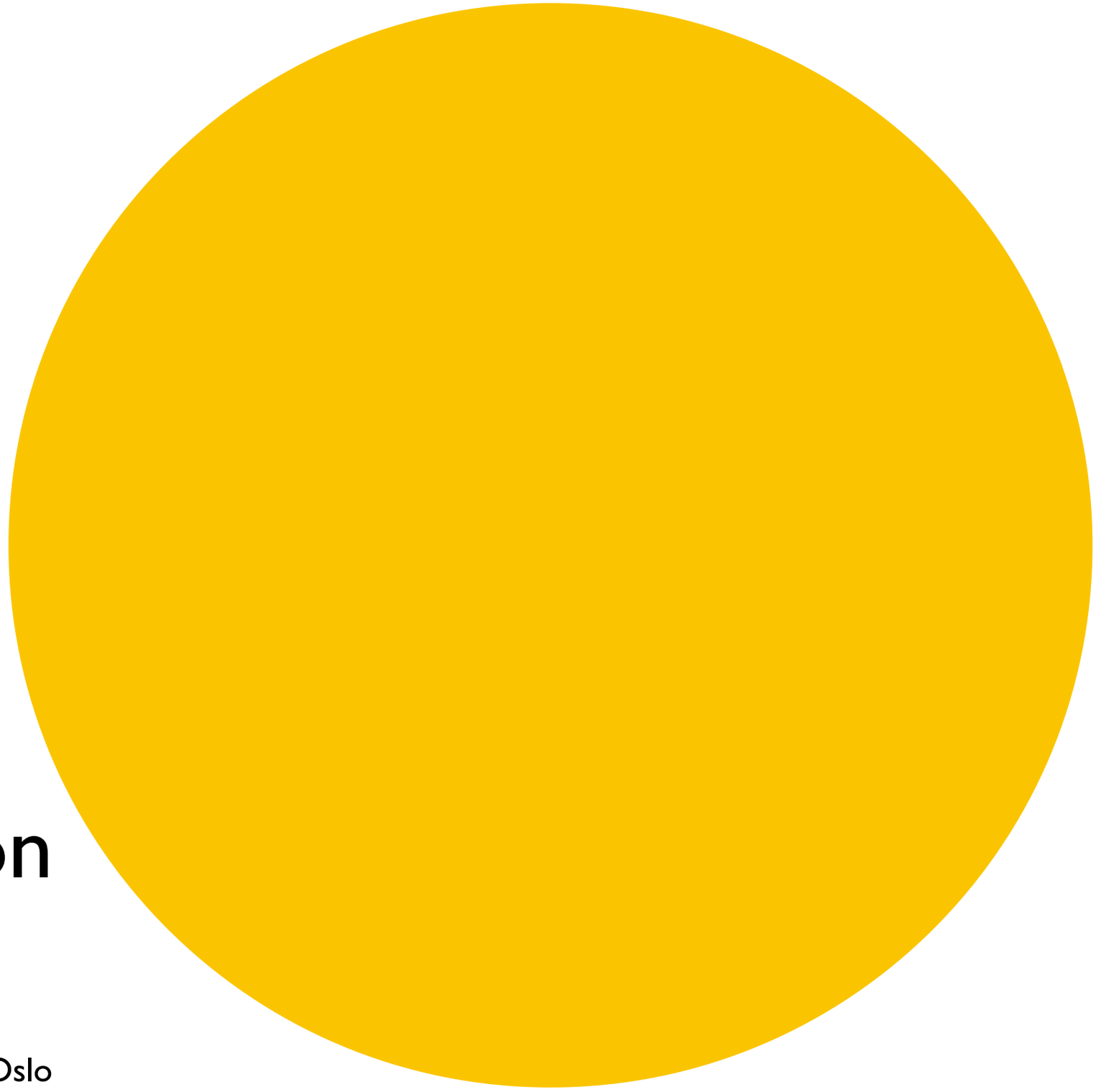
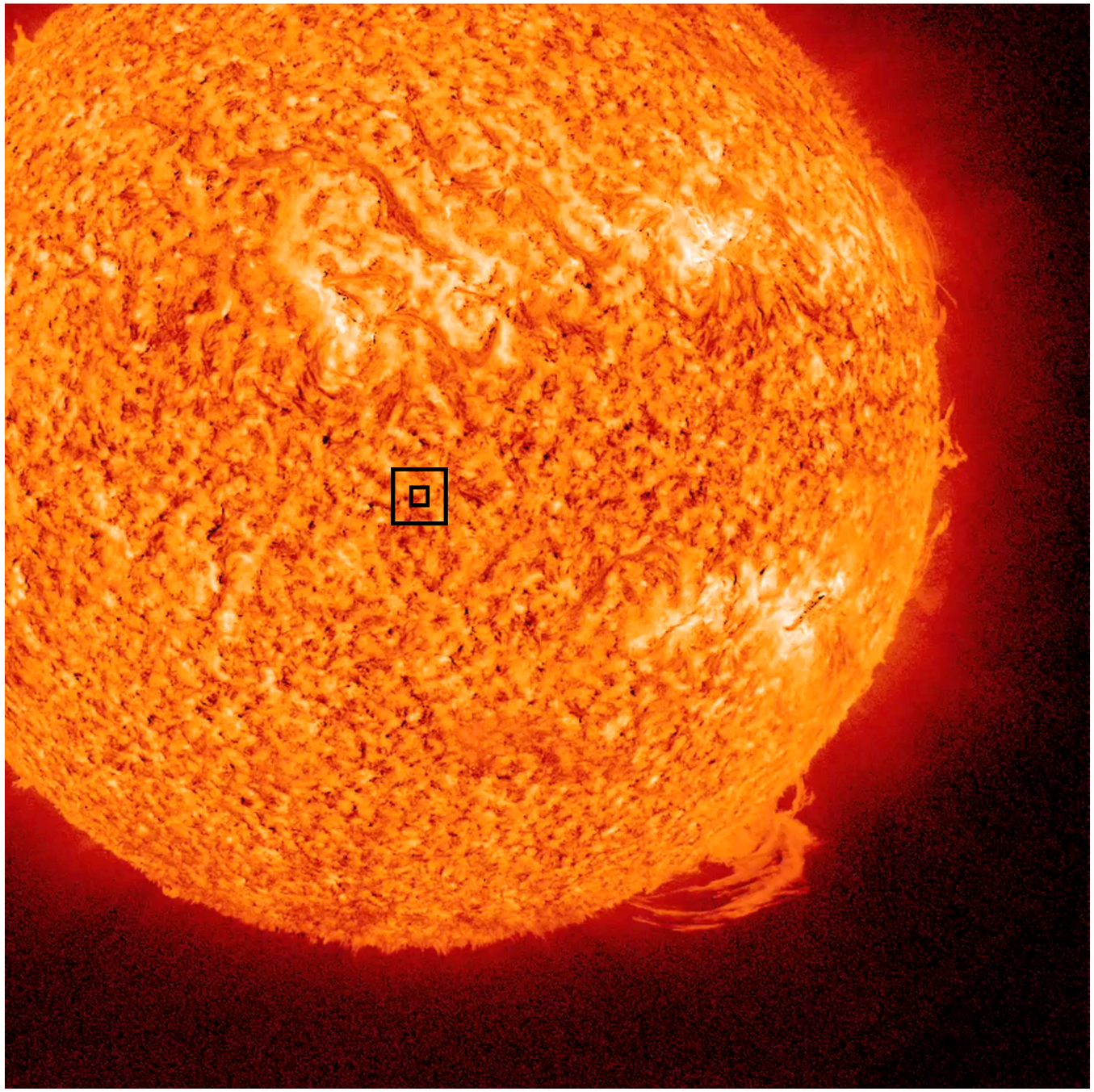
Rosseland Centre for Solar Physics



Nvidia Hackathon

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

Active regions!



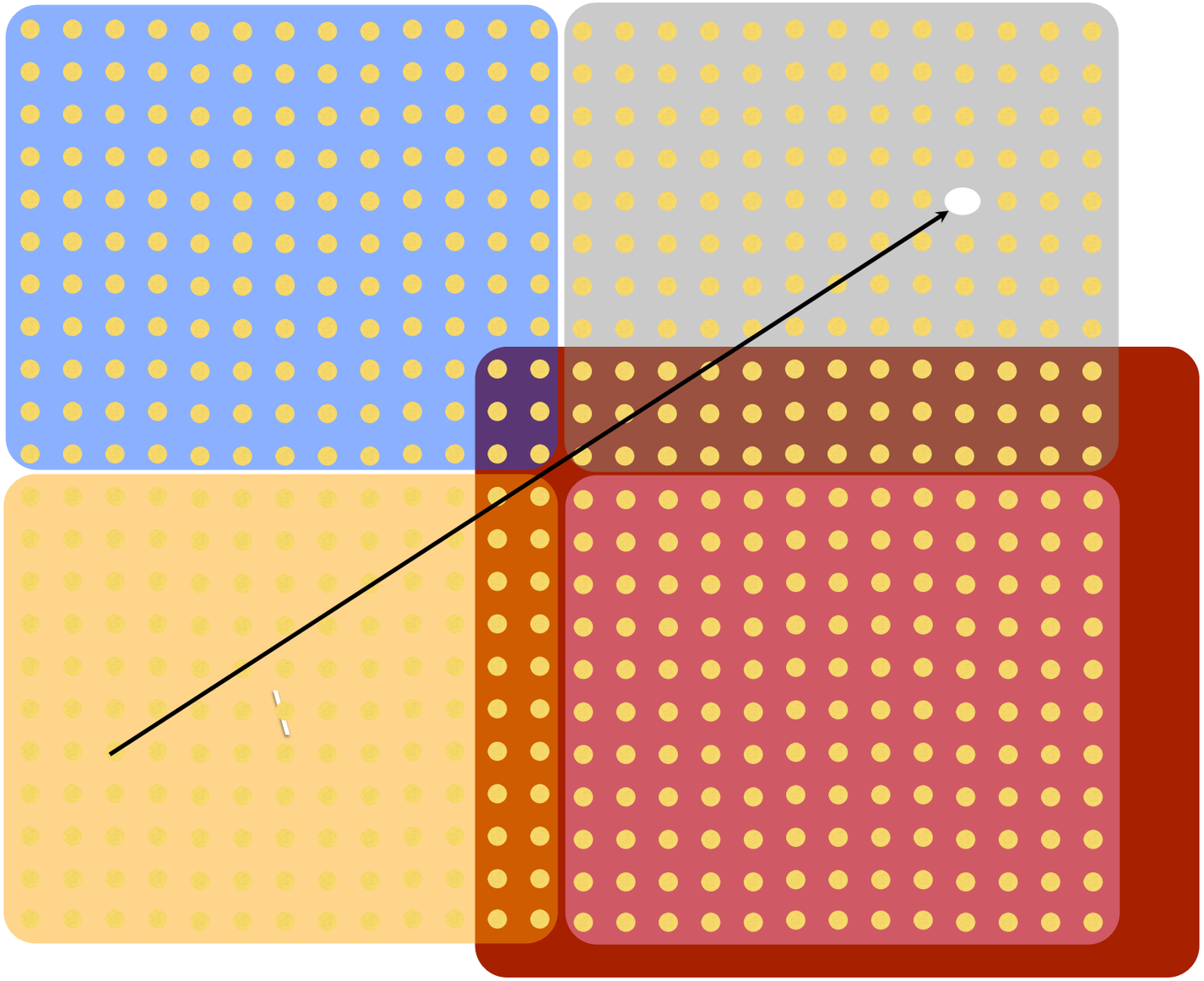
Bifrost
code specifics

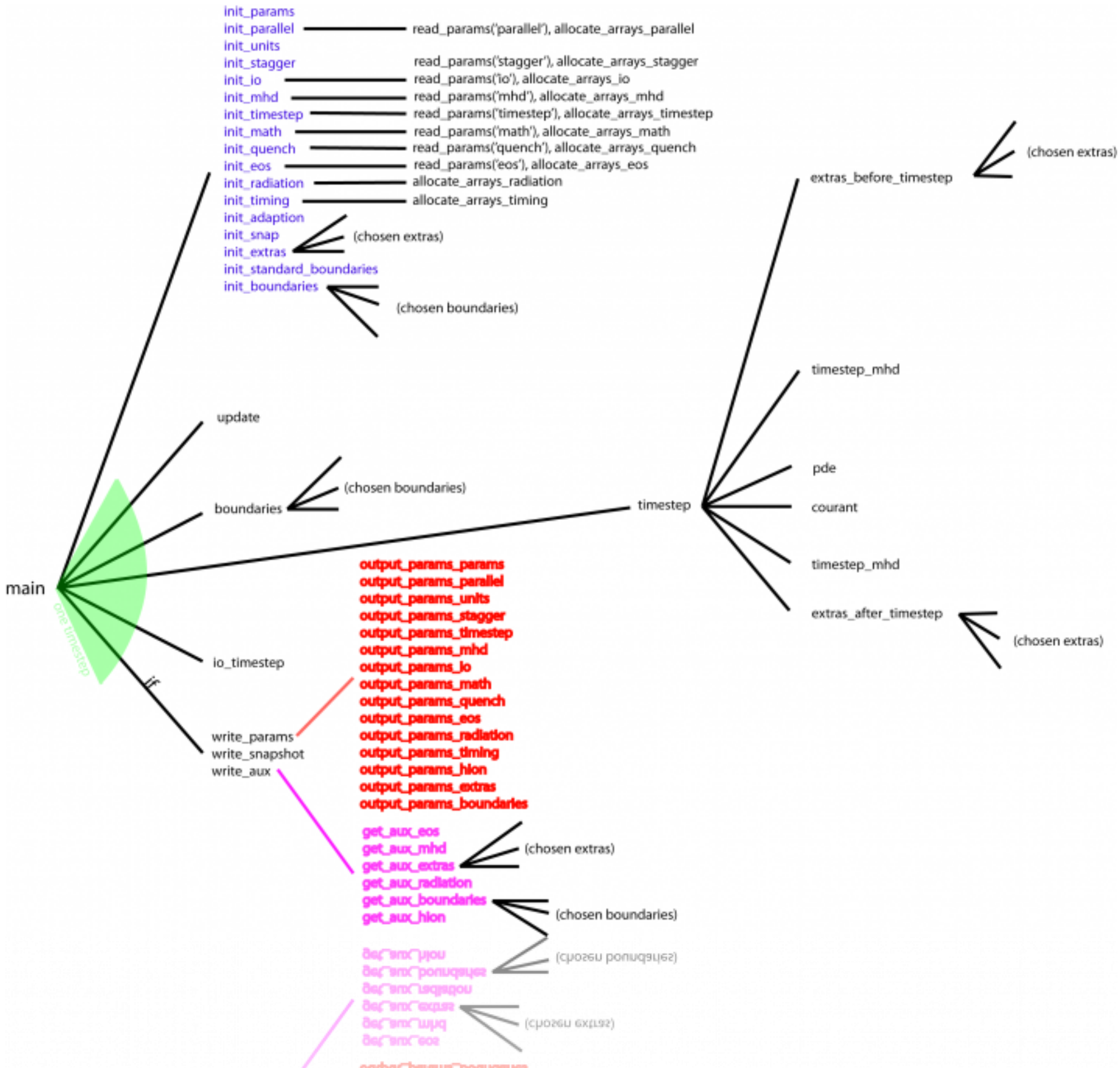
- 3D radiative magneto hydro dynamics
- 6th/5th order explicit code
  - Staggered grid
  - 3rd order timestepping
  - Radiative short characteristics scheme
  - Large number of gridpoints
  - Large number of timesteps

Structure

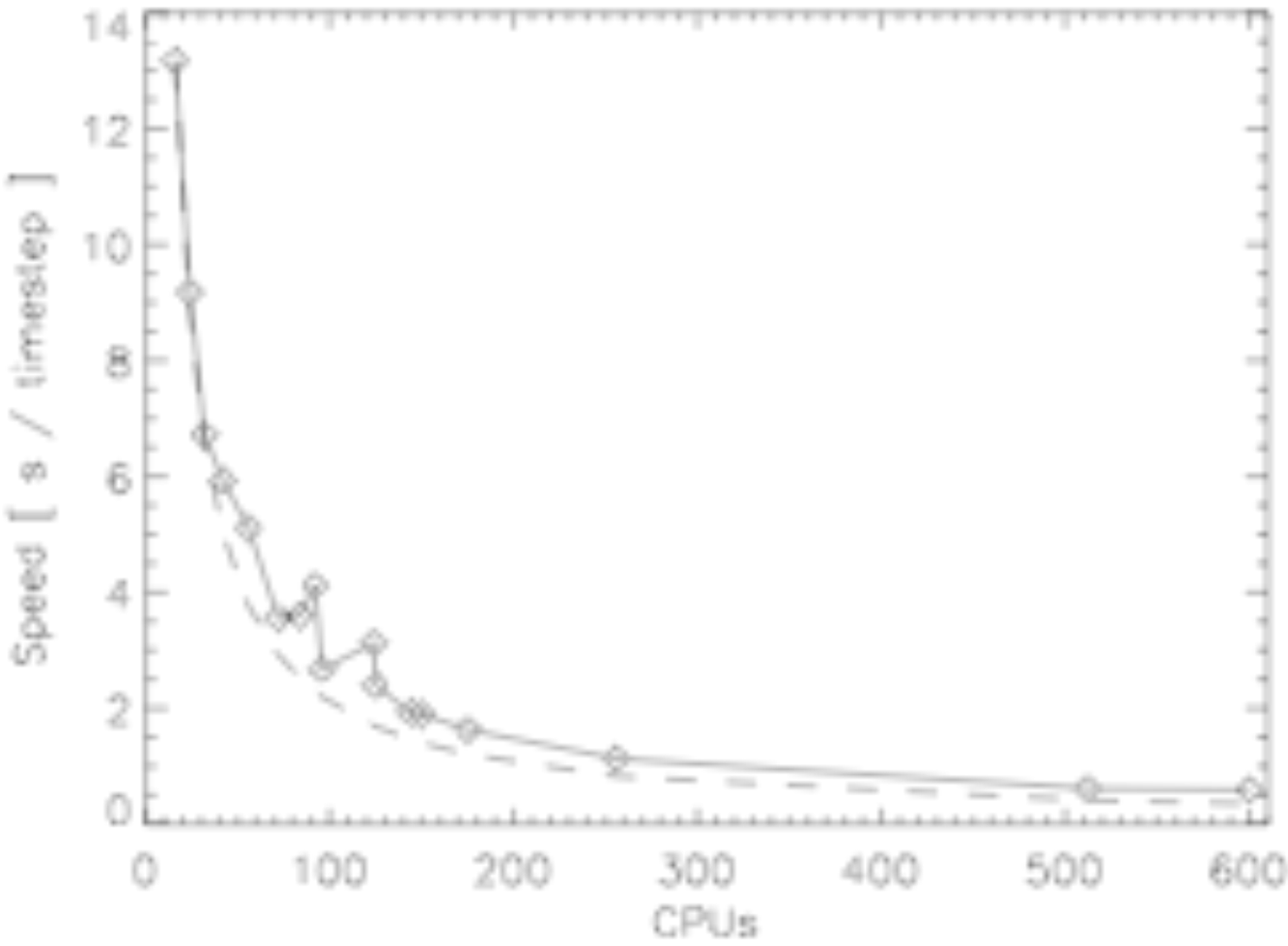
- Initialisation including input
- Modular
  - I/O
  - One main module
  - none to several extensions

Parallelization

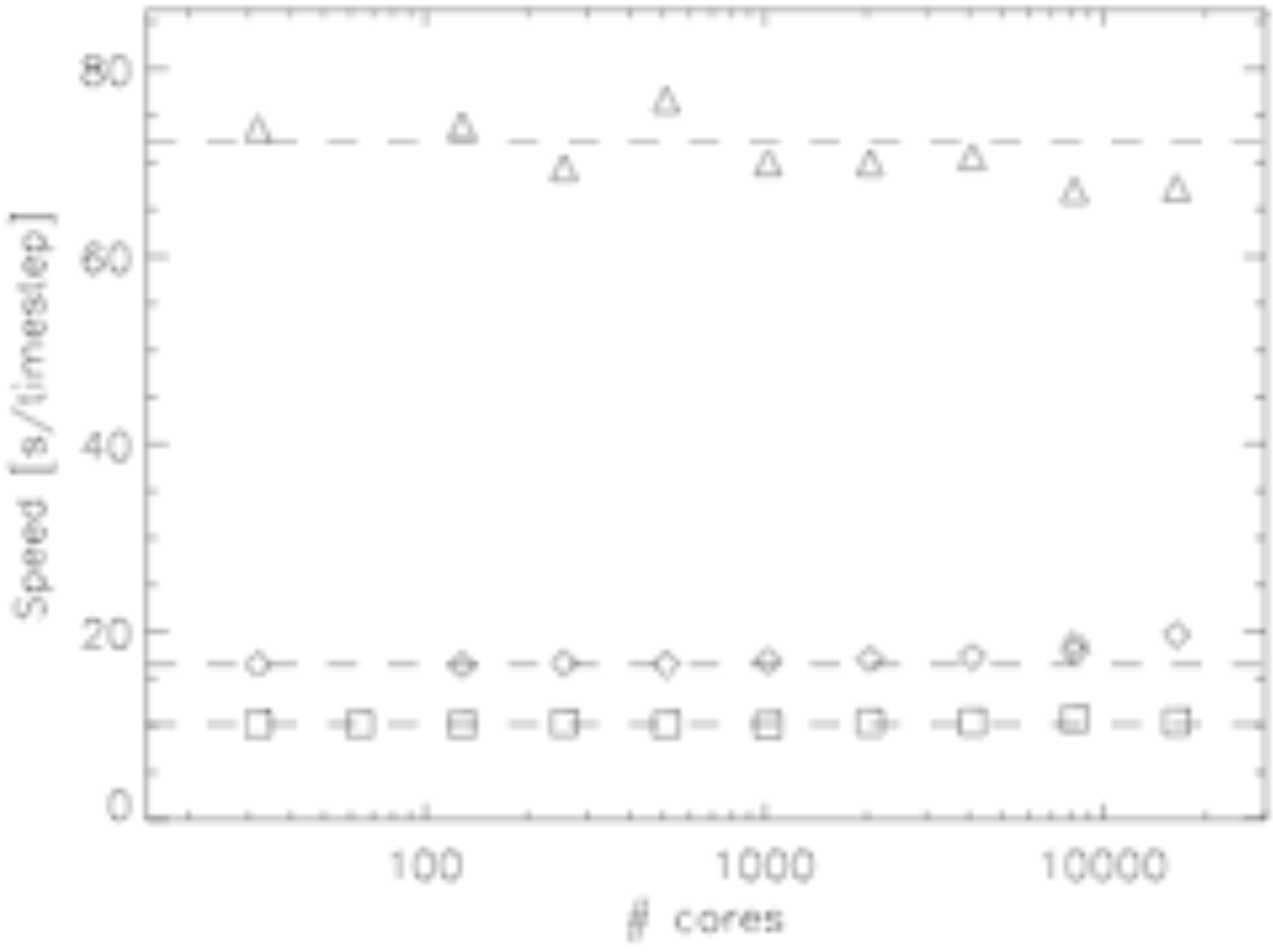



init_params
init_parallel
read_params('parallel'), allocate_arrays_parallel
init_units
init_stagger
read_params('stagger'), allocate_arrays_stagger
init_io
read_params('io'), allocate_arrays_io
init_mhd
read_params('mhd'), allocate_arrays_mhd
init_timestep
read_params('timestep'), allocate_arrays_timestep
init_math
read_params('math'), allocate_arrays_math
init_quench
read_params('quench'), allocate_arrays_quench
init_eos
read_params('eos'), allocate_arrays_eos
init_radiation
allocate_arrays_radiation
init_timing
allocate_arrays_timing
init_adaption
init_snap
(chosen extras)
init_extras
init_standard_boundaries
init_boundaries
(chosen boundaries)
extras_before_timestep
(chosen extras)
timestep_mhd
update
boundaries
(chosen boundaries)
pde
timestep
courant
timestep_mhd
main
extras_after_timestep
(chosen extras)
one timestep
io_timestep
if
output_params_params
output_params_parallel
output_params_units
output_params_stagger
output_params_timestep
output_params_mhd
output_params_io
output_params_math
output_params_quench
output_params_eos
output_params_radiation
output_params_timing
output_params_hion
output_params_extras
output_params_boundaries
write_params
write_snapshot
write_aux
get_aux_eos
get_aux_mhd
get_aux_extras
(chosen extras)
get_aux_radiation
get_aux_boundaries
get_aux_hion
(chosen boundaries)

Strong scaling



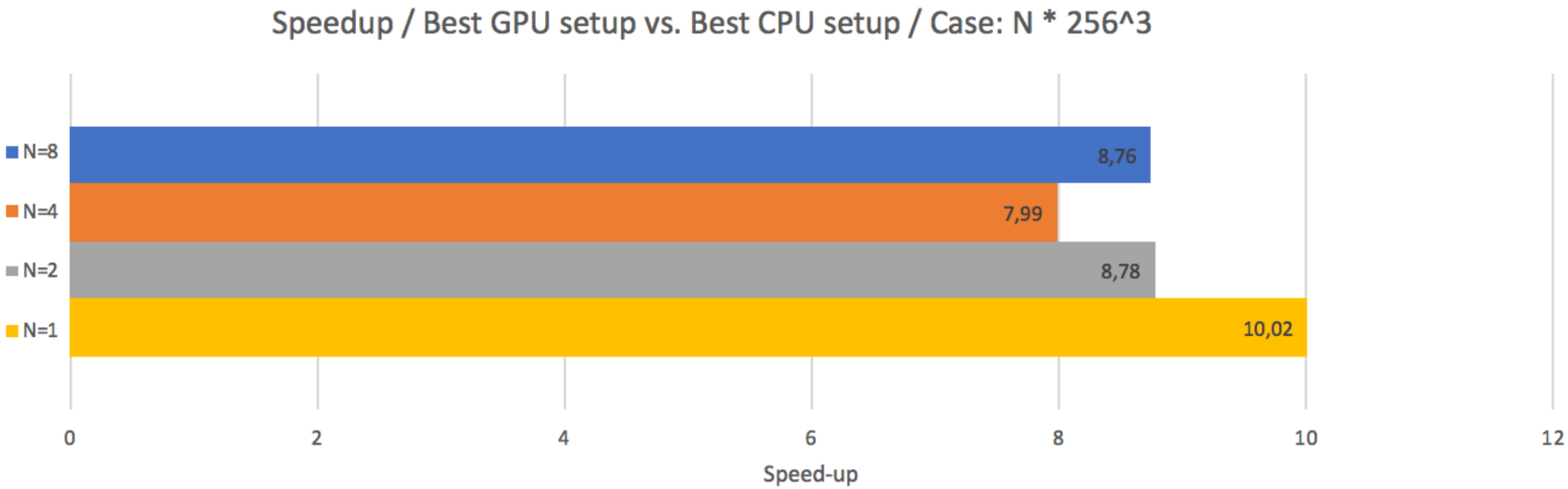
Weak scaling



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 * 256^3
N=8
N=4
N=2
N=1
8,76
7,99
8,78
10,02
0
2
4
6
8
10
12
Speed-up

Speed improvements

- Already included OpenACC directives in main code
- Radiative transfer
  - Change method?
  - Split Radiation/MHD to CPU/GPU
- Memory footprint