Summary of Hadronic Parallel Session 6A

Alberto Ribon
CERN EP-SFT

Geant4 Collaboration meeting, Sapporo, 29 September 2023

Parallel Session 6A : Hadronic Physics **2**

- Miguel Antonio Cortes-Giraldo "*n_TOF flux validation*"

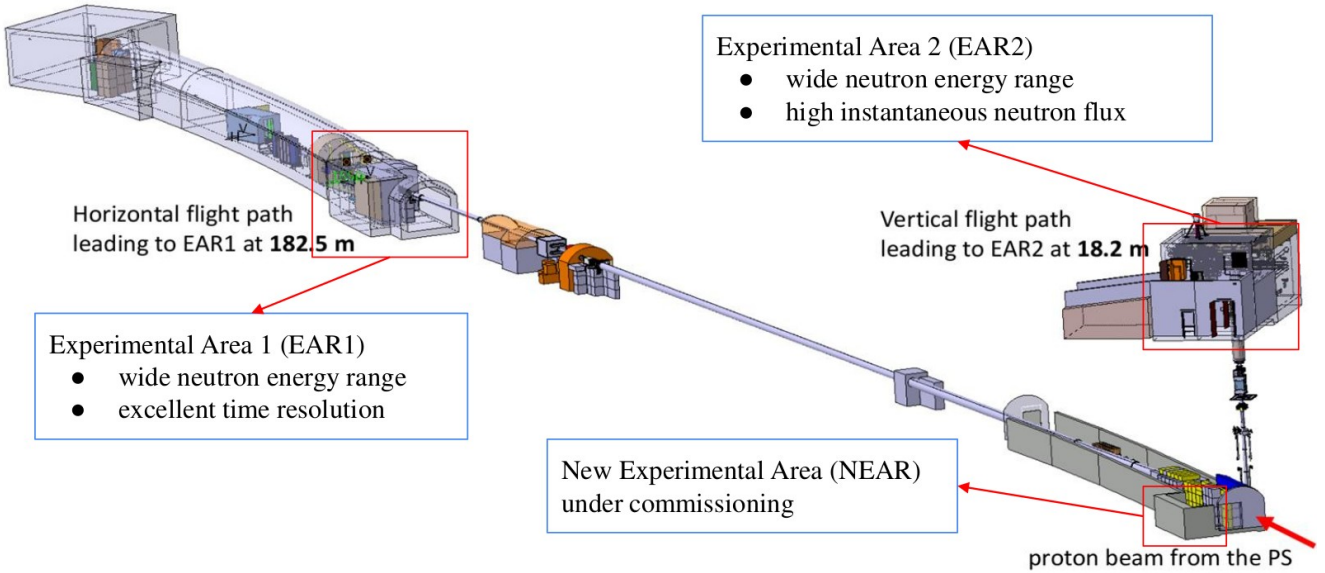
- Kihyeon Cho "*Beam simulation depending on physics lists*"
  - Related to both hadronic physics and physics lists

Miguel Antonio Cortes-Giraldo

“*n_TOF flux validation*”

Moira simulations for n_TOF

JA Pavón-Rodríguez[1,2], MA Cortés-Giraldo[1], M. Sabaté-Gilarte[2], A. Donadón-Servelle[2,3], V. Vlachoudis[2] , JM Quesada[1]



The CERN PS accelerator provides **n_TOF** with a 20 GeV/c proton beam, with a repetition rate of 1.2 s, avoiding any overlapping between consecutive neutrons pulses.

Moira simulations for n_TOF

JA Pavón-Rodríguez[1,2], MA Cortés-Giraldo[1], M. Sabaté-Gilarte[2], A. Donadón-Servelle[2,3], V. Vlachoudis[2] , JM Quesada[1]

Moira (μοίρα, /ˈmi:ra/) is a new application (C++), Geant4-based, progressively incorporating all FLUKA core functionalities. It provides Geant4 Physics, while FLUKA Physics are being implemented.

Moira presents a tool to **run FLUKA** and **Geant4** with **identical geometry** configurations and draw more robust comparisons between this two well-established MC codes.

Moira simulations for n_TOF

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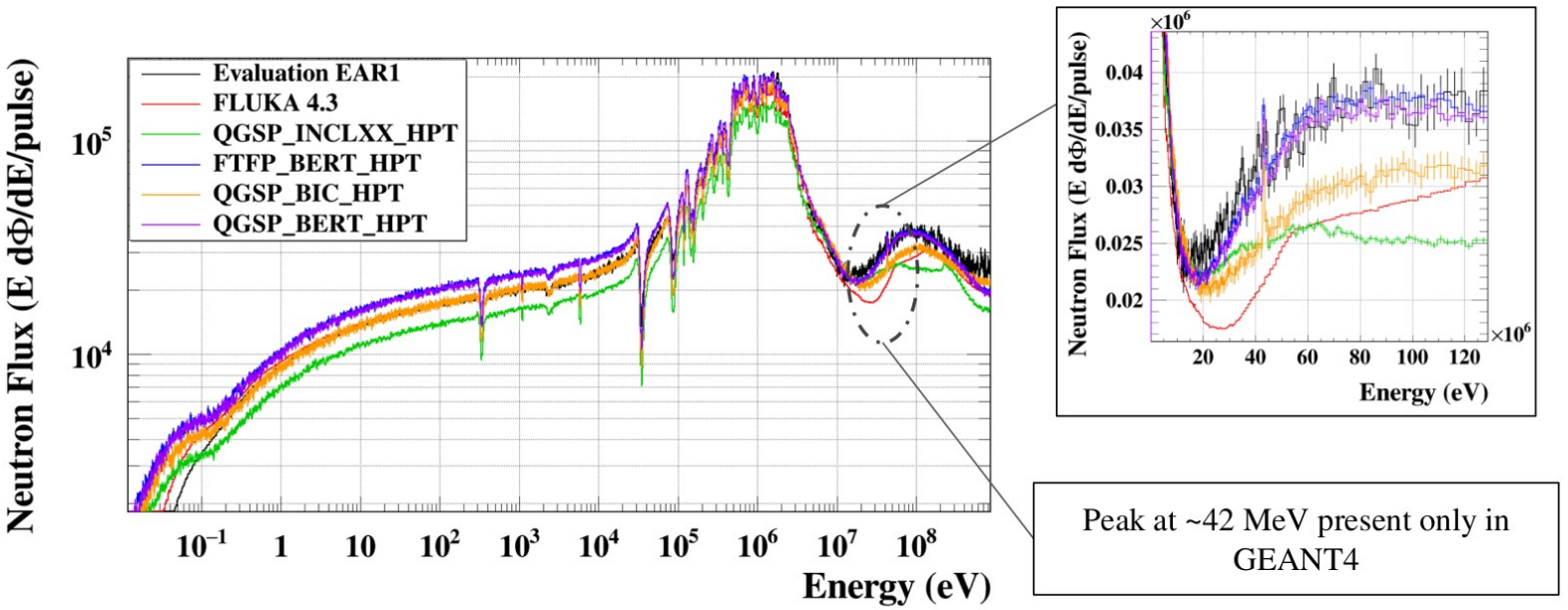
EAR1 simulations and experimental results

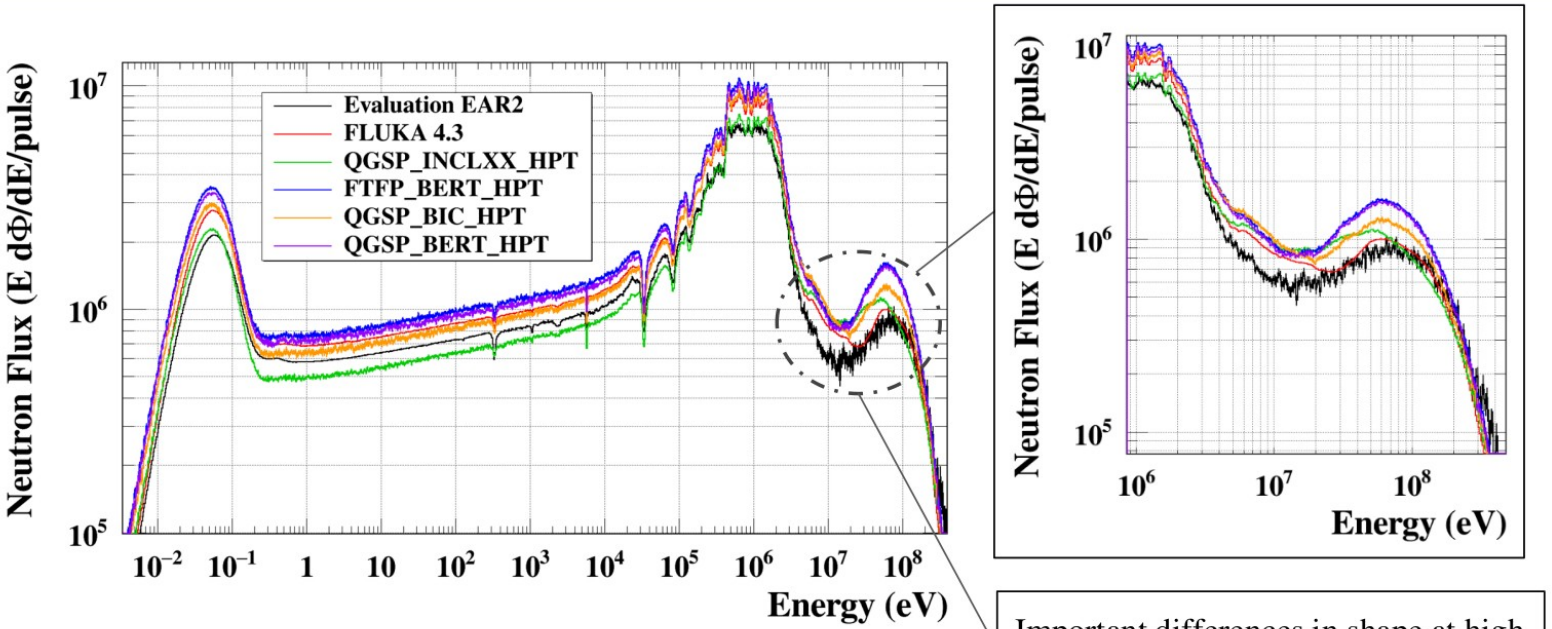


All physics lists incorporate **G4ThermalNeutrons** (< 4 eV)

Moira simulations for n_TOF

JA Pavón-Rodríguez[1,2], MA Cortés-Giraldo[1], M. Sabaté-Gilarte[2], A. Donadón-Servelle[2,3], V. Vlachoudis[2] , JM Quesada[1]

EAR2 simulations and experimental results



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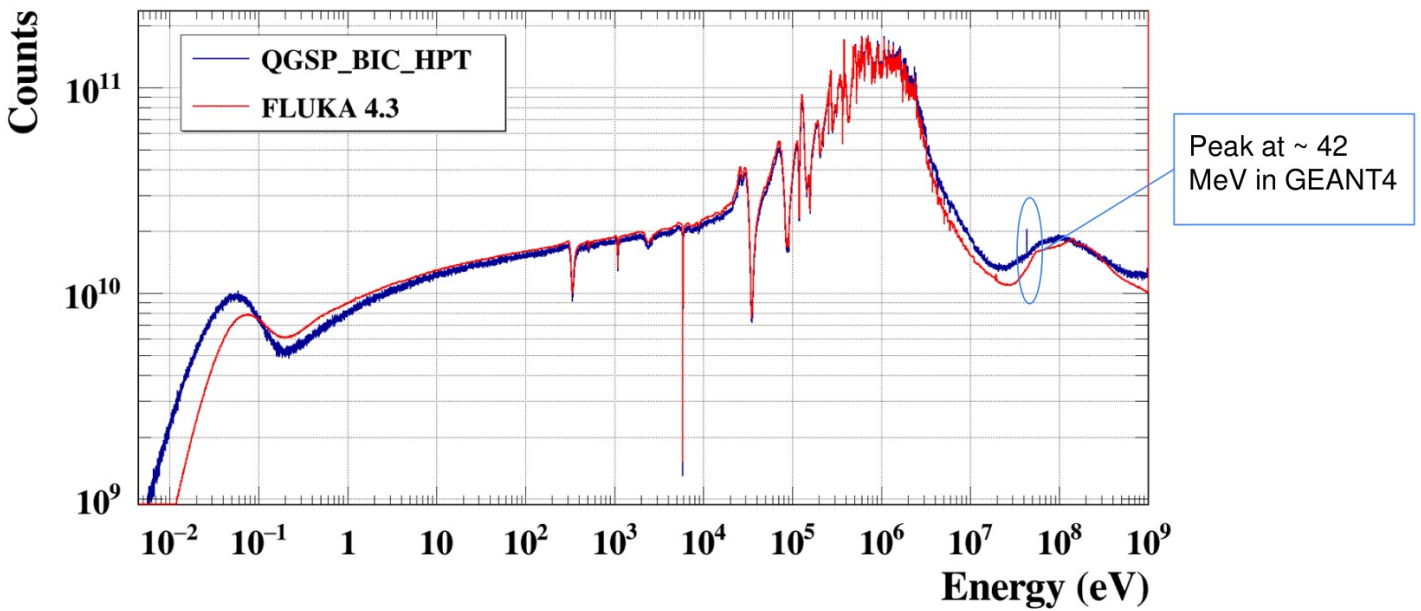
Moira simulations for n_TOF

JA Pavón-Rodríguez[1,2], MA Cortés-Giraldo[1], M. Sabaté-Gilarte[2], A. Donadón-Servelle[2,3], V. Vlachoudis[2] , JM Quesada[1]

FLUKA and Geant4 simulations at EAR1 scoring plane



Seems to be essentially due to neutrons emitted below 1 deg w.r.t. proton beam.

Kihyeon Cho

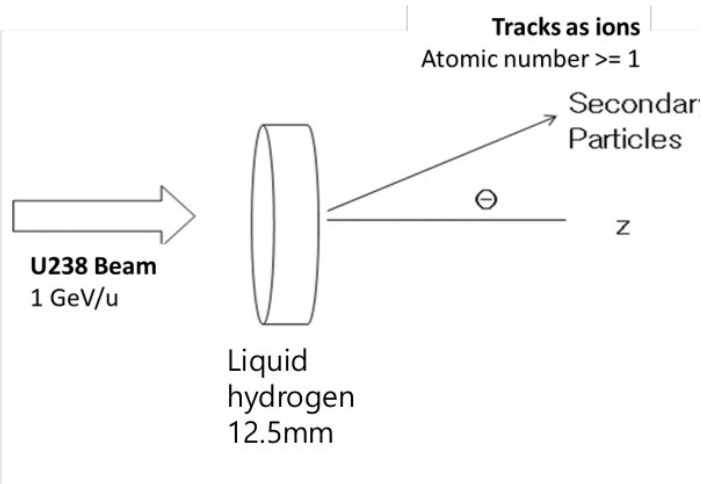
“*Beam simulation depending on physics lists*”

Beam simulation depending on physics lists

Kihyeon CHO (KISTI/UST)
Kyungho KIM (KISTI)

Conditions

- Conditions of experiments
  - Geant4 version: 11.0.2
  - 1 million events per each condition



Schematic of simulation

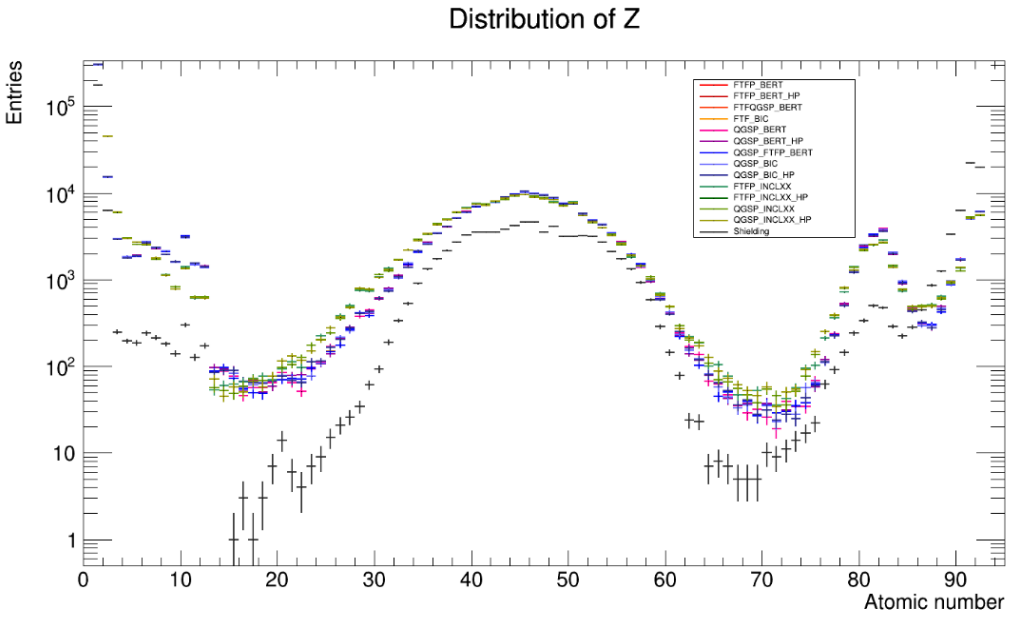
Simulation	Geant4 Beam		Target	
	Particle	Energy (MeV/u)	Materials	Thickness (mm)
U → Liquid Hydrogen	U	1000	Liquid Hydrogen	12.5

Beam & target conditions for validation

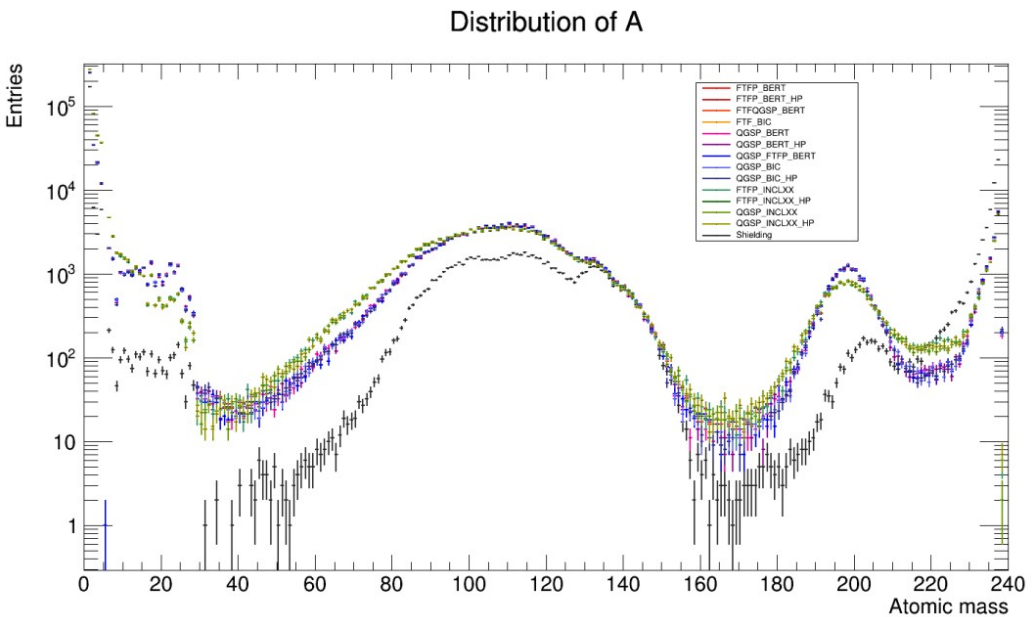
Beam simulation depending on physics lists

Kihyeon CHO (KISTI/UST)
Kyungho KIM (KISTI)

Distribution: Atomic Number



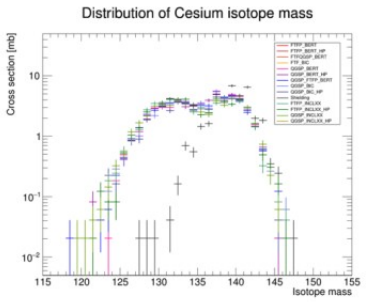
Distribution: Atomic Mass



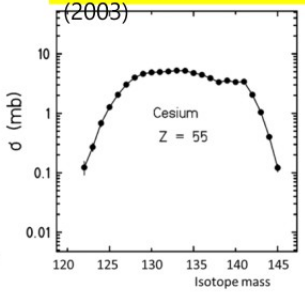
Beam simulation depending on physics lists

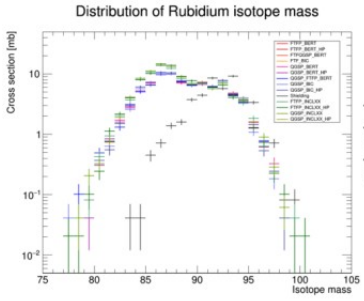
Kihyeon CHO (KISTI/UST)
Kyungho KIM (KISTI)

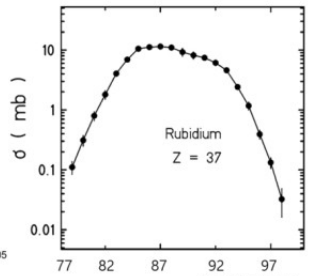
2) Validation compared with experiments



M. Bernas et al., Nucl. Phys. A 725, 213 (2003)







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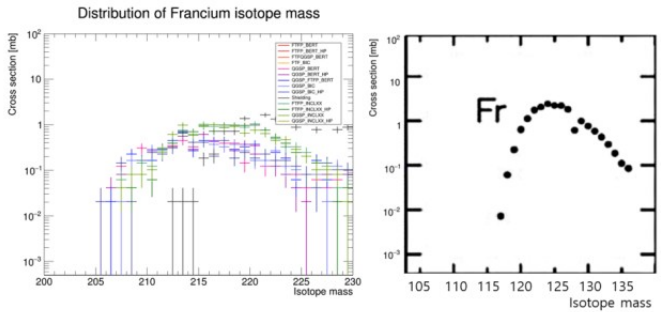
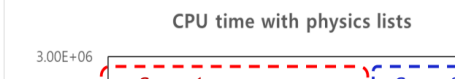


J. Taieb et al., Nucl. Phys. A 724, 413 (2003)

3) Cost effective CPU time

- Excluding 'Shielding' for our suitable list (due to long runtime)
- Others look same.
  - Any physics list (except Shielding) would be OK.
- What would be the best?

  => **FTFP_INCLXX**(_HP)



Beam simulation depending on physics lists

Kihyeon CHO (KISTI/UST)
Kyungho KIM (KISTI)

Conditions

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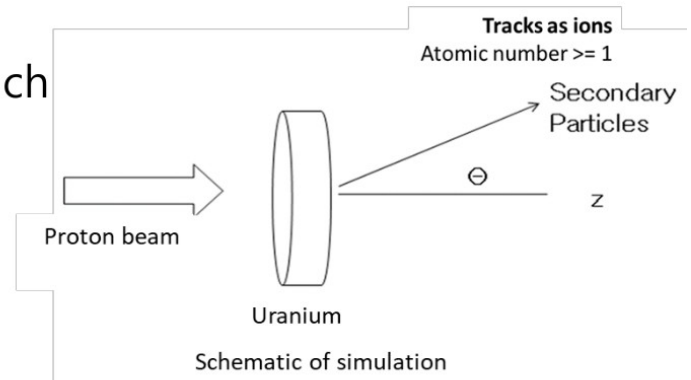

Schematic of simulation

Simulation	Geant4 Beam		Target	
	Particle	Energy (MeV/u)	Materials	Thickness (mm)
Proton → U	Proton	100, 200, 500, 1000	Uranium	6
Proton → U	Proton	100	Uranium	1, 2, 5, 6, 10

Beam & target conditions for validation

Beam simulation depending on physics lists

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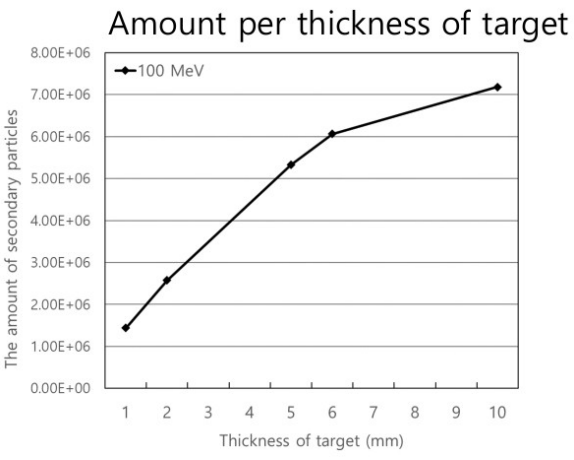
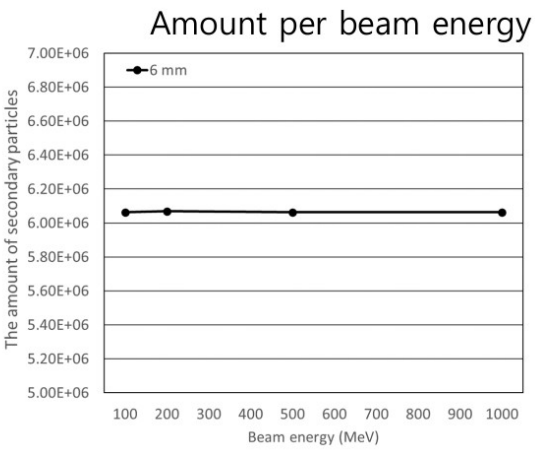
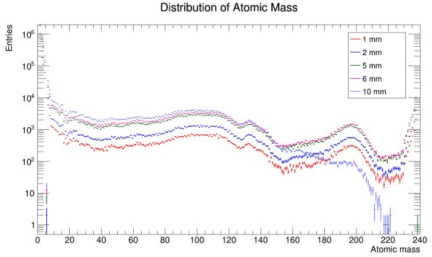
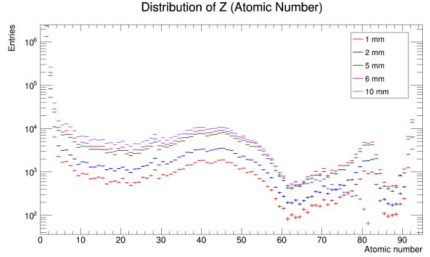
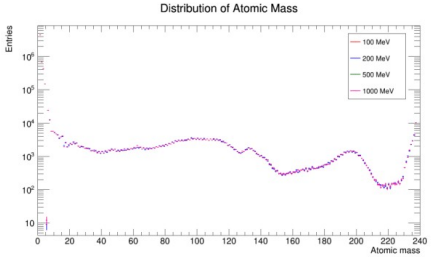
Amount of Secondary Particles

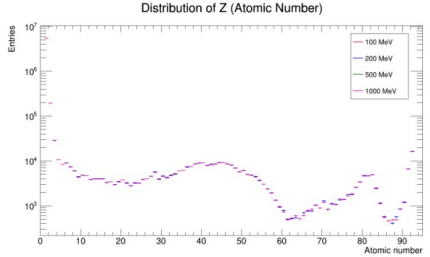












Kihyeon CHO (KISTI/UST)
Kyungho KIM (KISTI)

3. Summary & Plan

1. We studied heavy ion beam simulation on WGeant4.
   - We found the optimized physics lists among Geant4 reference physics lists.
   - The most optimized physics list is FTFP_INCL++(_HP).
2. Next, we will test $^{132}Sn/^{238}U$ beam emission to ^{9}Be target with various target thickness => RAON experiment

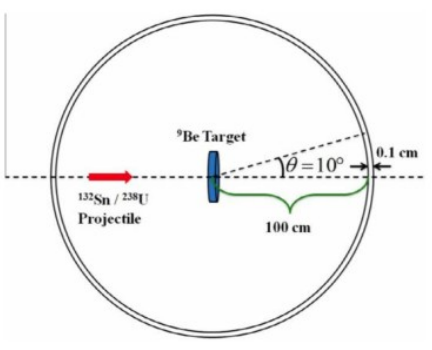
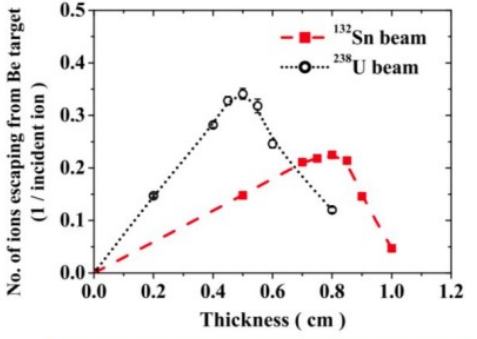


Fig. 9. Schematic diagram of the simulation setup.



J. W. Shin et al., NIM B 349, 221 (2015)