Future trackers: parameters/performance for LLP - two simple examples -

(not a complete overview, at least today)

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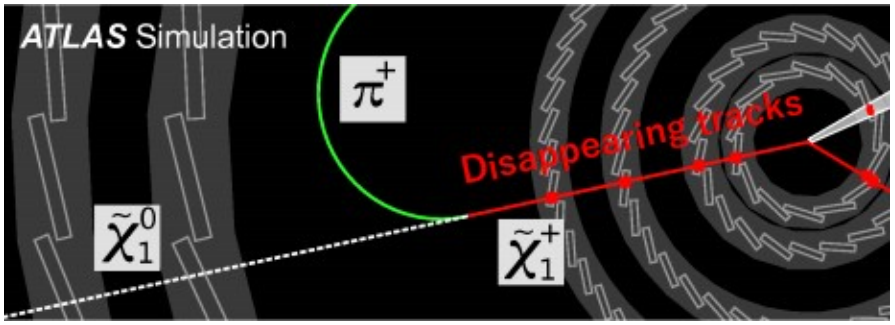
1) Radius of innermost tracking layer(s)
+ additional information

- Detection of charged long-lived particle with relatively short lifetime
  - Aka e.g. disappearing track
  - Very well motivated in e.g. dark-sector and susy models
  - Key feature: little/no visible decay products



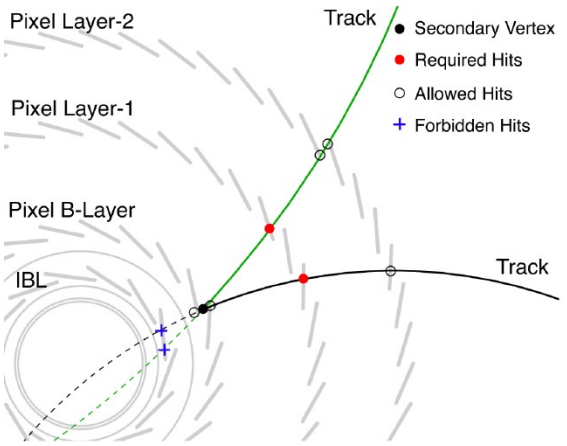
- Performance strongly depends on how "short" of a track we can reco:
  - Radius of innermost layers ← detector technology
    - In hadron colliders, especially radiation hardness
    - In lepton colliders.. space + beam losses?
    - Note: innermost layer close to I.P. of course also important for e.g. b/c-tagging
  - How many measurements to reco a track ← algorithms, environment

FCC study, see arXiv:1901.02987

- Capabilities that can differentiate 0.1-10 TeV from MeV-GeV particles
  - dE/dx (useful if low enough beta*gamma, depends on boost too)
  - TOF
  - ?
  - Note: this actually applies to the whole tracking detector volume

2) non-prompt track reconstruction

- Searches for LLP decay products in inner tracker
  - e.g. displaced vertices and/or leptons
  - transverse decay position ~ 1-500 mm
- Hard for pheno studies to study projections
  - Track reconstruction efficiency ← most urgent
  - Instrumental background ← often ~reducible



- A lot of interest for future collider reach in BSM EF groups (also RPF!)
- Two main components of track reco for non-prompt decays
  - "acceptance": fraction of charged particles produced at given position that leave at least X measurements in the tracker
    - Studied for LHC and, a little bit, HL-LHC (e.g. ATL-PHYS-PUB-2018-033)
    - Not much, afaik, for future collider ← **highest priority** and nice simple study using full simulation frameworks available
  - "algorithmic": efficiency in reconstructing charged particles within acceptance
    - Hard to project so much in the future: computing and algorithmic landscape will very likely be radically different

Final considerations

- LLP have been brought up in a variety of different topical groups across frontiers and require attention to the details of detector design

- Two simple “projects” discussed (seeking volunteers!)
  - Study of min radius for (few layers of) tracking detectors at future colliders
    - Corollary: determine requirements for other measurements to be useful (dE/dx,TOF,..)
  - “Acceptance” for non-prompt charged particles at future detectors
    - Corollary: how to change the layout to increase it

- In the future expand this list, driven by physics “wish-list”
  - Discussions along these lines happening in EF
    - EF-IF liason: Caterina Vernieri