GeantV

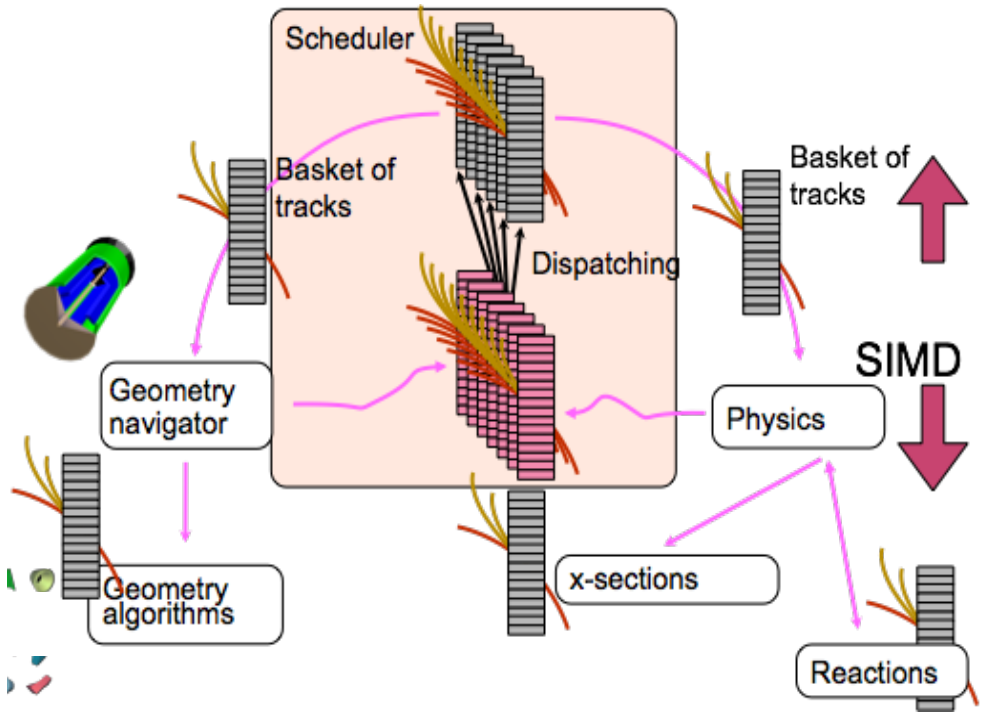
-Intel code modernization-

CERN openlab Open Day

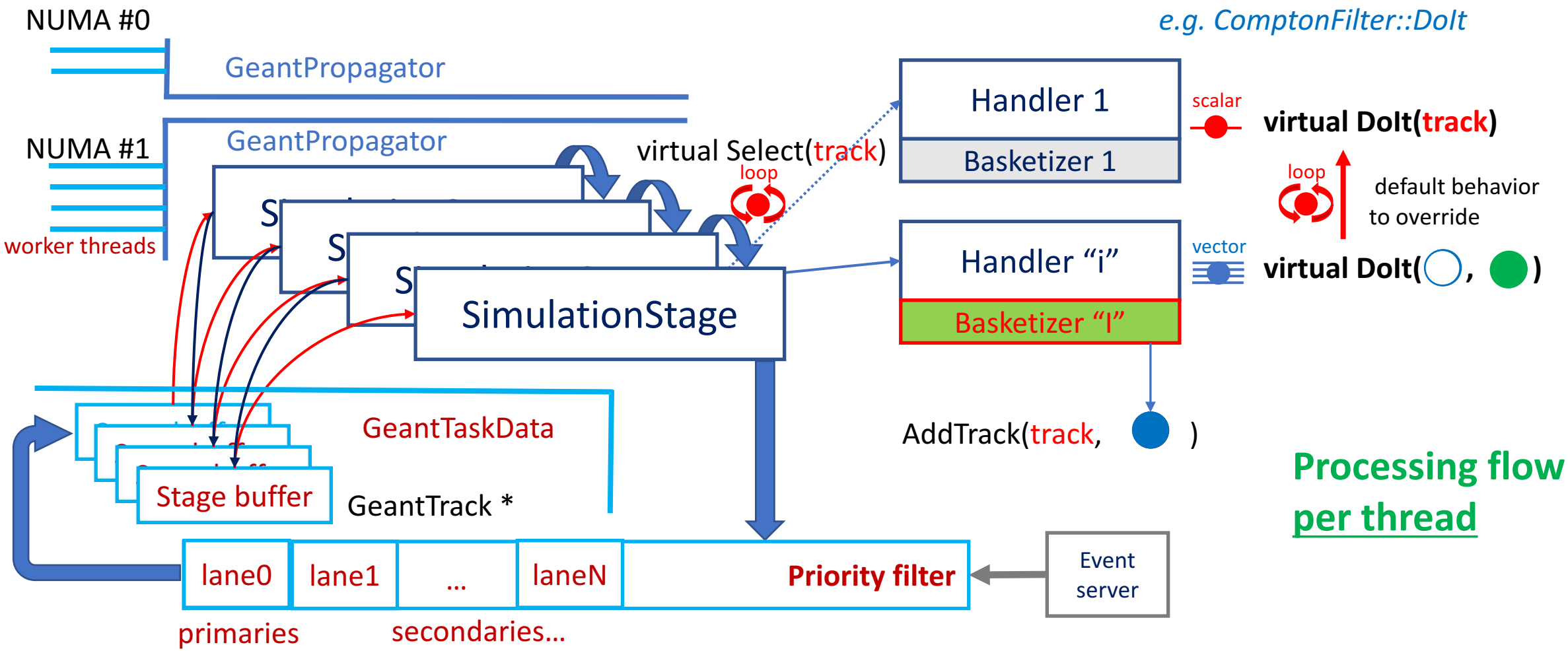
GeantV: modernizing detector simulation

- More than 50% of WLCG power used for simulations
  - The need for simulated samples will increase with luminosity
  - Faster full simulation & more fast simulation !
- GeantV: path towards a faster toolkit using more efficiently CPU resources
  - SIMD and NUMA topology aware, more cache friendly
  - More generic fast simulation integrated with full simulation
- Alpha and beta releases (2017 and 2018)
  - Deliver early a product for the community to test/adopt

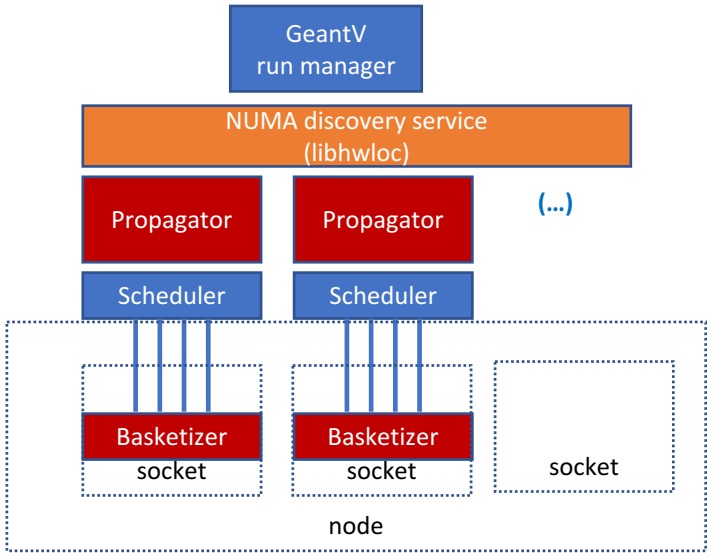
Aim for a 3x-5x faster code



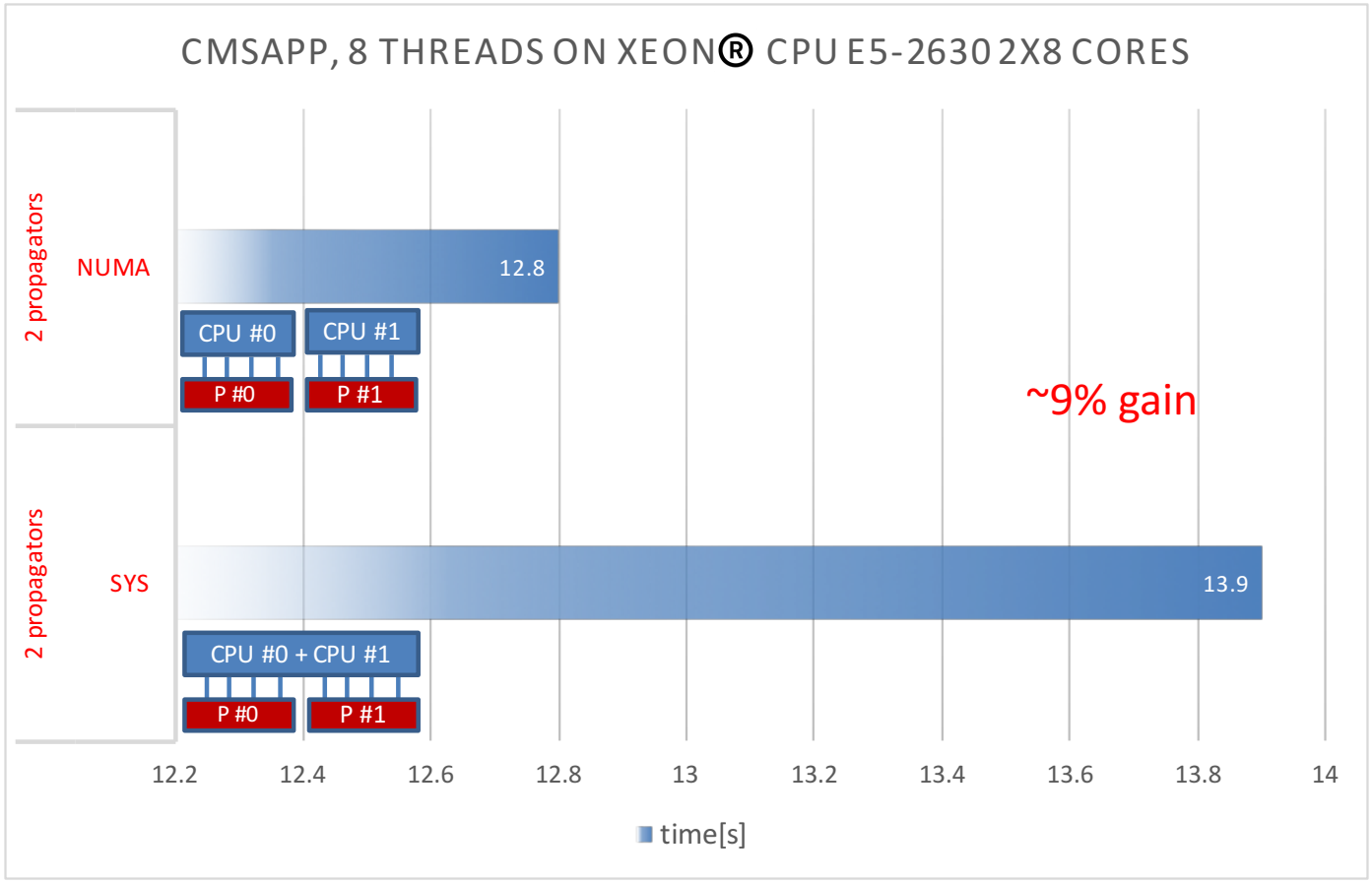
GeantV v3: A generic vector flow approach



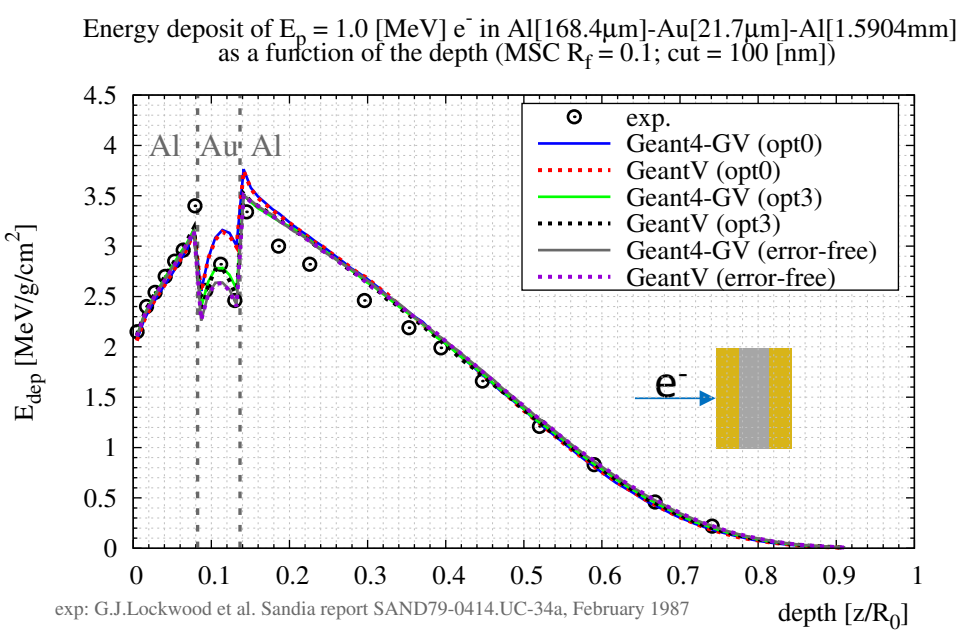
NUMA awareness vs. OS policy



- Topology detection using *hwloc*
- A propagator will use threads bound to the same NUMA node



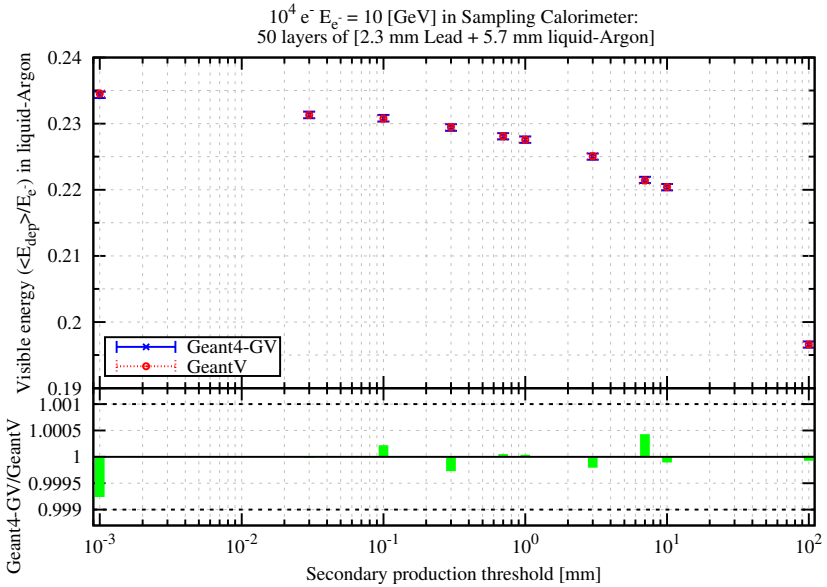
EM Physics models in GeantV



Multi-layered target

10^5 1 [GeV] e- in ATLAS bar. simpl. cal. : 50 layers of [2.3 mm Pb + 5.7 mm lAr]; p.cut = 0.7 [mm]

	e^-/e^+: ionisation, bremsstrahlung, msc; γ: Compton, conversion							
	GeantV				Geant4			
material	E_d[GeV]	rms [MeV]	tr.l. [m]	rms [cm]	E_d[GeV]	rms [MeV]	tr.l. [m]	rms [cm]
Pb	0.69450	15.198	51.015	1.189	0.69448	15.234	51.016	1.192
lAr	0.22792	14.675	106.11	7.592	0.22796	14.656	106.13	7.582



Mean number of :

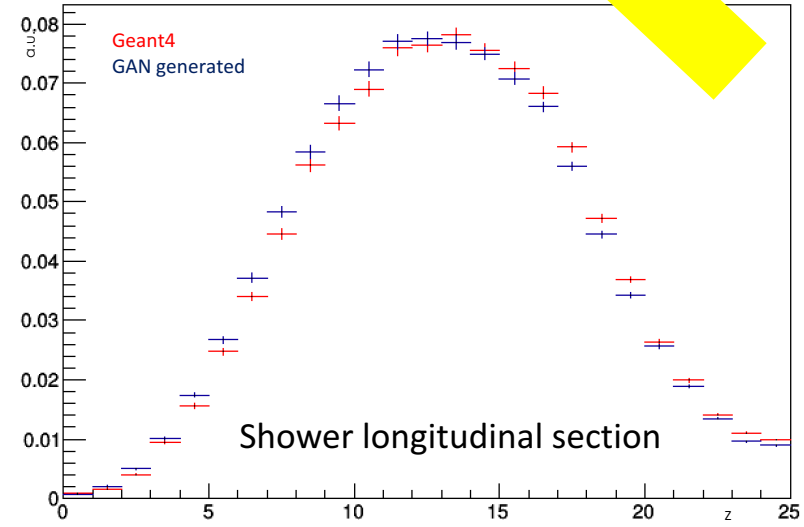
gamma	405.87	406.15
electron	9411.49	9419.44
positron	53.77	53.71
charged steps	11470	11476
neutral steps	49177	49222

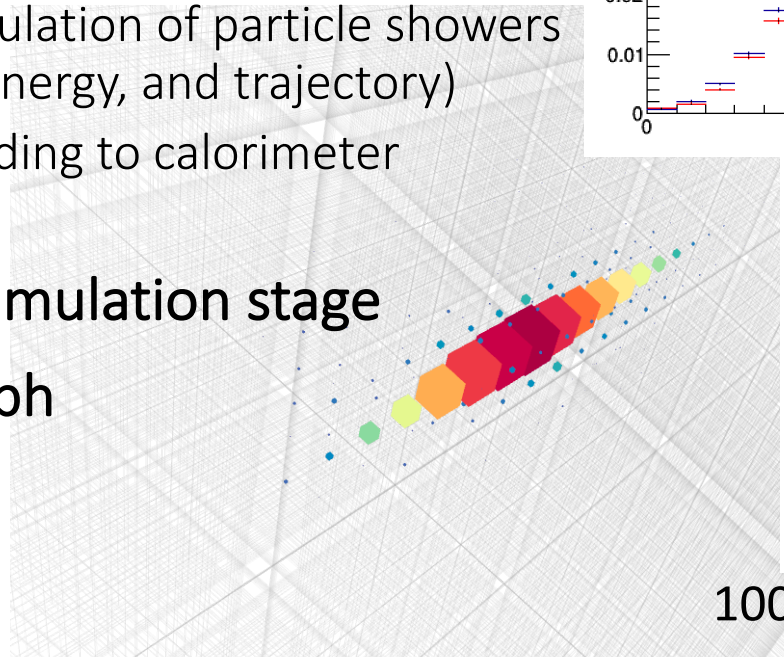
ATLAS simplified sampling calorimeter

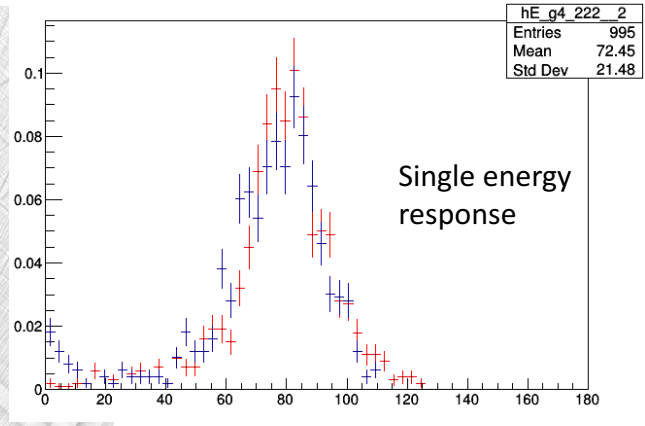
R&D: ML prototype for fast simulation

New IPCC !

- Fast simulation “hooks” à la G4 designed according to v3 flow
  - First implementation of the user interfaces
- First ML prototype for simulation of high granularity calorimeters
  - Complete GAN based model for the simulation of particle showers in calorimeter (including particle type, energy, and trajectory)
  - First algorithm meta-optimization according to calorimeter geometry
- Integration of the inference step as simulation stage
- TensorFlow + KERAS -> Neon -> Ngraph







100 GeV electrons

Next steps

- Deliver the alpha release in December 2017
  - Vectorization for some components: geometry, field propagation
  - Examples to demonstrate GeantV use and integration with experimental frameworks
  - Fast simulation ML prototype and integration of fast sim stages in GeantV
- Prepare for the beta release
  - Vectorization of physics models
  - Hadronic physics
  - Production-ready geometry
  - Examples demonstrating ML-based fast simulation usage for different detector types