

Optimize Performance with Intel® VTune™ Profiler

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VSC

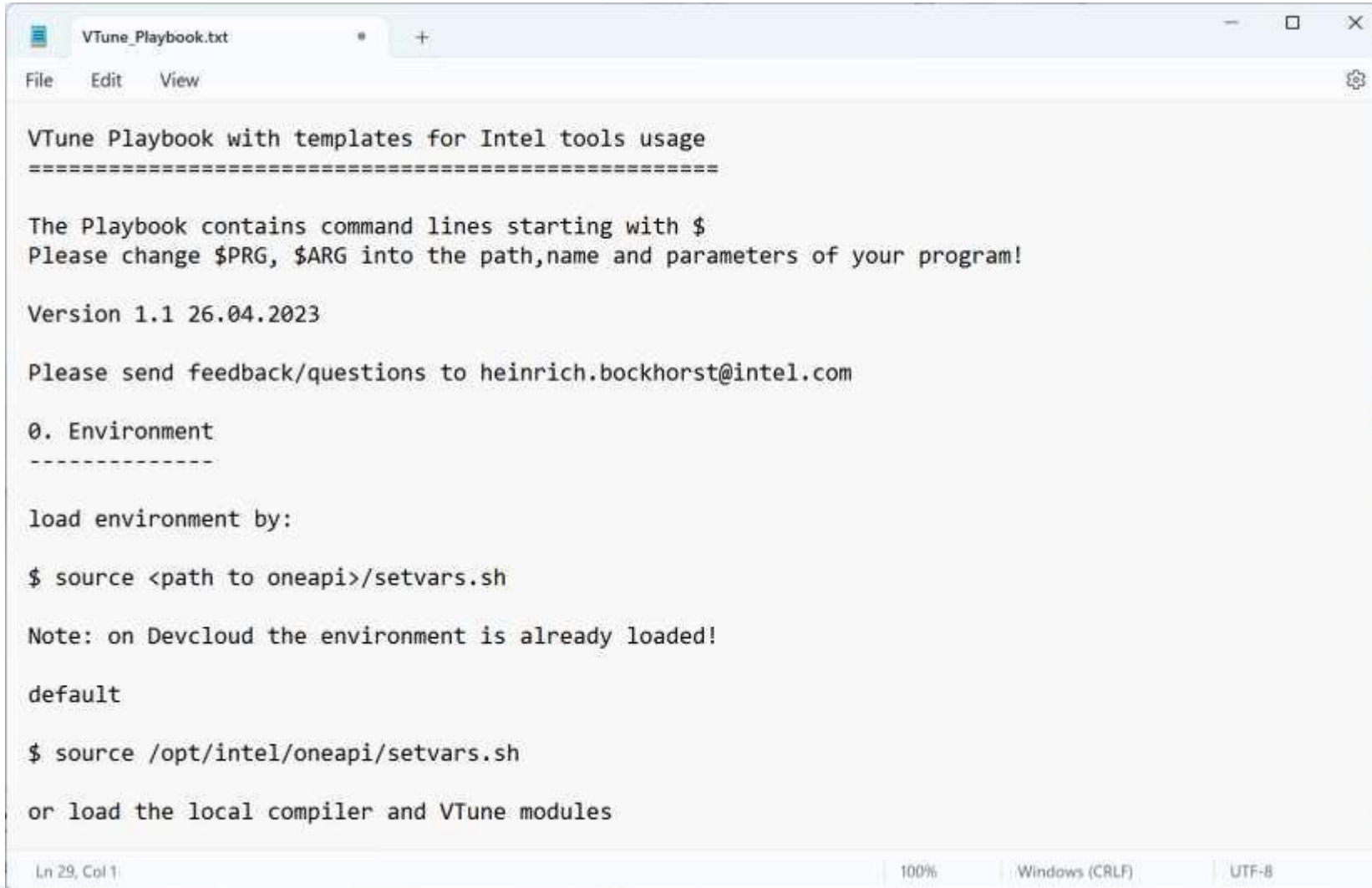
December 2023



Agenda

- VTune overview + VTune hotspots
- How to use VTune e.g., in a Cluster environment
- Demo
- VTune HPC analysis
- VTune GPU analysis
- Demo with GROMACS

Playbook for easy access to command lines



```
VTune_Playbook.txt
File Edit View
VTune Playbook with templates for Intel tools usage
=====

The Playbook contains command lines starting with $
Please change $PRG, $ARG into the path,name and parameters of your program!

Version 1.1 26.04.2023

Please send feedback/questions to heinrich.bockhorst@intel.com

0. Environment
-----

load environment by:

$ source <path to oneapi>/setvars.sh

Note: on Devcloud the environment is already loaded!

default

$ source /opt/intel/oneapi/setvars.sh

or load the local compiler and VTune modules

Ln 29, Col 1 100% Windows (CRLF) UTF-8
```

Demo slides/life

- Presentations contain sample snapshots
- Demo content might not match exactly these snapshots

Analysis based on APS results

- APS is first step in analysis.
- Check for hints provided in APS results
- APS provides only data on whole app
- VTune will provide function/loops/source code/assembly level analysis

Optimize Performance

Intel® VTune™ Profiler

Get the Right Data to Find Bottlenecks

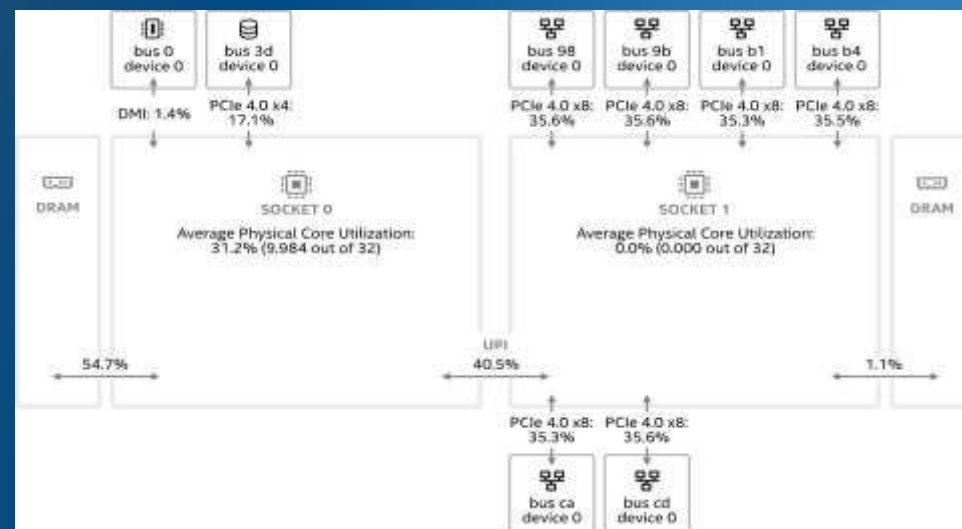
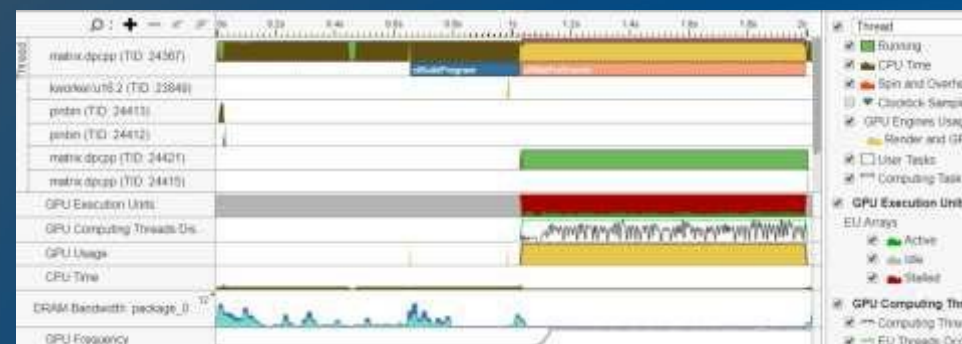
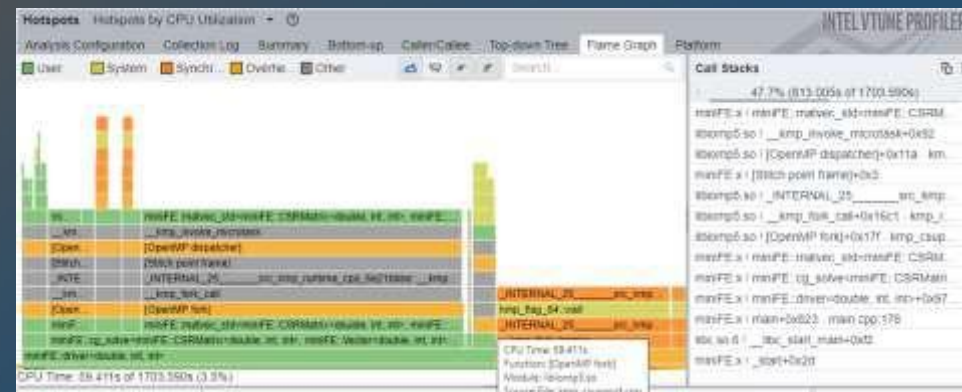
- A suite of profiling for CPU, GPU, FPGA, threading, memory, cache, storage, offload, power...
- Application or system-wide analysis
- DPC++, C, C++, Fortran, Python*, Go*, Java*, or a mix
- Linux, Windows, FreeBSD, Android, Yocto and more
- Containers and VMs

Analyze Data Faster

- Collect data HW/SW sampling and tracing w/o re-compilation
- See results on your source, in architecture diagrams, as a histogram, on a timeline...
- Filter and organize data to find answers

Work Your Way

- User interface or command line
- Profile locally and remotely
- GUI (desktop or web) or command line



Find Answers Fast

Intel® VTune™ Profiler

Adjust Data Grouping

Function / Call Stack
Source Function / Function / Call Stack
Sync Object / Function / Call Stack
Sync Object / Thread / Function / Call Stack
... (Partial list shown)

Double Click Function
to View Source

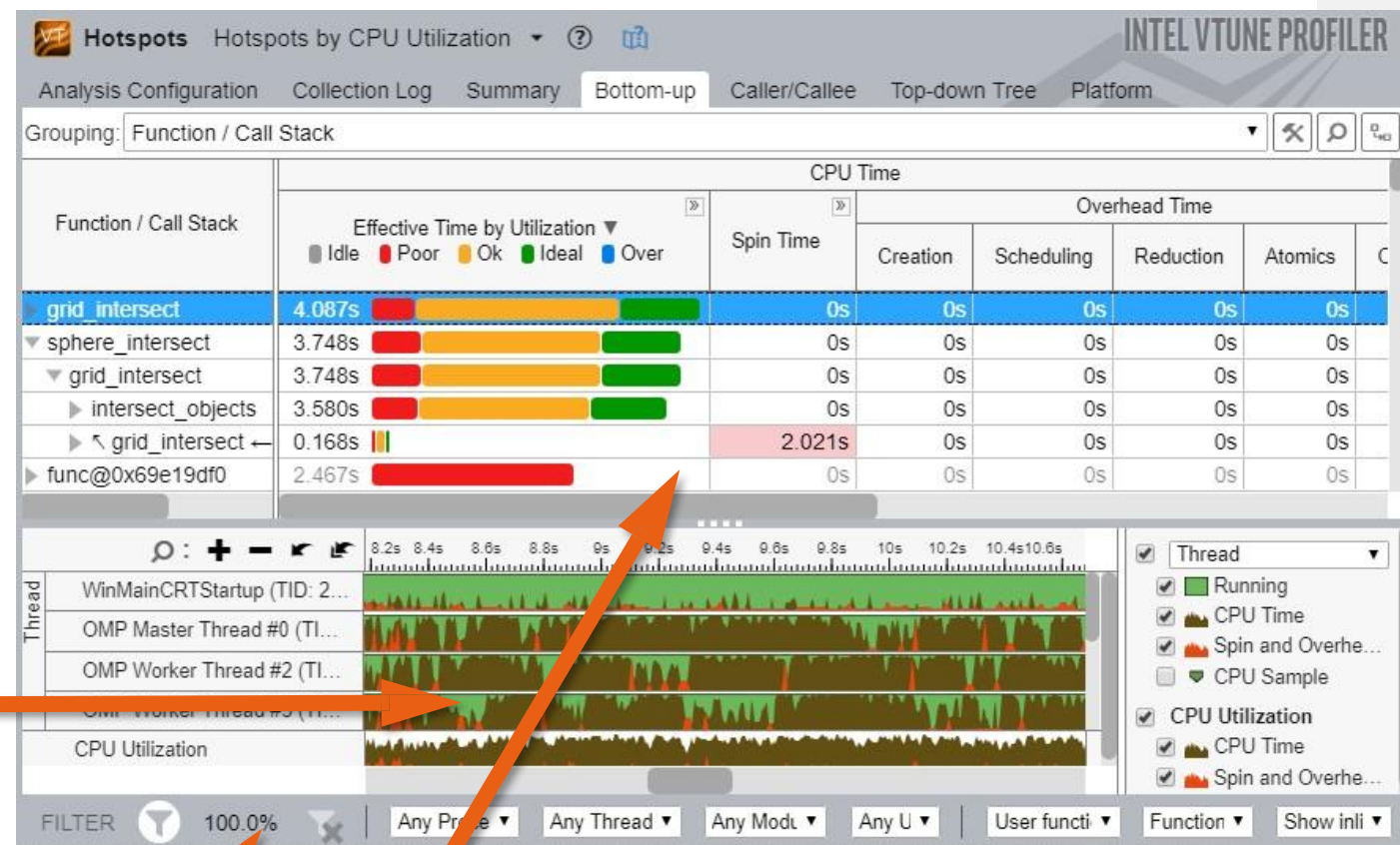
Click [►] for Call Stack

Filter by Timeline Selection (or
by Grid Selection)

Zoom In And Filter On Selection

Filter In by Selection

Remove All Filters



Filter by Process
& Other Controls

Tuning Opportunities Shown in Pink.
Hover for Tips

See Profile Data On Source / Asm

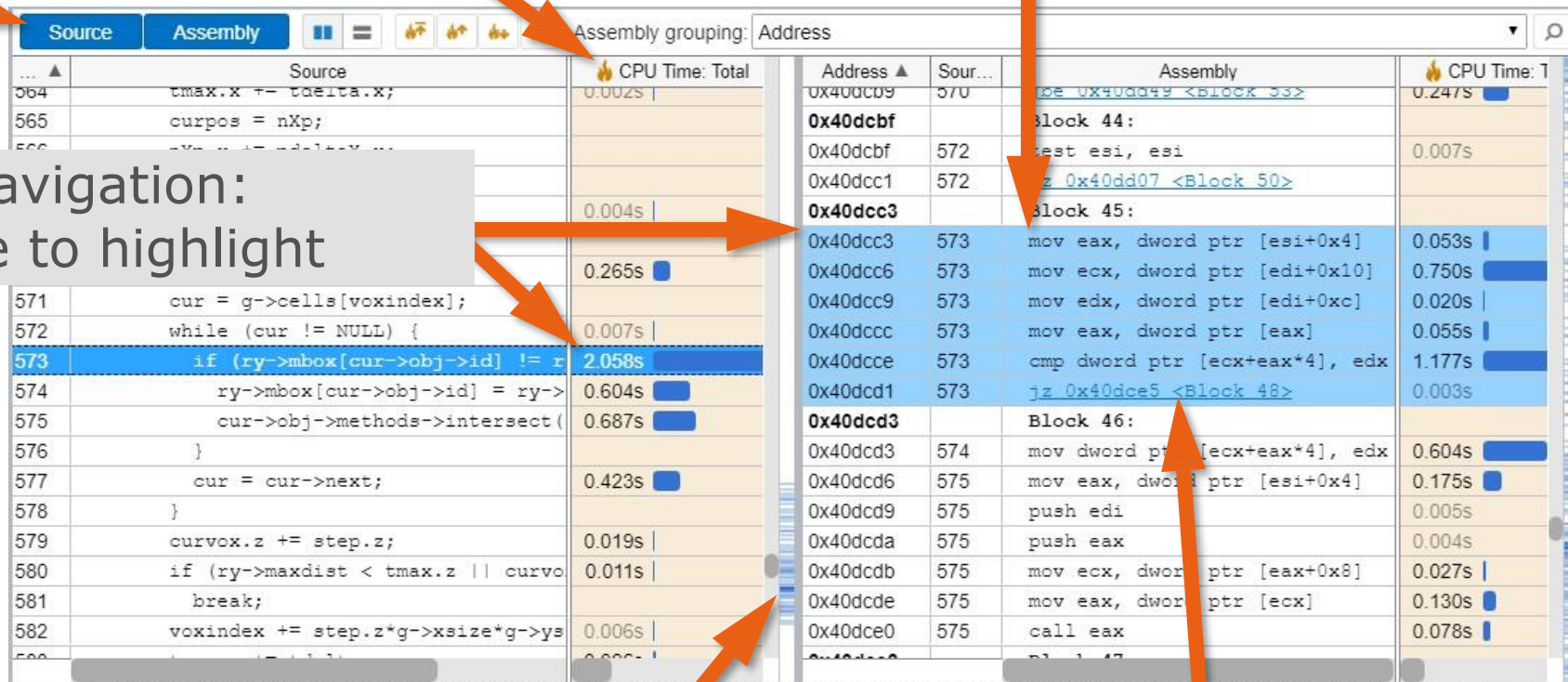
Double Click from Grid or Timeline

View Source / Asm or both

CPU Time

Right click for instruction reference manual

Quick Asm navigation:
Select source to highlight
Asm



Scroll Bar "Heat Map" is an overview of hot spots

Click jump to scroll Asm

Bottom-up tab – most popular tab

- Grouping: different ordering of results –check out different choices
- Source view: double click on function or loop will open another window – source must be compiled with “-g”. Source code must be available
- Zoom and filter in timeline section. Grid will adapt your choice
- Filter process/user code/libraries/loops/system functions (e.g. libc)
- Values in pink: e.g. high overhead like barrier waiting or low cpu utilization.

How to start an analysis GUI vs CMD

- Start GUI by `$ vtune-gui` on command line or by double clicking on Windows
- Click on “Configure Analysis ...”
- 3 Sections: WHERE,WHAT, HOW
- WHERE: local vs remote. We do local here
- WHAT : define your application with parameters and environment
- HOW: Analysis type like “Hotspots” or “APS” with additional parameters

Intel VTune Profiler

Welcome x Configure Analysis x

Configure Analysis

WHERE

Local Host

WHAT

Launch Application

Specify and configure your analysis target: an application or a script to execute. Follow [Prepare Application for Analysis](#) to compile your app for best analysis productivity.

Application:

C:\Users\hbockhor\OneDrive - Intel Corporation\Documents\Issues\2023\JIRA_VASP-2861

Application parameters:

☒ Use application directory as working directory

Advanced

HOW

Hotspots

Identify the most time consuming functions and drill down to see time spent on each line of source code. Focus optimization efforts on hot code for the greatest performance impact. [Learn more](#)

☒ User-Mode Sampling
☐ Hardware Event-Based Sampling

☒ Show additional performance insights

Details

Collect CPU sampling data
With stacks

CPU sampling interval, ms
10

Collect synchronization data
No

Collect signalling API data
No

Overhead

Copy command line here

Play, Stop, Save, Command Line

VTune and MPI

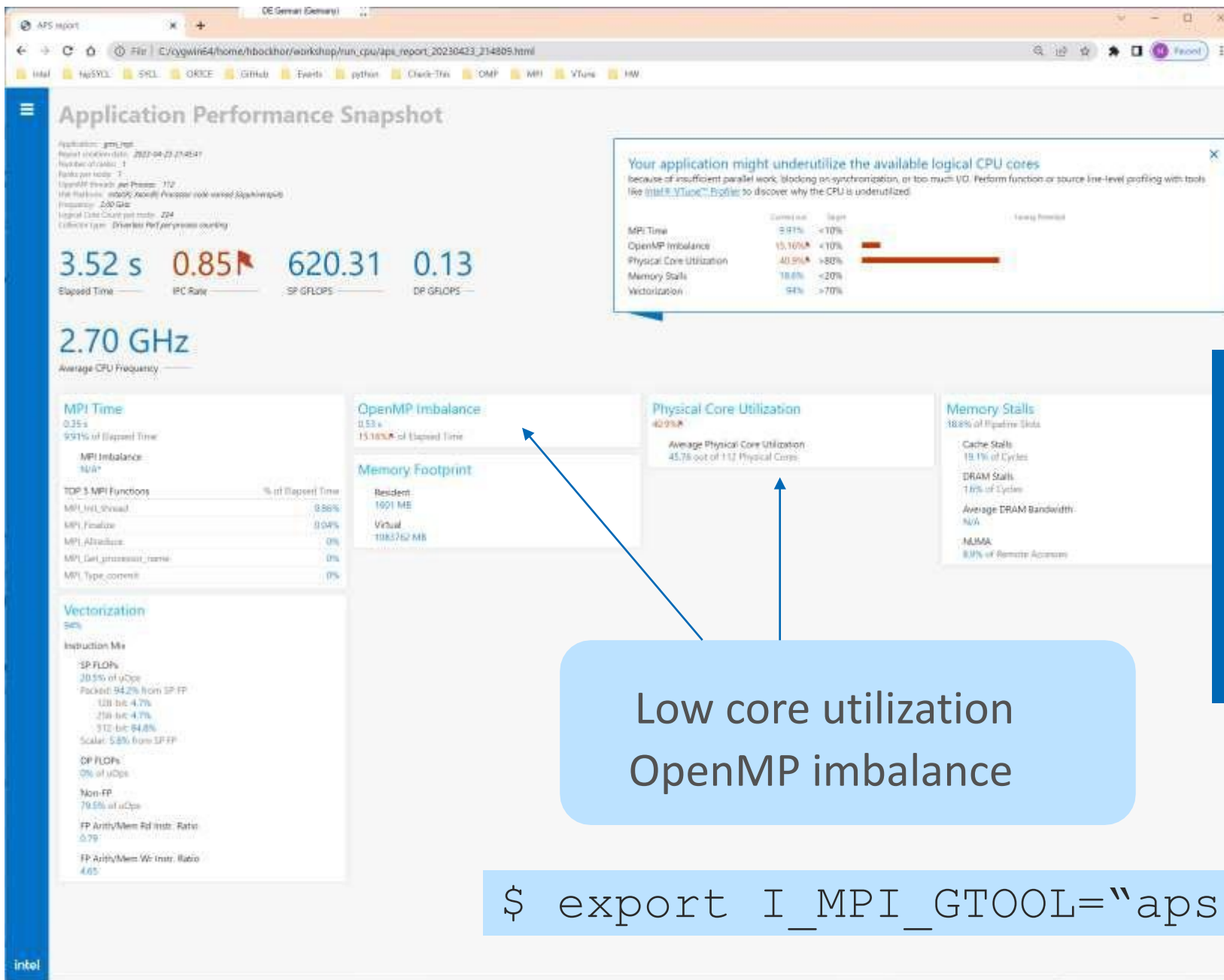
- To run VTune in an MPI job you may use the “-gtool” flag
- More convenient is the I_MPI_GTOOL environment variable. Example for HPC analysis:

```
$ export I_MPI_GTOOL= "vtune -c hpc-performance -r HPC:0"
```

run your program, as usual, under MPI. The setting will collect data on rank #0. Use a list of ranks or `:all` for multi rank analysis.

- More information:

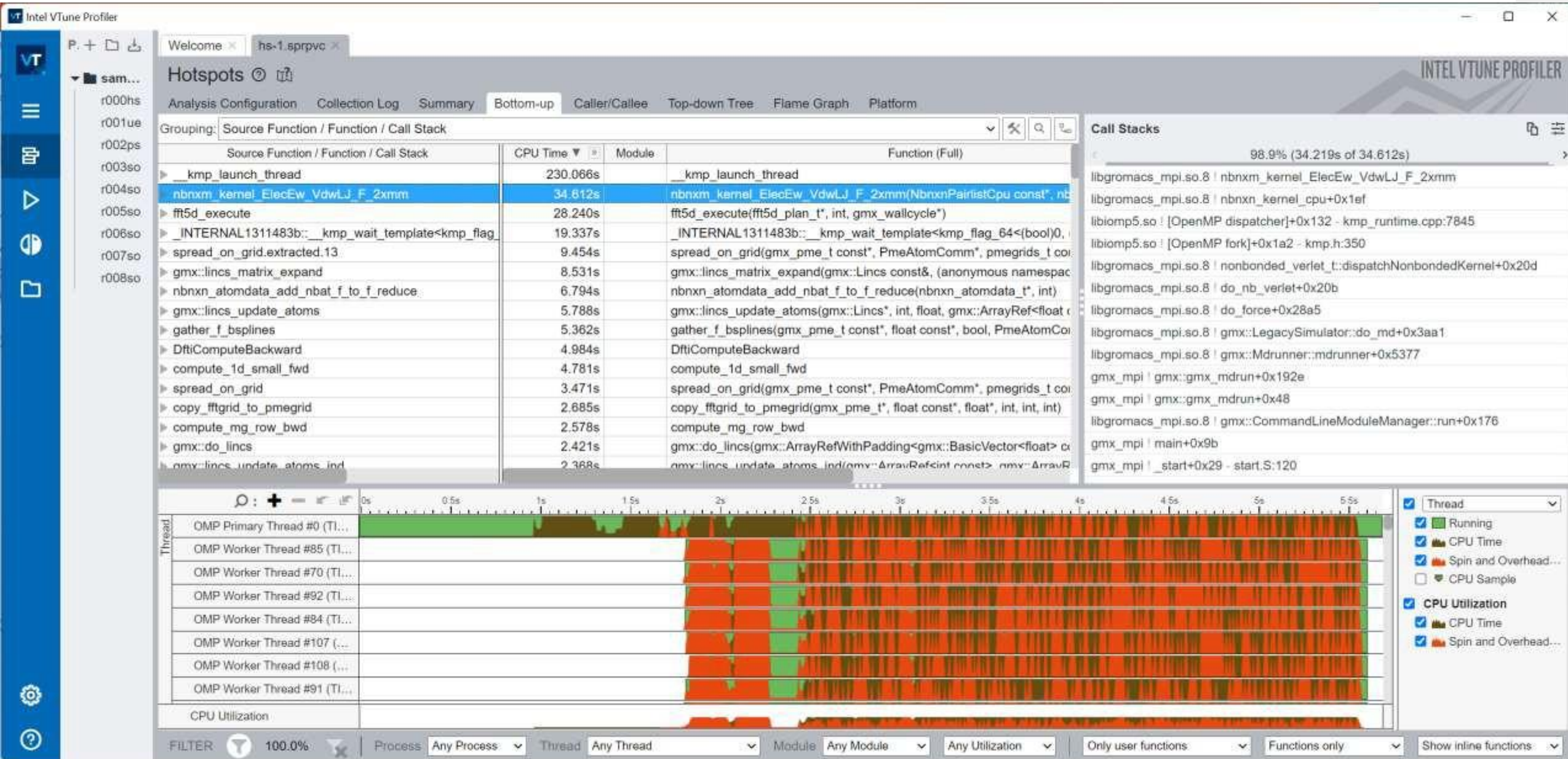
<https://www.intel.com/content/www/us/en/develop/documentation/mpi-developer-reference-linux/top/command-reference/mpiexec-hydra/gtool-options.html>

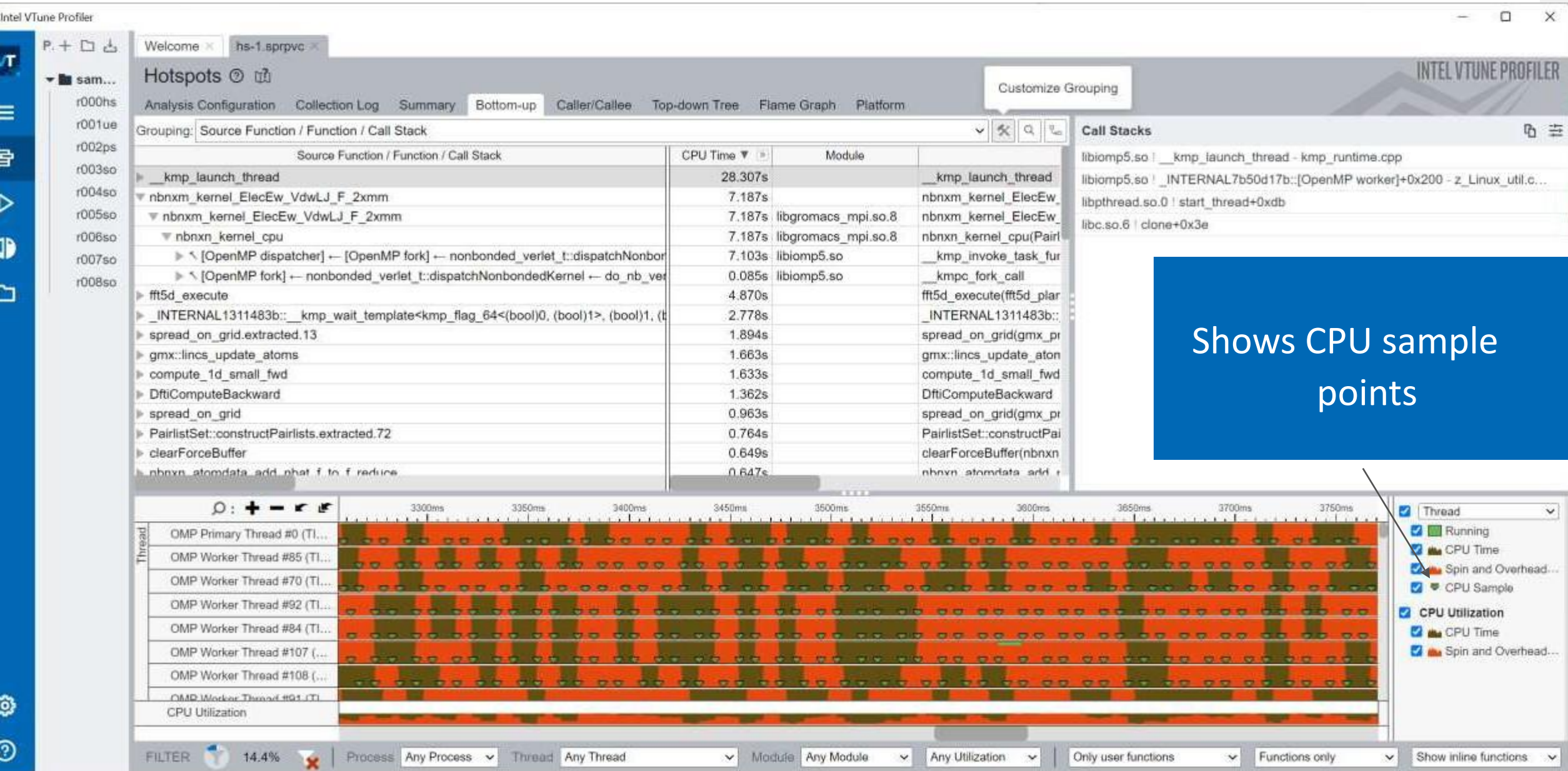


Note! This uses
switched off pinning
just to show VTune
features!

Low core utilization
OpenMP imbalance

```
$ export I_MPI_GTOOL="aps -r result :all"
```



More Resources

Intel® VTune™ Profiler – Performance Profiler

- [Product page](#) – overview, features, FAQs...
- Training materials – [Cookbooks](#), [User Guide](#), [Processor Tuning Guides](#)
- [Support Forum](#)
- [Online Service Center](#) - Secure Priority Support
- [What's New?](#)

Additional Analysis Tools

- [Intel® Advisor](#) – Design code for efficient vectorization, threading, memory usage, and accelerator offload
- [Intel® Inspector](#) – memory and thread checker/ debugger
- [Intel® Trace Analyzer and Collector](#) - MPI Analyzer and Profiler

Additional Development Products

- [oneAPI: A new era of heterogenous computing](#)



Summary

- Hotspots is the most common analysis after APS
- After Summary you may try bottom up
- Check out grouping and filtering features
- Many tutorials + YouTube videos available

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