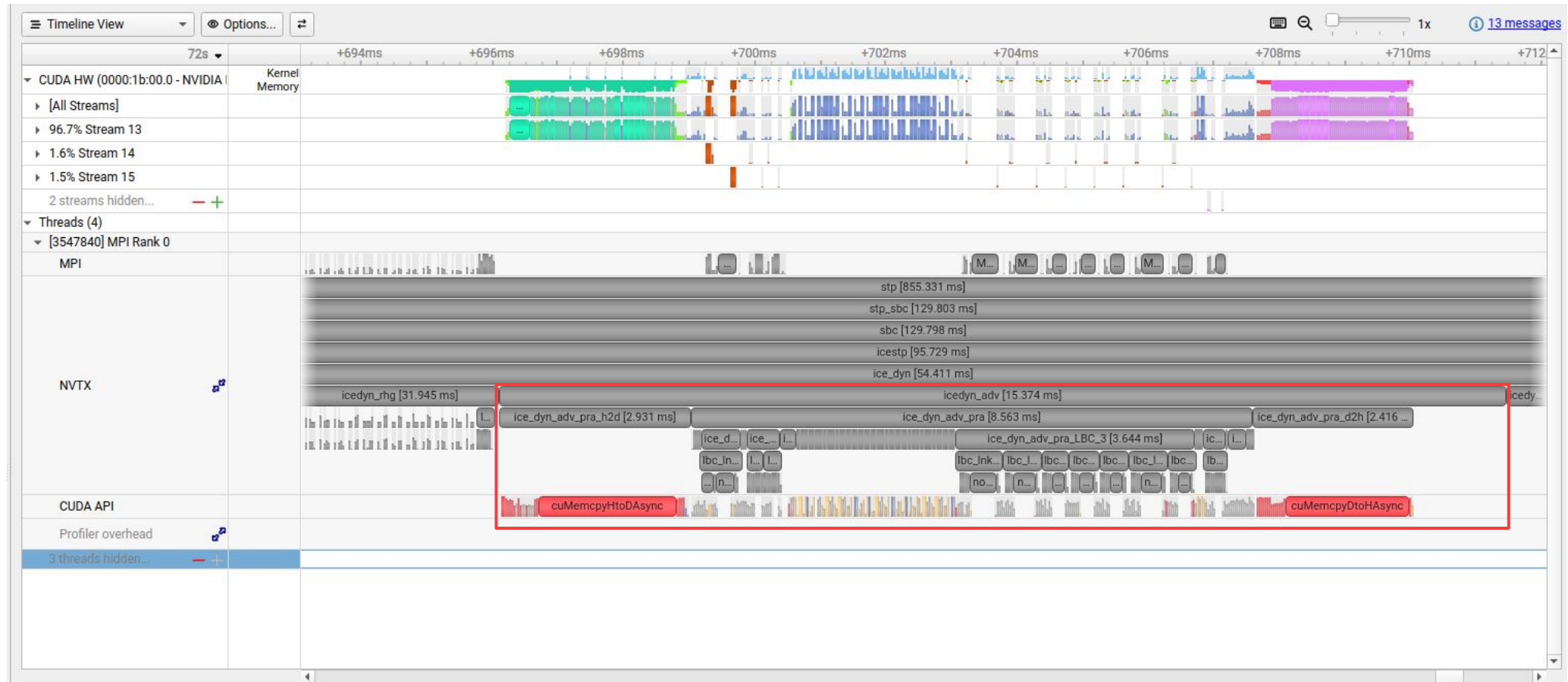




# Ocean model

create-config | [trace](#) | make cut | profile & analyze

bravas.py [profile](#) -j 0 config.yaml





# Ocean model

create-config | trace | make cut | profile & analyze

vi config.yaml

```
1 profile:
2   # Application setup.
3   application:
4     # Output directory for this experiment.
5     outdir: "./bravas_outdir"
6     # Path to the application binary.
7     binary: "./nemo"
8     # Environment file to load before executing any jobs.
9     env: ""
10
11  # Experimental setup options.
12  options:
13    arg_mode: zip
14    repeats: 1
15    trace_markers: ""
16
17  # Execution setup.
18  runner:
19    # Runner mode: 'job', 'mpi', or 'submit'.
20    mode: job
21    # Job name.
22    job_name: "bravas"
```



```
1 profile:
2   # Application setup.
3   application:
4     # Output directory for this experiment.
5     outdir: "./bravas_outdir"
6     # Path to the application binary.
7     binary: "./nemo"
8     # Environment file to load before executing any jobs.
9     env: ""
10
11  # Experimental setup options.
12  options:
13    arg_mode: zip
14    repeats: 1
15    trace_markers: "icedyn_adv"
16
17  # Execution setup.
18  runner:
19    # Runner mode: 'job', 'mpi', or 'submit'.
20    mode: job
21    # Job name.
22    job_name: "bravas"
```



# Ocean model

create-config | trace | make cut | profile & analyze

bravas.py **profile** config.yaml

bravas.py **analyze** config.yaml



For both OpenMP and OpenACC, on both MN5 and LUMI

| Version | Machine | Branch        |
|---------|---------|---------------|
| OpenACC | MN5     | master        |
|         | LUMI    | master        |
| OpenMP  | MN5     | loop-test-mn5 |
|         | LUMI    | loop-test     |



# Ocean model

create-config | trace | make cut | profile & analyze

bravas.py **profile** config.yaml  
bravas.py **analyze** config.yaml



For both OpenMP and OpenACC, on both MN5 and LUMI

Setup Overview

MN5

## OpenMP - Full

|                       | <b>N1_</b> |
|-----------------------|------------|
| Unique kernels (#)    | 76         |
| Kernel call count (#) | 11 008     |
| Kernel time (μs)      | 567 886    |
| H2D count (#)         | 11 344     |
| D2H count (#)         | 4 224      |
| H2D time (μs)         | 90 758     |
| D2H time (μs)         | 75 305     |
| H2D size (MB)         | 3 717.79   |
| D2H size (MB)         | 3 018.96   |

## OpenMP - Cut

|                       | <b>N1_</b> |
|-----------------------|------------|
| Unique kernels (#)    | 76         |
| Kernel call count (#) | 1 376      |
| Kernel time (μs)      | 71 513     |
| H2D count (#)         | 1 418      |
| D2H count (#)         | 528        |
| H2D time (μs)         | 11 437     |
| D2H time (μs)         | 9 540      |
| H2D size (MB)         | 464.72     |
| D2H size (MB)         | 377.37     |



# Ocean model

create-config | trace | make cut | profile & analyze

## Setup Overview

### MN5

#### OpenMP

|                       | N1_    |
|-----------------------|--------|
| Unique kernels (#)    | 76     |
| Kernel call count (#) | 1 376  |
| Kernel time (µs)      | 71 513 |
| H2D count (#)         | 1 418  |
| D2H count (#)         | 528    |
| H2D time (µs)         | 11 437 |
| D2H time (µs)         | 9 540  |
| H2D size (MB)         | 464.72 |
| D2H size (MB)         | 377.37 |

### LUMI

|                       | N1_     |
|-----------------------|---------|
| Unique kernels (#)    | 74      |
| Kernel call count (#) | 1 770   |
| Kernel time (µs)      | 147 374 |
| H2D count (#)         | 2 008   |
| D2H count (#)         | 616     |
| H2D time (µs)         | 43 624  |
| D2H time (µs)         | 23 022  |
| H2D size (MB)         | 461.57  |
| D2H size (MB)         | 373.28  |

#### OpenACC

|                       | N1_    |
|-----------------------|--------|
| Unique kernels (#)    | 79     |
| Kernel call count (#) | 1 074  |
| Kernel time (µs)      | 9 008  |
| H2D count (#)         | 778    |
| D2H count (#)         | 458    |
| H2D time (µs)         | 10 684 |
| D2H time (µs)         | 9 454  |
| H2D size (MB)         | 464.56 |
| D2H size (MB)         | 377.37 |

|                       | N1_    |
|-----------------------|--------|
| Unique kernels (#)    | 77     |
| Kernel call count (#) | 1 674  |
| Kernel time (µs)      | 42 545 |
| H2D count (#)         | 2 372  |
| D2H count (#)         | 608    |
| H2D time (µs)         | 47 275 |
| D2H time (µs)         | 22 736 |
| H2D size (MB)         | 461.57 |
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# Ocean model

create-config | trace | make cut | profile & analyze

## Setup Overview

### MN5

#### OpenMP

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# Ocean model

create-config | trace | make cut | profile & analyze

## Setup Overview

MN5

### OpenMP

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LUMI

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|                       | N1_    |
|-----------------------|--------|
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|-----------------------|--------|
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| H2D time (μs)         | 47 275 |
| D2H time (μs)         | 22 736 |
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# Ocean model

create-config | trace | make cut | profile & analyze

## Setup Overview

### MN5

#### OpenMP

|                       | N1_    |
|-----------------------|--------|
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| Kernel time (μs)      | 71 513 |
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#### OpenACC

|                       | N1_    |
|-----------------------|--------|
| Unique kernels (#)    | 79     |
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### LUMI

|                       | N1_     |
|-----------------------|---------|
| Unique kernels (#)    | 74      |
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|                       | N1_    |
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# Ocean model

create-config | trace | make cut | profile & analyze

MN5

LUMI

OpenMP | OpenACC



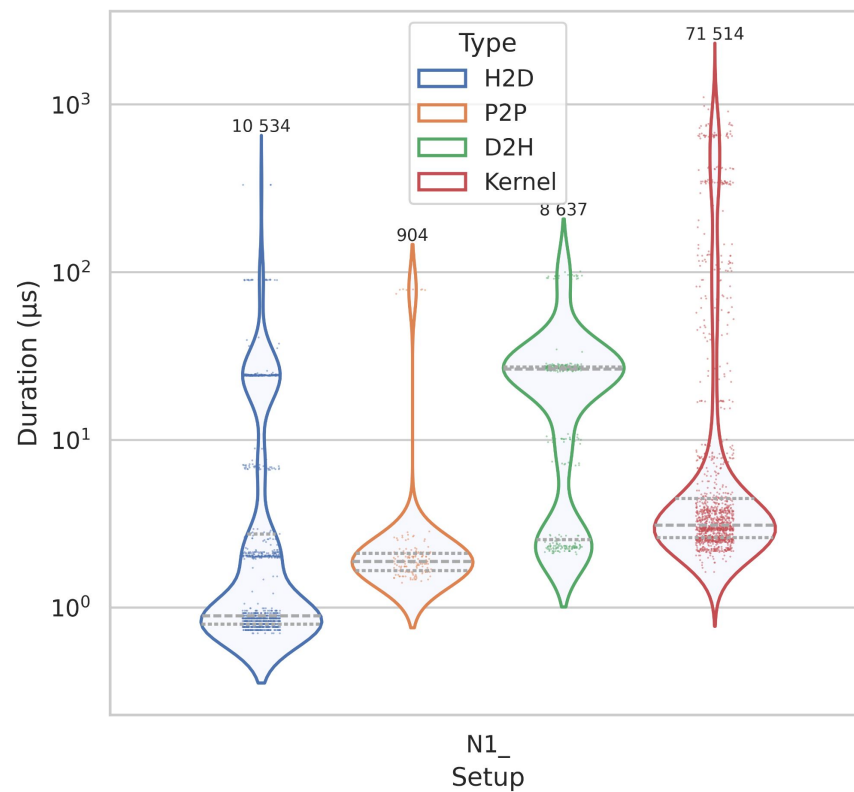
# Ocean model

create-config | trace | make cut | profile & analyze

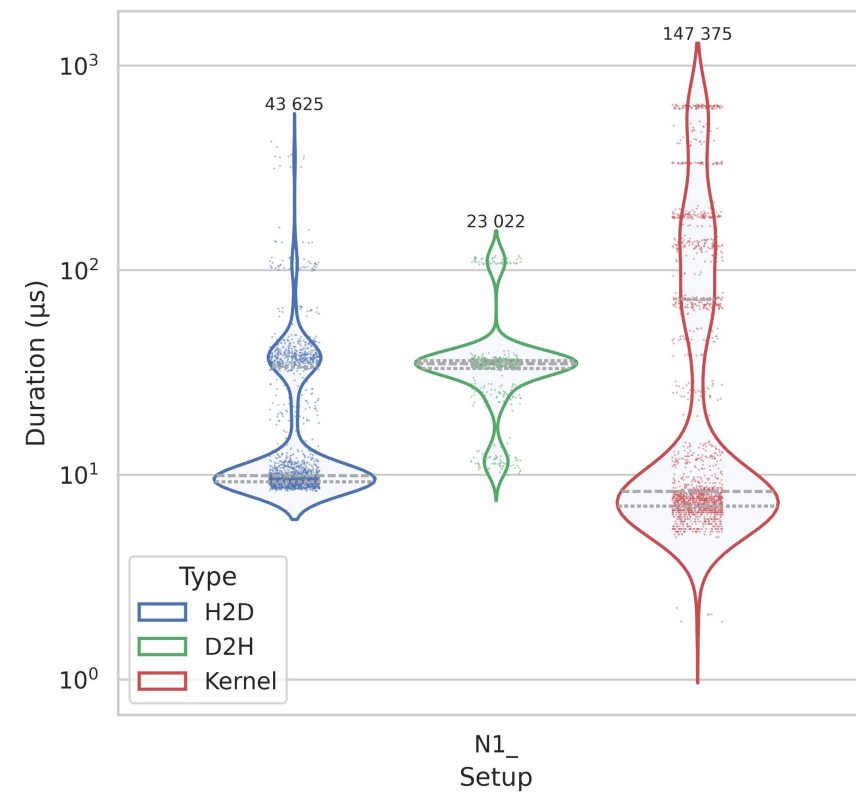
Runtime Overview

OpenMP | OpenACC

MN5



LUMI





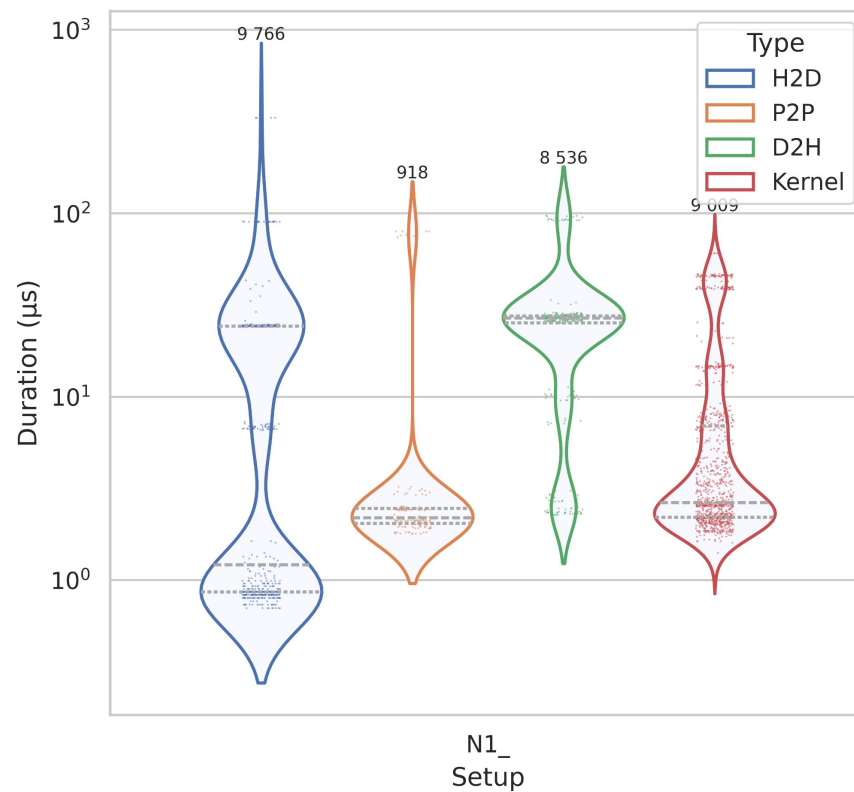
# Ocean model

create-config | trace | make cut | profile & analyze

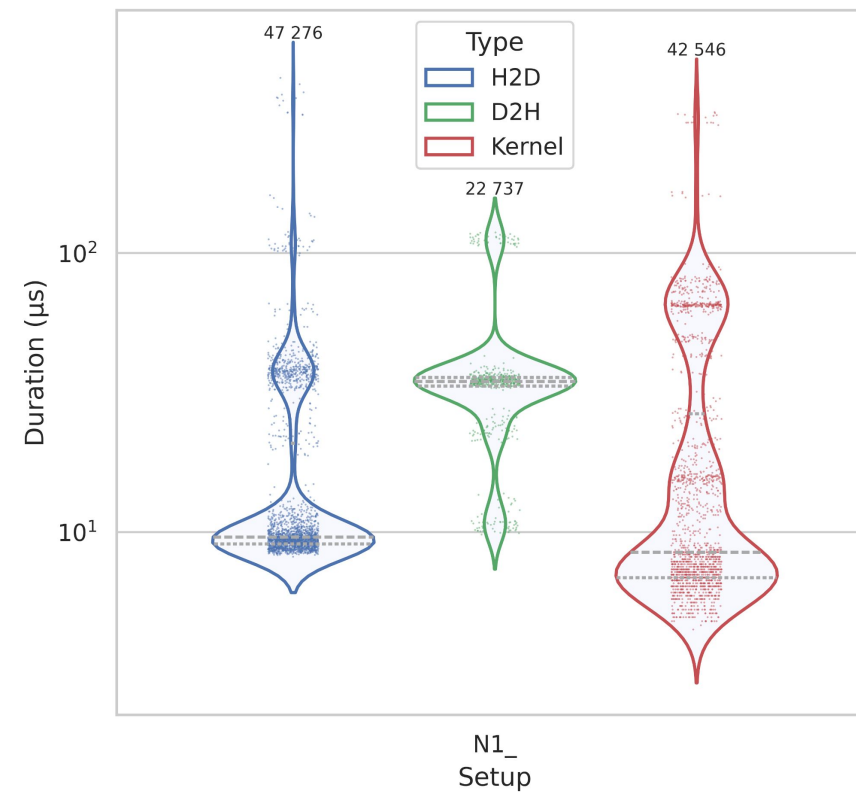
Runtime Overview

OpenMP | OpenACC

MN5



LUMI





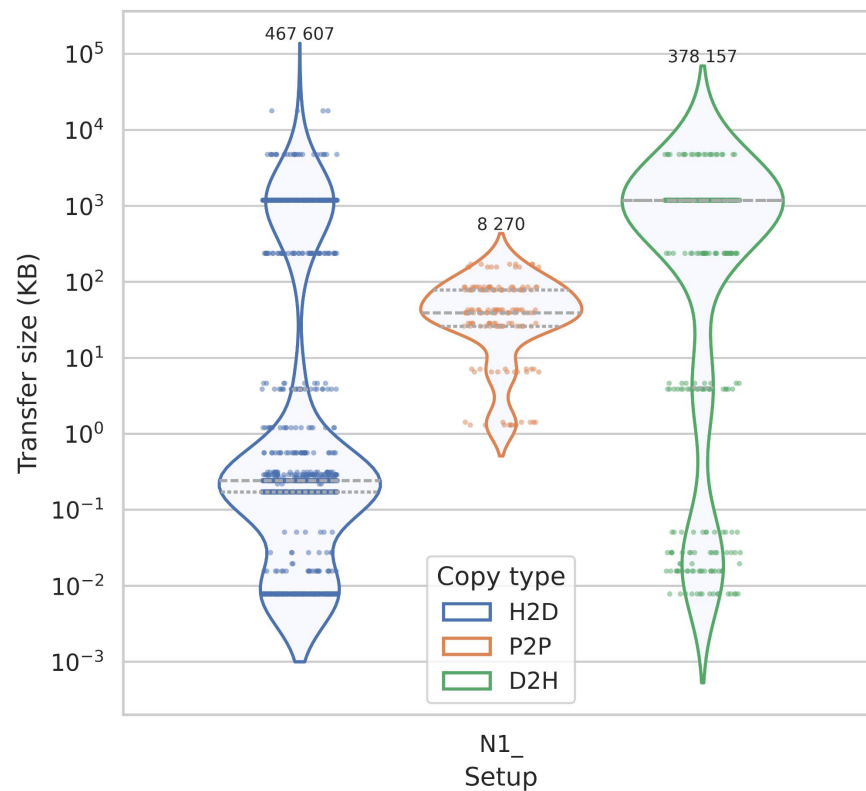
# Ocean model

create-config | trace | make cut | profile & analyze

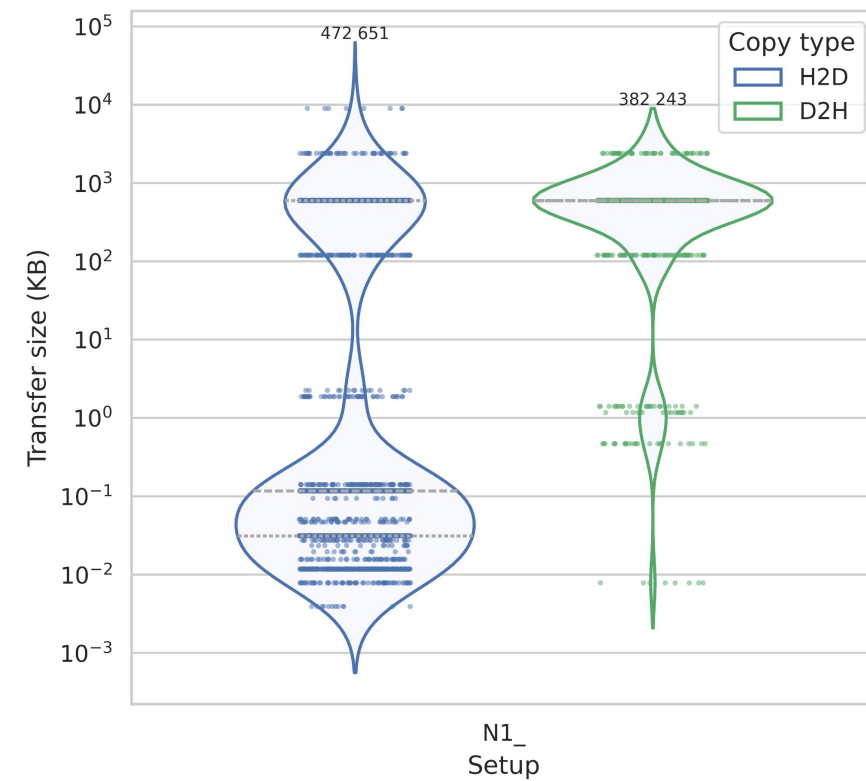
Memory Transfers

OpenMP | OpenACC

MN5



LUMI





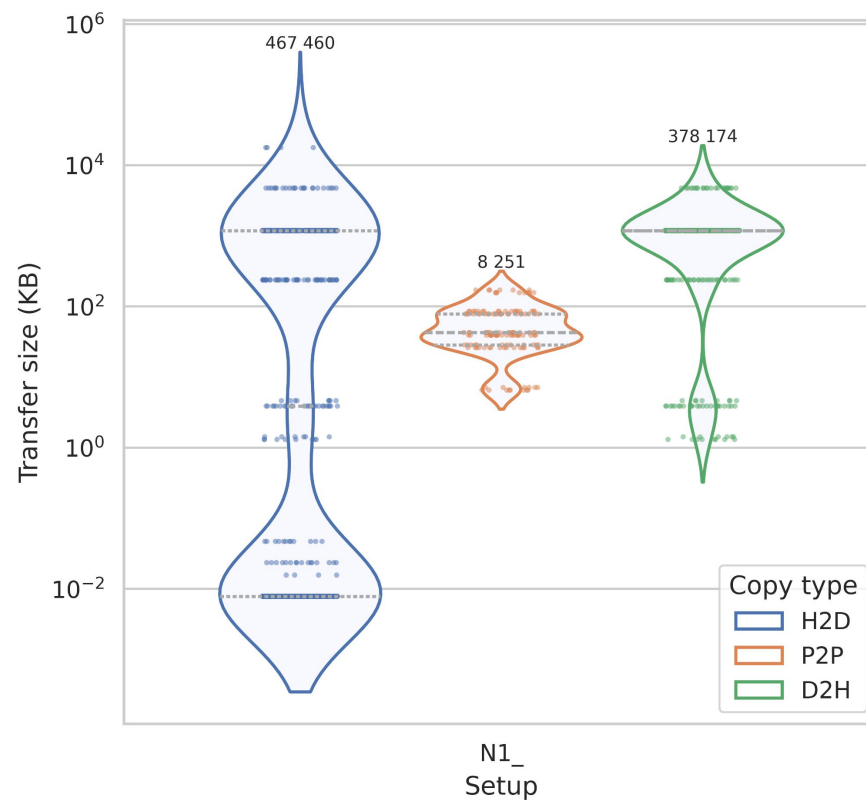
# Ocean model

create-config | trace | make cut | profile & analyze

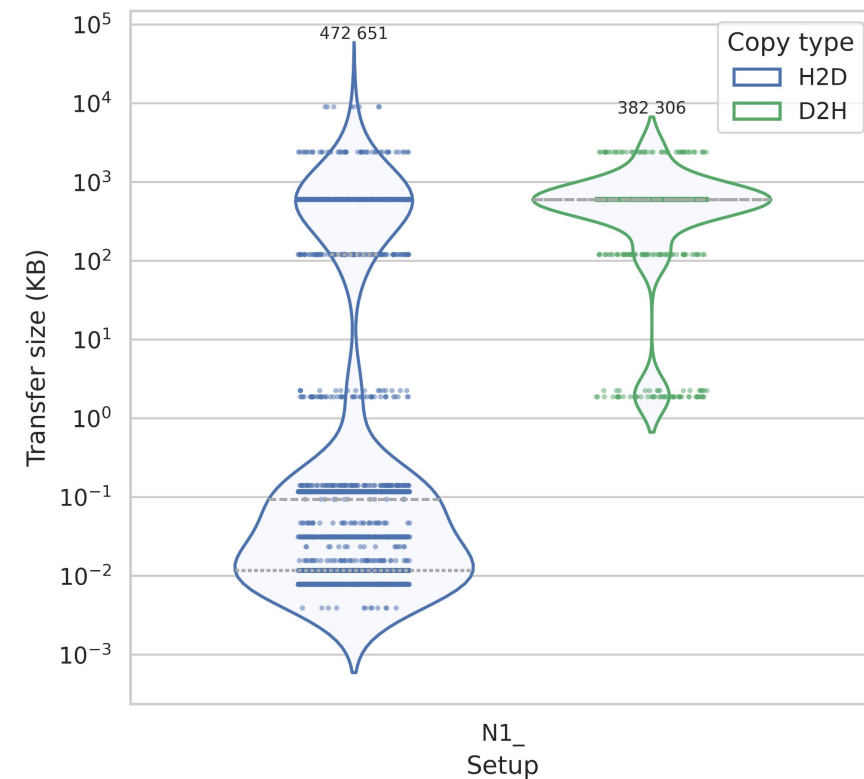
Memory Transfers

OpenMP | OpenACC

MN5



LUMI





# Ocean model

create-config | trace | make cut | profile & analyze

## Kernel Overview

### MN5

| KernelName                               | Calls | TotalDurationUs | AverageUs | Percentage |
|------------------------------------------|-------|-----------------|-----------|------------|
| icedyn_adv_pra_adv_y_F1L920_22           | 52    | 35 339.91       | 679.61    | 49.42      |
| icedyn_adv_pra_adv_x_F1L705_20           | 52    | 18 759.84       | 360.77    | 26.23      |
| icedyn_adv_pra_ice_dyn_adv_pra_F1L569_14 | 4     | 3 922.71        | 980.68    | 5.49       |
| icedyn_adv_pra_icemax3d_F1L1596_38       | 16    | 1 965.94        | 122.87    | 2.75       |
| cuda_assign_kernel                       | 498   | 1 612.77        | 3.24      | 2.26       |
| lbcInk_mpp_nfd_3d_ptr_gpu_dp_F1L2872_218 | 12    | 1 154.46        | 96.2      | 1.61       |
| icedyn_adv_pra_icemax4d_F1L1641_45       | 8     | 1 049.79        | 131.22    | 1.47       |
| lbcInk_mpp_nfd_4d_ptr_gpu_dp_F1L3482_266 | 4     | 960.38          | 240.1     | 1.34       |
| lbcInk_mpp_nfd_3d_ptr_gpu_dp_F1L2948_222 | 12    | 846.14          | 70.51     | 1.18       |
| lbcInk_mpp_nfd_4d_ptr_gpu_dp_F1L3558_270 | 4     | 679.55          | 169.89    | 0.95       |
| lbcInk_mpp_nfd_3d_ptr_gpu_dp_F1L2934_220 | 12    | 593.5           | 49.46     | 0.83       |
| lbcInk_mpp_nfd_4d_gpu_dp_F1L3179_242     | 4     | 502.46          | 125.62    | 0.7        |
| lbcInk_mpp_nfd_4d_ptr_gpu_dp_F1L3544_268 | 4     | 468.51          | 117.13    | 0.66       |
| lbcInk_mpp_nfd_4d_gpu_dp_F1L3241_244     | 4     | 320.61          | 80.15     | 0.45       |
| icedyn_adv_pra_hbig_F1L1182_28           | 80    | 306.79          | 3.83      | 0.43       |
| ...                                      | ...   | ...             | ...       | ...        |

### LUMI

| KernelName                                                         | Calls | TotalDurationUs | AverageUs | Percentage |
|--------------------------------------------------------------------|-------|-----------------|-----------|------------|
| mpp_Ink_3d_ptr_gpu_dp\$lbcInk_\$ck_L1561_413_cce\$noloop\$form     | 48    | 30 234.89       | 629.89    | 20.52      |
| mpp_Ink_3d_ptr_gpu_dp\$lbcInk_\$ck_L1571_416_cce\$noloop\$form     | 48    | 30 163.85       | 628.41    | 20.47      |
| adv_y\$icedyn_adv_pra_\$ck_L920_78_cce\$noloop\$form               | 104   | 19 301.17       | 185.59    | 13.1       |
| mpp_Ink_3d_ptr_gpu_dp\$lbcInk_\$ck_L1734_446_cce\$noloop\$form     | 24    | 7 998.79        | 333.28    | 5.43       |
| mpp_Ink_3d_ptr_gpu_dp\$lbcInk_\$ck_L1724_443_cce\$noloop\$form     | 24    | 7 993.07        | 333.04    | 5.42       |
| adv_x\$icedyn_adv_pra_\$ck_L705_70_cce\$noloop\$form               | 104   | 7 632.88        | 73.39     | 5.18       |
| mpp_nfd_3d_ptr_gpu_dp\$lbcInk_\$ck_L2934_363_cce\$noloop\$form     | 48    | 6 496.25        | 135.34    | 4.41       |
| mpp_nfd_4d_ptr_gpu_dp\$lbcInk_\$ck_L3544_444_cce\$noloop\$form     | 16    | 5 124.23        | 320.26    | 3.48       |
| mpp_nfd_4d_gpu_dp\$lbcInk_\$ck_L3241_405                           | 16    | 4 270.62        | 266.91    | 2.9        |
| mpp_nfd_3d_ptr_gpu_dp\$lbcInk_\$ck_L2872_360_cce\$noloop\$form     | 24    | 3 161.32        | 131.72    | 2.15       |
| mpp_nfd_4d_ptr_gpu_dp\$lbcInk_\$ck_L3482_441_cce\$noloop\$form     | 8     | 2 475.39        | 309.42    | 1.68       |
| mpp_nfd_4d_gpu_dp\$lbcInk_\$ck_L3179_402                           | 8     | 2 180.67        | 272.58    | 1.48       |
| icemax3d\$icedyn_adv_pra_\$ck_L1596_109_cce\$noloop\$form          | 32    | 2 102.58        | 65.71     | 1.43       |
| mpp_nfd_3d_ptr_gpu_dp\$lbcInk_\$ck_L2948_366_cce\$noloop\$form     | 12    | 1 528.98        | 127.42    | 1.04       |
| lbc_nfd_nogather_3d_gpu_dp\$lbcnfd_\$ck_L939_264_cce\$noloop\$form | 208   | 1 328.34        | 6.39      | 0.9        |
| ...                                                                | ...   | ...             | ...       | ...        |

OpenMP | OpenACC



# Ocean model

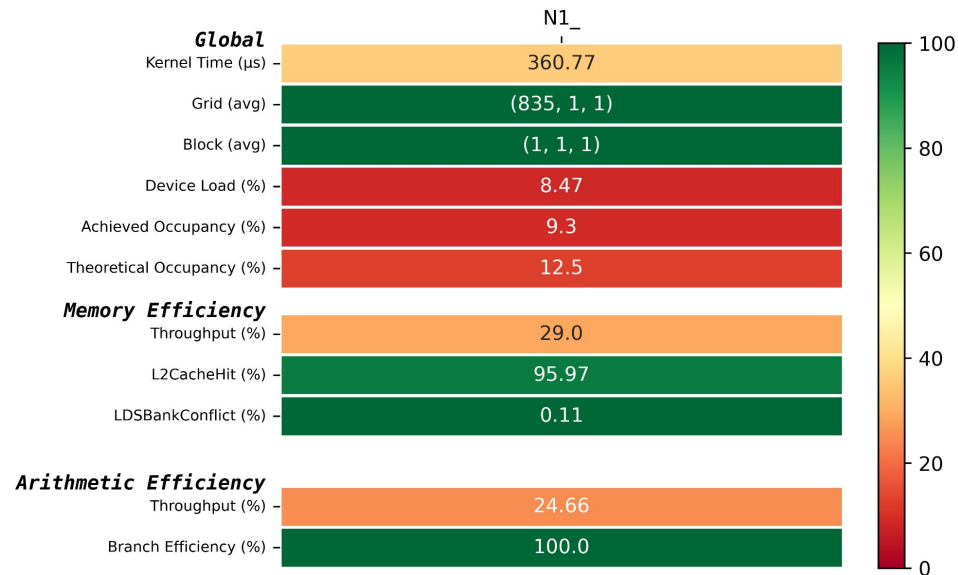
create-config | trace | make cut | profile & analyze

GPU Factors

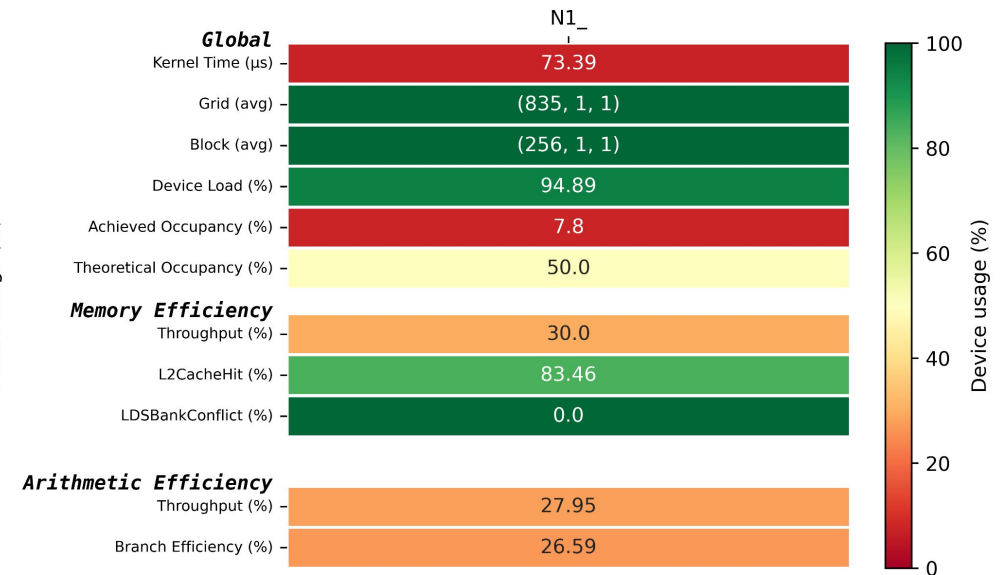
MN5

LUMI

icedyn\_adv\_pra\_adv\_x\_F1L705\_20



adv\_x\$icedyn\_adv\_pra\_\$ck\_L705\_70\_cce\$noloop\$form.kd



OpenMP | OpenACC



# Ocean model

create-config | trace | make cut | profile & analyze

## Kernel Overview

### MN5

| KernelName                            | Calls | TotalDurationUs | AverageUs | Percentage |
|---------------------------------------|-------|-----------------|-----------|------------|
| icedyn_adv_pra_adv_y_883              | 52    | 2 376.7         | 45.71     | 26.38      |
| icedyn_adv_pra_adv_x_667              | 52    | 2 034.18        | 39.12     | 22.58      |
| cuda_assign_kernel                    | 240   | 881.63          | 3.67      | 9.79       |
| icedyn_adv_pra_adv_y_1045             | 52    | 759.52          | 14.61     | 8.43       |
| icedyn_adv_pra_ice_dyn_adv_pra_543    | 4     | 241.5           | 60.38     | 2.68       |
| lbcnfd_lbc_nfd_nogather_3d_gpu_dp_939 | 104   | 210.56          | 2.02      | 2.34       |
| icedyn_adv_pra_ice_dyn_adv_pra_505    | 4     | 171.04          | 42.76     | 1.9        |
| lbcInk_mpp_nfd_3d_ptr_gpu_dp_3117     | 12    | 121.6           | 10.13     | 1.35       |
| lbcInk_mpp_nfd_3d_ptr_gpu_dp_3210     | 12    | 110.24          | 9.19      | 1.22       |
| lbcInk_mpp_nfd_3d_ptr_gpu_dp_3188     | 12    | 106.34          | 8.86      | 1.18       |
| icedyn_adv_pra_ice_dyn_adv_pra_360    | 4     | 101.28          | 25.32     | 1.12       |
| icevar_ice_var_zapneg_689             | 20    | 90.11           | 4.51      | 1.0        |
| icedyn_adv_pra_hbig_1101              | 4     | 87.74           | 21.94     | 0.97       |
| icedyn_adv_pra_ice_dyn_adv_pra_331    | 4     | 83.84           | 20.96     | 0.93       |
| icedyn_adv_pra_hbig_1158              | 4     | 79.65           | 19.91     | 0.88       |
| ...                                   | ...   | ...             | ...       | ...        |

### LUMI

| KernelName                                                           | Calls | TotalDurationUs | AverageUs | Percentage |
|----------------------------------------------------------------------|-------|-----------------|-----------|------------|
| adv_x\$icedyn_adv_pra_\$ck_L657_50_cce\$<br>noloo\$form              | 104   | 6 910.6         | 66.45     | 16.24      |
| adv_y\$icedyn_adv_pra_\$ck_L873_55_cce\$<br>noloo\$form              | 104   | 6 857.48        | 65.94     | 16.12      |
| icemax4d\$icedyn_adv_pra_\$ck_L1619_109_<br>cce\$noloo\$form         | 16    | 4 834.43        | 302.15    | 11.36      |
| icemax3d\$icedyn_adv_pra_\$ck_L1575_94_c<br>ce\$noloo\$form          | 32    | 2 576.81        | 80.53     | 6.06       |
| ice_dyn_adv_pra\$icedyn_adv_pra_\$ck_L27<br>8_47                     | 32    | 2 412.49        | 75.39     | 5.67       |
| ice_var_zapneg\$icevar_\$ck_L647_13_cce\<br>\$noloo\$form            | 40    | 1 963.37        | 49.08     | 4.61       |
| adv_y\$icedyn_adv_pra_\$ck_L1035_56_cce\<br>\$noloo\$form            | 104   | 1 630.57        | 15.68     | 3.83       |
| ice_dyn_adv_pra\$icedyn_adv_pra_\$ck_L53<br>4_8_cce\$noloo\$form     | 8     | 1 294.09        | 161.76    | 3.04       |
| lbc_nfd_nogather_3d_gpu_dp\$lbcnfd_\$ck_<br>L939_94_cce\$noloo\$form | 208   | 1 263.84        | 6.08      | 2.97       |
| mpp_nfd_3d_ptr_gpu_dp\$lbcInk_\$ck_L3038<br>_203_cce\$noloo\$form    | 48    | 814.72          | 16.97     | 1.91       |
| ice_dyn_adv_pra\$icedyn_adv_pra_\$ck_L28<br>6_49                     | 8     | 614.08          | 76.76     | 1.44       |
| ice_dyn_adv_pra\$icedyn_adv_pra_\$ck_L25<br>9_10_cce\$noloo\$form    | 8     | 587.52          | 73.44     | 1.38       |
| mpp_nfd_3d_ptr_gpu_dp\$lbcInk_\$ck_L2974<br>_202_cce\$noloo\$form    | 24    | 527.2           | 21.97     | 1.24       |
| ice_var_zapneg\$icevar_\$ck_L690_4_cce\$<br>noloo\$form              | 40    | 516.32          | 12.91     | 1.21       |
| hbig\$icedyn_adv_pra_\$ck_L1091_62_cce\$<br>noloo\$form              | 8     | 480.8           | 60.1      | 1.13       |
| ...                                                                  | ...   | ...             | ...       | ...        |

OpenMP | OpenACC



# Ocean model

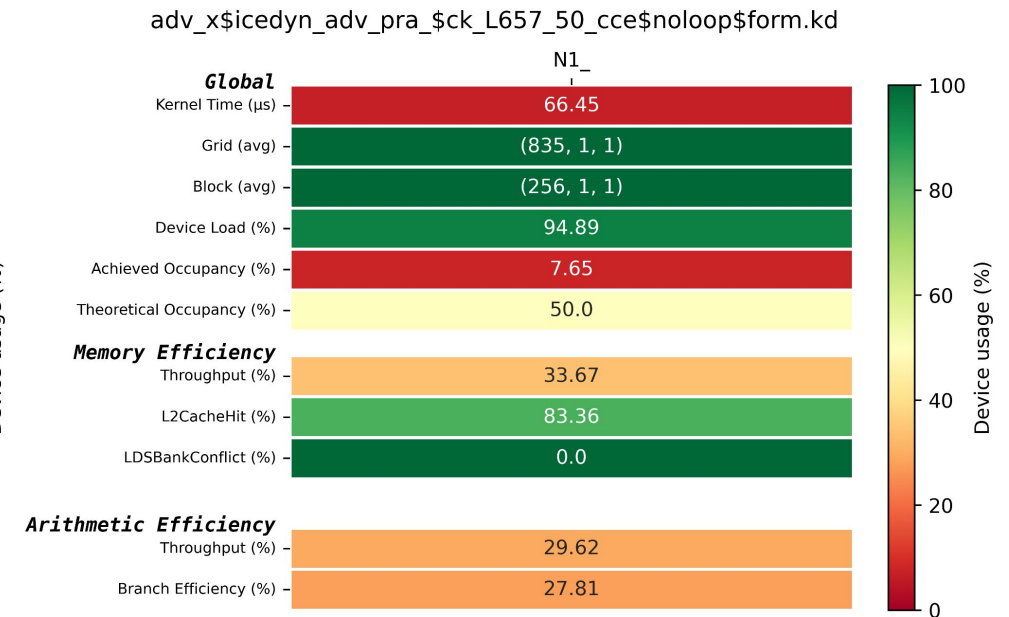
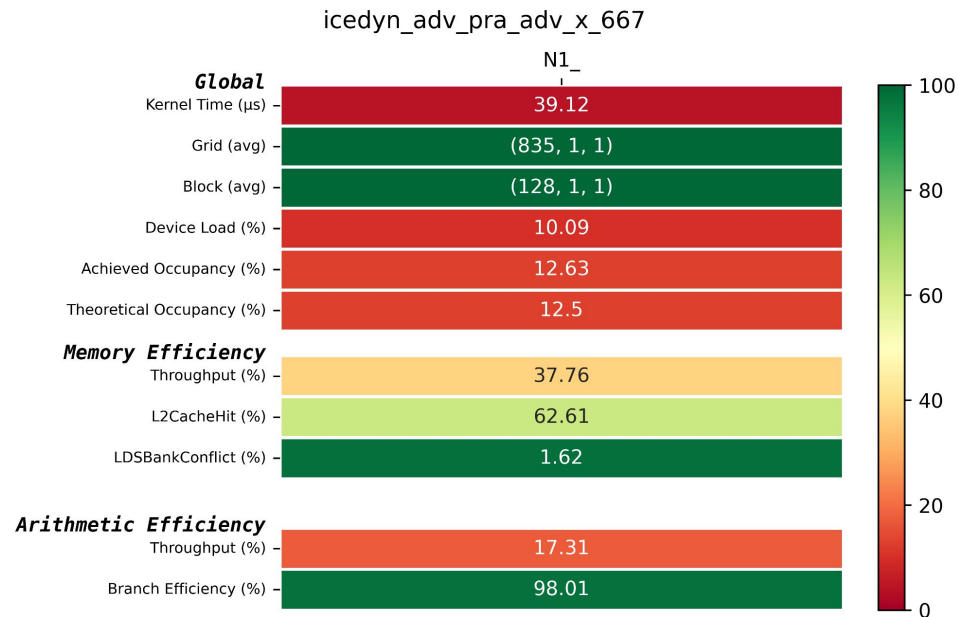
create-config | trace | make cut | profile & analyze

GPU Factors

MN5

LUMI

OpenMP | OpenACC



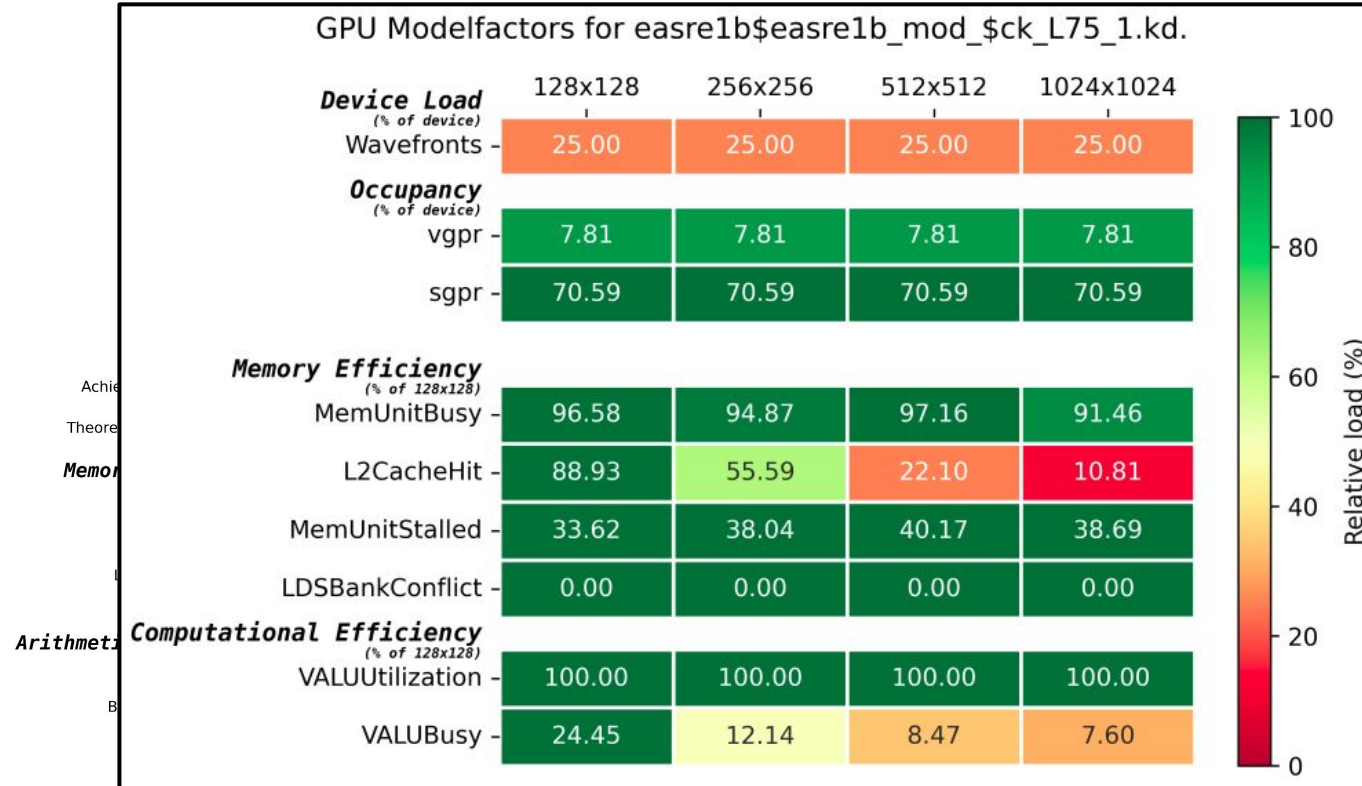


# Ocean model

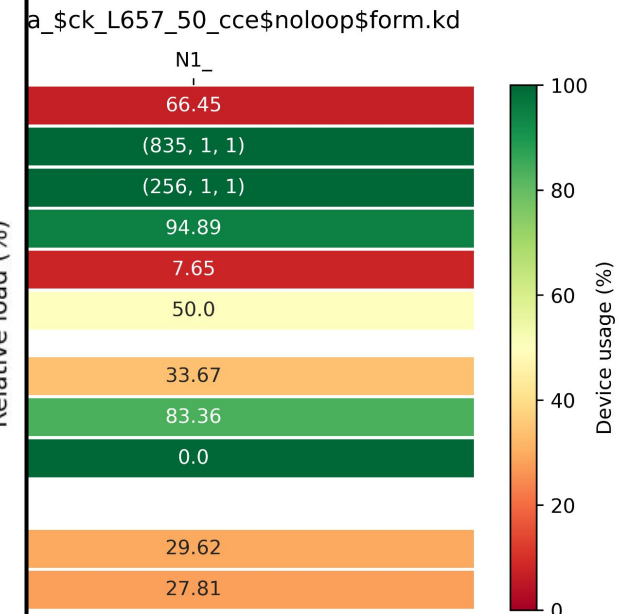
create-config | trace | make cut | profile & analyze

GPU Factors

OpenMP | OpenACC



LUMI



# BRAVAS Workflow



**Barcelona  
Supercomputing  
Center**

*Centro Nacional de Supercomputación*



# BRAVAS Workflow

create-config | profile | analyze



# BRAVAS Workflow

create-config | profile | analyze

bravas.py **create-config** [config.yaml]

```
1 profile:
2   # Application setup.
3   application:
4     # Output directory for this experiment.
5     outdir: None
6     # Path to the application binary.
7     binary: None
8     # Environment file to load before executing any jobs.
9     env: ""
10    # Wrapper script to wrap each binary execution with.
11    wrapper: ""
12    # Fixed arguments for the binary.
13    fixed_args: ""
14    # Variable arguments for the binary.
15    var_args: ""
16
17    # Experimental setup options.
18    options:
19      arg_mode: zip
20      repeats: 1
21      trace_markers: ""
```



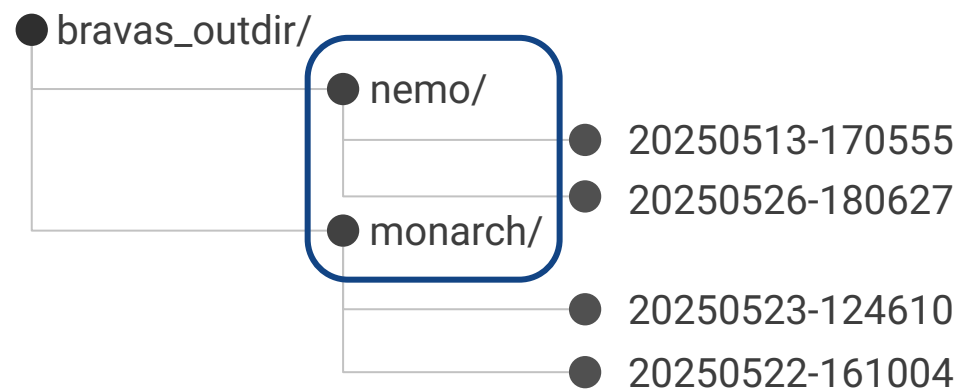


# BRAVAS Workflow

create-config | profile | analyze

bravas.py **create-config** [config.yaml]

```
1 profile:
2   # Application setup.
3   application:
4     # Output directory for this experiment.
5     outdir: None
6     # Path to the application binary.
7     binary: None
8     # Environment file to load before executing any jobs.
9     env: ""
10    # Wrapper script to wrap each binary execution with.
11    wrapper: ""
12    # Fixed arguments for the binary.
13    fixed_args: ""
14    # Variable arguments for the binary.
15    var_args: ""
16
17  # Experimental setup options.
18  options:
19    arg_mode: zip
20    repeats: 1
21    trace_markers: ""
```





# BRAVAS Workflow

create-config | profile | analyze

bravas.py **create-config** [config.yaml]

```
1  profile:
2    # Application setup.
3    application:
4      # Output directory for this experiment.
5      outdir: None
6      # Path to the application binary.
7      binary: None ←
8      # Environment file to load before executing any jobs.
9      env: "" ←
10     # Wrapper script to wrap each binary execution with.
11     wrapper: "" ←
12     # Fixed arguments for the binary.
13     fixed_args: "" ←
14     # Variable arguments for the binary.
15     var_args: "" ←
16
17     # Experimental setup options.
18     options:
19       arg_mode: zip
20       repeats: 1
21       trace_markers: "" ←
```



# BRAVAS Workflow

create-config | profile | analyze

bravas.py **create-config** [config.yaml]

```
59 analyze:
60 # The results folder name in the outdir to perform the analysis on.
61 # By default the latest timestamp will be used.
62 res_folder: ""
63
64 # Create a table with all kernels, their calls, and duration stats.
65 # Options for value:
66 # none: do not create the table
67 # basic: create the table without coloring
68 # colored: create the table and color rows
69 kernel_overview: none
70
71 # Create a GPU Factors overview for each provided kernel.
72 gpu_factors: ""
73
74 # Create a runtime scaling figure or table for the given nodes.
75 # Options for value:
76 # none: do not create a scaling overview
77 # figure: create a figure with the runtimes
78 # table: create a table with the runtimes
79 # figure_table: create a figure and a table with the runtimes
80 runtime_scaling: none
81
82 # Create an energy scaling figure or table for the given nodes.
83 # Options for value:
84 # none: do not create a scaling overview
85 # figure: create a figure with the performance per watt
86 # table: create a table with the performance per watt
87 # figure_table: create a figure and a table with the performance per watt
88 energy_scaling: none
```

```
90 # Create figures with memory transfers against bytes transferred.
91 # Options for value:
92 # none: do not create figures
93 # aggregated: create a figure per setup with aggregated values for all ranks
94 # setups: create a figure containing aggregated values for all setups
95 # List[int]: create a figure per setup containing aggregated values for the
96 # provided ranks
97 # all: create a figure per setup containing values for all ranks
98 memory_transfers: none
99
100 # Create a table with statistics on memory transfers.
101 setup_overview: false
102
103 # Create figures with the GPU kernel time and cumulative memory times.
104 # Options for value:
105 # none: do not create figures
106 # aggregated: create a figure per setup with aggregated values for all ranks
107 # setups: create a figure containing aggregated values for all setups
108 # List[int]: create a figure per setup containing aggregated values for the
109 # provided ranks
110 # all: create a figure per setup containing values for all ranks
111 runtime_ratios: none
112
113 # Create a table with kernels that have LDSBankConflicts.
114 ldsbankconflicts: false
```



# BRAVAS Workflow

create-config | [profile](#) | analyze

bravas.py [profile](#) conf.yaml

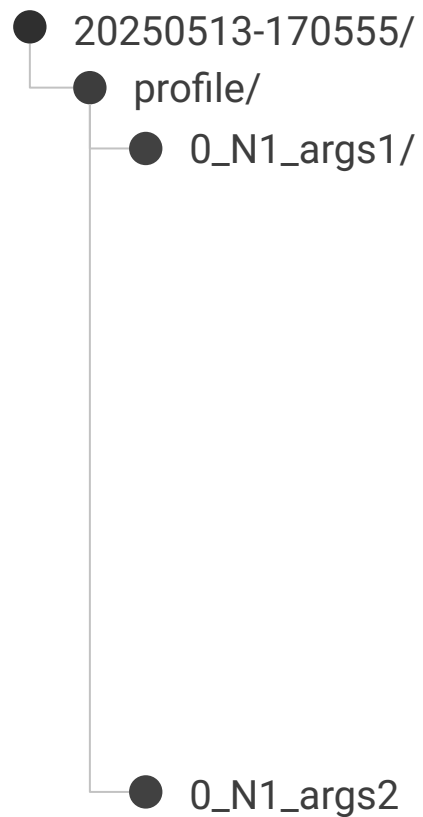
- 20250513-170555/
  - profile/



# BRAVAS Workflow

create-config | [profile](#) | analyze

bravas.py [profile](#) conf.yaml

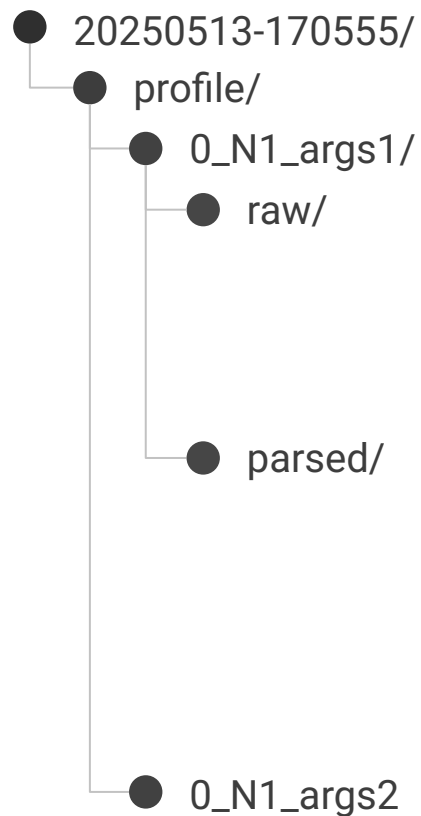




# BRAVAS Workflow

create-config | [profile](#) | analyze

bravas.py [profile](#) conf.yaml

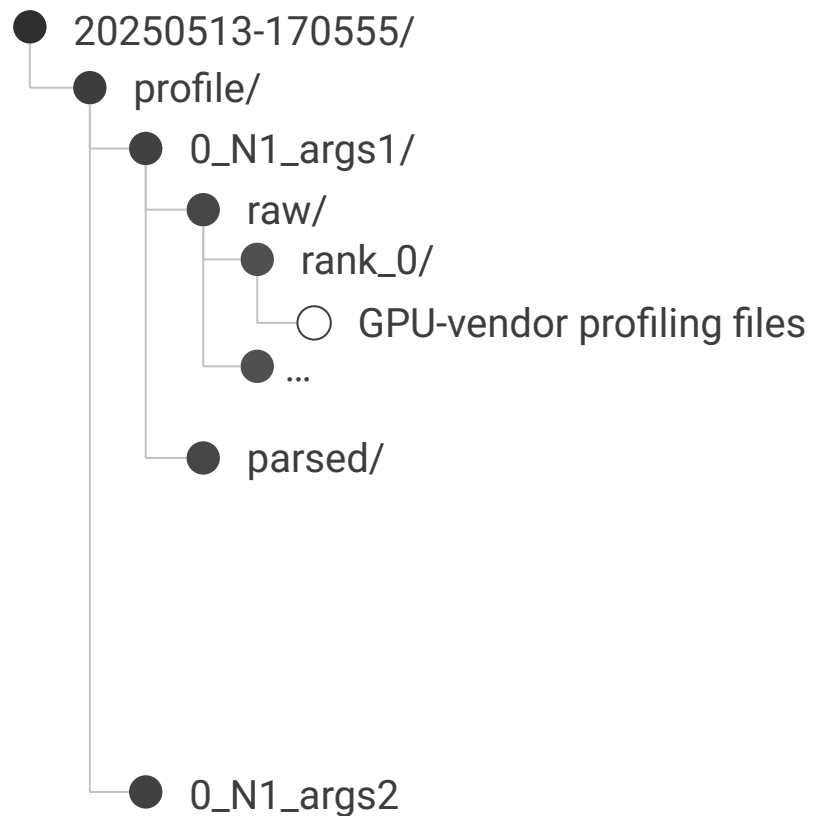




# BRAVAS Workflow

create-config | [profile](#) | analyze

bravas.py [profile](#) conf.yaml

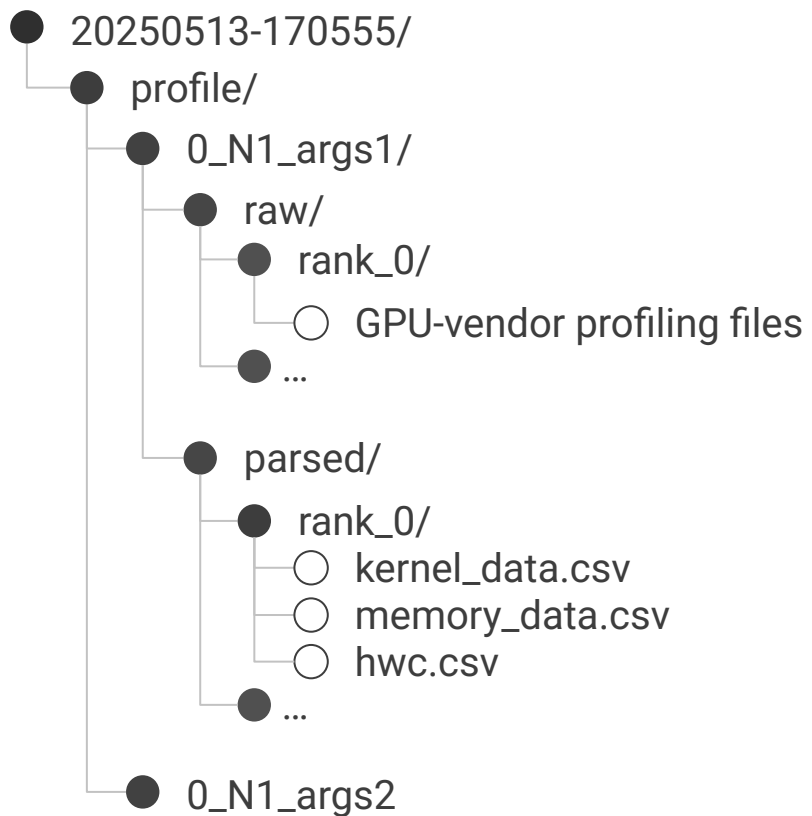




# BRAVAS Workflow

create-config | [profile](#) | analyze

bravas.py [profile](#) conf.yaml

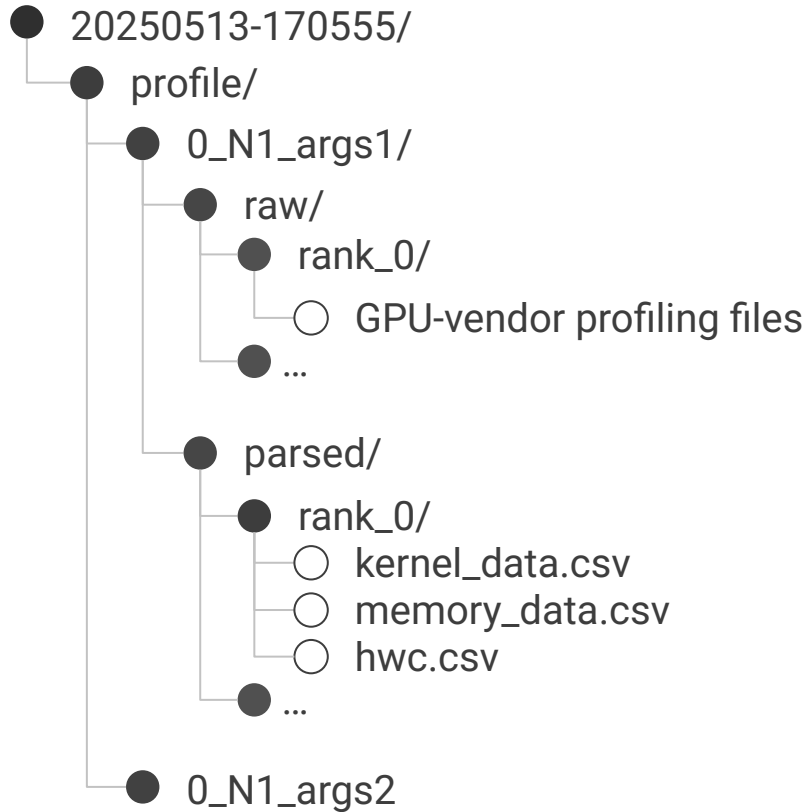




# BRAVAS Workflow

create-config | [profile](#) | analyze

bravas.py [profile](#) conf.yaml



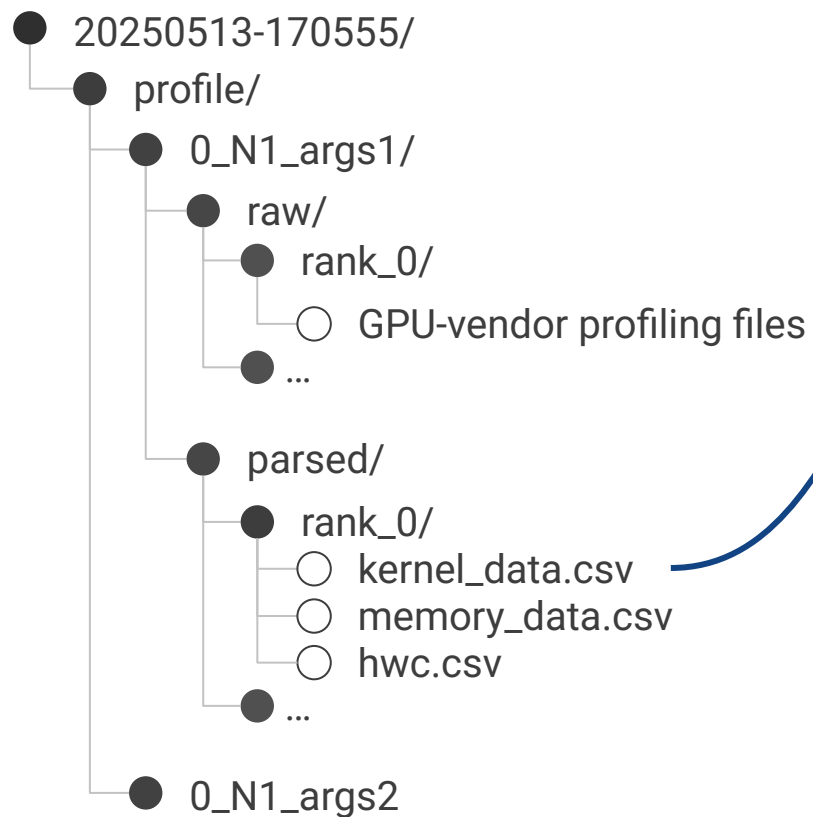
**All hidden from the user!**



# BRAVAS Workflow

create-config | [profile](#) | analyze

bravas.py [profile](#) conf.yaml



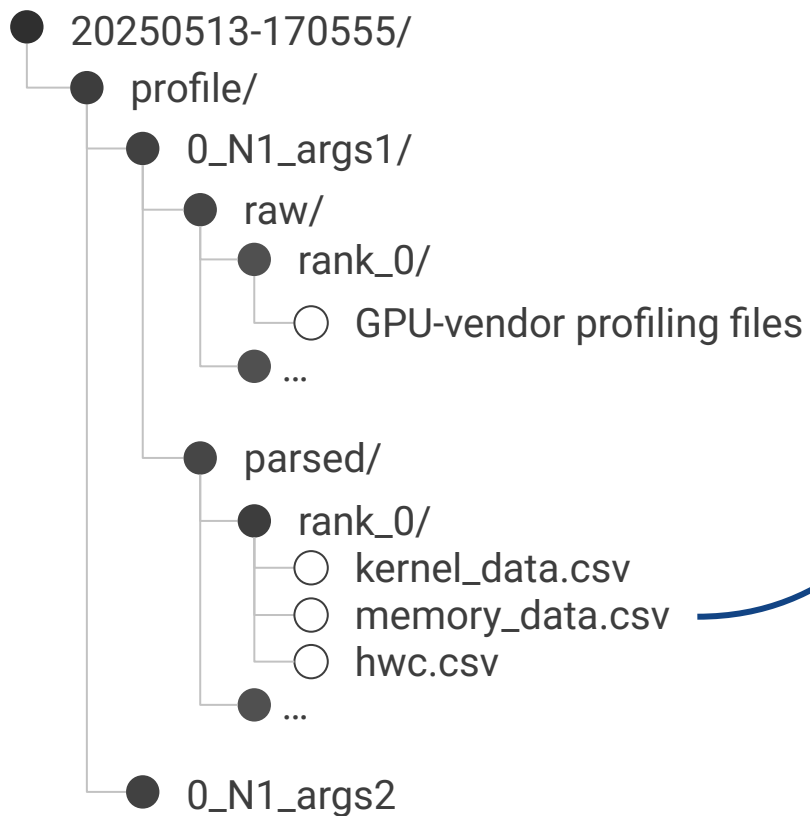
```
1 kernel_name,timestamp,duration_us,grid_x,grid_y,grid_z,block_x,block_y,block_z
2 cuda_assign_kernel,68465067023,6.848,9,1,1,128,1,1
3 cuda_assign_kernel,68466657038,7.808,9,1,1,128,1,1
4 cuda_assign_kernel,68468302925,7.744,9,1,1,128,1,1
5 cuda_assign_kernel,68469559884,6.112,7,1,1,128,1,1
6 cuda_assign_kernel,68470829547,6.464,8,1,1,128,1,1
7 cuda_assign_kernel,68473840073,7.776,9,1,1,128,1,1
8 cuda_assign_kernel,68474558856,7.904,11,1,1,128,1,1
9 cuda_assign_kernel,68475459624,6.848,9,1,1,128,1,1
10 cuda_assign_kernel,68477419175,6.816,9,1,1,128,1,1
11 cuda_assign_kernel,68478279046,4.672,4,1,1,128,1,1
12 icedyn_adv_pra_ice_dyn_adv_pra_258,68478285574,3.744,1188,1,1,128,1,1
13 icedyn_adv_pra_icemax3d_1588,68478381094,3.904,940,2,1,32,4,1
14 icedyn_adv_pra_icemax3d_1596,68478386054,3.456,929,2,1,32,4,1
15 icedyn_adv_pra_icemax3d_1588,68478430374,3.84,940,2,1,32,4,1
16 icedyn_adv_pra_icemax3d_1596,68478435398,3.424,929,2,1,32,4,1
17 icedyn_adv_pra_icemax3d_1588,68478451526,3.904,940,2,1,32,4,1
18 icedyn_adv_pra_icemax3d_1596,68478456614,3.392,929,2,1,32,4,1
19 icedyn_adv_pra_icemax3d_1588,68478472070,3.296,940,2,1,32,4,1
20 icedyn_adv_pra_icemax3d_1596,68478476486,3.392,929,2,1,32,4,1
21 cuda_assign_kernel,68497951193,3.84,4,1,1,128,1,1
22 lbclnk_mpp_lnk_3d_ptr_gpu_dp_1597,68497956697,3.104,27,1,1,128,1,1
23 lbclnk_mpp_lnk_3d_ptr_gpu_dp_1607,68498003097,2.464,27,1,1,128,1,1
24 lbclnk_mpp_lnk_3d_ptr_gpu_dp_1656,68534194624,2.176,27,1,1,128,1,1
25 lbclnk_mpp_lnk_3d_ptr_gpu_dp_1704,68534212256,2.208,27,1,1,128,1,1
26 lbclnk_mpp_lnk_3d_ptr_gpu_dp_1776,68534265760,2.304,29,1,1,128,1,1
27 lbclnk_mpp_lnk_3d_ptr_gpu_dp_1851,68549875029,4.48,8,1,1,128,1,1
28 lbclnk_mpp_lnk_3d_ptr_gpu_dp_1873,68549933237,2.08,29,1,1,128,1,1
29 icedyn_adv_pra_ice_dyn_adv_pra_278,68558546608,8.0,4750,1,1,128,1,1
30 icedyn_adv_pra_ice_dyn_adv_pra_286,68558563184,4.544,1188,1,1,128,1,1
```



# BRAVAS Workflow

create-config | [profile](#) | analyze

bravas.py [profile](#) conf.yaml



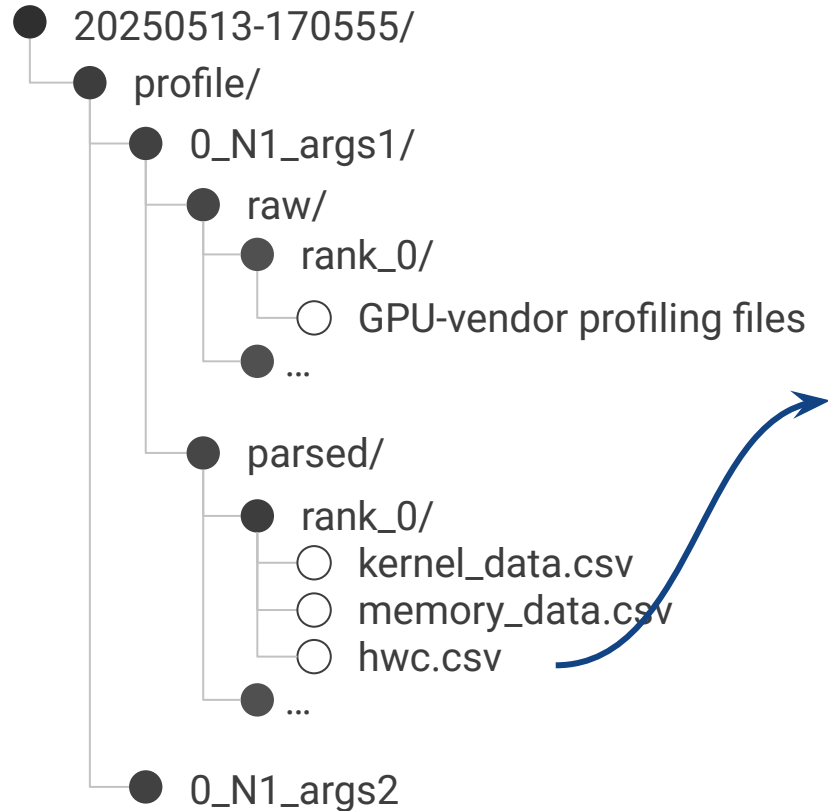
```
1 copy_type,timestamp,duration_us,size_bytes
2 H2D,68460956658,1.024,36
3 H2D,68460963986,0.768,152
4 H2D,68461078866,6.848,243152
5 H2D,68461117746,6.848,243152
6 H2D,68461334897,332.704,18236400
7 H2D,68461669681,25.184,1215760
8 H2D,68461696913,24.768,1215760
9 H2D,68461847313,24.896,1215760
10 H2D,68462025777,24.384,1215760
11 H2D,68462117233,6.88,243152
12 H2D,68462291601,24.448,1215760
13 H2D,68462311157,24.384,1215760
14 H2D,68462311157,24.384,1215760
15 H2D,68462311157,24.384,1215760
16 H2D,68462311157,24.384,1215760
17 H2D,68462311157,24.384,1215760
18 H2D,68462311157,24.384,1215760
19 H2D,68463545456,24.288,1215760
20 H2D,68463718192,24.544,1215760
21 H2D,68463867344,24.768,1215760
22 H2D,68464066928,24.16,1215760
23 H2D,68464257167,24.672,1215760
24 H2D,68464434031,24.192,1215760
25 H2D,68464612943,24.224,1215760
26 H2D,68464785551,24.16,1215760
27 H2D,68465082575,24.16,1215760
28 H2D,68465242063,24.16,1215760
29 H2D,68465421103,24.256,1215760
30 H2D,68465588975,24.224,1215760
345 H2D,71337614210,0.864,8
346 D2H,71337620866,2.496,3968
347 P2P,71337768770,1.92,26720
```



# BRAVAS Workflow

create-config | [profile](#) | analyze

bravas.py [profile](#) conf.yaml



```
1 KernelName,NumberOfThreads,MemoryThroughput,KernelExecutionTimeUs,LDSBankConflict,OccupancyLimitNumberOfBlocks,OccupancyLimitRegisters,OccupancyLimitSharedMemory,OccupancyLimitBlockSize,L2CacheHit,TheoreticalOccupancy,BranchEfficiency,ArithmeticThroughput,AchievedOccupancy,DeviceLoad,KernelTimeUs,GridX,GridY,GridZ,BlockX,BlockY,BlockZ,MaxThreadsDevice
2 cuda_assign_kernel,889.6,3.9869999999999997,8811.2,0.06300000000000003,32.0,32.0,32.0,16.0,0.6235,100.0,95.5125,0.20400000000000004,7.8025,0.05600000000000003,6.14457142857143,7.0476190476190474,1.0,1.0,128.0,1.0,1.0,270336
3 icedyn_adv_pra_adv_x_667,106880.0,38.34384615384616,43689.846153846156,1.633076923076923,32.0,2.0,32.0,16.0,62.68692307692308,12.5,97.950000000000003,17.521538461538462,12.51923076923077,10.097692307692306,35.194442307692285,830.0,1.0,1.0,128.0,1.0,1.0,270336
4 icedyn_adv_pra_adv_y_1045,150400.0,71.08538461538461,17474.46153846154,1.1553846153846155,32.0,7.0,32.0,16.0,78.50846153846153,43.75,99.99,9.443076923076925,36.997692307692304,29.145384615384618,14.329846153846152,1181.5,1.0,1.0,128.0,1.0,1.0,270336
5 icedyn_adv_pra_adv_y_883,115200.0,45.537692307692296,54887.38461538462,1.5861538461538465,32.0,2.0,32.0,16.0,78.91384615384615,12.5,97.78999999999999,14.180769230769231,12.21923076923077,10.344615384615386,47.50766346153848,905.0,1.0,1.0,128.0,1.0,1.0,270336
6 icedyn_adv_pra_hbig_1181,30464.0,4.634656,0.0,32.0,4.0,32.0,16.0,13.95,25.0,9.16,2.38,6.66,2.81,22.728,238.0,1.0,1.0,128.0,1.0,1.0,270336
7 icedyn_adv_pra_hbig_1158,30464.0,4.99,30624.0,0.0,32.0,7.0,32.0,16.0,13.52,43.75,95.55,2.9,6.87,3.2,20.316,238.0,1.0,1.0,128.0,1.0,1.0,270336
8 icedyn_adv_pra_hbig_1185,30464.0,6.79,15264.0,0.0,32.0,7.0,32.0,16.0,11.1,43.75,88.06,3.72,9.27,4.52,8.384,238.0,1.0,1.0,128.0,1.0,1.0,270336
9 icedyn_adv_pra_ice_dyn_adv_pra_258,152064.0,15.0,5728.0,0.57,32.0,12.0,32.0,16.0,2.04,75.0,97.41,17.87,49.11,24.33,3.856,1188.0,1.0,1.0,128.0,1.0,1.0,270336
10 icedyn_adv_pra_ice_dyn_adv_pra_278,608000.0,22.93,10880.0,0.68,32.0,10.0,32.0,16.0,34.63,62.5,96.26,46.56,51.89,38.62,8.264000000000001,4750.0,1.0,1.0,128.0,1.0,1.0,270336
11 icedyn_adv_pra_ice_dyn_adv_pra_286,152064.0,12.92,6624.0,0.45,32.0,10.0,32.0,16.0,2.21,62.5,96.26,19.59,59.68,27.97,4.904,1188.0,1.0,1.0,128.0,1.0,1.0,270336
12 icedyn_adv_pra_ice_dyn_adv_pra_331,30464.0,41.68,19904.0,0.03,32.0,5.0,32.0,16.0,18.44,31.25,100.0,8.14,11.69,9.3,20.852,238.0,1.0,1.0,128.0,1.0,1.0,270336
13 icedyn_adv_pra_ice_dyn_adv_pra_360,106880.0,43.6,28576.0,0.9,32.0,3.0,32.0,16.0,23.41,18.75,97.65,12.21,15.88,11.51,25.204,835.0,1.0,1.0,128.0,1.0,1.0,270336
14 icedyn_adv_pra_ice_dyn_adv_pra_505,106880.0,30.81,41312.0,0.51,32.0,3.0,32.0,16.0,25.54,18.75,99.05,12.6,15.17,10.9,42.807874999999996,835.0,1.0,1.0,128.0,1.0,1.0,270336
15 icedyn_adv_pra_ice_dyn_adv_pra_533,30464.0,14.93,5088.0,0.02,32.0,7.0,32.0,16.0,8.89,43.75,99.99,4.86,11.79,6.21,2.9279999999999995,238.0,1.0,1.0,128.0,1.0,1.0,270336
16 icedyn_adv_pra_ice_dyn_adv_pra_543,256.0,1.81,75264.0,9.3,32.0,5.0,32.0,16.0,62.92,31.25,99.67,0.06,4.87,0.06,60.492,2.0,1.0,1.0,128.0,1.0,1.0,270336
17 icedyn_adv_pra_ice_dyn_adv_pra_568,30464.0,41.44,20352.0,0.04,32.0,4.0,32.0,16.0,21.08,25.0,100.0,7.23,11.7,9.39,14.648000000000001,238.0,1.0,1.0,128.0,1.0,1.0,270336
18 icedyn_adv_pra_icemax3d_1588,240640.0,12.594999999999999,5976.0,1.1524999999999999,32.0,10.0,32.0,16.0,13.8375,62.5,99.98,22.04,51.0425,27.64,3.85,940.0,2.0,1.0,32.0,4.0,1.0,270336
19 icedyn_adv_pra_icemax3d_1596,237824.0,16.4125,6192.0,1.325,32.0,10.0,32.0,16.0,35.010000000000005,62.5,99.98,23.220000000000002,51.6525,28.6475,3.4140000000000006,929.0,2.0,1.0,32.0,4.0,1.0,270336
20 icedyn_adv_pra_icemax4d_1633,421120.0,19.925,8544.0,1.26,32.0,9.0,32.0,16.0,17.63,56.25,99.985,37.21,46.315,31.560000000000002,5.526000000000001,940.0,3.5,1.0,32.0,4.0,1.0,270336
21 icedyn_adv_pra_icemax4d_1641,416192.0,23.165,8912.0,1.375,32.0,9.0,32.0,16.0,40.95,56.25,99.985,37.78,48.125,32.295,5.6819999999999995,929.0,3.5,1.0,32.0,4.0,1.0,270336
22 icevar_ice_var_zapneg_646,152064.0,13.62,5542.4,0.6020000000000001,32.0,12.0,32.0,16.0,0.502,75.0,97.3,16.894,65.246,28.107999999999997,2.6631999999999993,1188.0,1.0,1.0,128.0,1.0,1.0,270336
23 icevar_ice_var_zapneg_652,30464.0,11.864,7520.0,0.3520000000000004,32.0,12.0,32.0,16.0,36.06,75.0,97.19,3.474,12.969999999999999,7.355999999999999,3.380775000000001,238.0,1.0,1.0,128.0,1.0,1.0,270336
24 icevar_ice_var_zapneg_669,30464.0,8.96,5523.2,0.132,32.0,12.0,32.0,16.0,15.344,7.0,98.52,3.492,15.318000000000001,6.287999999999999,2.2112000000000003,238.0,1.0,1.0,128.0,1.0,1.0,270336
```



# BRAVAS Workflow

create-config | profile | analyze

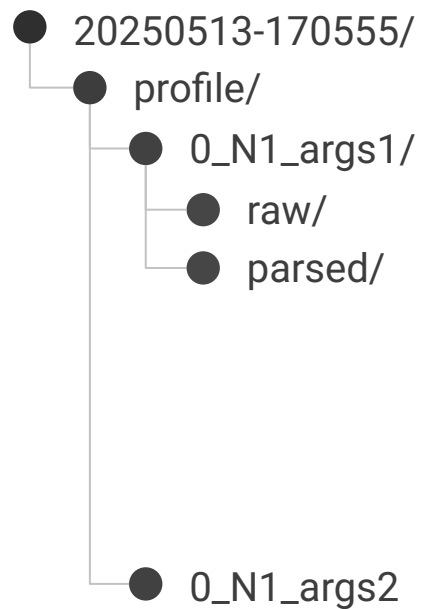
bravas.py **analyze** conf.yaml



# BRAVAS Workflow

create-config | profile | analyze

bravas.py **analyze** conf.yaml

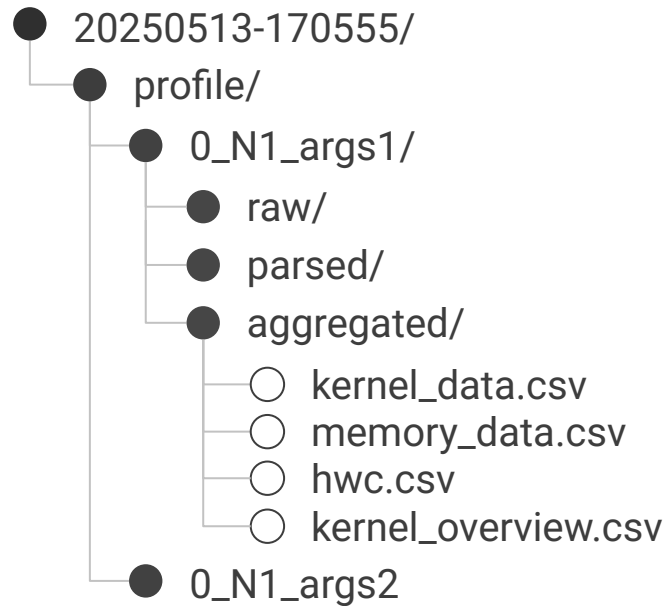




# BRAVAS Workflow

create-config | profile | analyze

bravas.py **analyze** conf.yaml



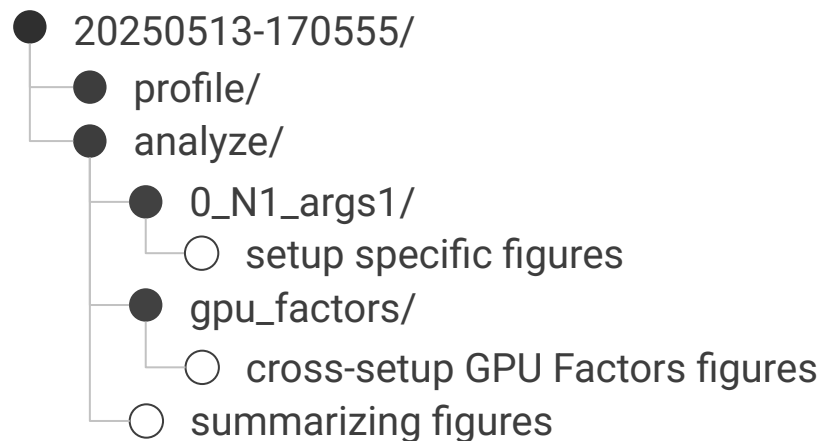
```
1 KernelName,Calls,TotalDurationUs,AverageUs,Percentage
2 icedyn_adv_pra_adv_y_883,416,19740.398999999998,47.45288221153846,27.816882206508865
3 icedyn_adv_pra_adv_x_667,416,14639.235,35.19046875,20.628654749501358
4 cuda_assign_kernel,1920,7036.643,3.6649182291666667,9.915578173483484
5 icedyn_adv_pra_adv_y_1045,416,5964.0050000000001,14.336550480769233,8.404086693689926
6 icedyn_adv_pra_ice_dyn_adv_pra_543,32,1927.67,60.2396875,2.716346783214511
7 lbcnfd_lbc_nfd_nogather_3d_gpu_dp_939,832,1678.29100000000002,2.017176682692308,2.3649381684353985
8 icedyn_adv_pra_ice_dyn_adv_pra_505,32,1369.94600000000001,42.810812500000004,1.9304385139975135
9 lbclnk_mpp_nfd_3d_ptr_gpu_dp_3117,96,974.168,10.147583333333333,1.372733980977301
10 lbclnk_mpp_nfd_3d_ptr_gpu_dp_3210,96,886.397,9.233302083333333,1.2490528148495297
11 lbclnk_mpp_nfd_3d_ptr_gpu_dp_3188,96,851.739,8.87228125,1.200215022689747
12 icedyn_adv_pra_ice_dyn_adv_pra_360,32,808.409,25.26278125,1.1391572139793946
13 icevar_ice_var_zapneg_689,160,724.895,4.5305937499999995,1.021474734481671
14 icedyn_adv_pra_hbig_1101,32,703.711,21.99096875,0.9916236239411655
15 icedyn_adv_pra_ice_dyn_adv_pra_331,32,666.142,20.8169375,0.938683840524613
16 icedyn_adv_pra_hbig_1158,32,627.613,19.61290625,0.8843912877482188
17 lbclnk_mpp_lnk_3d_ptr_gpu_dp_1851,96,601.1189999999999,6.261656249999999,0.847057671686089
18 lbclnk_mpp_lnk_3d_ptr_gpu_dp_1597,192,588.7639999999999,3.0664791666666666,0.8296478118518771
19 icevar_ice_var_zapneg_652,160,543.837,3.39898125,0.7663396149460384
20 lbclnk_mpp_lnk_3d_ptr_gpu_dp_1607,192,522.3989999999999,2.7208281249999993,0.7361305841790746
21 icedyn_adv_pra_icemax3d_1588,128,494.172,3.86071875,0.6963549375954813
22 lbcnfd_lbc_nfd_nogather_4d_gpu_dp_1631,224,484.85999999999996,2.1645535714285713,0.6832330748050173
23 icedyn_adv_pra_ice_dyn_adv_pra_568,32,466.685,14.58390625,0.6576220507267655
24 icedyn_adv_pra_icemax3d_1596,128,437.661000000000006,3.4192265625000005,0.6167233237475533
25 icevar_ice_var_zapneg_646,160,430.3019999999999,2.6893874999999996,0.606353501123517
26 lbclnk_mpp_lnk_3d_ptr_gpu_dp_1704,192,423.966,2.20815625,0.5974252233485624
27 lbclnk_mpp_lnk_3d_ptr_gpu_dp_1656,192,423.55,2.2059895833333334,0.596839023292631
28 icedyn_adv_pra_icemax4d_1641,64,366.238,5.72246875,0.5160786925100852
29 icevar_ice_var_zapneg_669,160,356.062,2.2253875,0.5017393372957639
30 icedyn_adv_pra_icemax4d_1633,64,355.328,5.552,0.5007050323893849
```



# BRAVAS Workflow

create-config | profile | analyze

bravas.py **analyze** conf.yaml



# Analyze Figures



**Barcelona  
Supercomputing  
Center**

*Centro Nacional de Supercomputación*



# Analyze Figures

Setup Summery | Kernel Overview | GPU Factors | Memory Transfers | Runtime Ratios | LDSBankConflicts

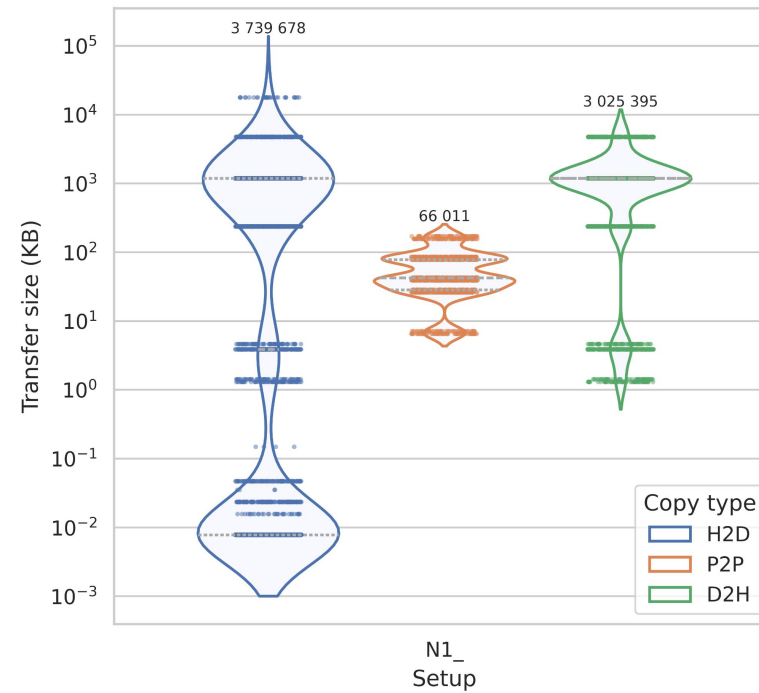


# Analyze Figures

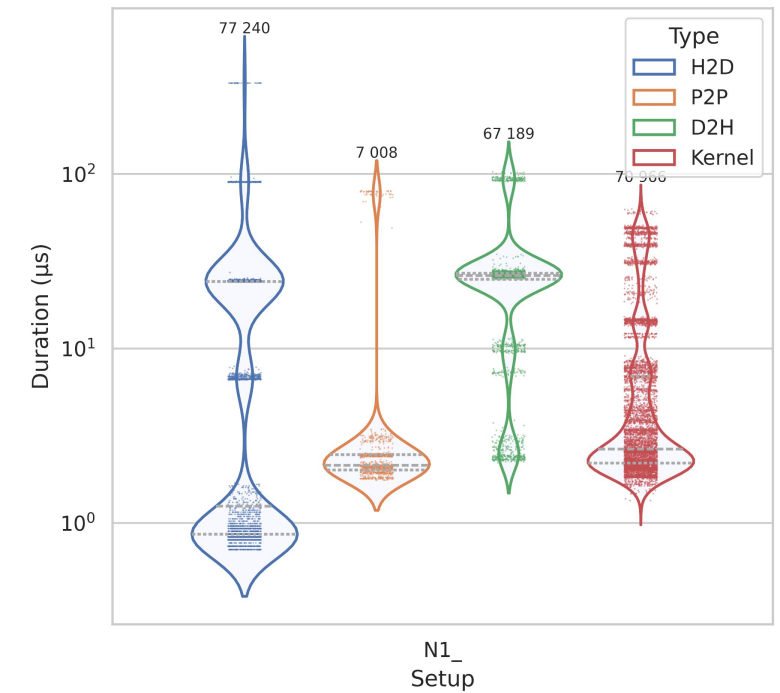
[Setup Summery](#) | Kernel Overview | GPU Factors | Memory Transfers | Runtime Ratios | LDSBankConflicts

|                       | N1_      |
|-----------------------|----------|
| Unique kernels (#)    | 79       |
| Kernel call count (#) | 8 592    |
| Kernel time (μs)      | 70 965   |
| H2D count (#)         | 6 232    |
| D2H count (#)         | 3 664    |
| H2D time (μs)         | 84 247   |
| D2H time (μs)         | 74 196   |
| H2D size (MB)         | 3 716.49 |
| D2H size (MB)         | 3 018.95 |

Setup Overview



Memory Transfers



Runtime Ratios



# Analyze Figures

Setup Summery | Kernel Overview | GPU Factors | Memory Transfers | Runtime Ratios | LDSBankConflicts

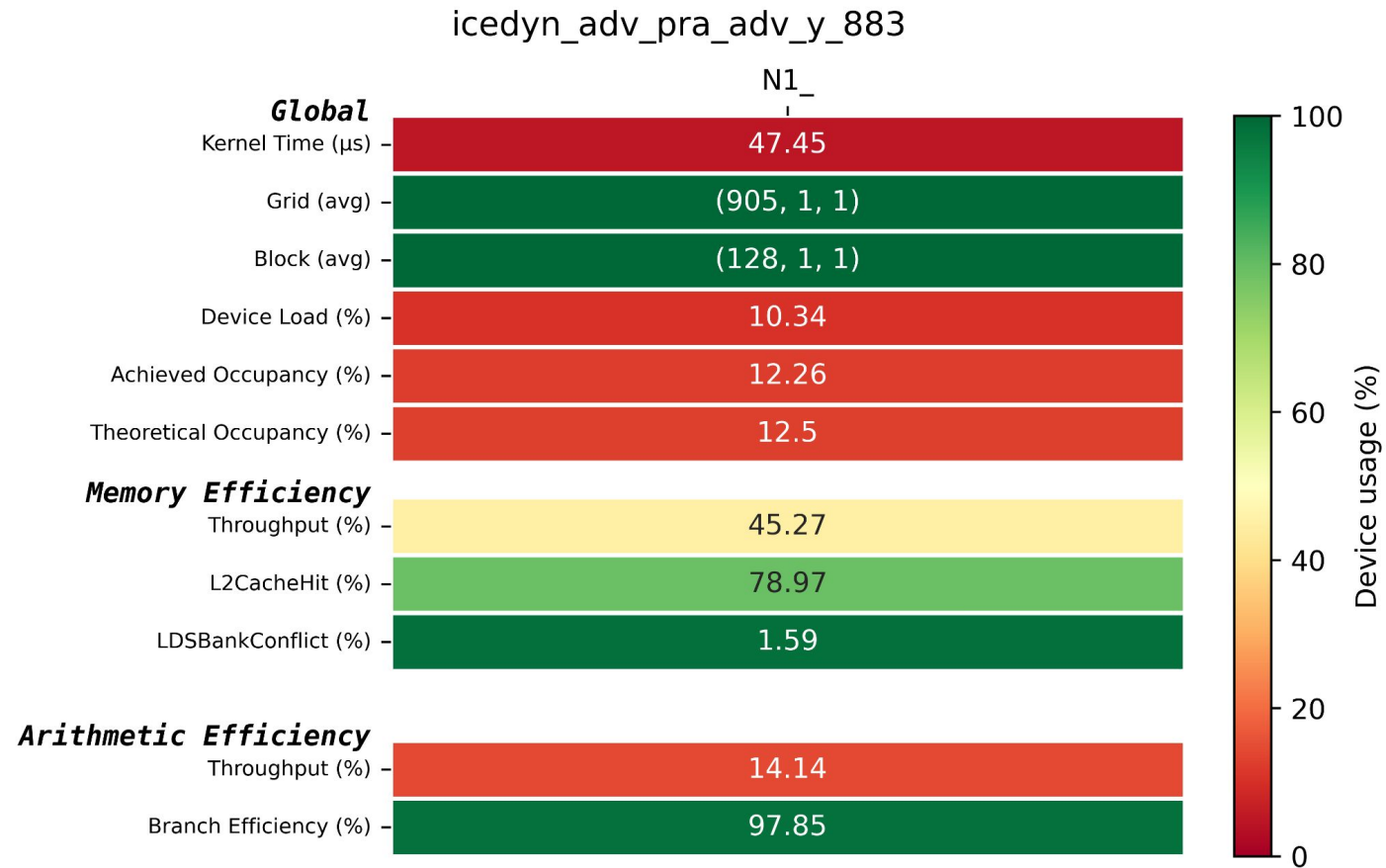
| KernelName                            | Calls | TotalDurationUs | AverageUs | Percentage |
|---------------------------------------|-------|-----------------|-----------|------------|
| icedyn_adv_pra_ice_dyn_adv_pra_543    | 416   | 19 740.4        | 47.45     | 27.82      |
| icedyn_adv_pra_adv_x_667              | 416   | 14 639.24       | 35.19     | 20.63      |
| cuda_assign_kernel                    | 1 920 | 7 036.64        | 3.66      | 9.92       |
| icedyn_adv_pra_adv_y_1045             | 416   | 5 964.01        | 14.34     | 8.4        |
| icedyn_adv_pra_ice_dyn_adv_pra_543    | 32    | 1 927.67        | 60.24     | 2.72       |
| lbcnfd_lbc_nfd_nogather_3d_gpu_dp_939 | 832   | 1 678.29        | 2.02      | 2.36       |
| icedyn_adv_pra_ice_dyn_adv_pra_505    | 32    | 1 369.95        | 42.81     | 1.93       |
| lbcInk_mpp_nfd_3d_ptr_gpu_dp_3117     | 96    | 974.17          | 10.15     | 1.37       |
| lbcInk_mpp_nfd_3d_ptr_gpu_dp_3210     | 96    | 886.4           | 9.23      | 1.25       |
| lbcInk_mpp_nfd_3d_ptr_gpu_dp_3188     | 96    | 851.74          | 8.87      | 1.2        |
| icedyn_adv_pra_ice_dyn_adv_pra_360    | 32    | 808.41          | 25.26     | 1.14       |
| icevar_ice_var_zapneg_689             | 160   | 724.9           | 4.53      | 1.02       |
| icedyn_adv_pra_hbig_1101              | 32    | 703.71          | 21.99     | 0.99       |
| icedyn_adv_pra_ice_dyn_adv_pra_331    | 32    | 666.14          | 20.82     | 0.94       |
| icedyn_adv_pra_hbig_1158              | 32    | 627.61          | 19.61     | 0.88       |
| ...                                   | ...   | ...             | ...       | ...        |

| KernelName                            | Calls | TotalDurationUs | AverageUs | Percentage |
|---------------------------------------|-------|-----------------|-----------|------------|
| icedyn_adv_pra_adv_y_883              | 416   | 19 740.4        | 47.45     | 27.82      |
| icedyn_adv_pra_adv_x_667              | 416   | 14 639.24       | 35.19     | 20.63      |
| cuda_assign_kernel                    | 1 920 | 7 036.64        | 3.66      | 9.92       |
| icedyn_adv_pra_adv_y_1045             | 416   | 5 964.01        | 14.34     | 8.4        |
| icedyn_adv_pra_ice_dyn_adv_pra_543    | 32    | 1 927.67        | 60.24     | 2.72       |
| lbcnfd_lbc_nfd_nogather_3d_gpu_dp_939 | 832   | 1 678.29        | 2.02      | 2.36       |
| icedyn_adv_pra_ice_dyn_adv_pra_505    | 32    | 1 369.95        | 42.81     | 1.93       |
| lbcInk_mpp_nfd_3d_ptr_gpu_dp_3117     | 96    | 974.17          | 10.15     | 1.37       |
| lbcInk_mpp_nfd_3d_ptr_gpu_dp_3210     | 96    | 886.4           | 9.23      | 1.25       |
| lbcInk_mpp_nfd_3d_ptr_gpu_dp_3188     | 96    | 851.74          | 8.87      | 1.2        |
| icedyn_adv_pra_ice_dyn_adv_pra_360    | 32    | 808.41          | 25.26     | 1.14       |
| icevar_ice_var_zapneg_689             | 160   | 724.9           | 4.53      | 1.02       |
| icedyn_adv_pra_hbig_1101              | 32    | 703.71          | 21.99     | 0.99       |
| icedyn_adv_pra_ice_dyn_adv_pra_331    | 32    | 666.14          | 20.82     | 0.94       |
| icedyn_adv_pra_hbig_1158              | 32    | 627.61          | 19.61     | 0.88       |
| ...                                   | ...   | ...             | ...       | ...        |



# Analyze Figures

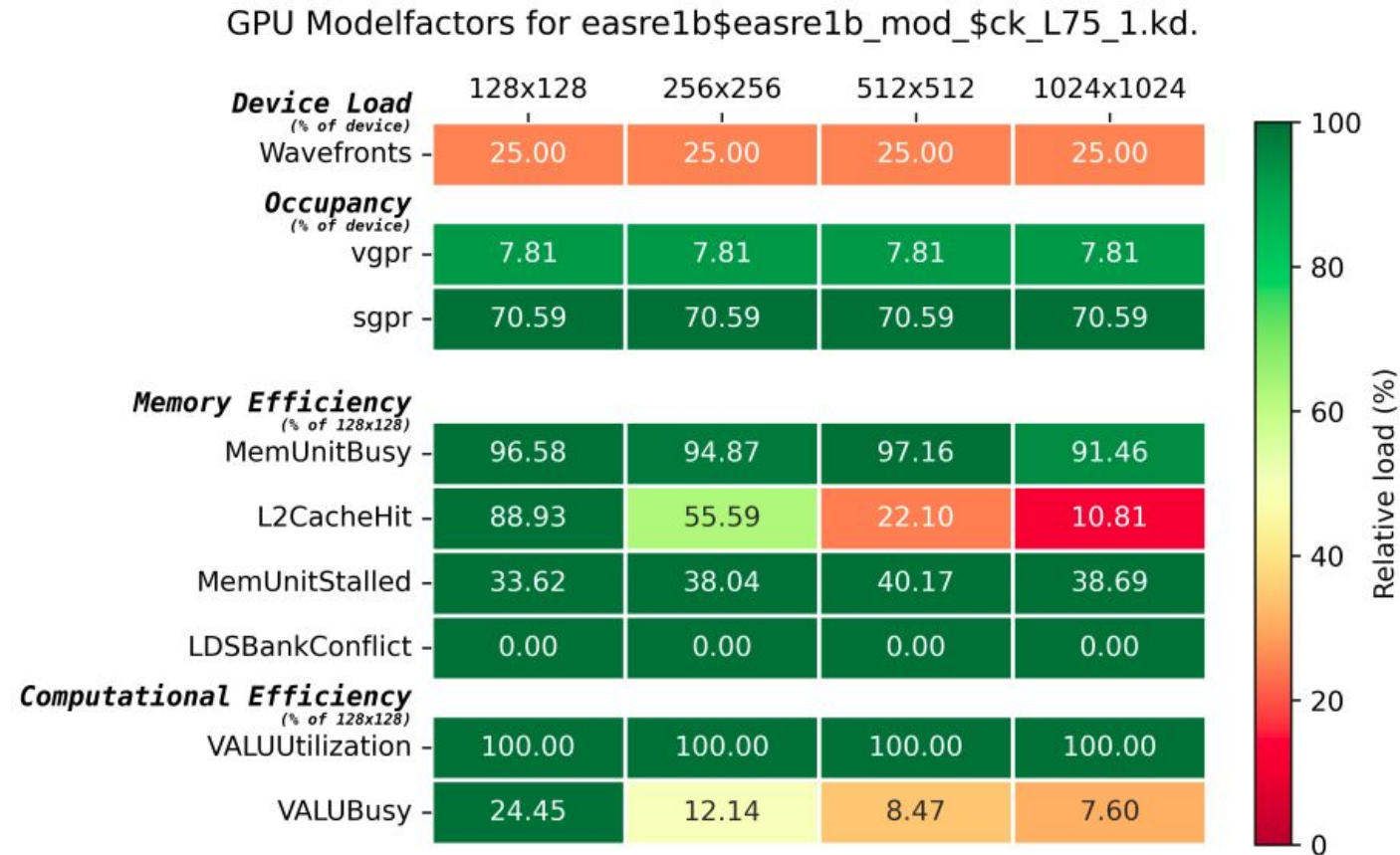
Setup Summery | Kernel Overview | [GPU Factors](#) | Memory Transfers | Runtime Ratios | LDSBankConflicts





# Analyze Figures

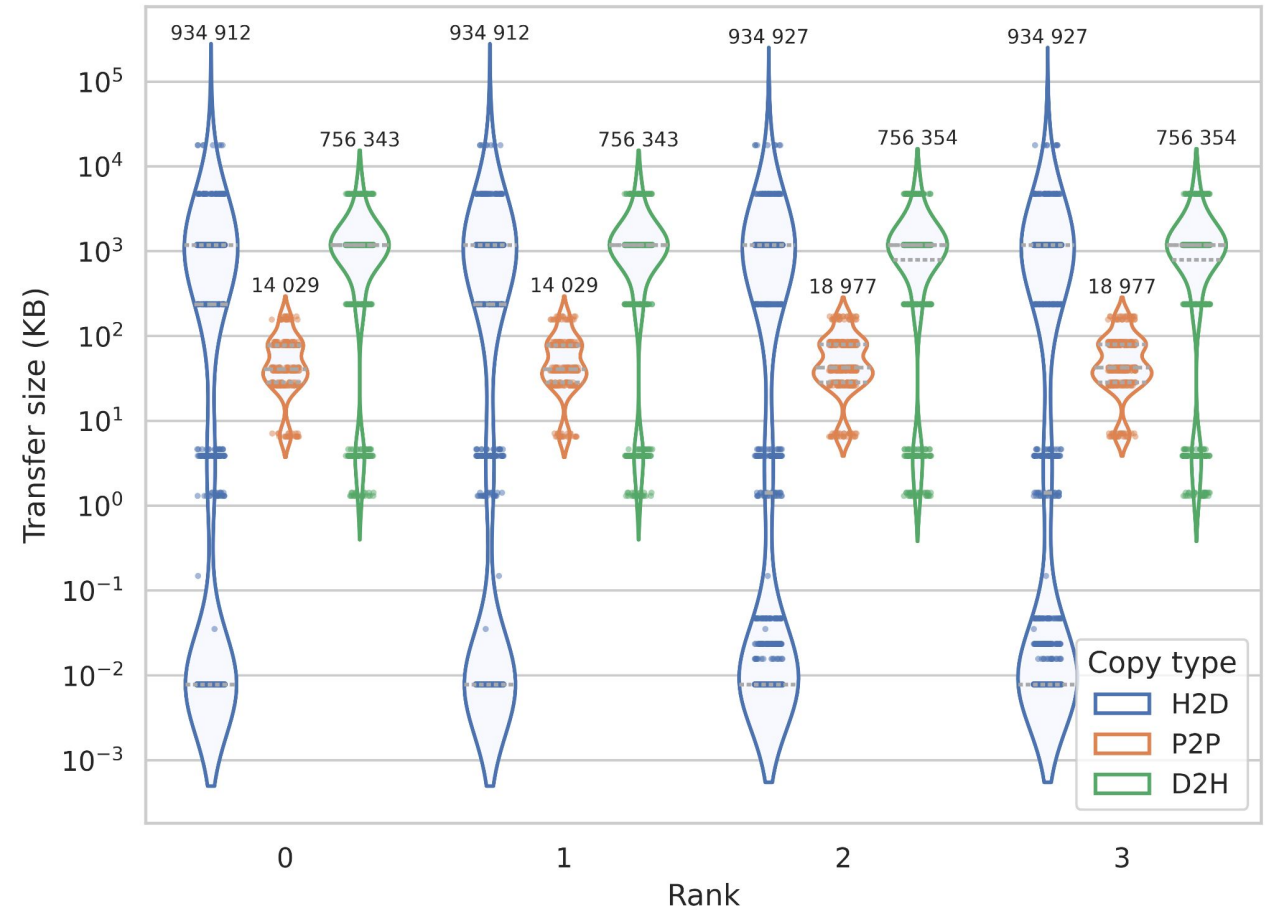
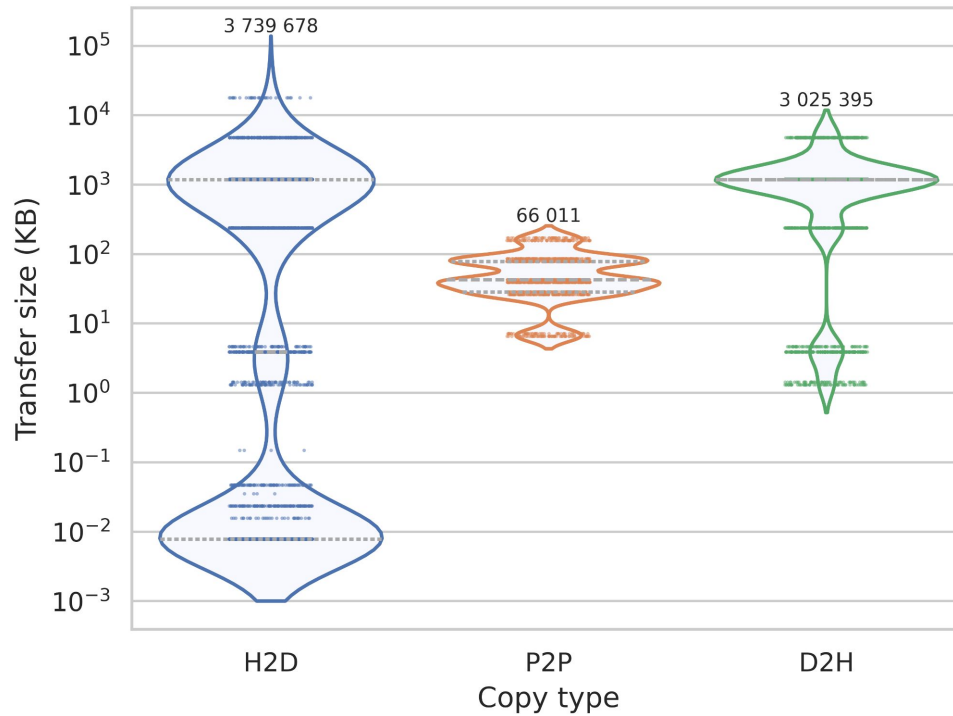
Setup Summery | Kernel Overview | [GPU Factors](#) | Memory Transfers | Runtime Ratios | LDSBankConflicts





# Analyze Figures

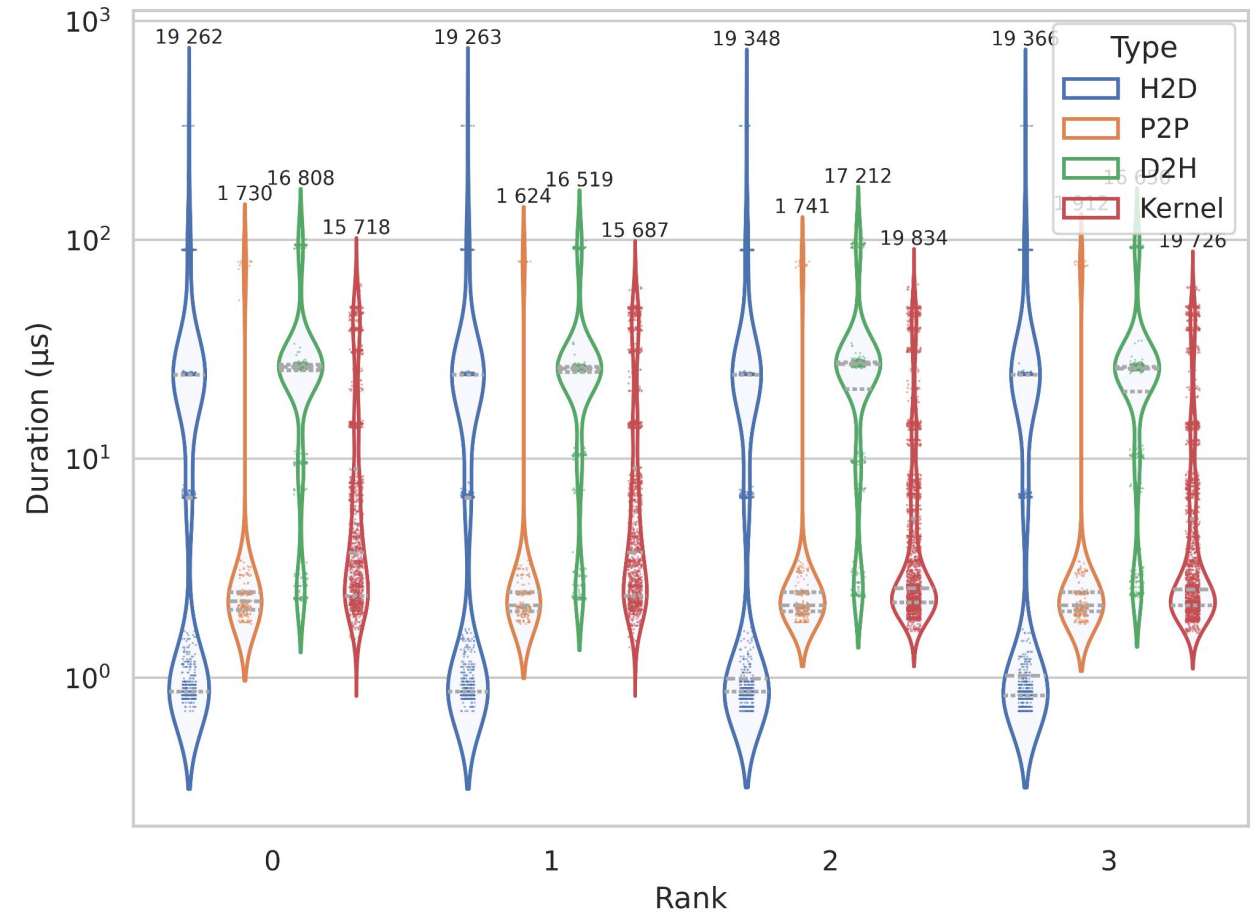
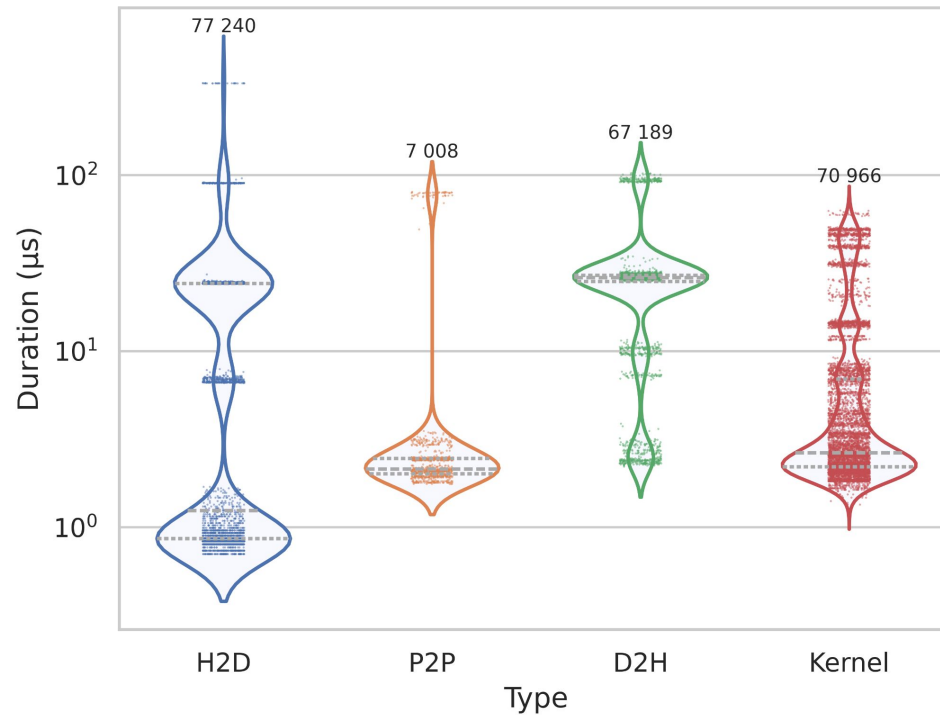
Setup Summery | Kernel Overview | GPU Factors | Memory Transfers | Runtime Ratios | LDSBankConflicts





# Analyze Figures

Setup Summery | Kernel Overview | GPU Factors | Memory Transfers | Runtime Ratios | LDSBankConflicts





# Analyze Figures

Setup Summery | Kernel Overview | GPU Factors | Memory Transfers | Runtime Ratios | [LDSBankConflicts](#)



| Rank | KernelName                | LDSBankConflict |
|------|---------------------------|-----------------|
| 0    | icedyn_adv_pra_adv_x_667  | 1.63            |
| 0    | icedyn_adv_pra_adv_y_883  | 1.59            |
| 0    | icedyn_adv_pra_adv_y_1045 | 1.16            |
| 0    | cuda_assign_kernel        | 0.06            |
| 1    | icedyn_adv_pra_adv_x_667  | 1.61            |
| 1    | icedyn_adv_pra_adv_y_883  | 1.6             |
| 1    | icedyn_adv_pra_adv_y_1045 | 1.12            |
| 1    | cuda_assign_kernel        | 0.06            |
| 2    | icedyn_adv_pra_adv_x_667  | 1.62            |
| 2    | icedyn_adv_pra_adv_y_883  | 1.59            |
| 2    | icedyn_adv_pra_adv_y_1045 | 1.11            |
| 2    | cuda_assign_kernel        | 0.03            |
| 3    | icedyn_adv_pra_adv_x_667  | 1.62            |
| 3    | icedyn_adv_pra_adv_y_883  | 1.6             |
| 3    | icedyn_adv_pra_adv_y_1045 | 1.16            |
| 3    | cuda_assign_kernel        | 0.03            |
| ...  | ...                       | ...             |