Differences in stopping simulations using Geant3 or Geant4

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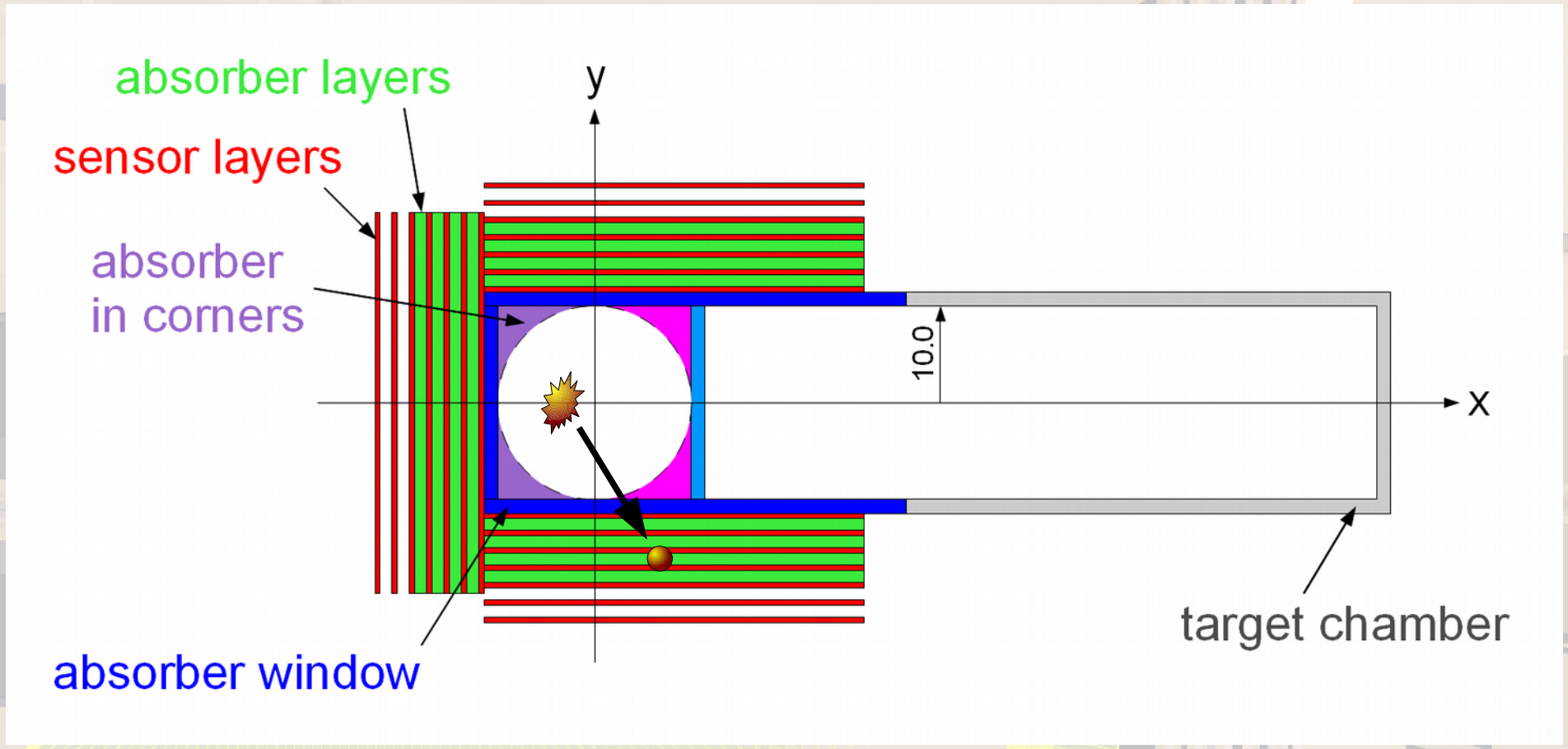
Hypernuclear target system



production of double Λ hypernuclei:

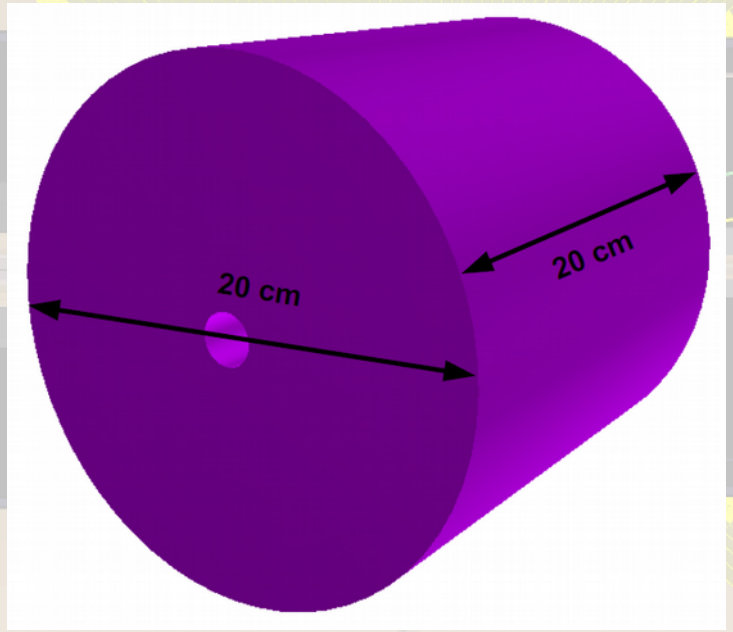
- Ξ^- from primary vertex (-0.3, 0, -55) [cm]
- Ξ^- stopped in absorber material (boron)

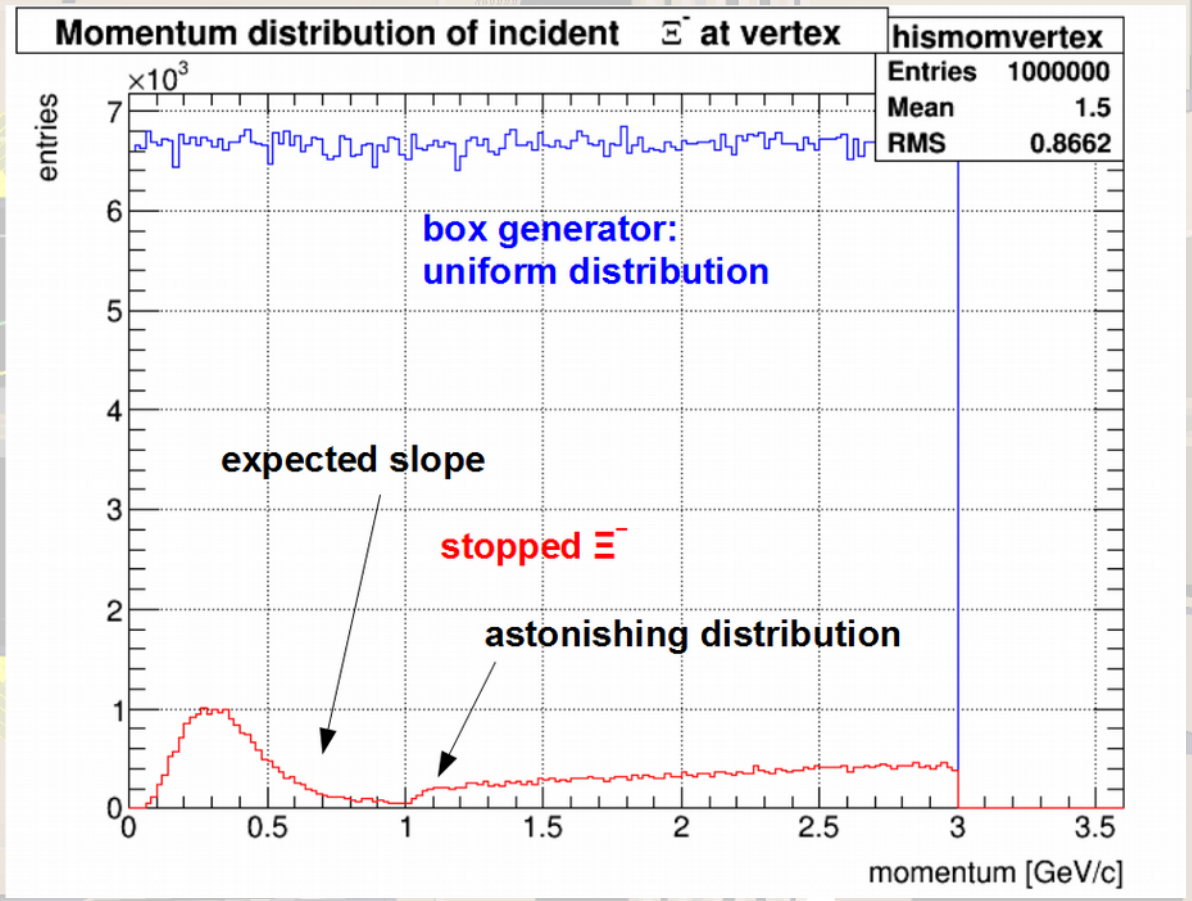
  → condition in simulations: $\beta < 0.0008 \approx p(\Xi^-) < 1$ MeV/c

G4 simulation of Ξ^- in tube absorber

observed problem in Geant4 stopping simulations

⇒ using simple geometry to study the effect:





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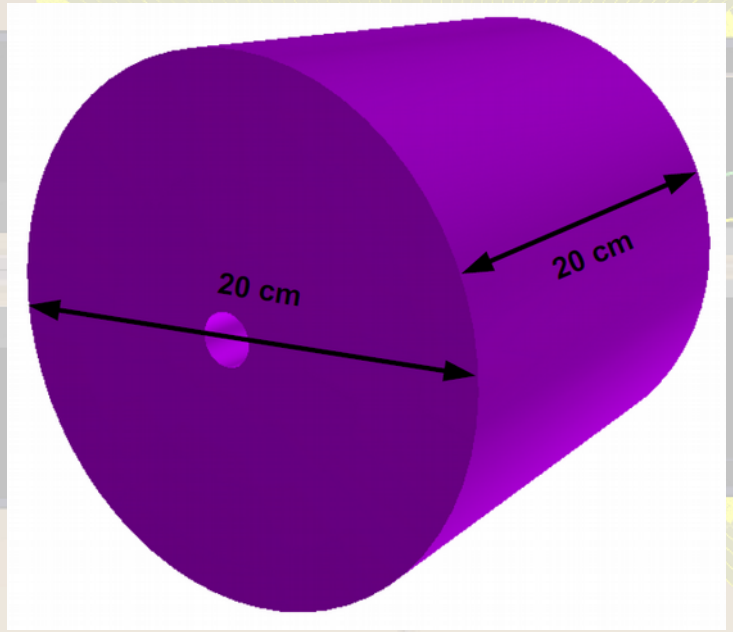
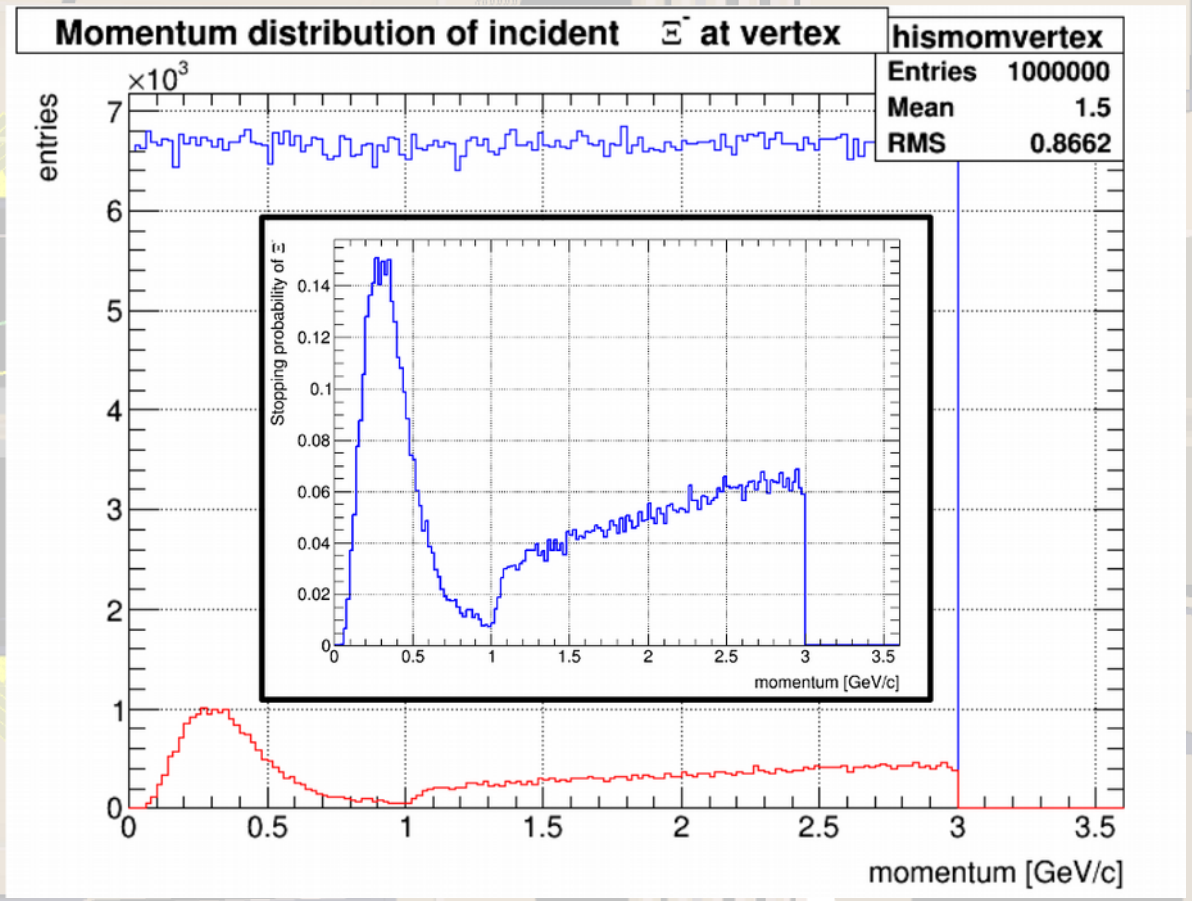
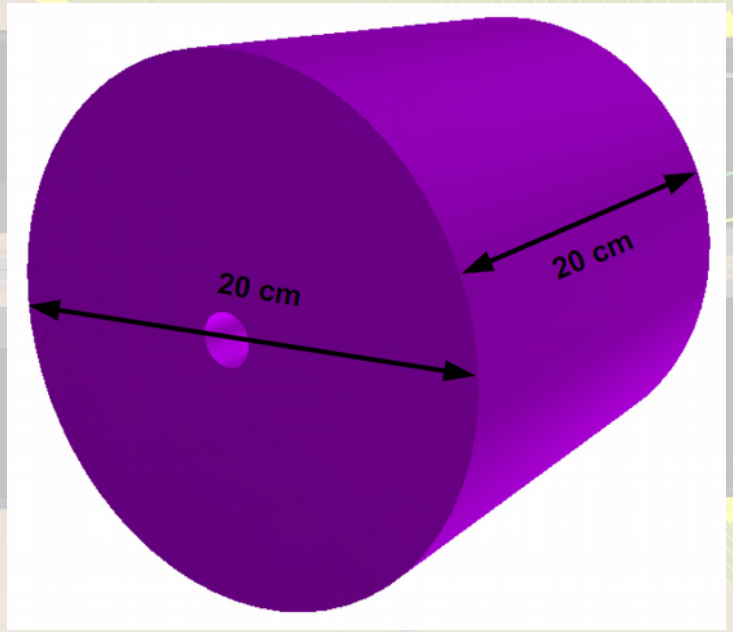


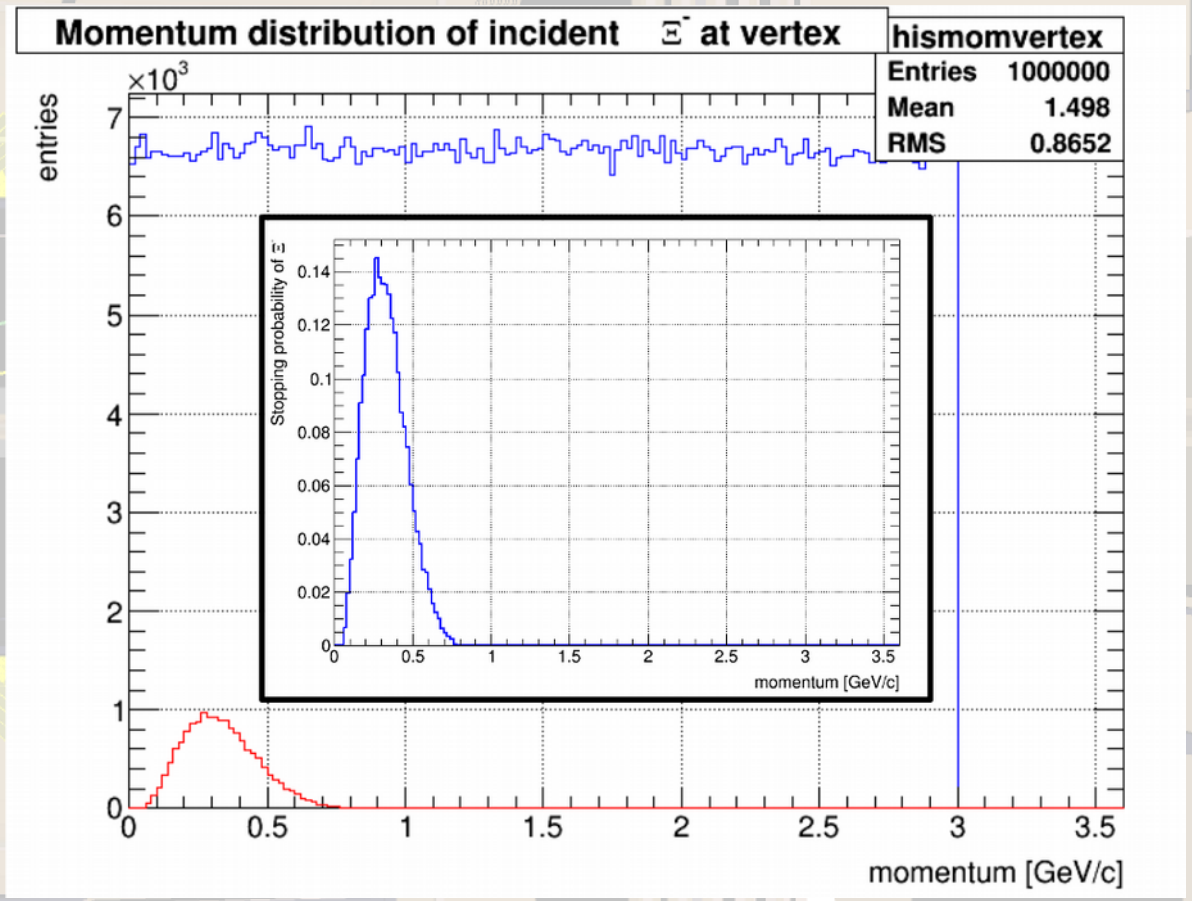


G3 simulation of $\bar{\Xi}^-$ in tube absorber

comparison to Geant3 stopping simulations

⇒ using very same simple geometry





problem was reported in $\bar{P}$ANDA software meeting!

interim solution with Geant4: cut on $p(\bar{\Xi}^-) < 500$ MeV/c

Simulation of Ξ^- in block absorber

more extensive examination in a block absorber:

- **stopping**:

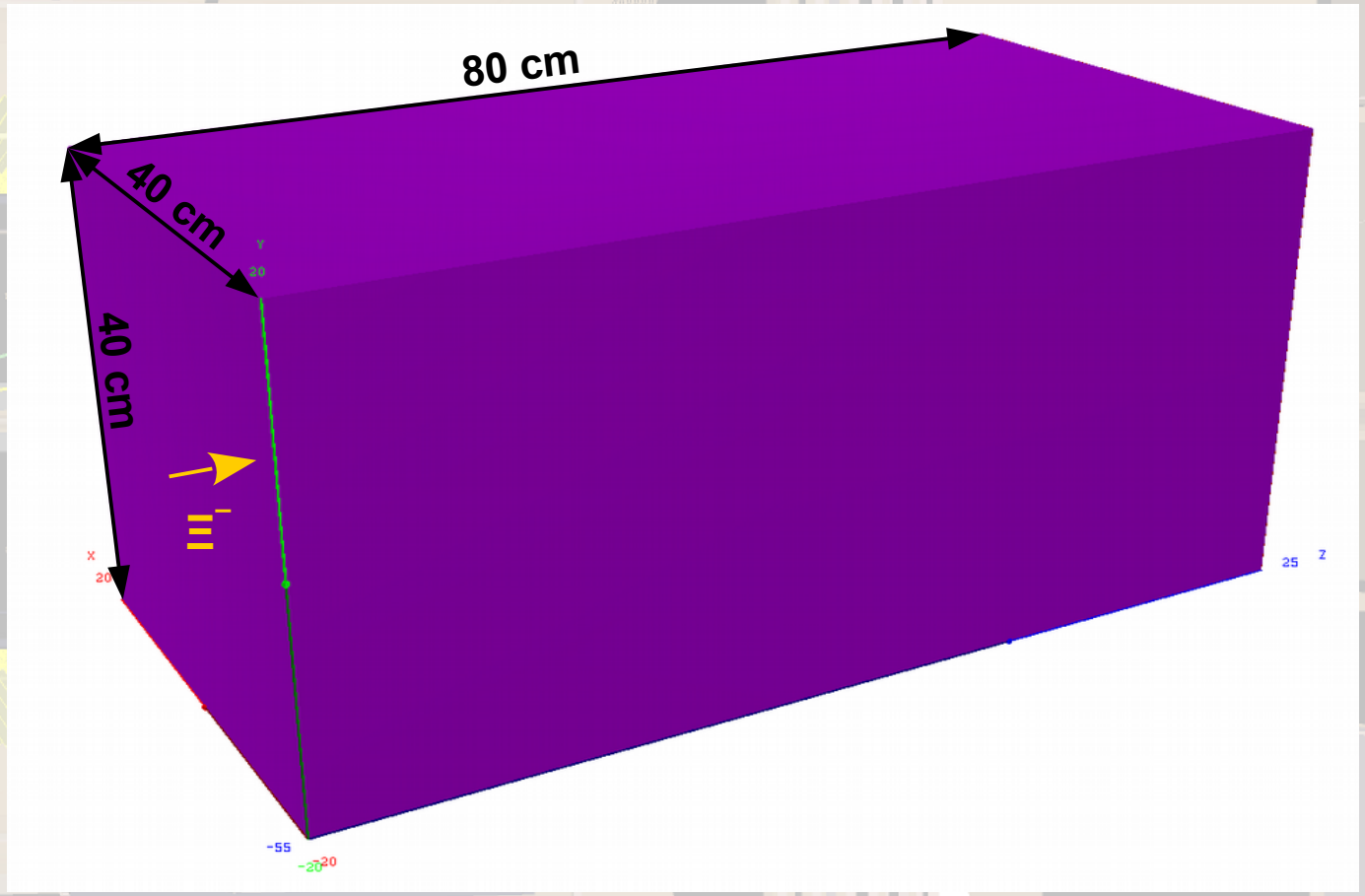
  $p(\Xi^-) < 1$ MeV/c

- **decays in flight**:

  $\Xi^- \rightarrow \Lambda + \pi^-$

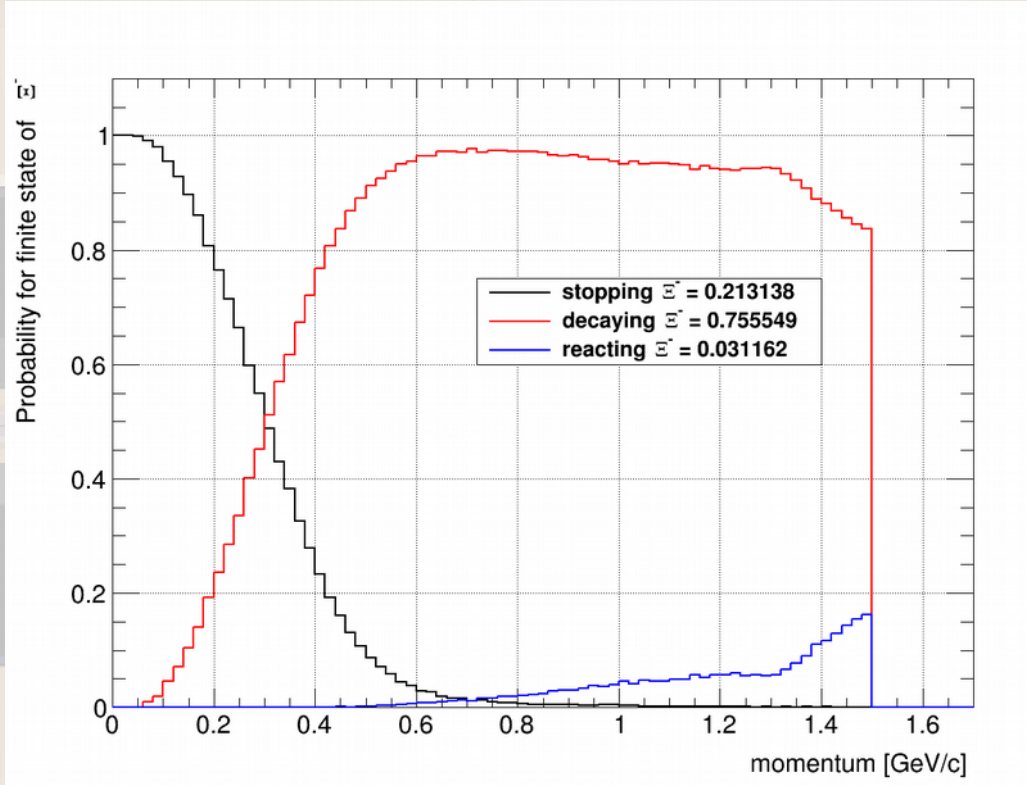
- **reactions**:

  $\Xi^- \rightarrow$ daughters $\neq \Lambda + \pi^-$



Simulation results

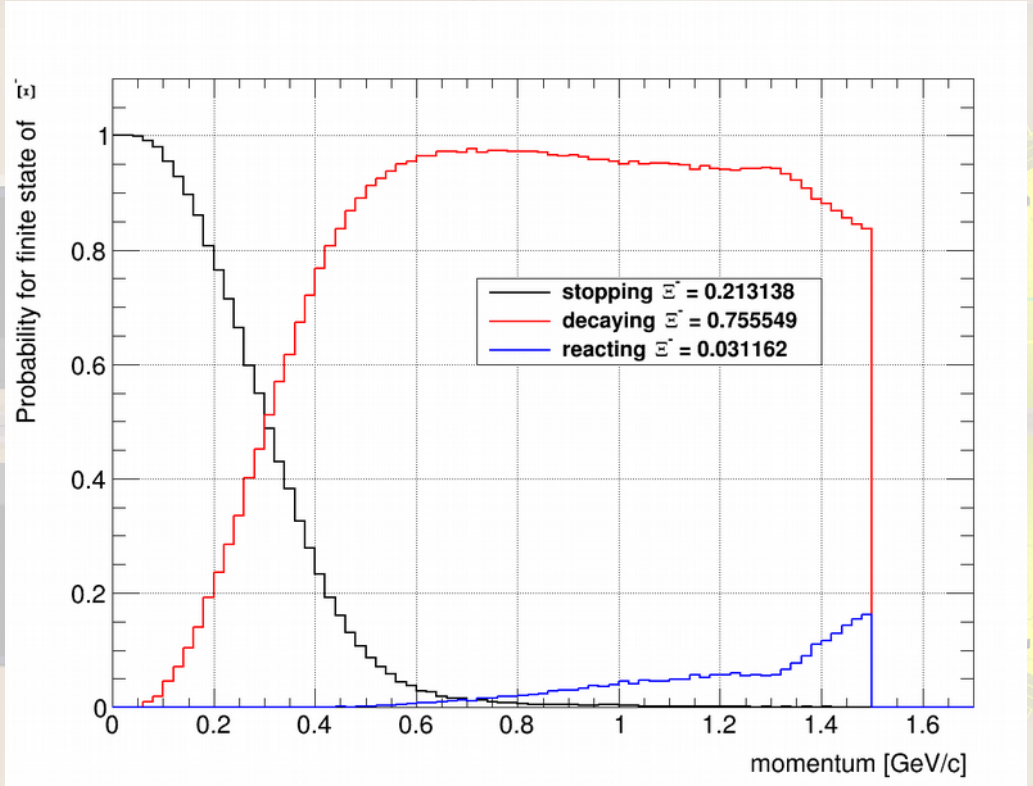
Geant3



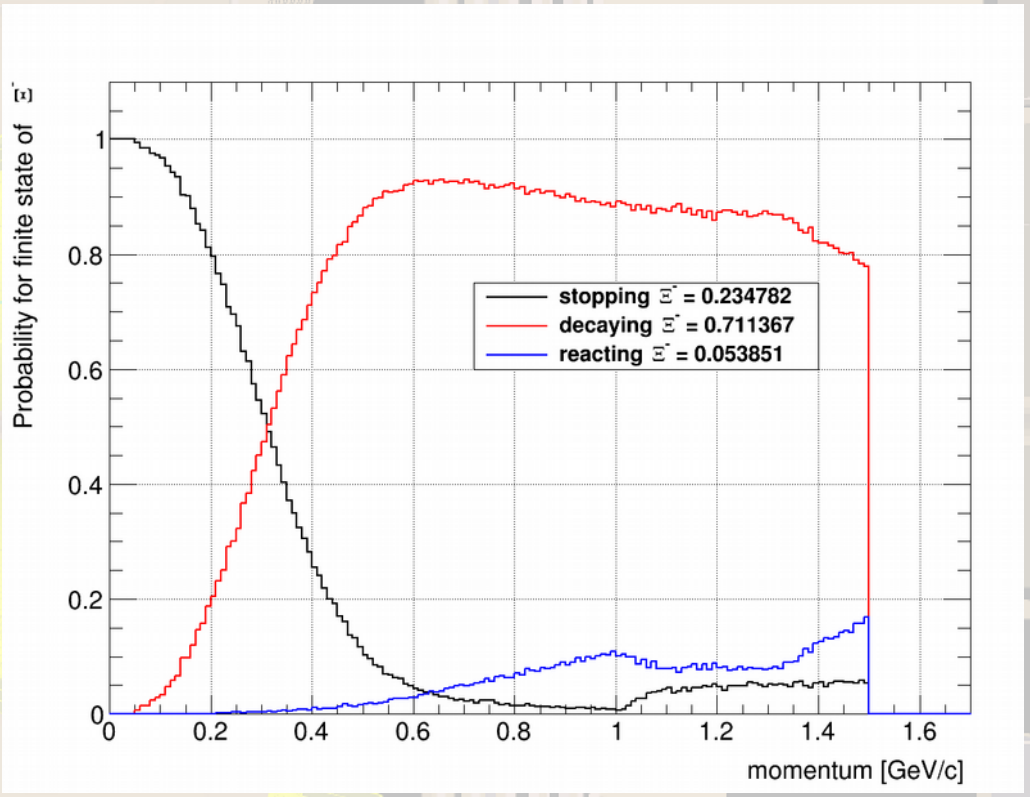
→ stopping of Ξ^- with the lowest momenta

Simulation results

Geant3



Geant4

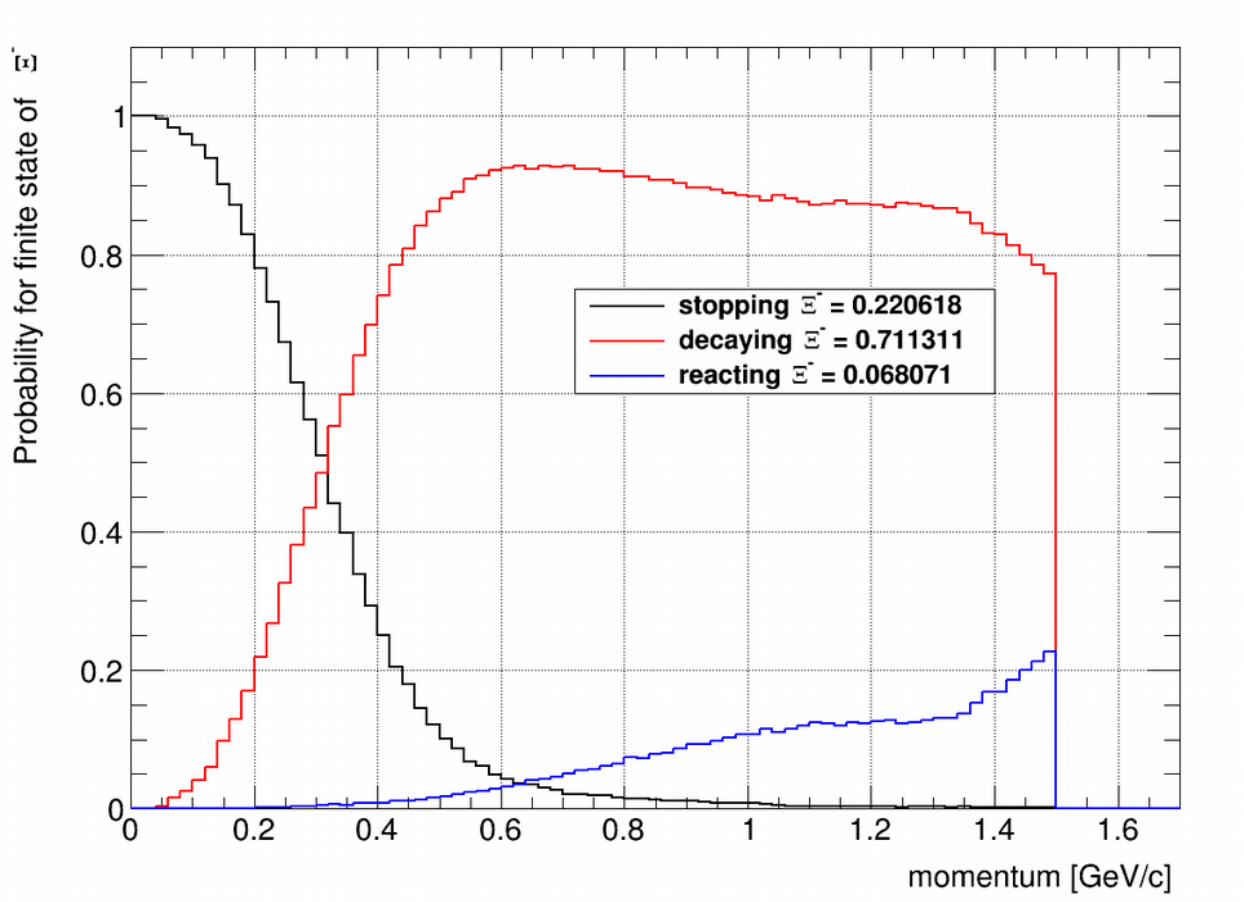


→ stopping of Ξ^- above 1 GeV/c seems to belong to reactions
→ confirmed in simulation steps

Conclusion

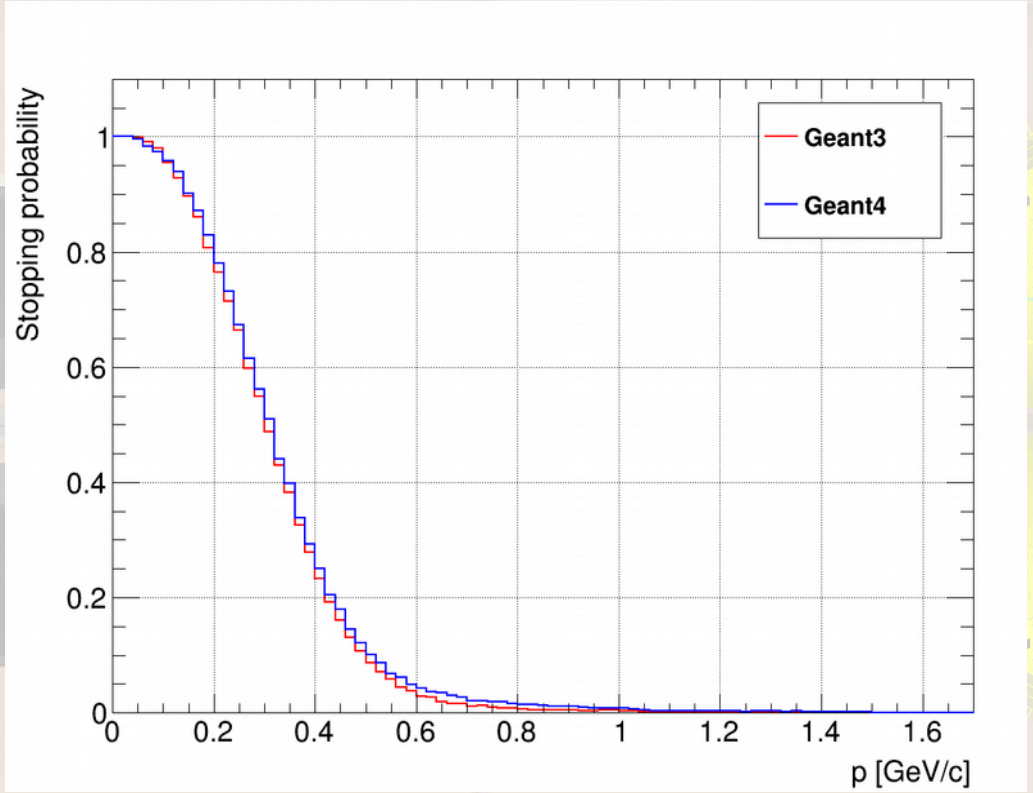
observation in the last simulation step:

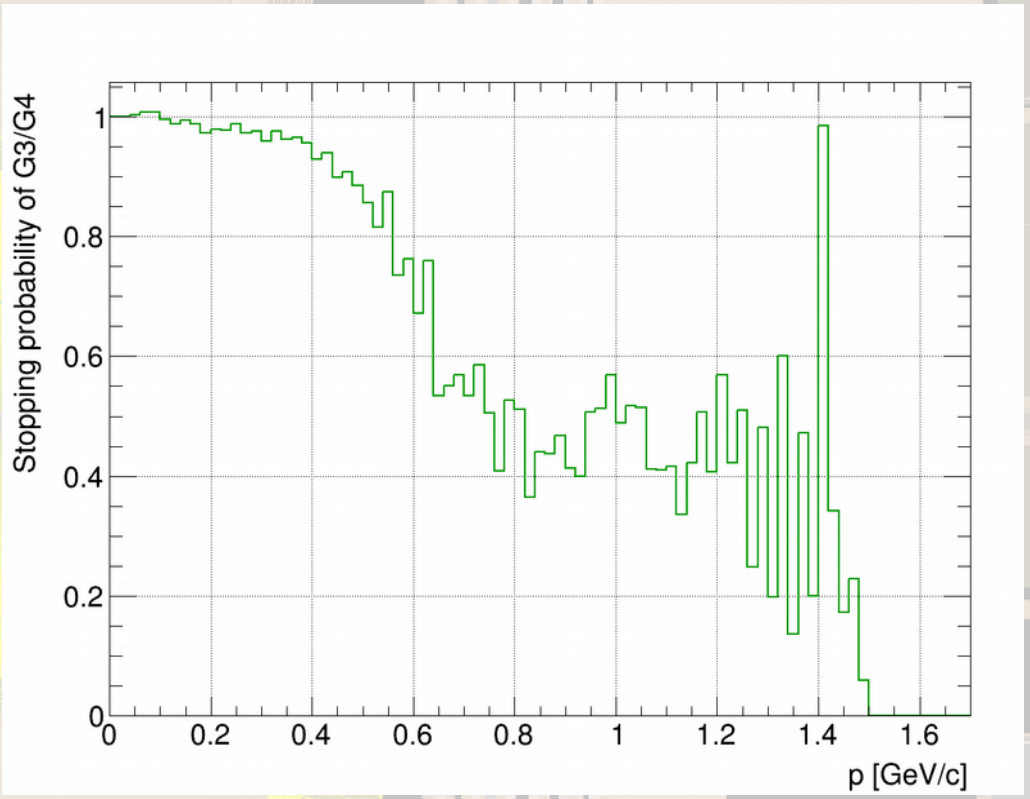
- drop of the whole Ξ^- momentum to 0 GeV/c
- production of secondaries
  $\Rightarrow$ additional condition for stopping with Geant4: no secondaries



Comparison: Geant3 and Geant4

stopping





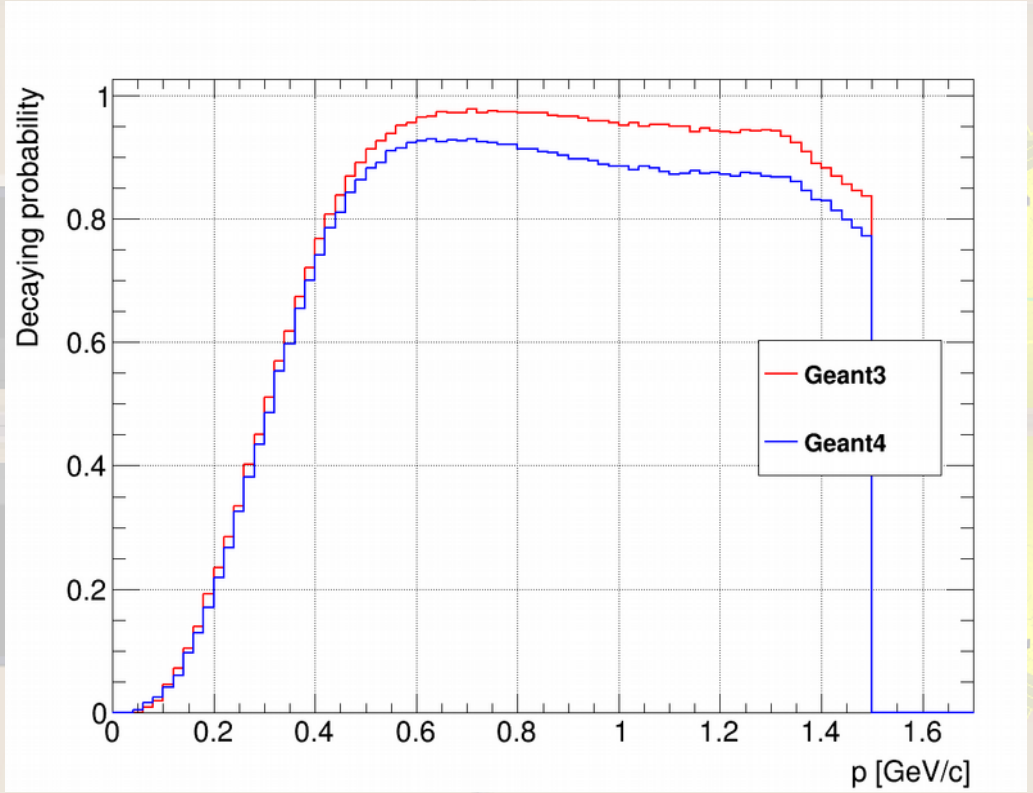
Geant3: 21.3 %

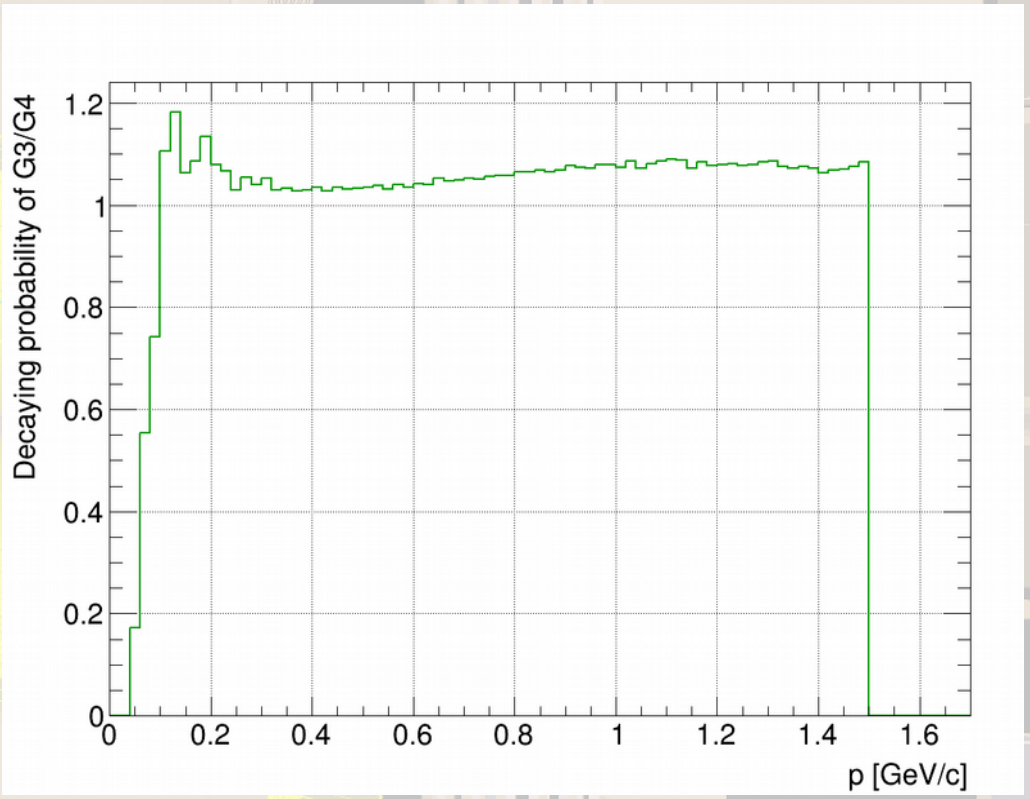
Geant4: 22.1 %

→ acceptable for our main topic

Comparison: Geant3 and Geant4

decays in flight





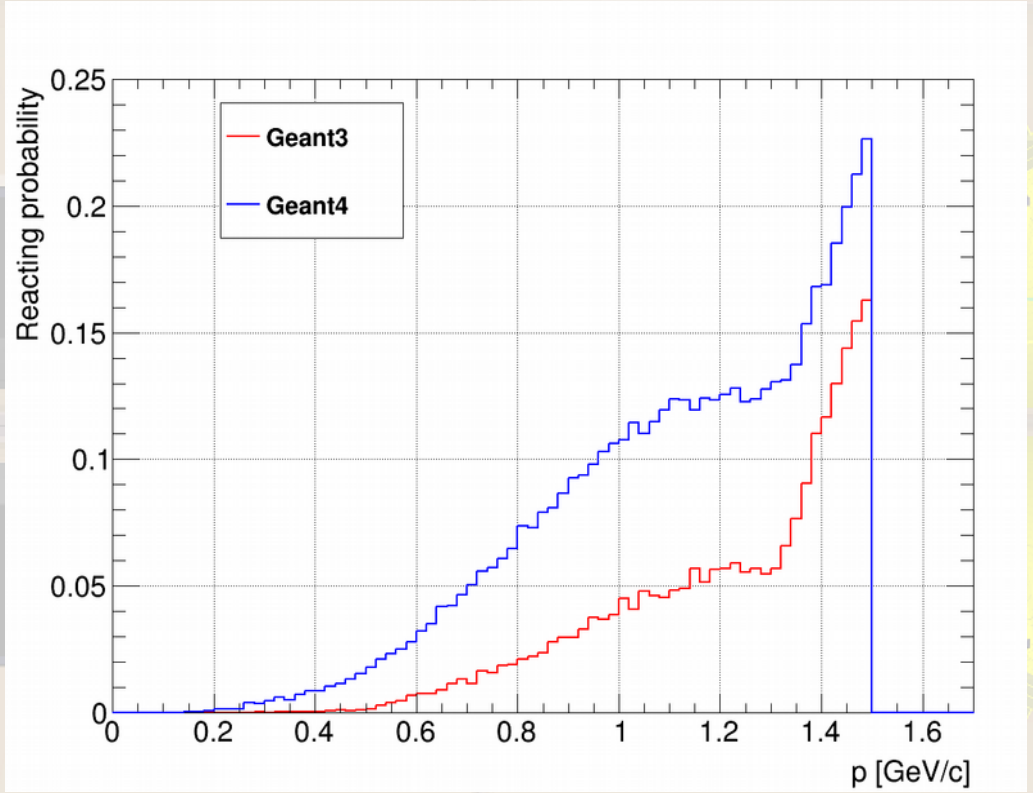
Geant3: 75.6 %

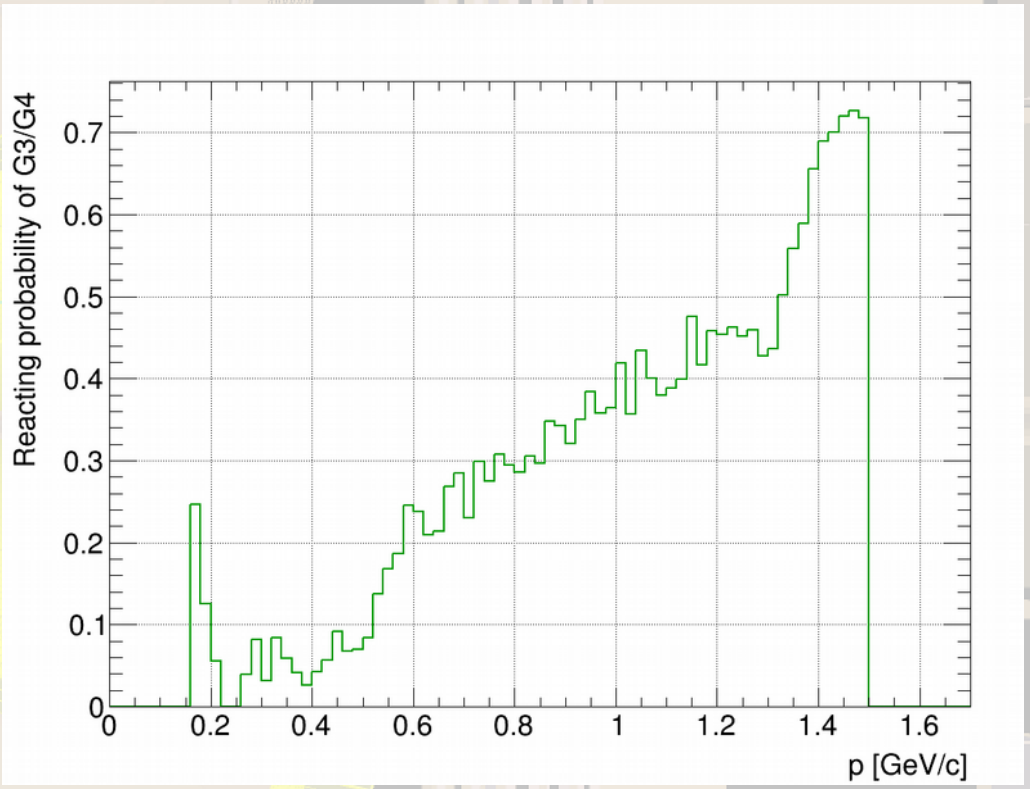
Geant4: 71.1 %

→ significant difference

Comparison: Geant3 and Geant4

reactions





Geant3: 3.1 %

Geant4: 6.8 %

→ significant difference

Final conclusion

Web research:
partly „big discrepancies“ between Geant3 and Geant4 reported for calorimeter simulations

→ decision to use Geant4 with recent modifications in our code