OAK RIDGE National Laboratory

Celeritas physics interface

Seth R Johnson

ORNL is managed by UT–Battelle, LLC for the US Department of Energy

U.S. DEPARTMENT OF ENERGY

Celeritas core team:

Philippe Canal, Stefano Tognini, Tom Evans, Soon Yun Jun, Guilherme Lima, Amanda Lund, Vincent Pascuzzi, Paul Romano

HSF Detector Simulation on GPU Community Meeting
May 3–6, 2022

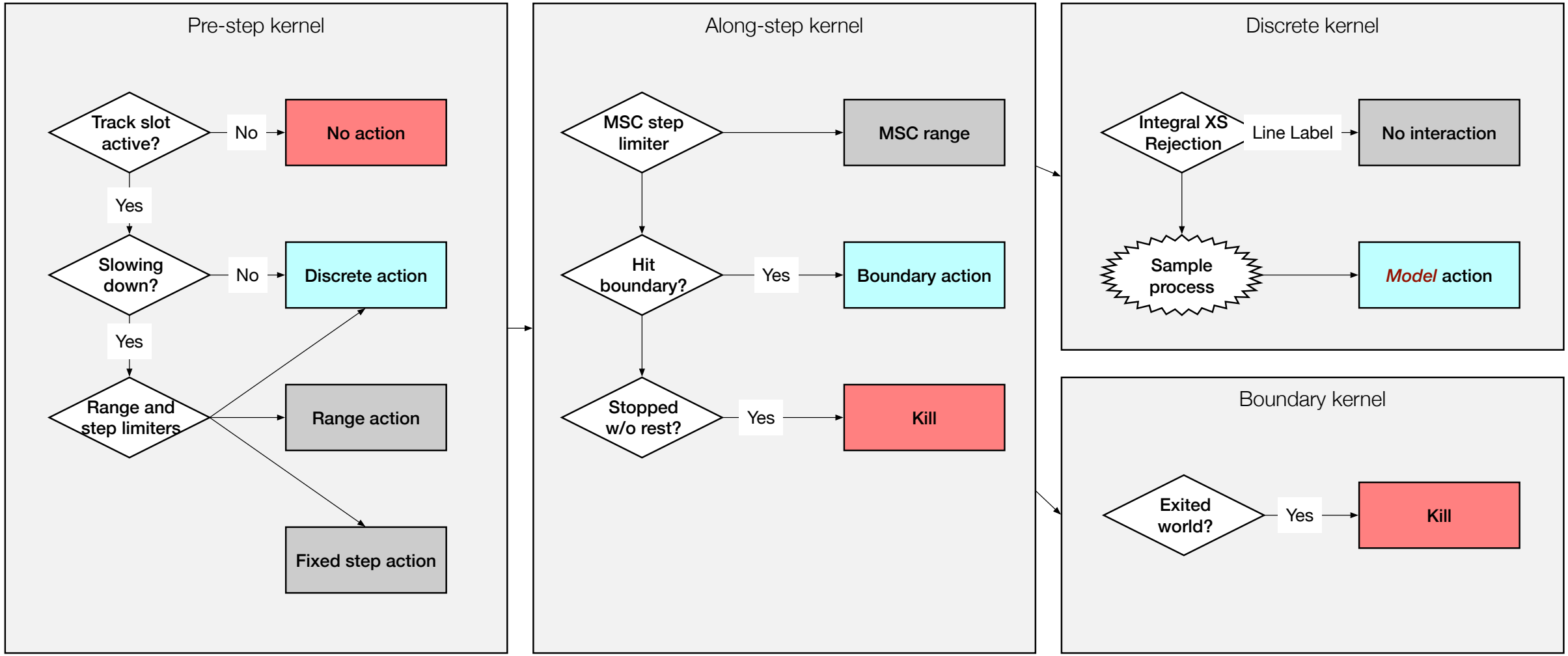
Transport loop

```
extend_from_primaries          ▷ Copy primaries to device, create track initializers
while Tracks are alive do
    initialize_tracks          ▷ Create new tracks in empty slots
    pre_step                   ▷ Sample mean free path, calculate step limits
    along_step                 ▷ Propagation, slowing down
    boundary                   ▷ Cross a geometry boundary
    discrete_select            ▷ Discrete model selection
    launch_models              ▷ Launch interaction kernels for applicable models
    extend_from_secondaries    ▷ Create track initializers from secondaries
end while
```

Control flow with “actions”

- Action interface: pure abstract C++ class
  - Explicit action: virtual function given problem data to launch kernel
  - Implicit action: no kernel launch but useful for diagnostics
- Event loop is a loop over explicit actions
- Setup-time user configuration based on physics, field, output…
- Some day: model action dependencies as DAG to eliminate user errors and possible CUDA graph acceleration

Kernels and actions



Interaction kernels

- "Dolt" method of discrete model
- Interactor is a "distribution"-like object
  - Input: starting particle state
  - Output: sampled secondaries, new direction, state
- Templated launcher adapts Interactor to higher-level code