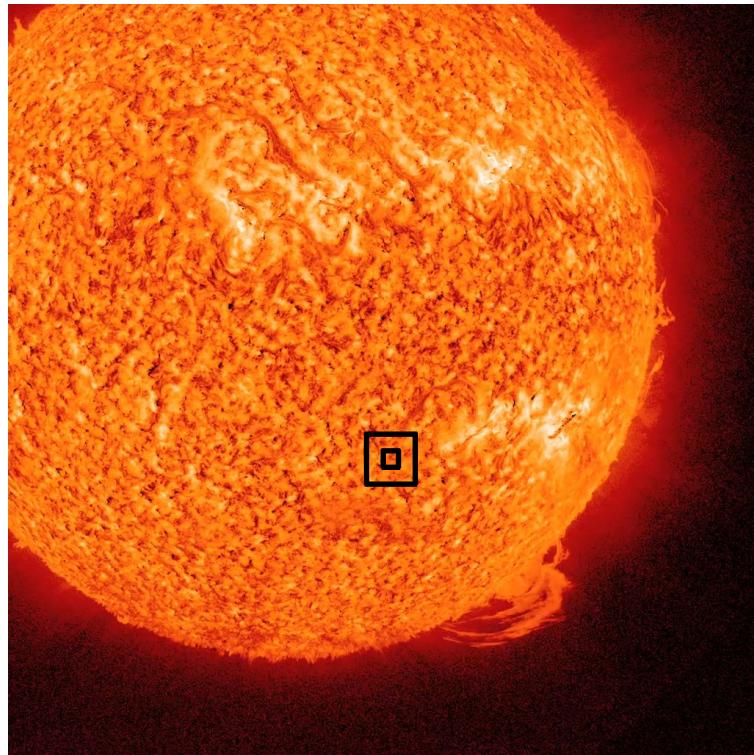


Roseland
Centre
for Solar
Physics

Nvidia Hackathon

Bifrost Vikings
Roseland Centre for Solar Physics, Univ Oslo
Lugano, Switzerland

Active regions!

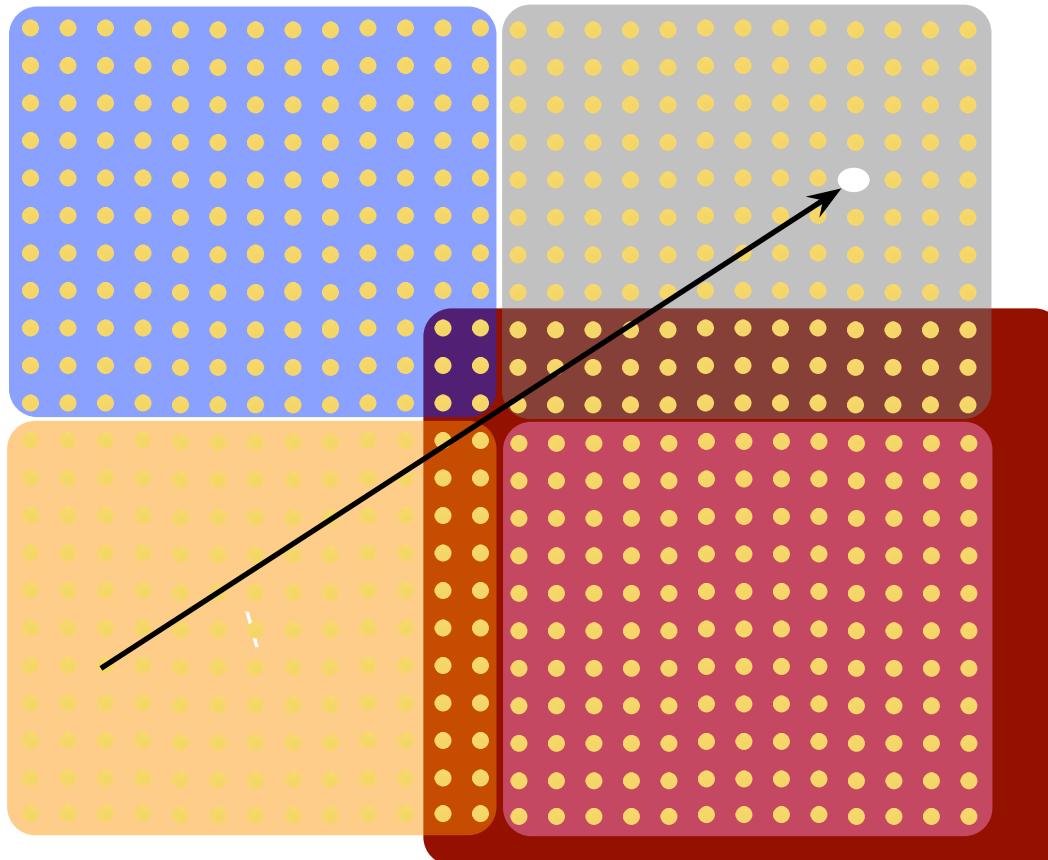


Bifrost

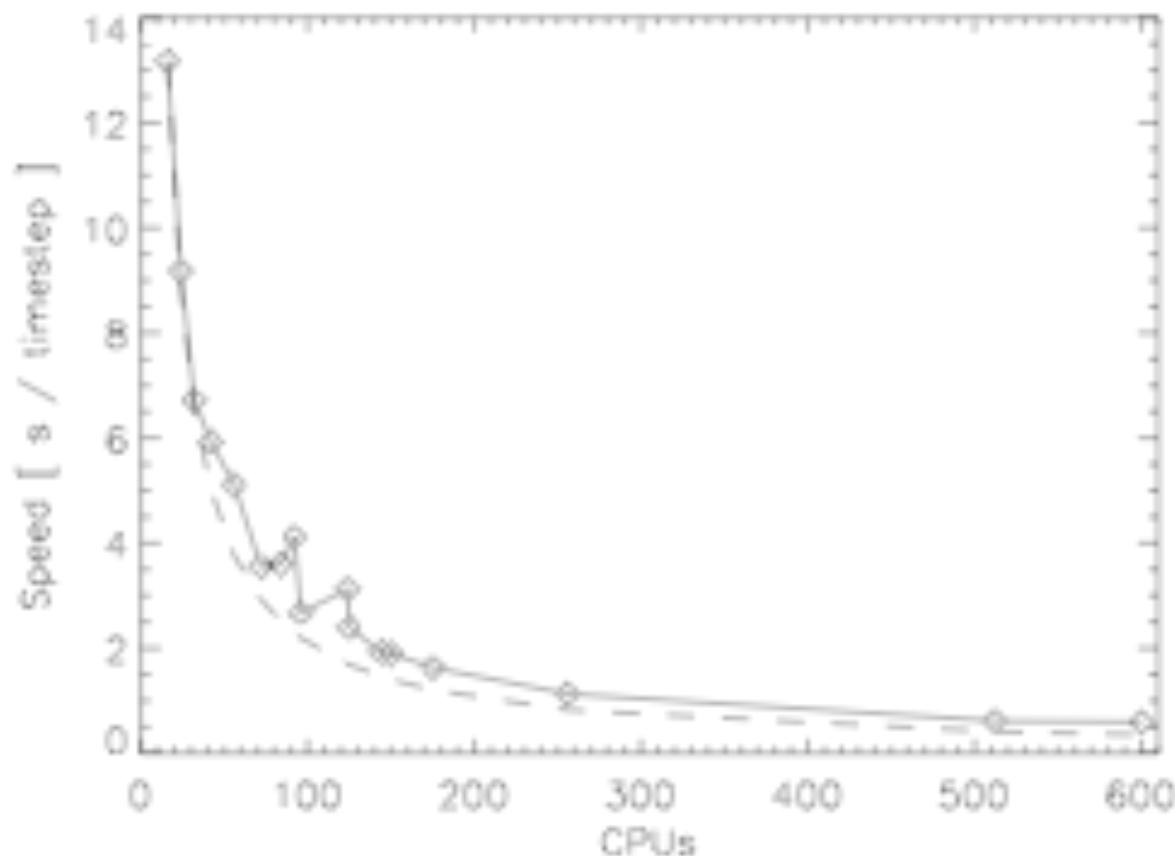
code specifics

- 3D radiative magneto hydro dynamics
- 6th/5th order explicit code
 - Staggered grid
- 3rd order timestepping
- Radiative short characteristics scheme
- Large number of gridpoints
- Large number of timesteps

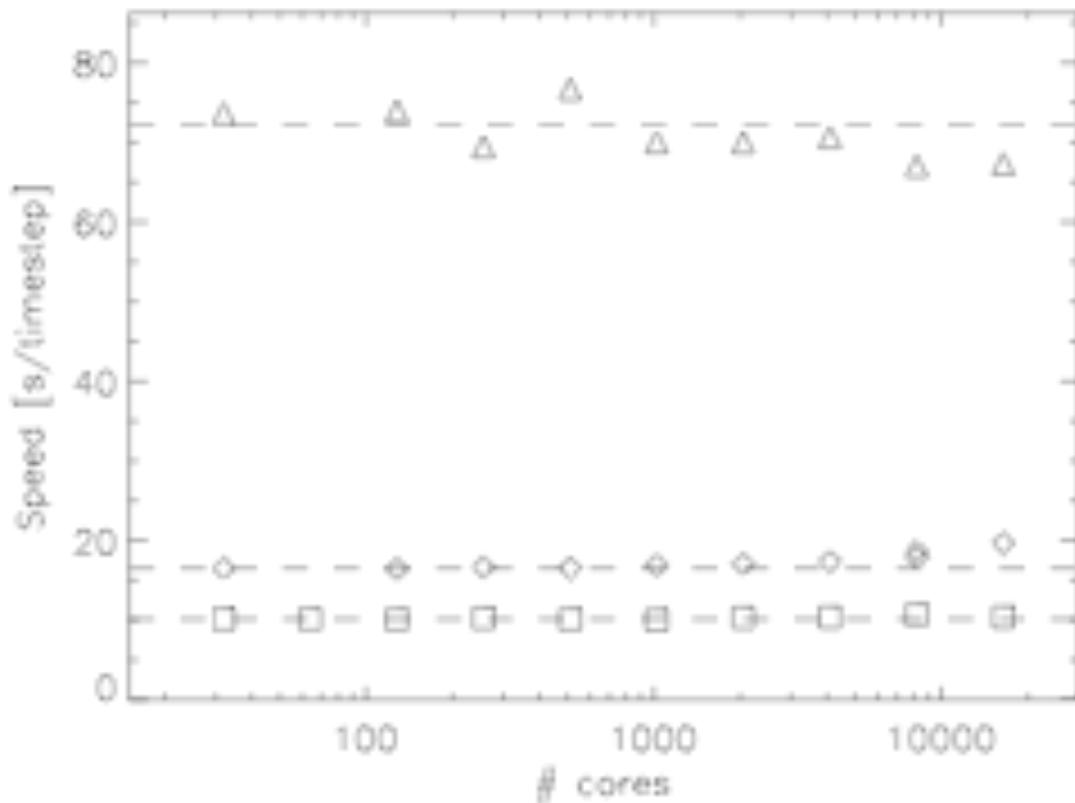
Parallelization



Strong scaling



Weak scaling

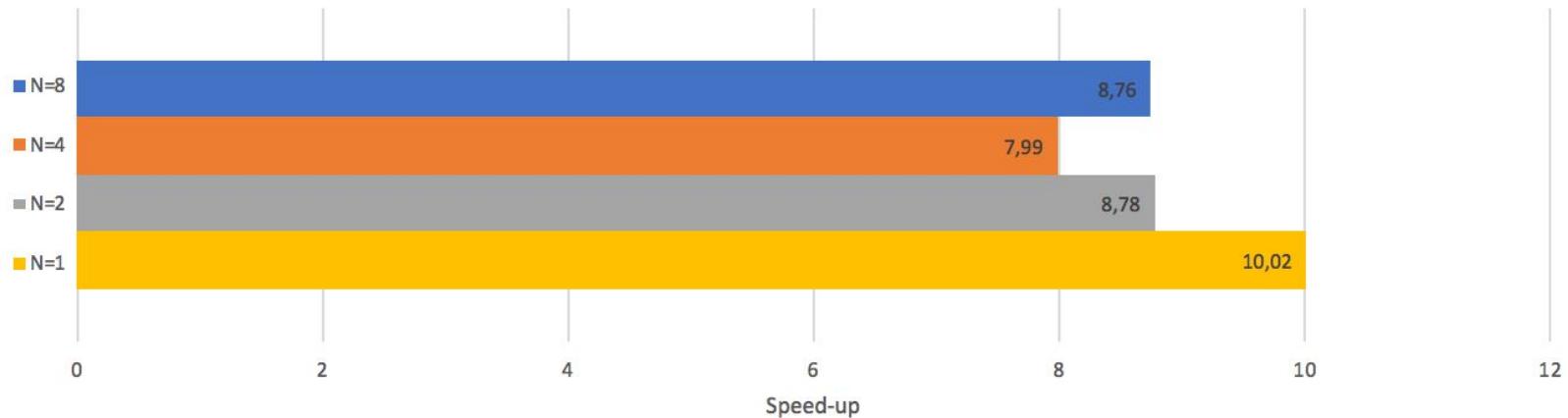


Memory

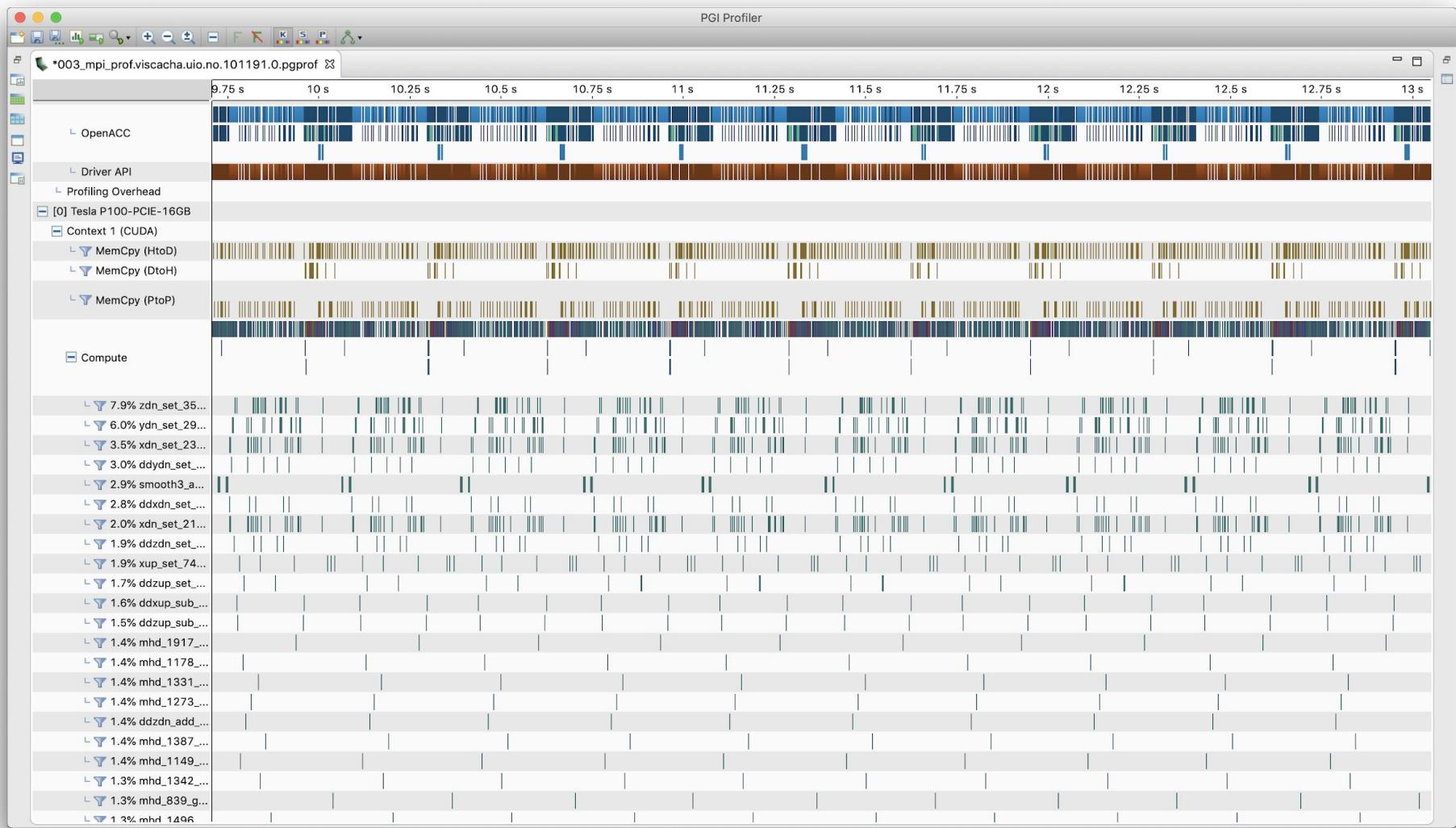
- at 50^3 , needs roughly 700 MB/thread
 - Strongly depends on added modules
 - Radiation takes up large amounts of memory
- Some reduction is possible (footprint vs speed)

Speed-up

Speedup / Best GPU setup vs. Best CPU setup / Case: N * 256³



Profiling



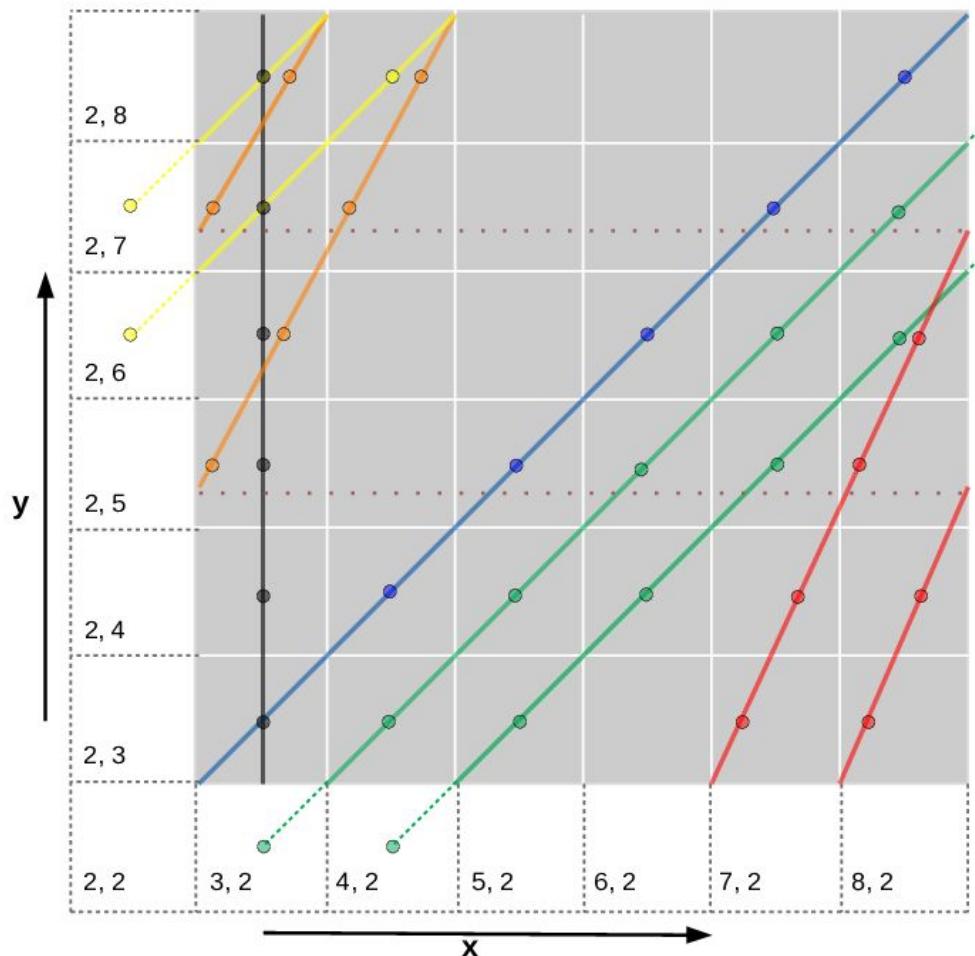
Improvements

- 15% speed up of the code after removing some memory communication (CPU-GPU) overhead
- Radiative transfer
 - Debugging the code
 - Prototyping **OptiX**

OptiX™

- Ray tracing engine
- Optimized for current and future generations of NVIDIA GPU architectures
- Simple kernel implementations
- Although designed for rendering, the problem potentially can be inverted and used for radiative heat transfer

Radiative transfer with OptiX



```
[OptiX][id = 0] :: grid point hit [no: 52] :: 2.000000 5.000000 0.000000
[OptiX][id = 0] :: closest array point hit :: 2 5 0
[OptiX][id = 0] :: .... scalar field value :: 7.000000
[OptiX][f(x)] :: length_to_center :: 29.000000
[OptiX][id = 0] :: grid point hit [no: 53] :: 3.000000 5.000000 0.000000
[OptiX][id = 0] :: closest array point hit :: 3 5 0
[OptiX][id = 0] :: .... scalar field value :: 8.000000
[OptiX][f(x)] :: length_to_center :: 34.000000
[OptiX][id = 0] :: grid point hit [no: 63] :: 3.000000 6.000000 0.000000
[OptiX][id = 0] :: closest array point hit :: 3 6 0
[OptiX][id = 0] :: .... scalar field value :: 9.000000
[OptiX][f(x)] :: length_to_center :: 45.000000
[OptiX][id = 0] :: grid point hit [no: 73] :: 3.000000 7.000000 0.000000
[OptiX][id = 0] :: closest array point hit :: 3 7 0
[OptiX][id = 0] :: .... scalar field value :: 10.000000
[OptiX][f(x)] :: length_to_center :: 58.000000
[OptiX][id = 0] :: grid point hit [no: 74] :: 4.000000 7.000000 0.000000
[OptiX][id = 0] :: closest array point hit :: 4 7 0
[OptiX][id = 0] :: .... scalar field value :: 11.000000
[OptiX][f(x)] :: length_to_center :: 65.000000
[OptiX][id = 0] :: grid point hit [no: 84] :: 4.000000 8.000000 0.000000
[OptiX][id = 0] :: closest array point hit :: 4 8 0
[OptiX][id = 0] :: .... scalar field value :: 12.000000
[OptiX][f(x)] :: length_to_center :: 80.000000
[OptiX][id = 0] :: grid point hit [no: 94] :: 4.000000 9.000000 0.000000
[OptiX][id = 0] :: closest array point hit :: 4 9 0
[OptiX][id = 0] :: .... scalar field value :: 13.000000
[OptiX][f(x)] :: length_to_center :: 97.000000
[OptiX][id = 0] :: grid point hit [no: 95] :: 5.000000 9.000000 0.000000
[OptiX][id = 0] :: closest array point hit :: 5 9 0
[OptiX][id = 0] :: .... scalar field value :: 14.000000
[OptiX][f(x)] :: length_to_center :: 106.000000

:: Print integrated values ...
0 -> 15
./points.x 0.62s user 2.64s system 90% cpu 3.616 total
(OpenACC)%
/mn/stornext/d9/mikolajs/Bifrost/EXTERNAL/OptiX_radiation
```