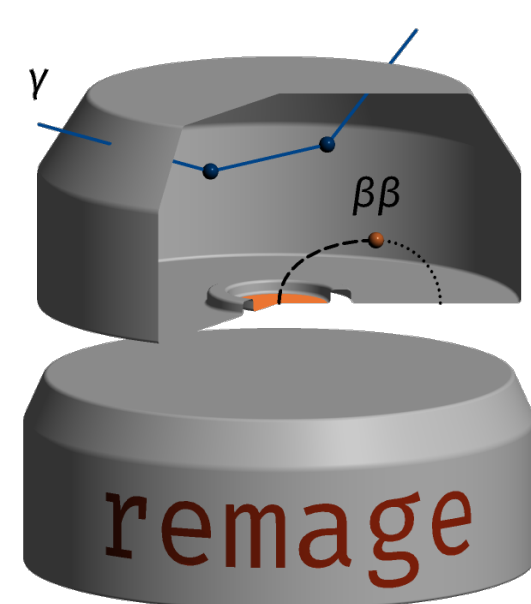




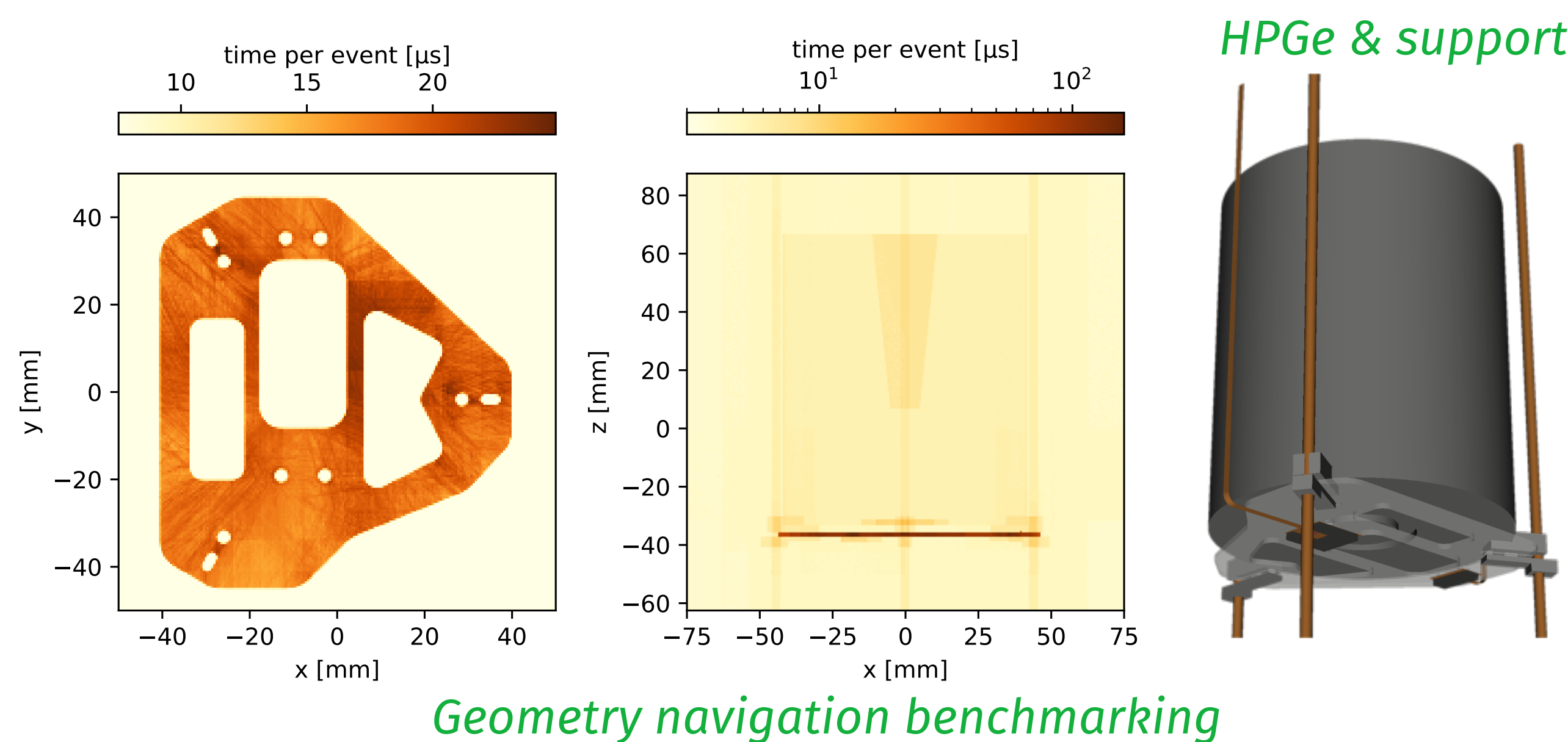
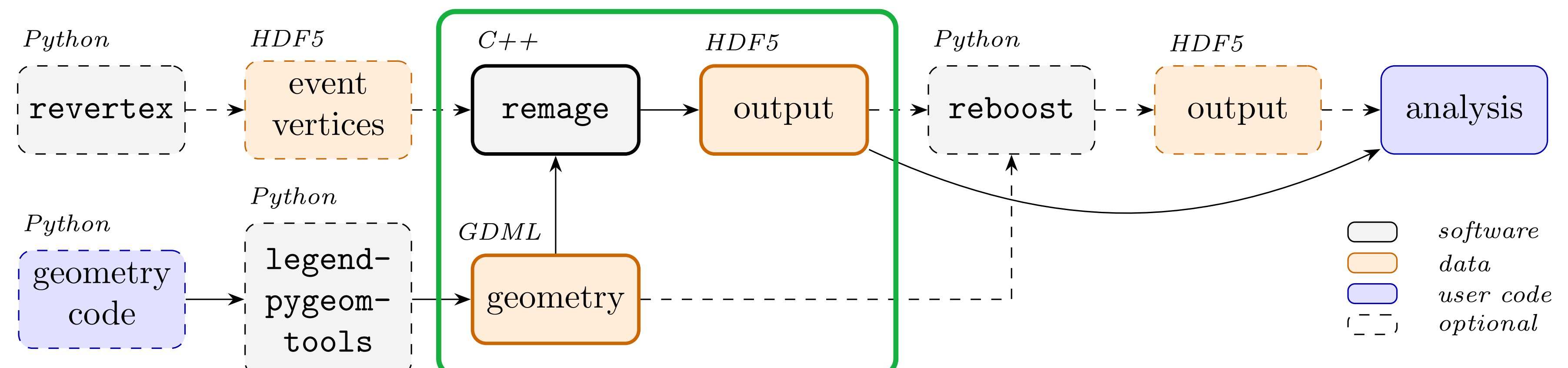
remage — a Geant4-based simulation framework for low-background experiments

L. Pertoldi [TUM] <luigi.pertoldi@tum.de>, T. Dixon, E. Esch, R. Henning, M. Huber, M. Neuberger, Z. Wang, V. Biancacci, S. Calgari, G. Marshall
LRT2026, York • 20 Sept 2026

→ <https://remage.readthedocs.io>

Modular design

- Composability and maintenance
- Well defined interfaces
- (Optional) components can be swapped

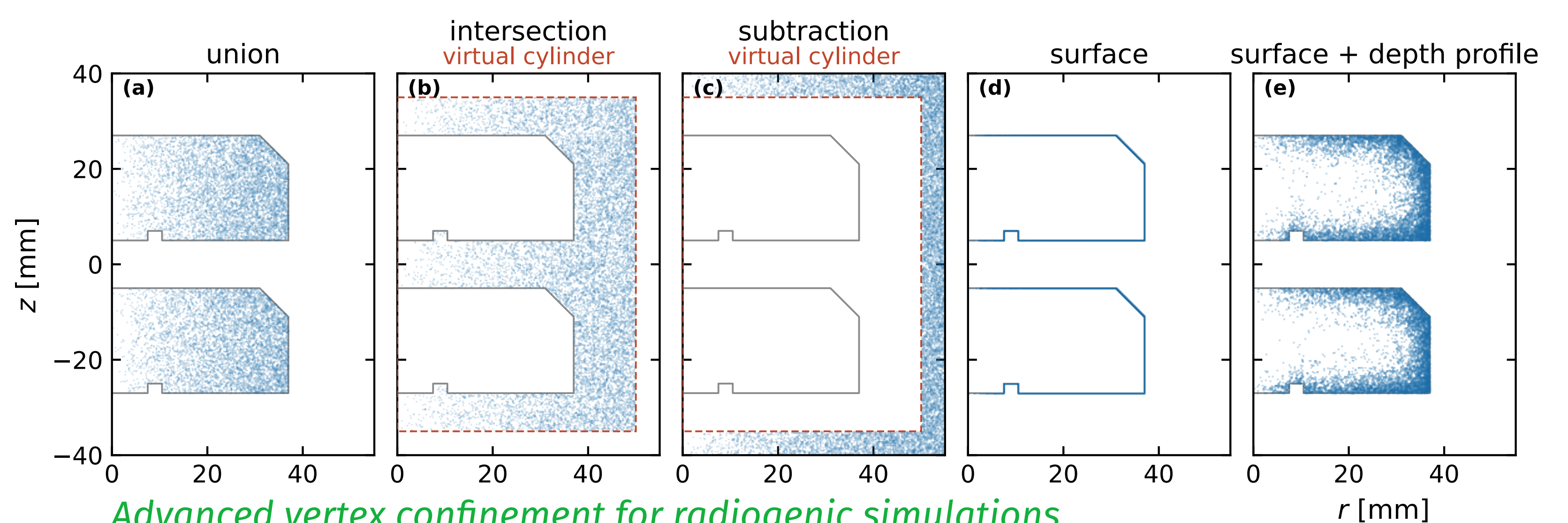


Low-background physics list & event generators

- Radiogenic and cosmogenic physics
- Efficient "conditional tracking" techniques

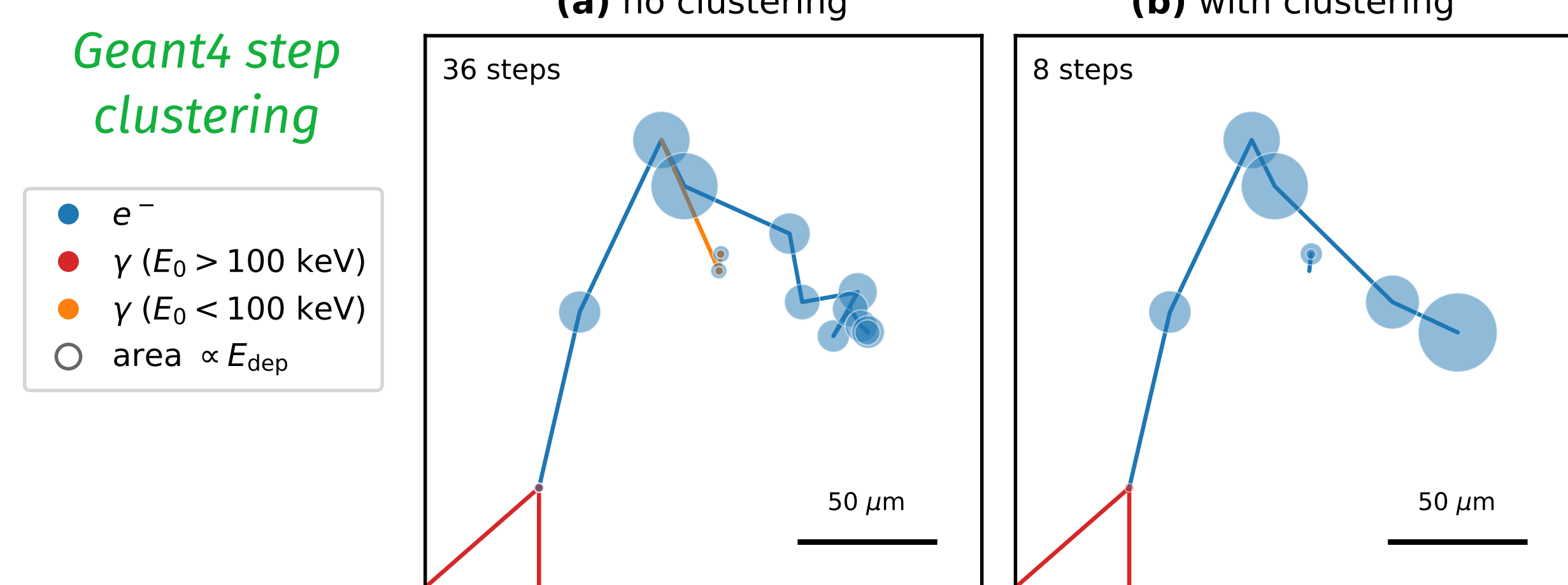
Decoupling between geometry and tracking (Geant4)

- Avoid C++ / compilation, can use pyg4ometry
- Easier to learn, develop & maintain
- Geometry benchmarking tools



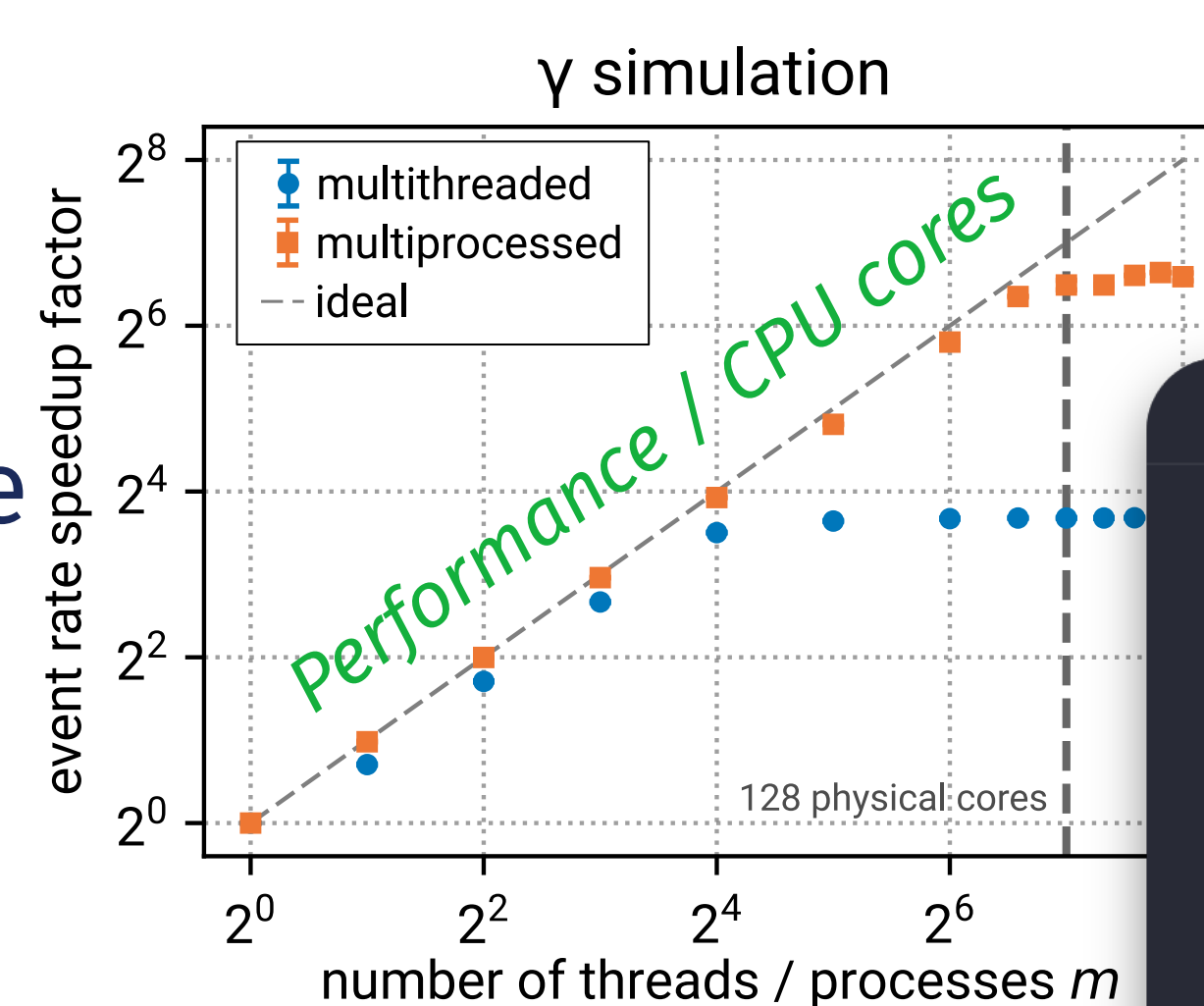
HDF5 optimized output

- Language/toolkit agnostic, Python and Julia tools ready
- Schemes for common detector types (solid-state, optical)
- Step clustering for simulation performance (I/O)



Modern software development practices

- No compilation required: containers & conda-forge
- Extensive online documentation
- Continuous validation and deployment (CI/CD)
- Scales well with computing resources (HPC)



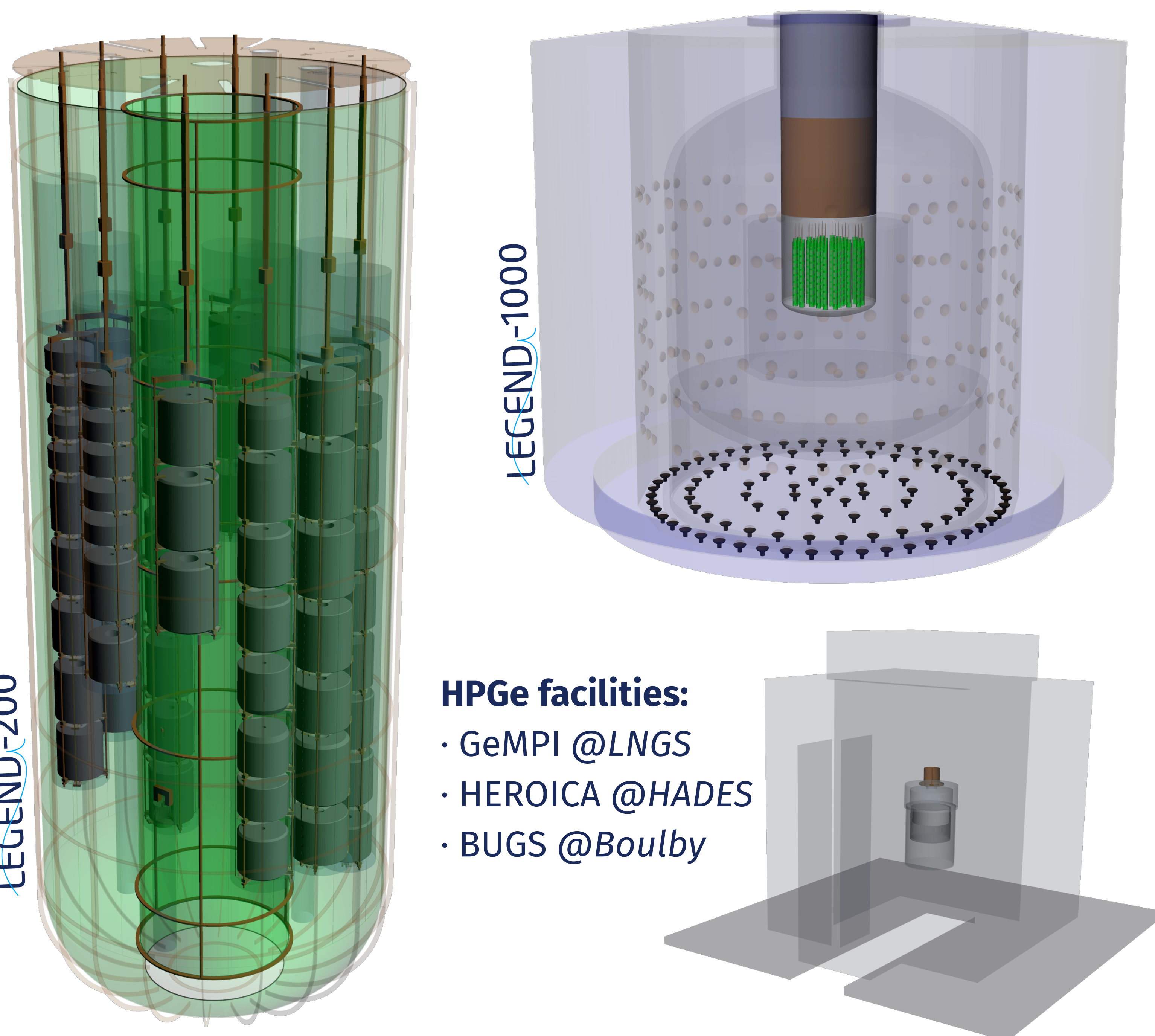
Easy installation with pixi!

```
zsh
# install pixi with: curl -fsSL https://pixi.sh/install.sh | sh
> pixi exec remage -i
...download & extract [00:00:33] [=====] 1.99 GiB @ 33.81 MiB/s geant4
...installing packages [00:00:33] [=====] 422/423

[Summary] → CHLPEP::HepRandom seed changed to: 362249527 (from system entropy)
[Summary] → Entering interactive mode
remage>
```

Applications

→ <https://github.com/legend-exp/legend-pygeom->



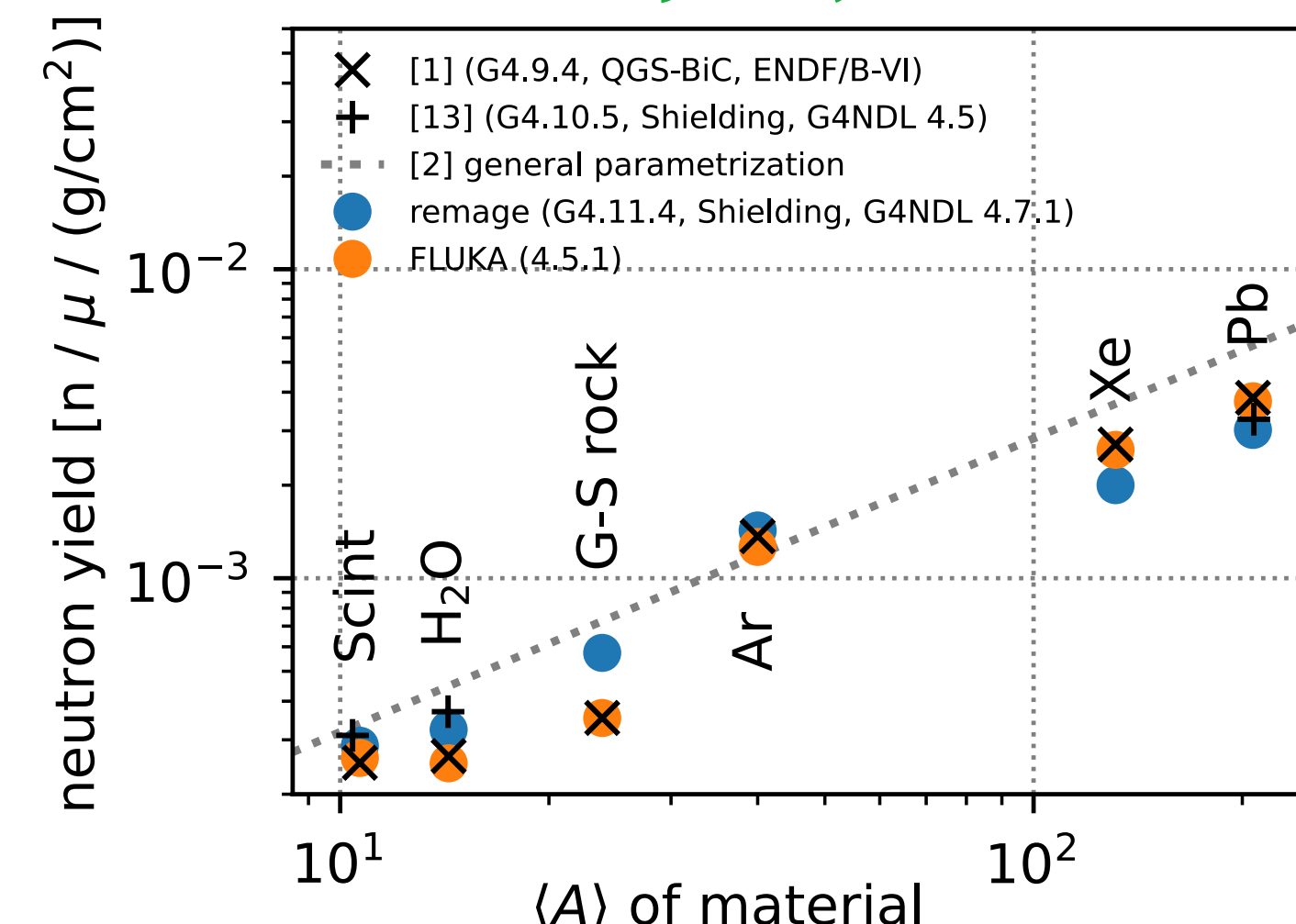
HPGe facilities:

- GeMPI @LNGS
- HEROICA @HADES
- BUGS @Boulby

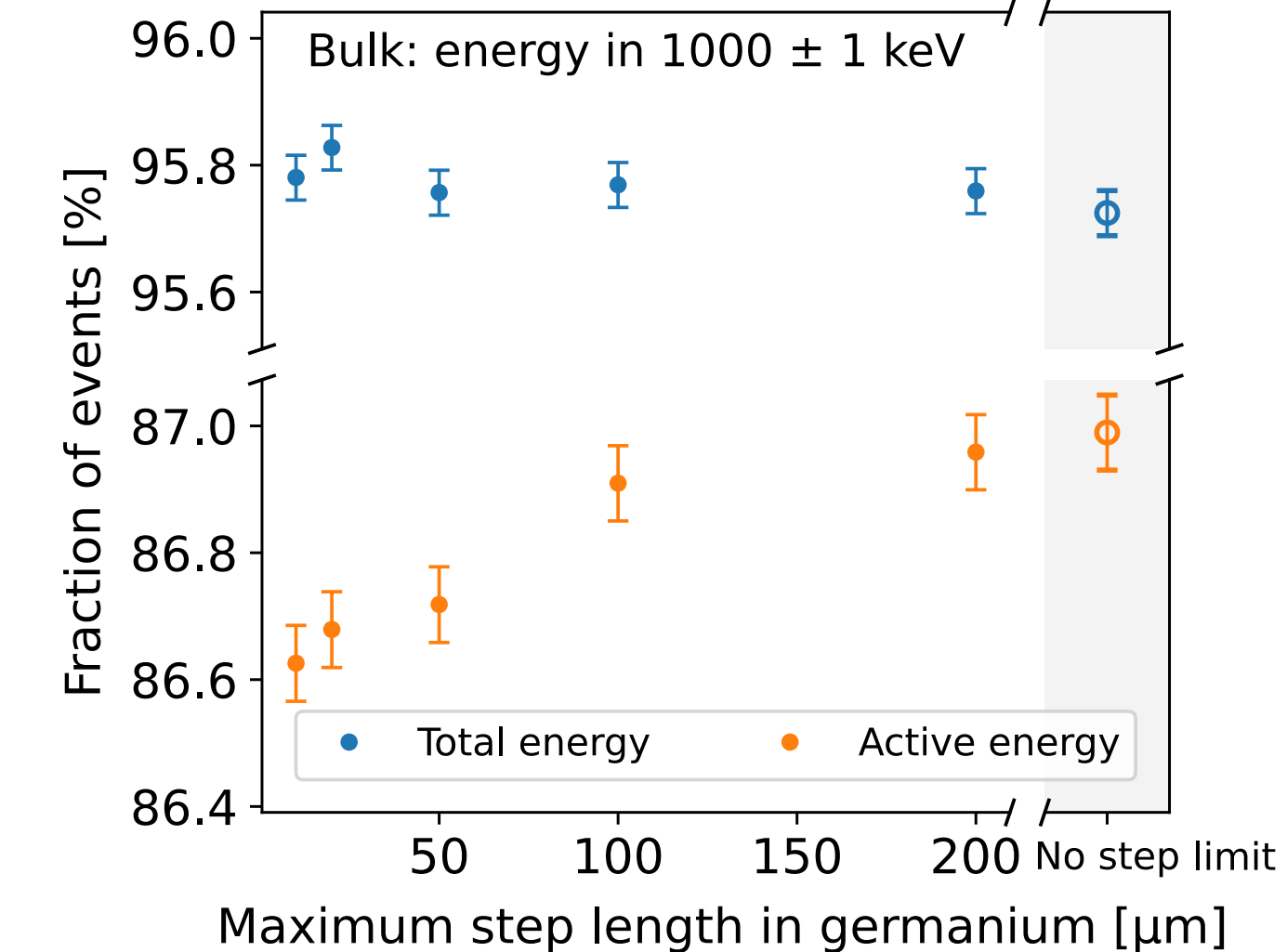
Extensive physics validation suite

- Run automatically at each code change

Neutron yield from muons



Geant4 step sizes



End-to-end validation with HPGe ²²⁸Th data

