TABULATED PHYSICS STATUS REPORT

J. Apostolakis, M. Novak

Outline

* Goals, requirements
* Current state, data tables
* Sample Results
* Summary & outlook

Goals, requirements

- Obtain a rough, compact implementation of physics, in order to study the behavior of the prototype
- Requirements
  - Mimic real physics modeling in its most important effects - energy deposition, track length, #steps, #secondary tracks
- Limitations
  - Concerns about effects of 'tables' of interactions on correlations, energy resolution and any observables that depend on tails

Form, type of data

Form and type of data:

- tabulated vales of x-sections, $\lceil E/\lceil x$ from any GEANT4 physics list for all particles and all elements over a flexible energy grid
- all major processes are involved: *Ionisation, Decay, inElastic, Elastic, RestCapture, Brehms, PairProd, Annihilation, CoulombScatt, Photoel, Compton, Conversion, Capture, Fission*
- flexible number of final states for all particles, all active reactions, all elements are also extracted from GEANT4 and stored in tables

Current state, data tables

A more or less complete physics transport has been implemented based on these x-section, $\mathrm{d}E/\mathrm{d}x$ and final state data tables (no MSC).

Tabulating final states would be correct only if:

- number of energy bins $\rightarrow \infty \checkmark \not\rightarrow \infty \implies E, \bar{P}$ conservation violation
- number of final states $\rightarrow \infty \checkmark \not\rightarrow \infty \implies$ possible poor representation of the final state space

Tables used in this work:

- $E_{min} = 1[keV]$, $E_{max} = 300[MeV]$, $\# E_{bins} = 100$, # final states at each bin 100, 1000 for decay
- $E_{min} = 1[keV]$, $E_{max} = 10[GeV]$, $\# E_{bins} = 1000$, # final states at each bin 50, 1000 for decay

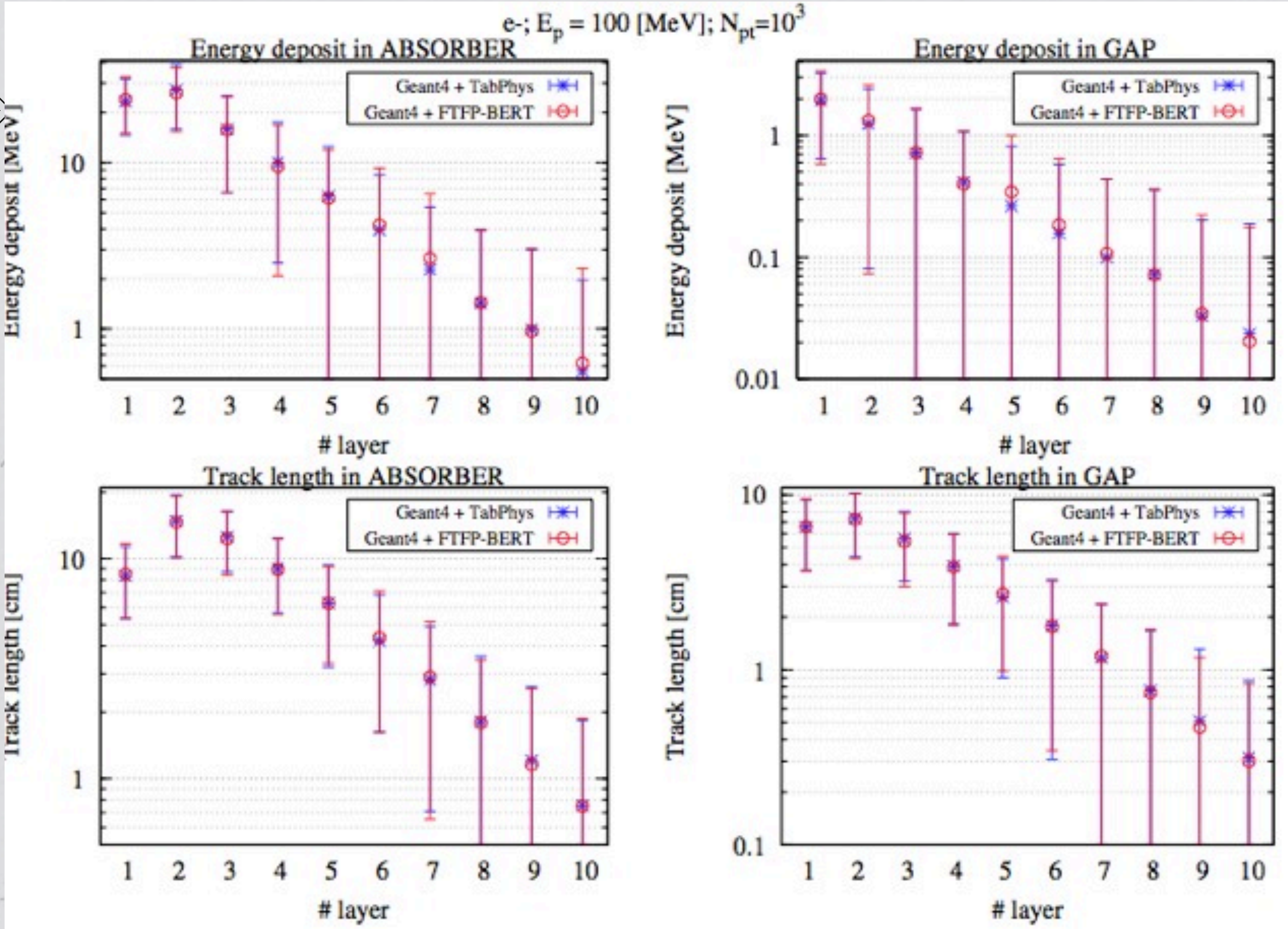
SAMPLE RESULTS

Sample Results

- Presentation of results
- shown 24 Sept 2014

- $e^-, E_p = 1[GeV]$
- $e^-, E_p = 100[MeV]$
- $p^+, E_p = 1[GeV]$
- $p^+, E_p = 100[MeV]$
- $\gamma, E_p = 1[GeV]$
- $\gamma, E_p = 20[MeV]$
- $K^-, E_p = 100[MeV]$
- $\pi^+, E_p = 100[MeV]$
- $\pi^-, E_p = 100[MeV]$
- $\mu^+, E_p = 100[MeV]$
- $\mu^-, E_p = 100[MeV]$

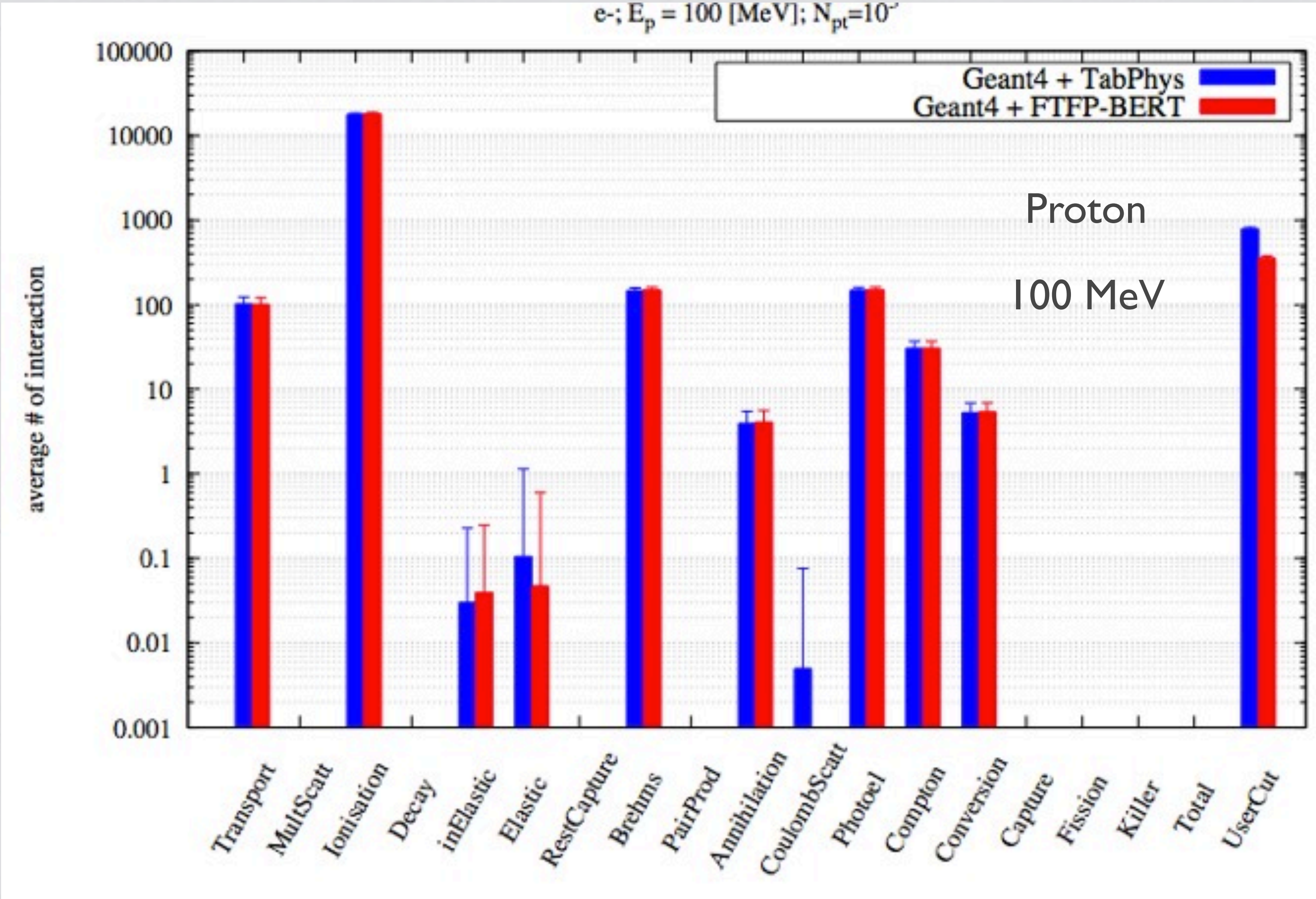
Energy deposit and step length



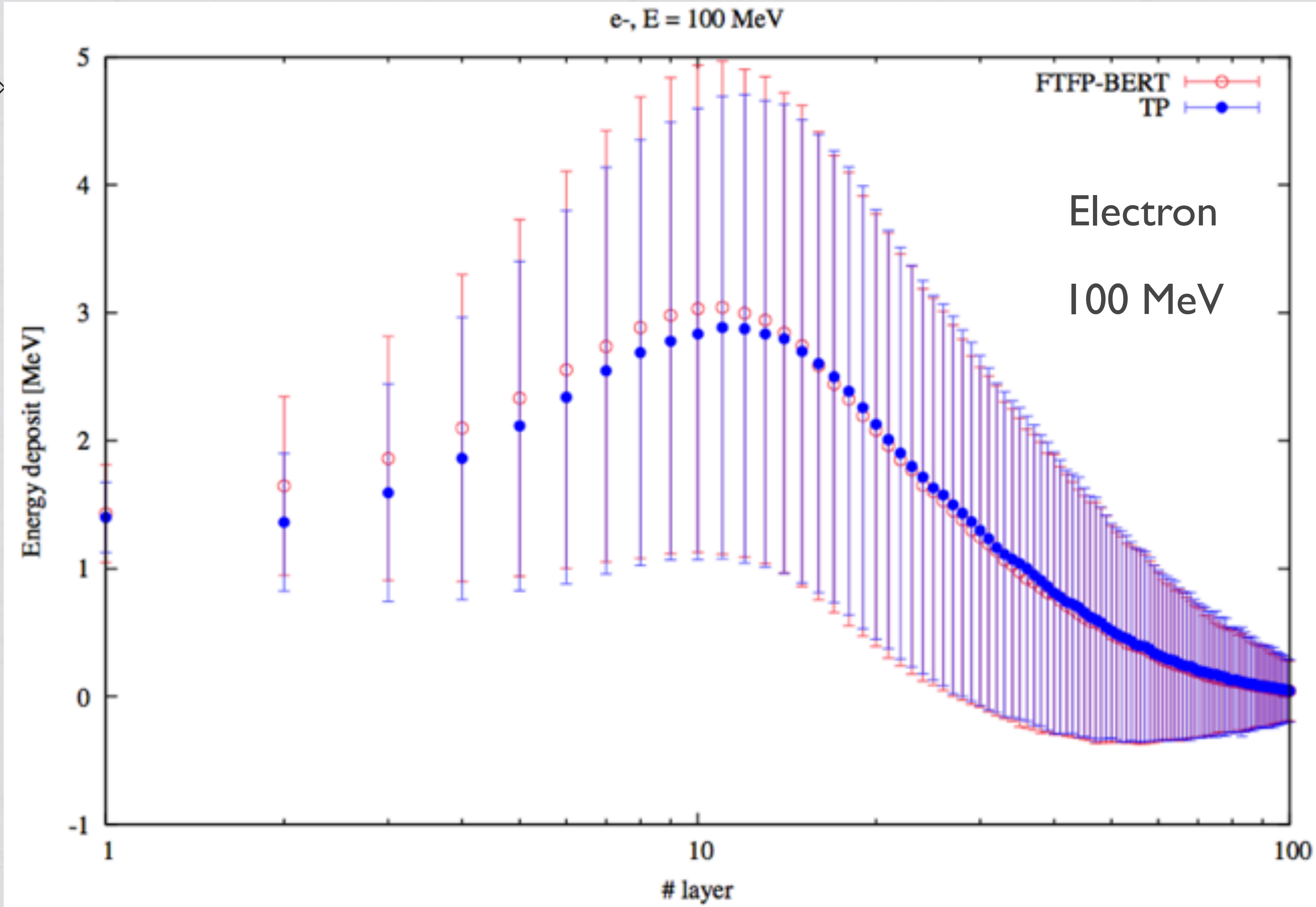
Proton

100 MeV

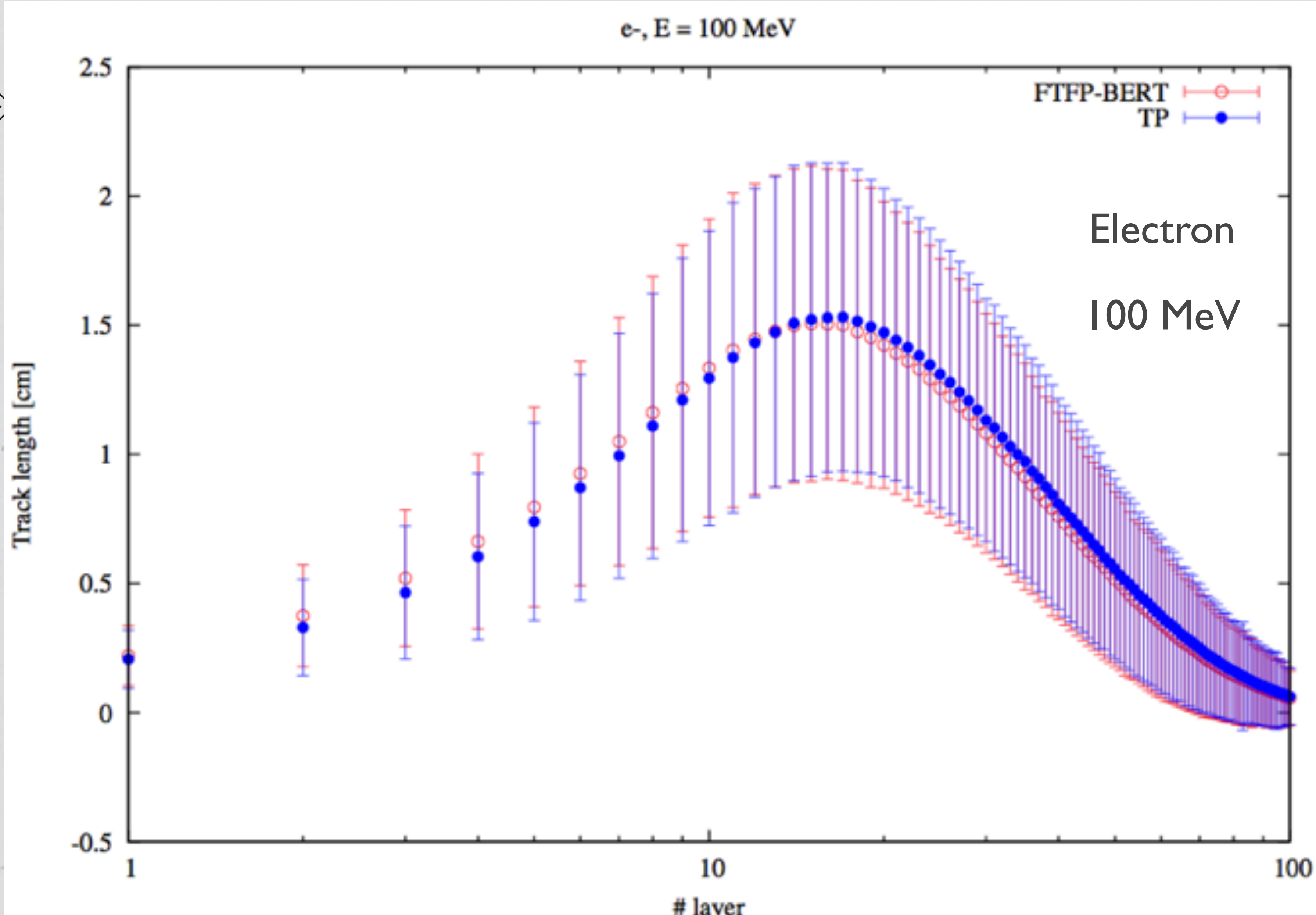
Process statistics



Energy Deposition vs Layer



Track Length vs Layer



Summary / Outlook

Goal: ✓

obtain a compact, simple form of physics to study the behaviour of the prototype and its concepts.

Requirements: ✓

mimic the most important effects of the "real physics" to the tracks and to the characteristics of the transport: *energy deposit, track length, # steps, # secondary tracks, etc.*

Already **good enough** for these goals - maybe with small fixes needed.

Should be usable already for some fast simulation use cases

Should not invest more in this **dead end** for decent physics