# Structure of physics processes in CORSIKA 8

## A tutorial for model builders

most up-to-date description of CORSIKA 8 architecture given in arXiv:1902.02822

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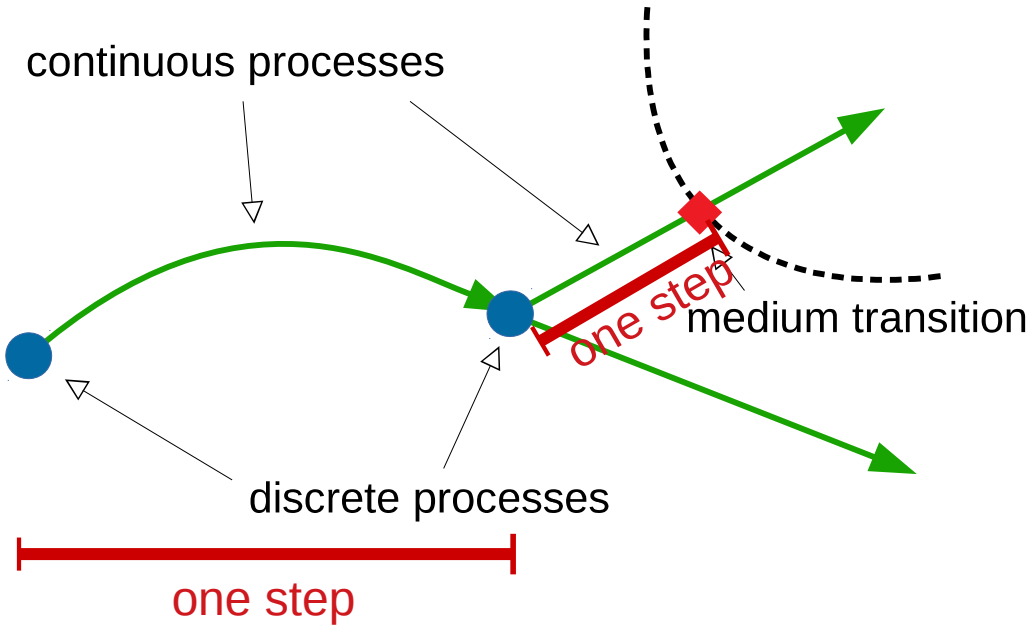
# General simulation setup

- Compose *Environment*
- Define *ProcessSequence*
  - e.g. auto procSeq = sibyll << sibyllNuc << decay << eLoss << cut;
- Stack with primary particle(s)
- Cascade(env, tracking, procSeq, stack)
- Cascade.Run()

# Cascade

- Cascade::Run: „main loop“
- Cascade::Step: step of a single particle




**continuous processes:**
- energy losses
- Cherenkov, radio emission

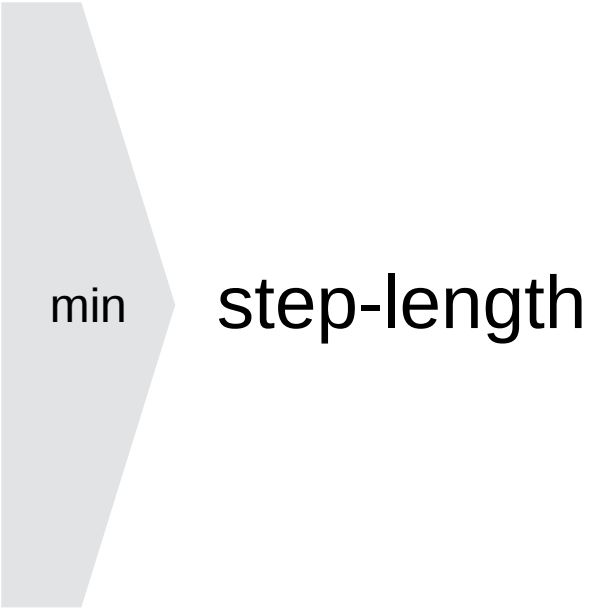
**discrete processes:**
- collisions
- decays
- cascade eq. table filling

**boundary crossing processes:**
- observation level
- transition radiation

# Cascade::Step

**1. trajectory determination (tracking)**

- closest intersection with volumes along current direction
- maximum step-length from continuous processes and e.o.m. integrator
- sampled collision point
- sampled decay point



# Cascade::Step

2. apply all continuous processes
3. (perform discrete process)

# Continuous process

- MaxStepLength(Particle, Trajectory)
  - keep energy losses small to keep cross sections valid
  - make sure particle stops at the point where its energy drops below absorption threshold
- DoContinuous(Particle, Trajectory, Stack)
- example: Processes/EnergyLoss

# Discrete processes

- DecayProcess
  - GetLifetime(Particle), in lab frame
  - DoDecay(Particle, Stack)
  - example: Processes/Pythia/Decay
- InteractionProcess
  - GetInteractionLength(Particle, Trajectory)
  - DoInteraction(Particle, Stack)
  - example: Processes/Sibyll/Interaction
- within DoInteraction/-Decay: Particle.Delete(), Particle.AddSecondary(...)

# Environment

- VolumeTreeNode:
  - GetVolume()
  - GetModelProperties() → provides material properties, currently density (inhomogeneous!), composition, grammage/length conversion for trajectories
  - accessible via Particle.GetNode()
- flexible extension of medium properties anticipated!

# PROPOSAL

- Possibilities for inclusion of PROPOSAL:
  - PROPOSAL as „sink“: less work, inconsistent tracking (?), CORSIKA cannot „see“ what happens
  - tight integration: rip out physics and implement it in our framework

# Discussion

- multiple scattering: where? how?
- What material properties are needed?
- Inhomogeneous media possible?