Monte Carlo Simulation Study for Verification of Target and Beamline on µSR Facility in RAON

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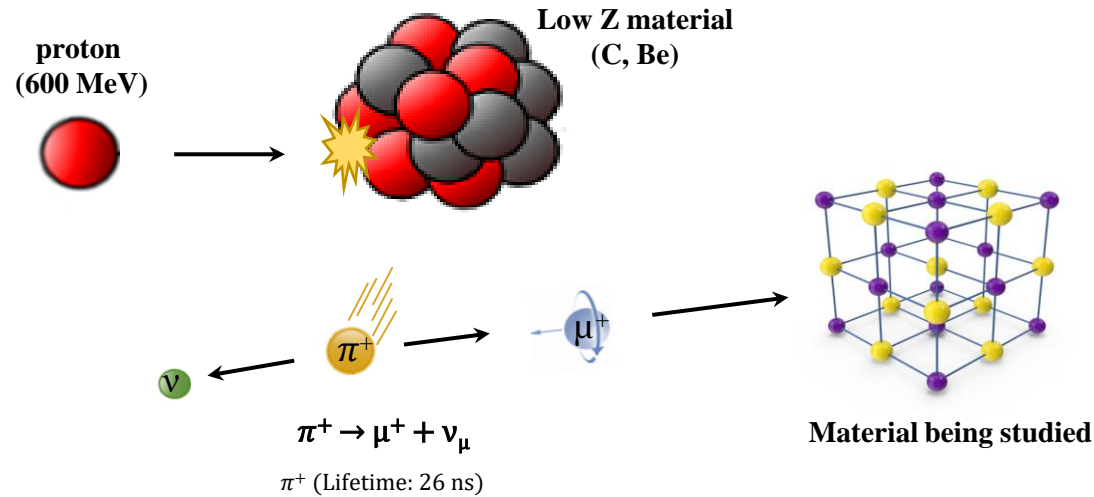*Monte Carlo Simulation for Verification of μSR facility*
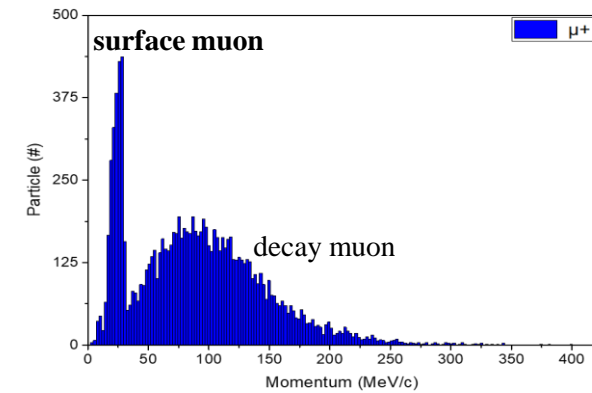
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Chapter1. Introduction

What is μSR facility?

- Muon Spin Rotation/Relaxation/Resonance

Example of μSR experiment

proton
(600 MeV)

Low Z material
(C, Be)

Material being studied

$\pi^+ \rightarrow \mu^+ + \nu_\mu$

π^+ (Lifetime: 26 ns)

Type of muon

surface muon ($\approx$ 28.5 MeV/c)

cloud muon

decay muon

Target

surface muon

decay muon

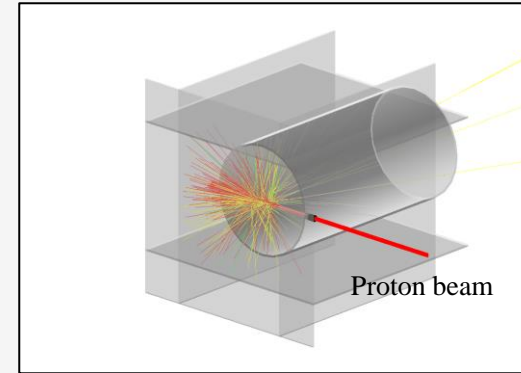µSR facility of RAON, KOREA

Design of muon beamline

Design of graphite target

Target verification

Proton beam

Beamline verification

µSR facility of RAON, KOREA

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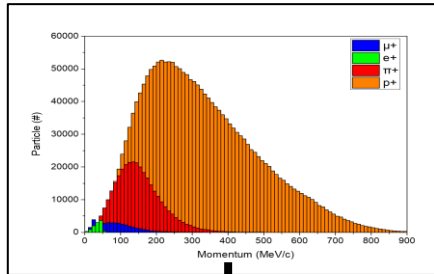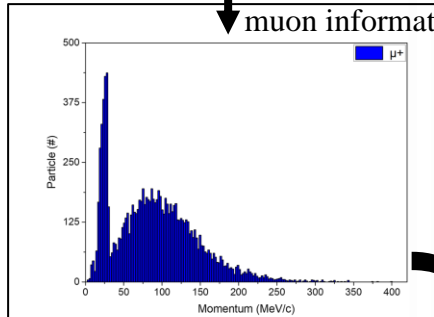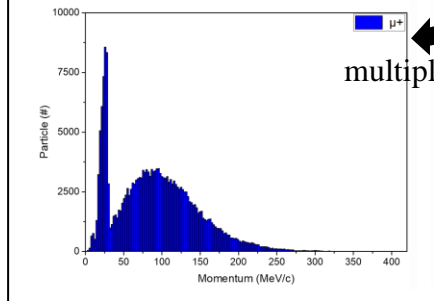
Chapter2. Methods and Results

- First of all, determination of locations of the focal planes.
- Secondly, collection of particle information at each focal plane.
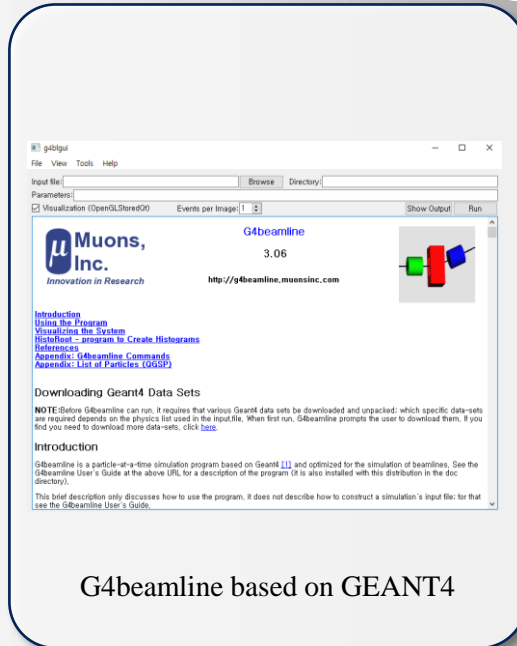- Finally, determination of particle identification (PID) methods at each focal plane.
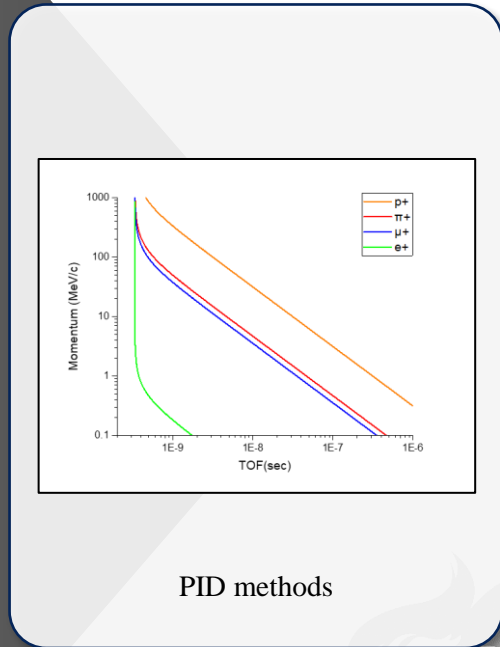

muon information

multiplication

First of methods

G4beamline based on GEANT4

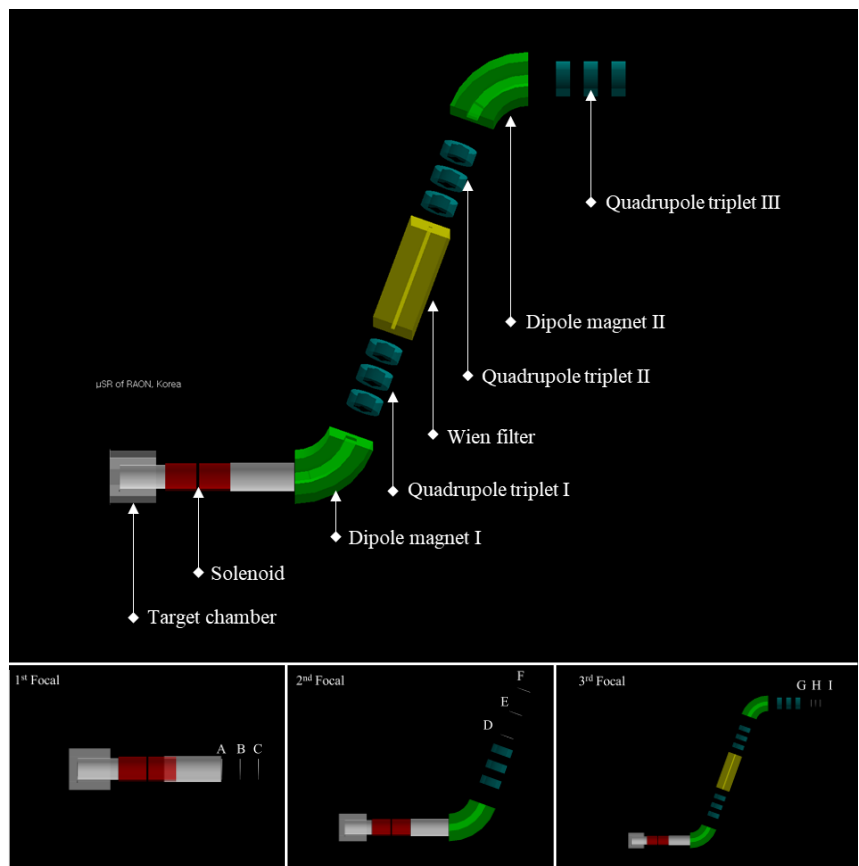**Second of methods**

Particle information at each focal plane

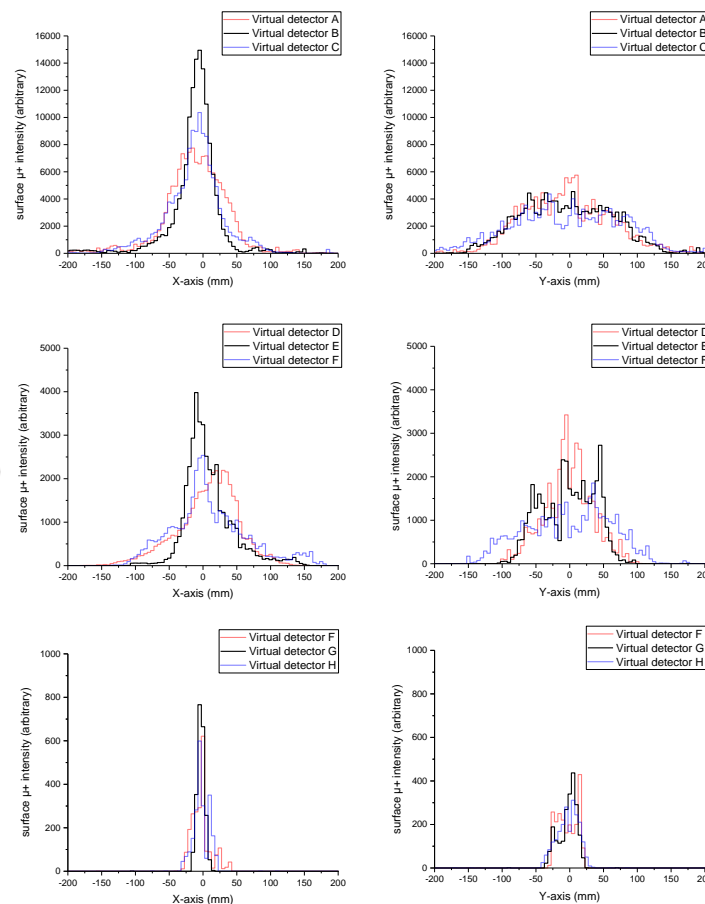| Particle	Beam intensity at focal planes (particles/s)		
	1st Focal plane	2nd Focal plane	3rd Focal plane
μ^+	1.78×10^6	2.10×10^4	8.00×10^2
surface μ^+	1.47×10^5	1.29×10^4	6.82×10^2
e^+	3.23×10^5	2.11×10^4	N/D
p^+	9.43×10^6	7.88×10^3	N/D
π^+	9.36×10^4	N/D	N/D
e^-	8.62×10^7	N/D	N/D

Finally

PID methods

Chapter2. Methods and Results

Determination of focal planes
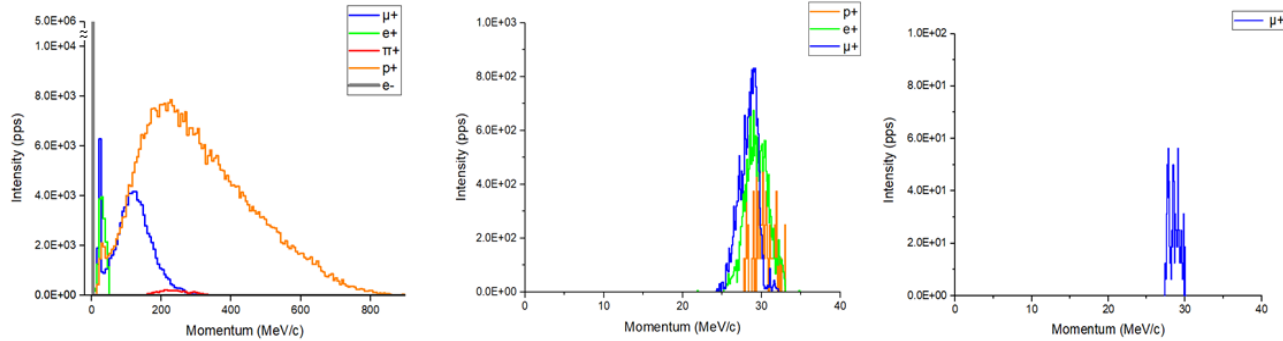

Configuration of μSR facility in RAON

Three focal planes and particle position information

Virtual detector	Distance from the end of components	
	Components position	Distance (mm)
Virtual detector A	Solenoid	1100
Virtual detector B		1550
Virtual detector C		2000
Virtual detector D	Quadrupole triplet I	390
Virtual detector E		1290
Virtual detector F		2190
Virtual detector G	Quadrupole triplet III	700
Virtual detector H		1000
Virtual detector I		1300

Chapter2. Methods and Results

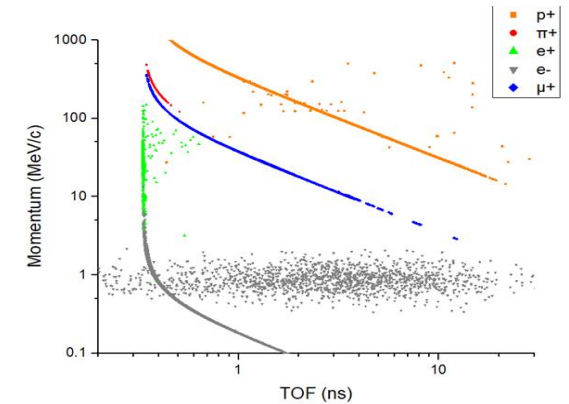## Collection of particle information

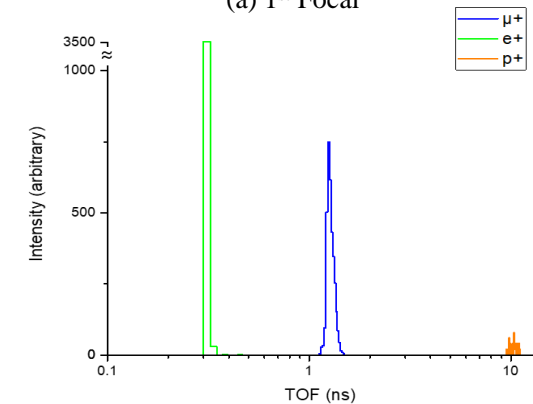(a) 1st Focal plane

(b) 2nd Focal plane

(c) 3rd Focal plane

Particle beam information

Particle	Beam intensity at focal planes (particles/s)		
	1st Focal plane	2nd Focal plane	3rd Focal plane
μ⁺	1.78×10^6	2.10×10^4	8.00×10^2
surface μ⁺	1.47×10^5	1.29×10^4	6.82×10^2
e⁺	3.23×10^5	2.11×10^4	N/D
p⁺	9.43×10^6	7.88×10^3	N/D
π⁺	9.36×10^4	N/D	N/D
e⁻	8.62×10^7	N/D	N/D

Determination of PID methods

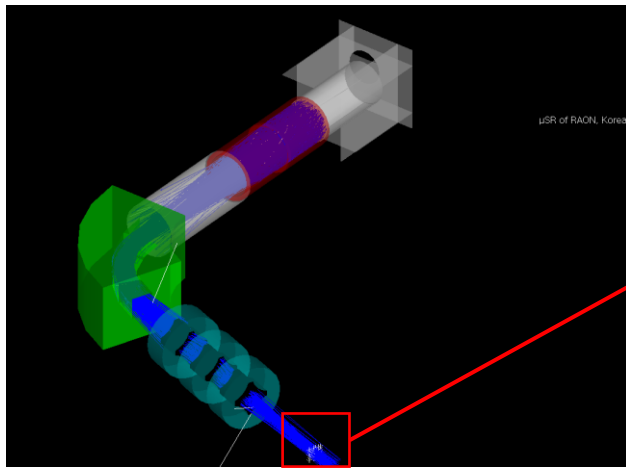
(a) 1st Focal

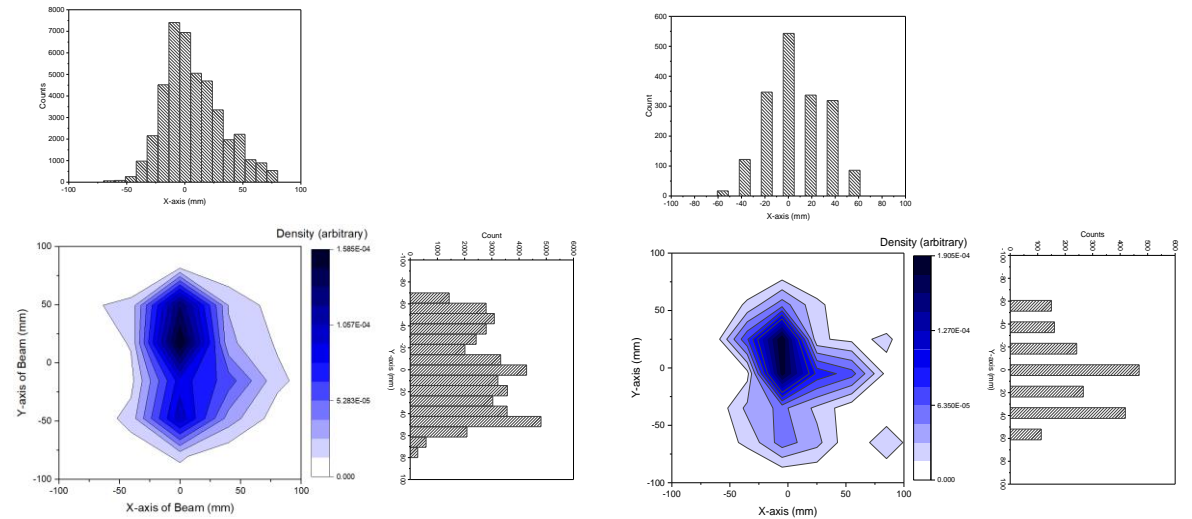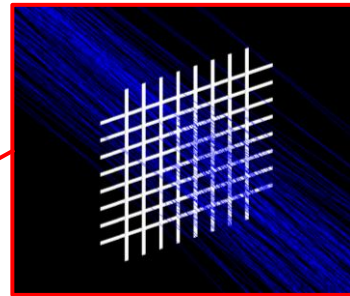(b) 2nd Focal

Example of particle identification method

Chapter3. Conclusion

➢ The proper measurement locations and PID method for the verification were determined using Monte-Carlo simulations.

➢ The result of validity was verified.

➢ Muon Beam Profile Monitor (µBPM) is required to perform measurements.

➢ The basic data for µBPM design was derived.

Example of µBPM

Example of µBPM simulation

All surface muon distribution

Detected surface muon distribution

Thanks for
your attention!

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