Di-muon simulations with Geant4 : Preliminary results

Sanchari Thakur

In collaboration with :

Partha Pratim Bhaduri,
Nilay Kr. Bhowmik & SK Anowar

Variable Energy Cyclotron Centre, Kolkata, India

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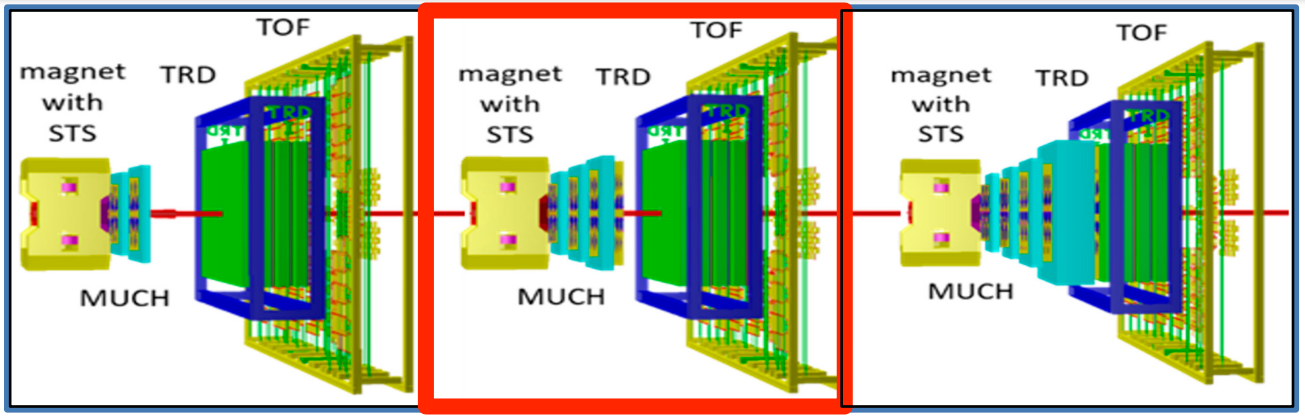
OUTLINE:

- MuCh setup for di-muon analysis
- Simulation details
- Comparison between Geant3 and Geant4 in :
  - MC level
  - Digi level
  - Reconstructed level
- Summary and Outlook

Di-muon analysis in CBM experiment at FAIR: Muon Chamber Setup



Case 1 | Case 2 | Case 3

- 3 absorbers+ 2 tracking stations
- E_{beam} < 4A GeV & M_{inv} <= 1 GeV/c^2

- 4 Absorbers + 4 Tracking stations
- E_{beam} > 4A GeV & M_{inv} <= 1 GeV/c^2

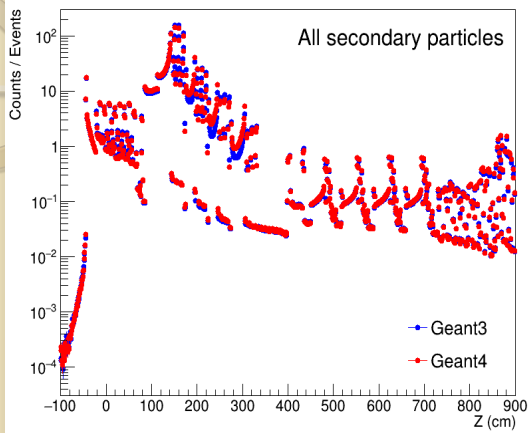
- 5 absorbers+ 4 tracking stations
- M_{inv} > 1 GeV/c^2

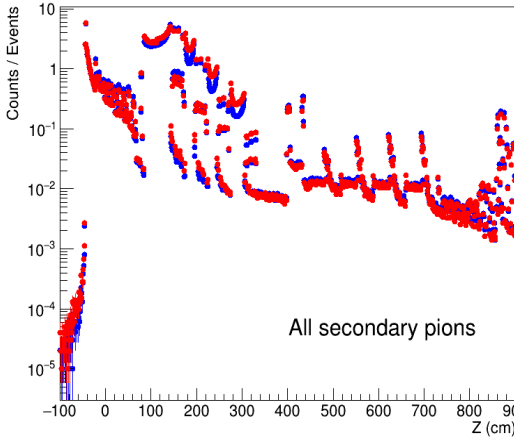
LMVM Setup

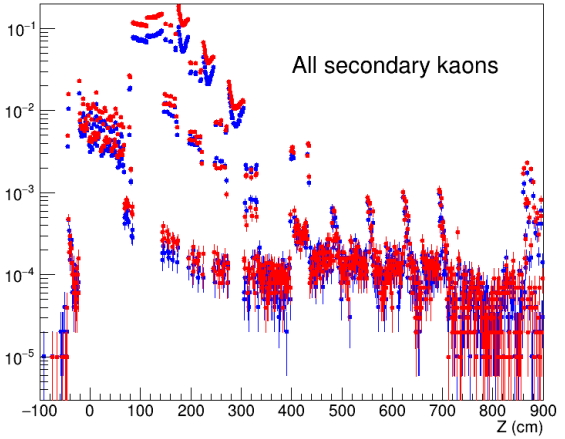
Di-muon analysis in CBM experiment at FAIR: simulation details

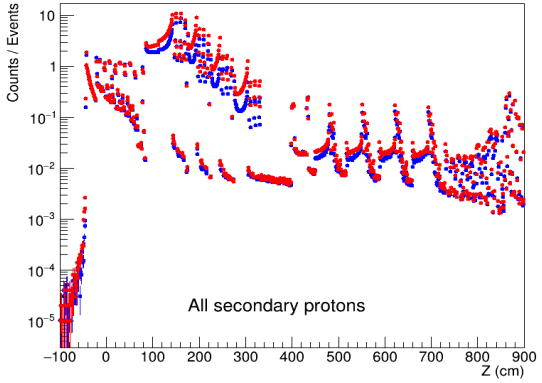
Input file:	UrQMD
System:	Au+Au central at 10A GeV/c
Events analyzed:	1M
Geometry Setup:	sis100_muon_lmvm (v21c)
CBM Root version:	CBMROOT 22092025
Transport engine:	GEANT3 and GEANT4
Primary selection:	Geant process id = 0
Reconstructible tracks:	• STS points ≥ 7 • MuCh points ≥ 11 • TRD points ≥ 1 • TOF points ≥ 1
Analysis:	• MC level (transport.C) • Digi Level (digi.C) • Reco Level (reco_event.C,)

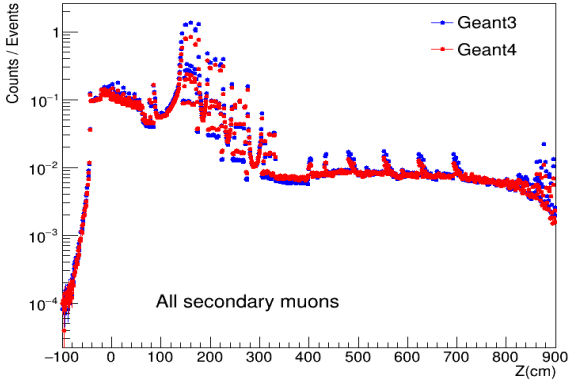
Secondary MC particle production in the absorbers



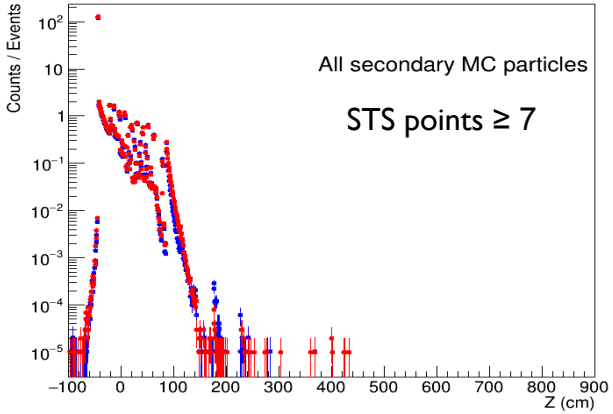


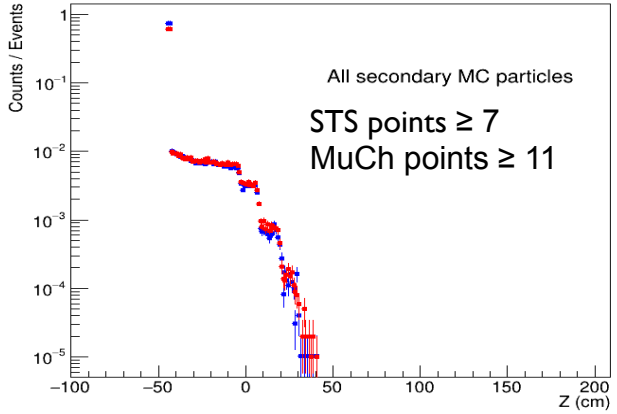


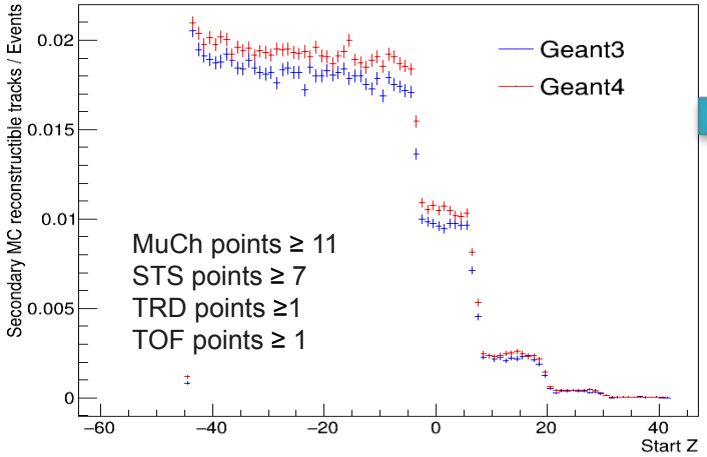




Secondary MC particle production in the absorbers

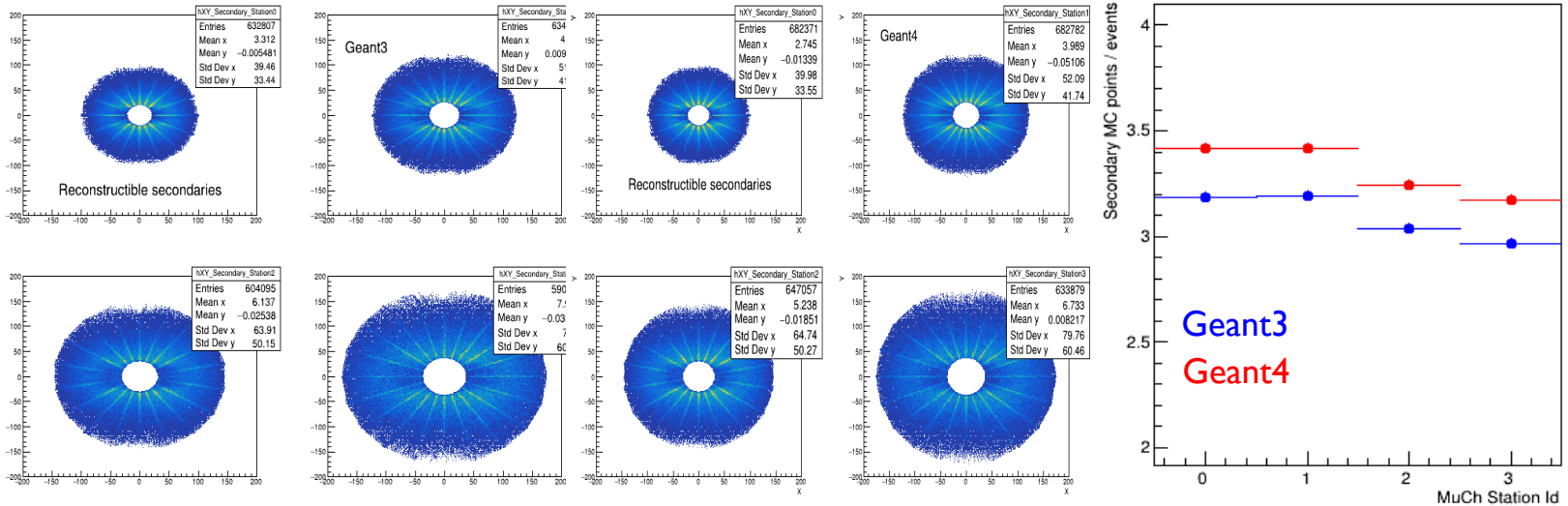






Reconstructible
Secondary MC tracks

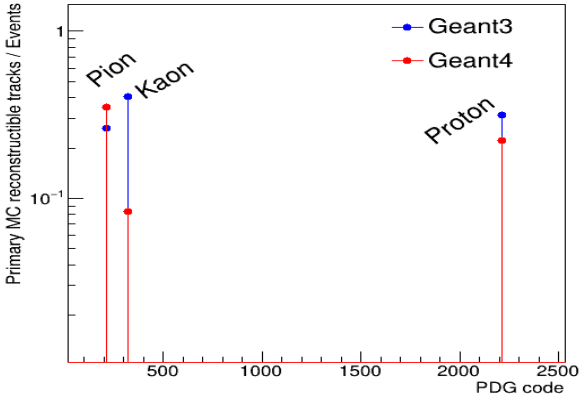
Station-wise XY distribution of secondary MuCh points

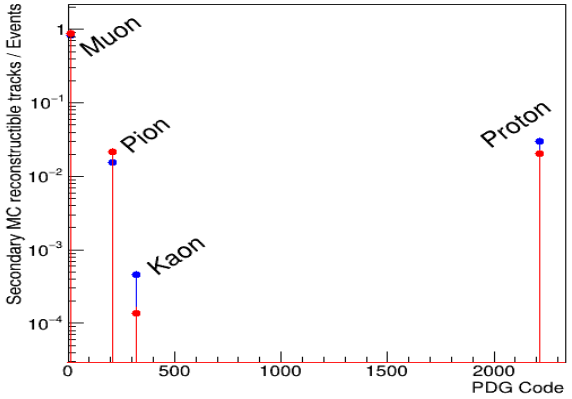


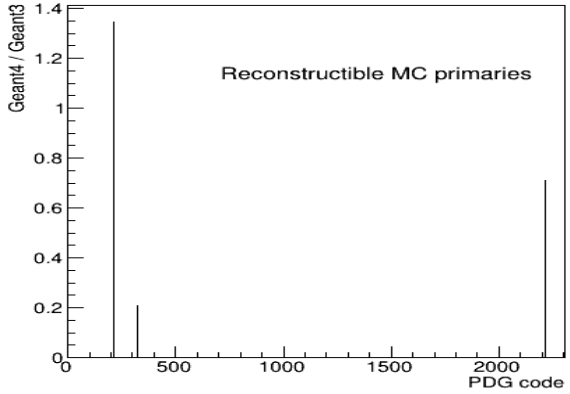
Geant3 Geant4

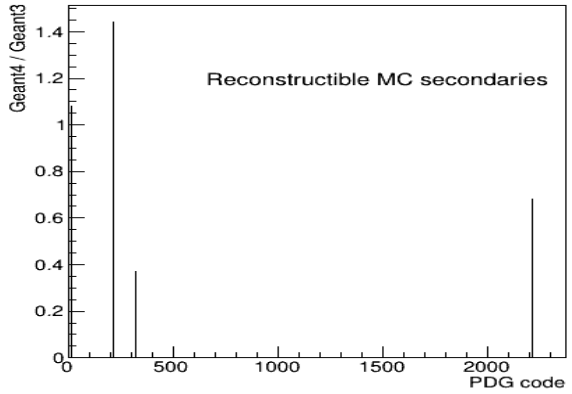
The MuCh points are associated with the reconstructible MC tracks satisfying the cuts:
No. of MuCh points ≥ 11, STS points ≥ 7, TRD points ≥1 and TOF points ≥ 1

Particle compositions in the reconstructible MC tracks



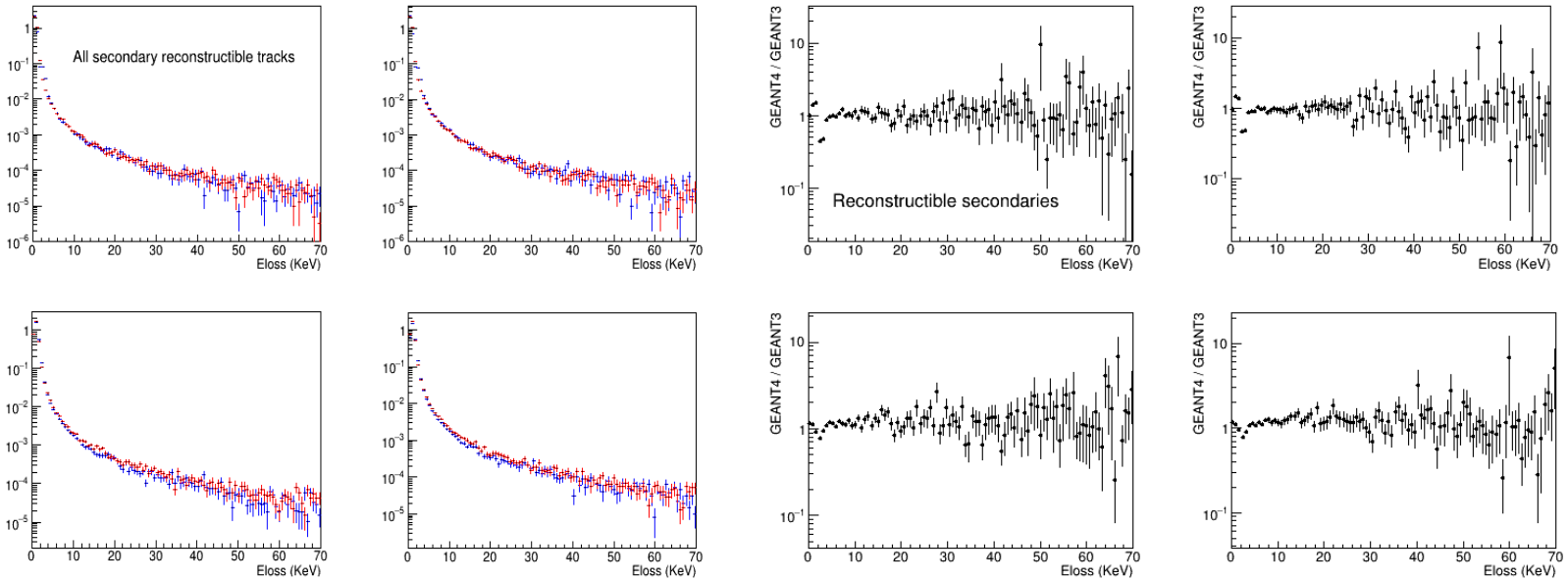






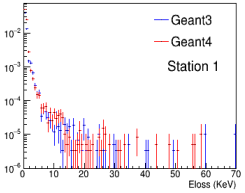
Cuts used: No. of MuCh points ≥ 11, STS points ≥ 7, TRD points ≥1,TOF points ≥ 1

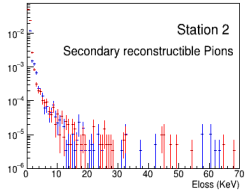
Station-wise energy loss distribution of MuCh points

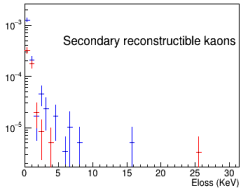


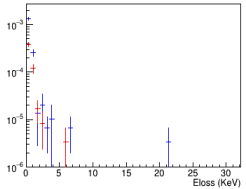
The MuCh points are associated with the reconstructible MC tracks satisfying the cuts: No. of MuCh points ≥ 11, STS points ≥ 7, TRD points ≥1 and TOF points ≥ 1

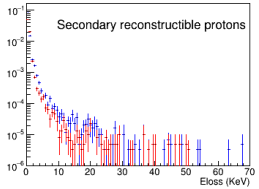
Energy loss of identified secondary reconstructible MC tracks

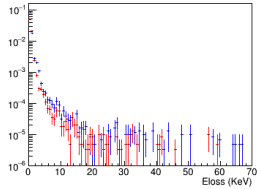


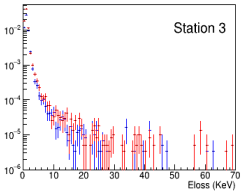


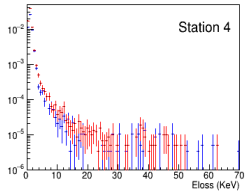


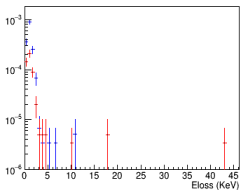


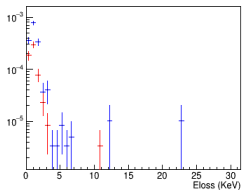


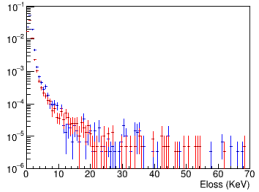


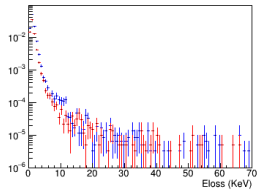


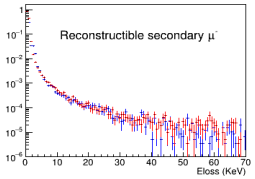


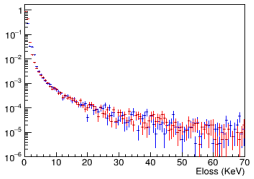


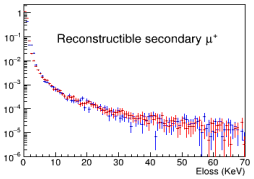


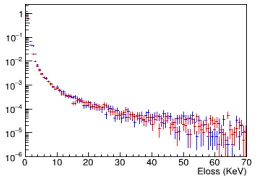


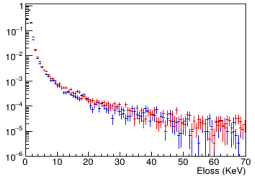


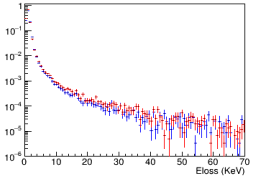


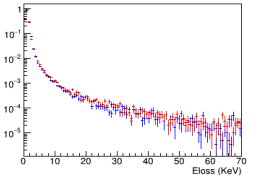


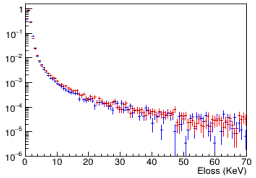




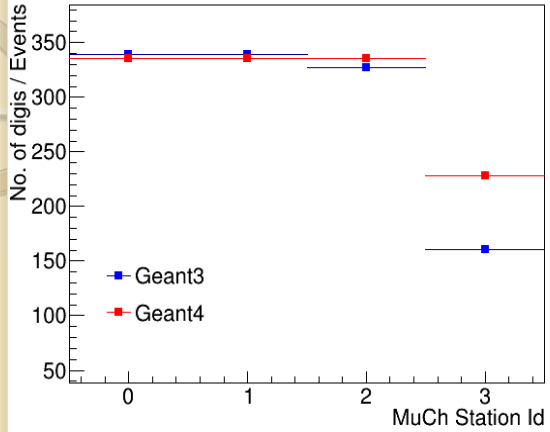


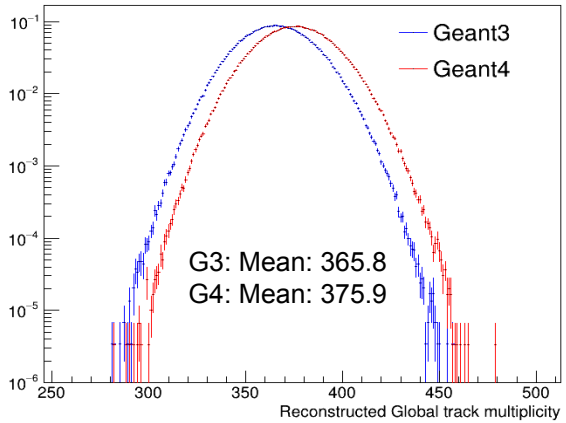


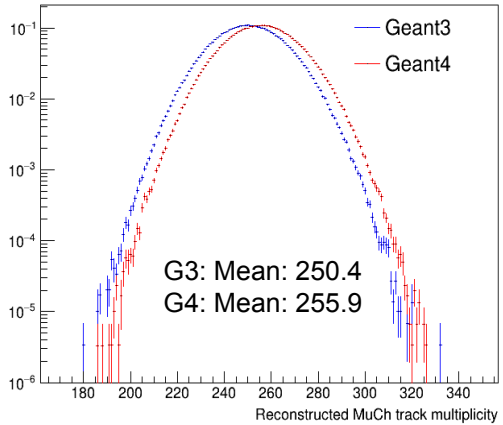




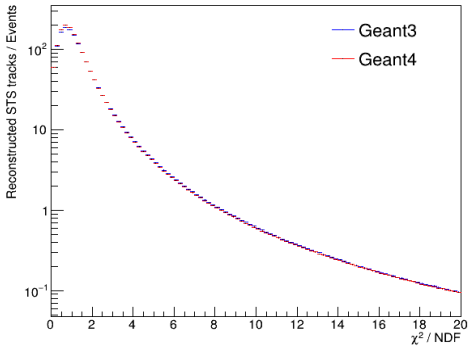
MuCh station-wise digi Multiplicity Distribution at Reconstructed level

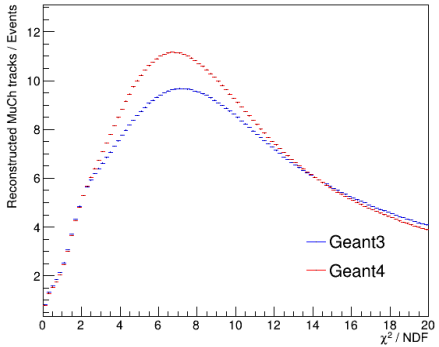




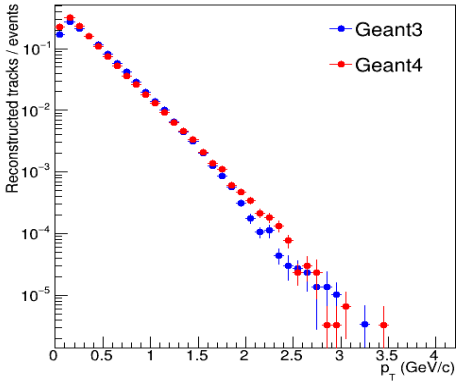


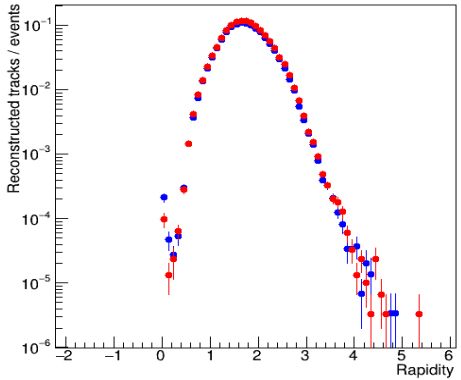
χ2 distribution of reconstructed MuCh and STS tracks

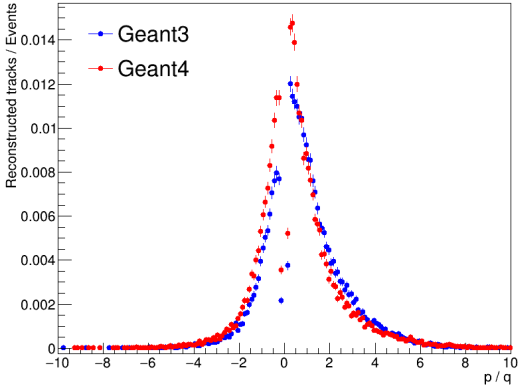


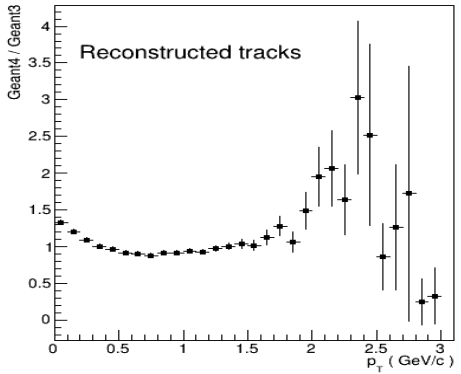


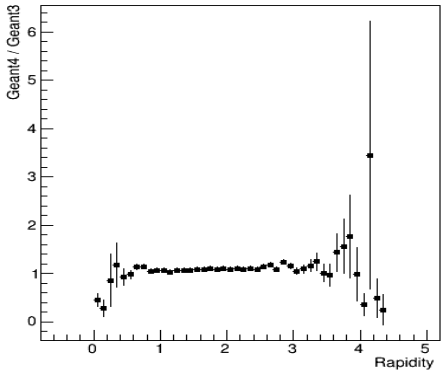
p_T and rapidity distribution of reconstructed muon candidates







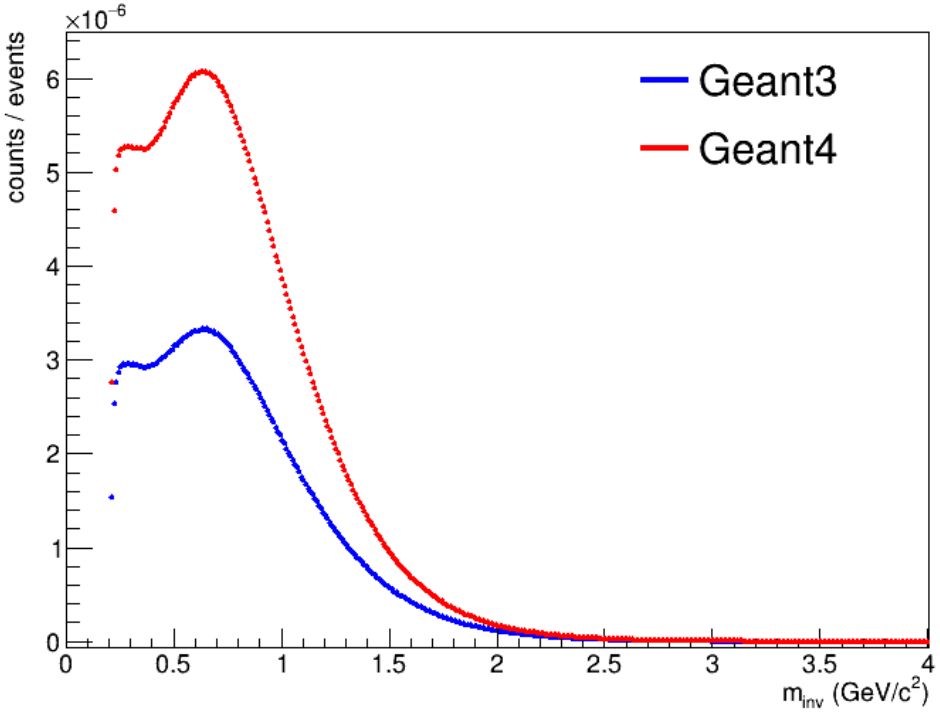




Cuts used:

No. of MuCh hits ≥ 11
STS hits ≥ 7
TRD hits ≥1
TOF hits ≥ 1
χ^2_{sts} < 2.6
χ^2_{much} < 3.0
χ^2_{vertex} < 2.4

Combinatorial background comparison (Reconstructed level)



Cuts used:

No. of MuCh hits ≥ 11
No. of STS hits ≥ 7
No. of TRD hits ≥1
No. of TOF hits ≥ 1

$\chi^2_{sts} < 2.6$
$\chi^2_{much} < 3.0$
$\chi^2_{vertex} < 2.4$

Summary and outlook

- Comparison of the simulation results between Geant3 and Geant4 using LMVM setup for 1M events
- Studied secondary MC particle production through the absorbers
- MuCh station-wise density distribution of secondary MC particles and their energy loss distributions
- Multiplicity distribution of reconstructed tracks, transverse momentum and rapidity distribution of the muon candidates at reconstructed level
- Combinatorial background comparison between Geant3 and Geant4
- Next step is to study the comparison in more detailed way with full 5M statistics
- To repeat the full analysis with new configuration (2 GEM and 2 Straw tubes)

Acknowledgement: Anna Senger and Sayak Chatterjee

Thank You