Ramses Team

Members
Romain Teyssier (PU astro & PACM)
Jonathan Palafoutas (PU PACM)
Robel Geda (PU astro)
James Sunseri (PU astro)
Rayan Ait Ekioui (PU astro)
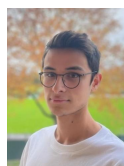Takanori Akieda-Codron (PU astro)

Mentors
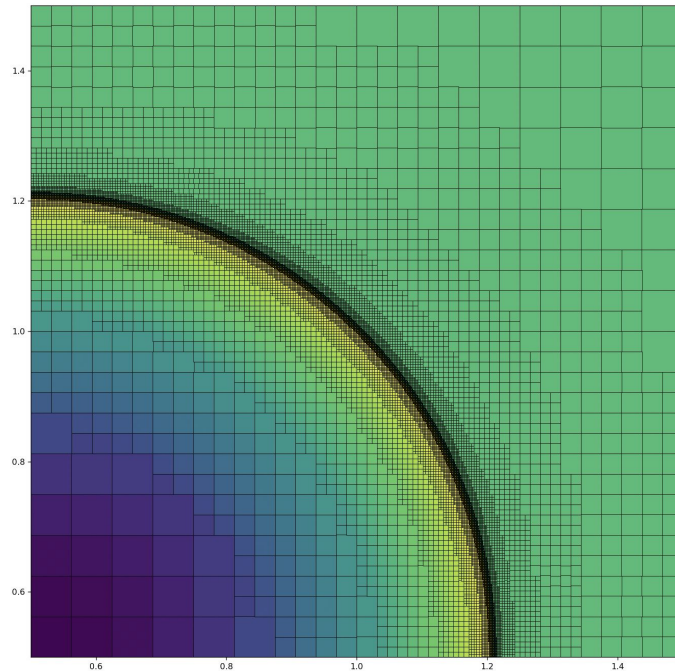Matt Coleman
(PU Research Computing)
Brent Leback (Nvidia)

RAMSES (mini-ramses)

Adaptive Mesh Refinement for radiative MHD with self-gravity and PIC for astrophysical fluid flows

- PDE solvers using cell-by-cell adaptive grids
- MPI
- Modern Fortran
- Godunov Finite Volume Scheme
- Nvidia Fortran (CUDA)

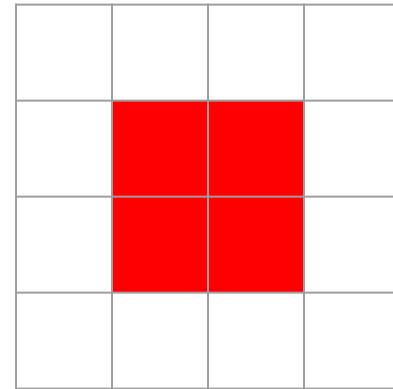https://bitbucket.org/rteyssie/mini-ramses/src/develop/

Goals

- First version written by Bob Caddy for a unigrid on a single GPU
- Extend to unigrid with multiple GPUs
- Profile the resulting code with Nsight Systems and Nsight Compute
- Optimize data transfer exploiting concurrency
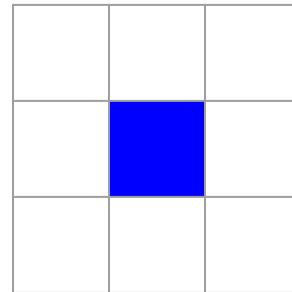- Explore next steps: AMR with multiple GPUs

Comparing kernel size, compute time, and memory

$$\frac{\text{\# updates}}{\text{\# kernel elements}} = \frac{\color{red}{2\times2\times2}}{4\times4\times4} = \frac{1}{8}$$
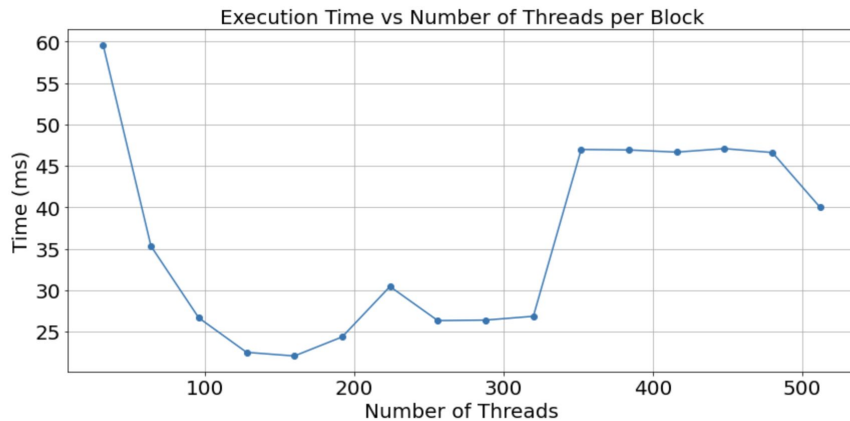
(ncentral=2)

$$= \frac{\color{blue}{1}}{3\times3\times3} = \frac{1}{27}$$

(ncentral=1)

Execution Time vs Number of Threads per Block

(ncentral=2)

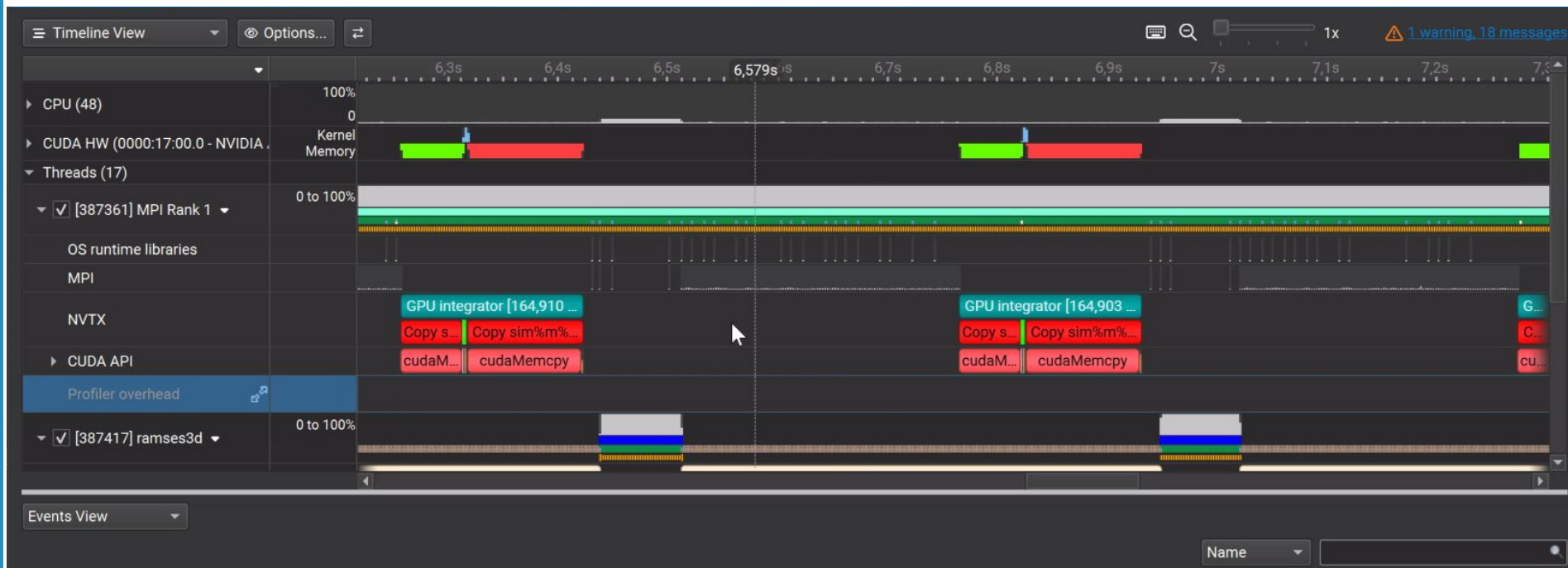

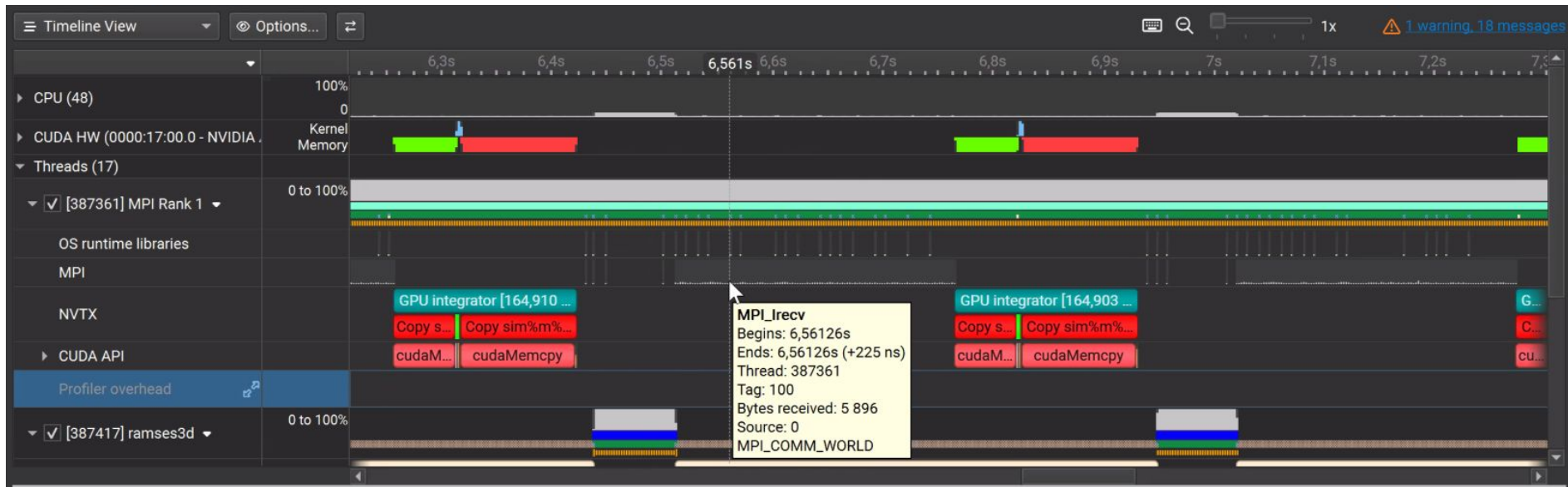Kernel execution Time vs Number of Threads per Block
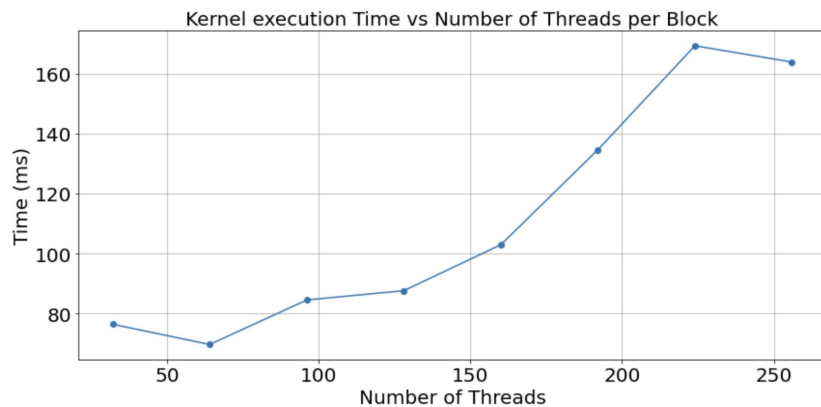
(ncentral=1)

$$\frac{\text{old exec time}}{\text{new exec time}} = 3.2 \approx 27/8$$

Memory

- Shared memory per block for ncentral=1:   **12 KB**
- Shared memory per block for ncentral=2:   **40 KB**
- Shared memory per block for ncentral=4: **200 KB** ⚠️

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