(Multi-)Thinning in CORSIKA 8

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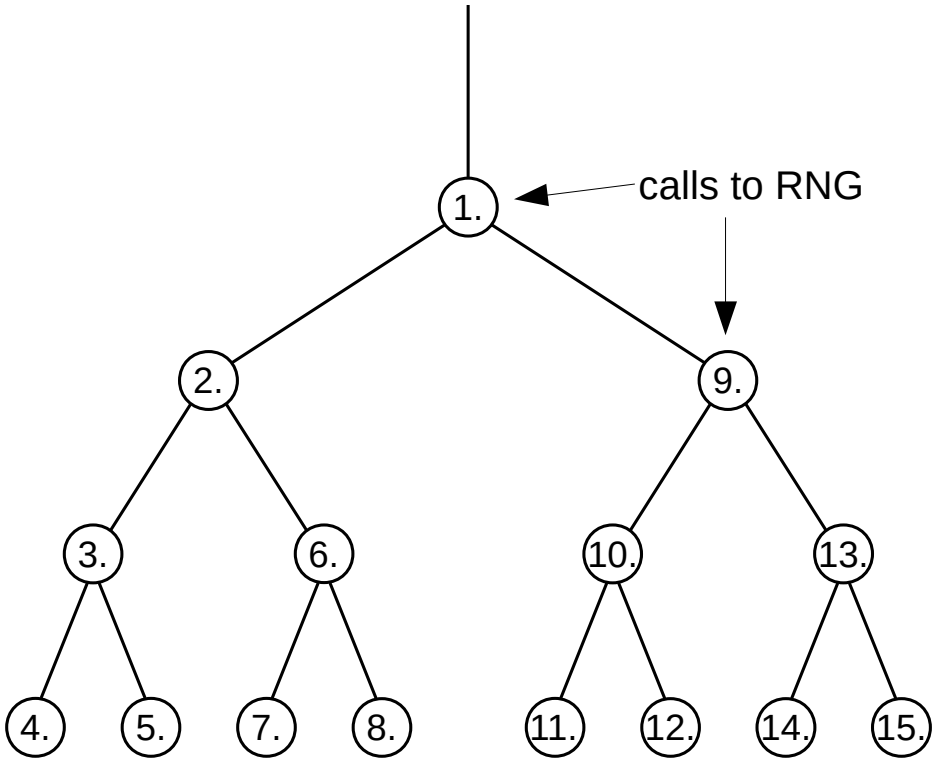
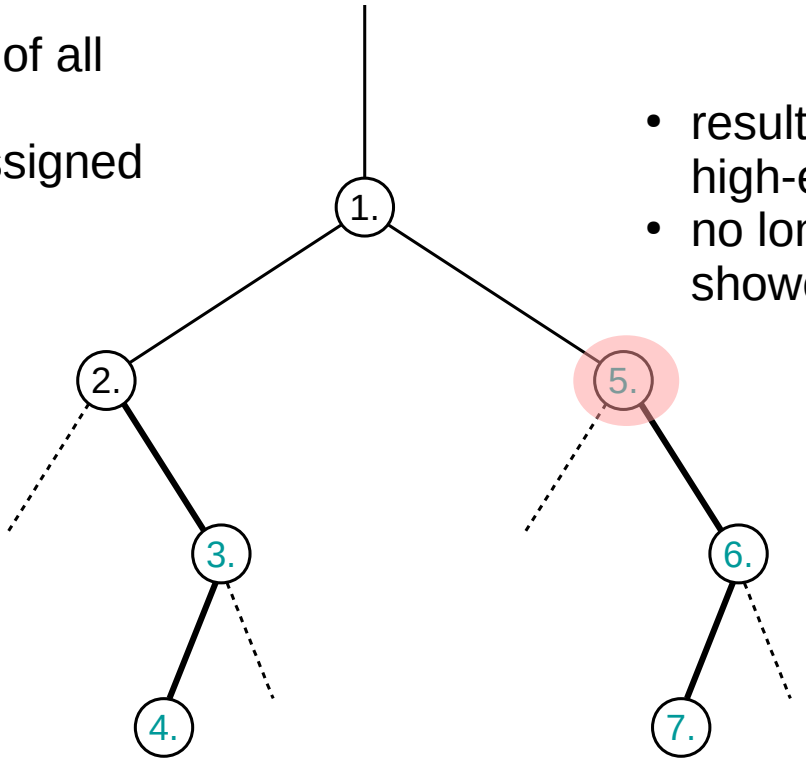
Full shower



Thinned shower

- follow only random subset of all particles
- compensated by weight assigned to surviving particles



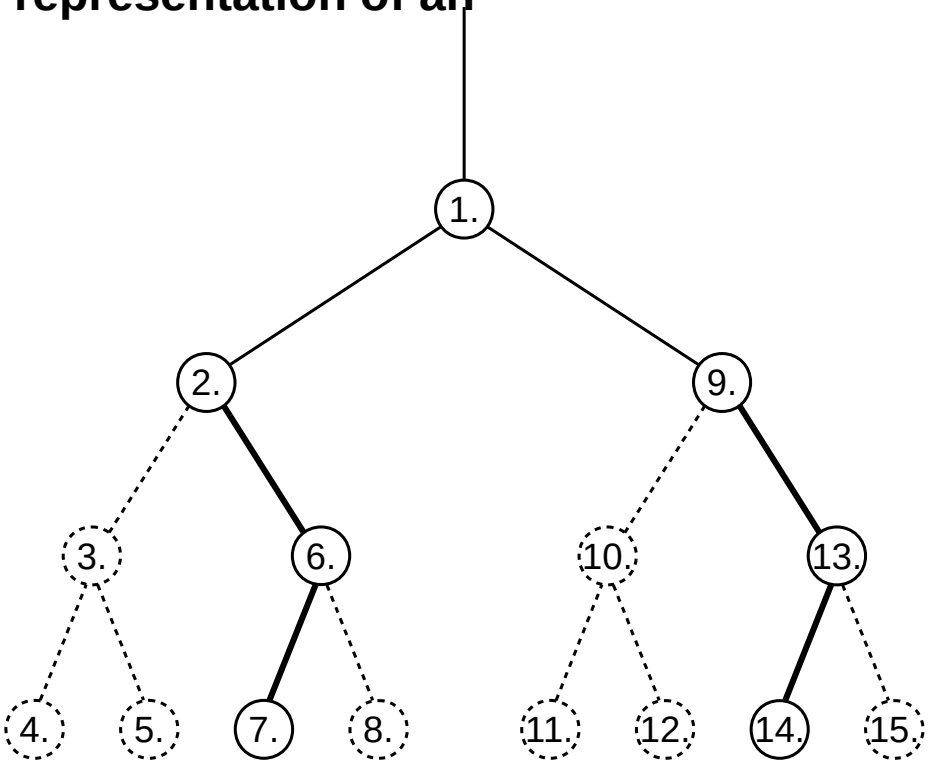
- resulting shower differs even in high-energy, non-thinned parts
- no longer corresponds to unthinned shower even with same seed

(almost) Multi-thinned shower

How to make a thinned representation of an unthinned shower?

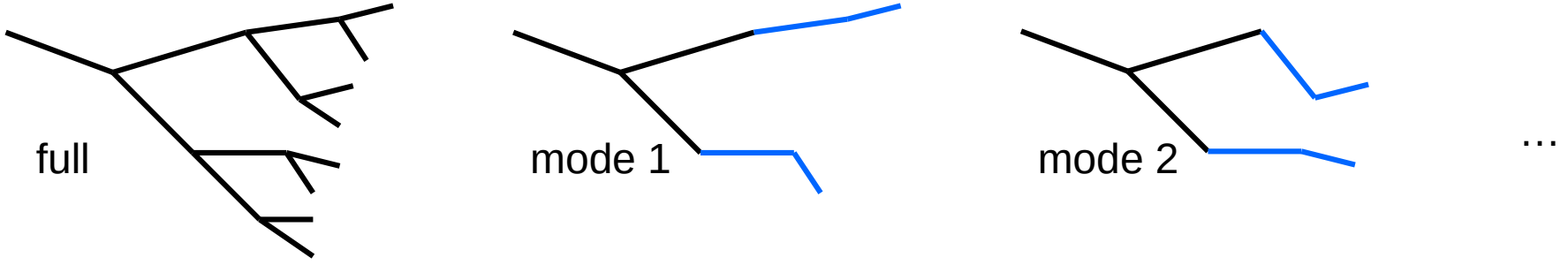
keep and propagate
discarded particles

two sets of output,
full and thinned version



multi-weight

- CORSIKA 7 has multiple weights / thinning modes doi:10.5445/IR/1000039436
  - study effect for several sets of thinning parameters in same run
  - test bias & artificial fluctuations directly with same parameters for all modes (but different seeds)
- discarded particles = negative weight



CORSIKA 8

- **Do we want this behaviour in CORSIKA 8?**
- quite intrusive, output modules have to distinguish between un-, simply-, multi-thinned
  - particle output with 0/1/N weights
  - *N* longitudinal profiles, radio traces, …
- multi-thinning could just be default
  - delete particles when discarded in all modes
  - N=1 is normal thinning
  - optional unthinned mode

CORSIKA 8

- alternative: just one mode, but select between delete/keep discarded particle
- set weight=0 for discarded particles
  → no change in modules necessary
- multi-thinning can be emulated
  by running shower again