

ENGE Focal Plane Detector

Shunsuke NIWA

the Univ. of Tokyo

on behalf of JLab hypernuclear collaboration

Feb. 13th, 2026

Hypernuclear Collaboration Meeting 2026

Contents

Introduction

ENGE Spectrometer

ENGE Focal Plane detector

Scintillating Fibers Test

Types of Scintillating Fibers

Comparison of Detected Light Yields

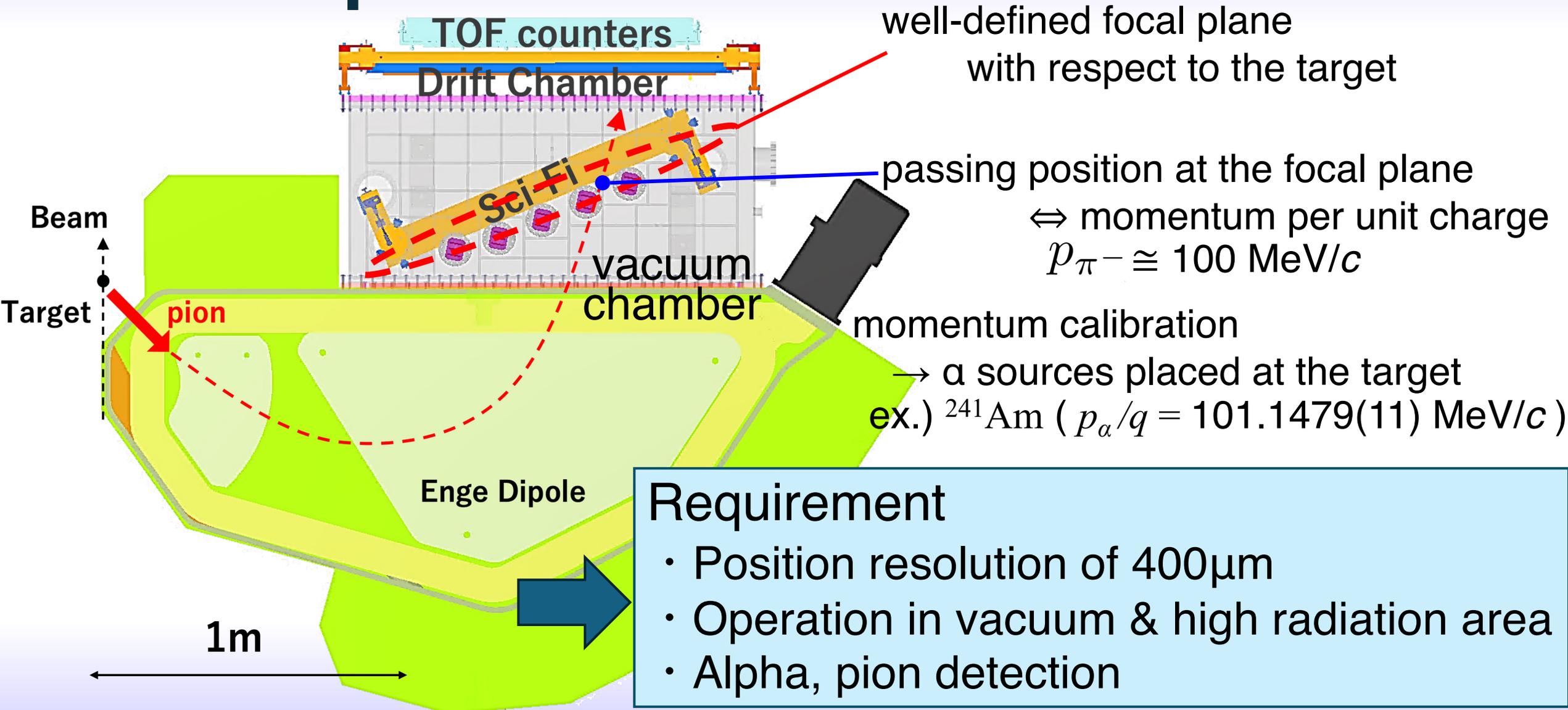
Fibers Connection Effect Test

Comparison of Detected Light Yields

Summary

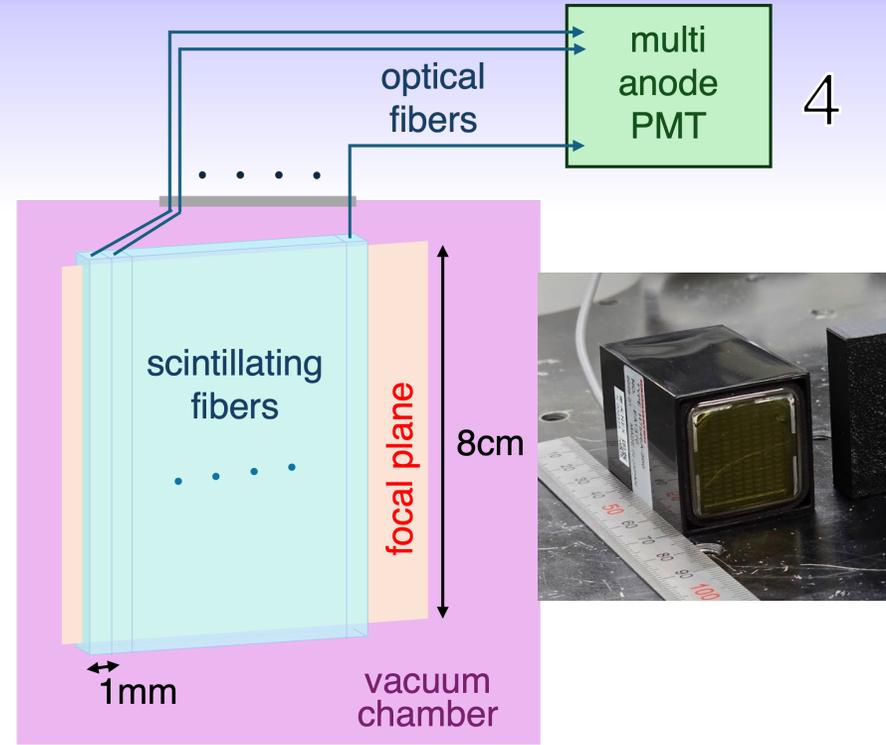
Introduction

ENGE Spectrometer

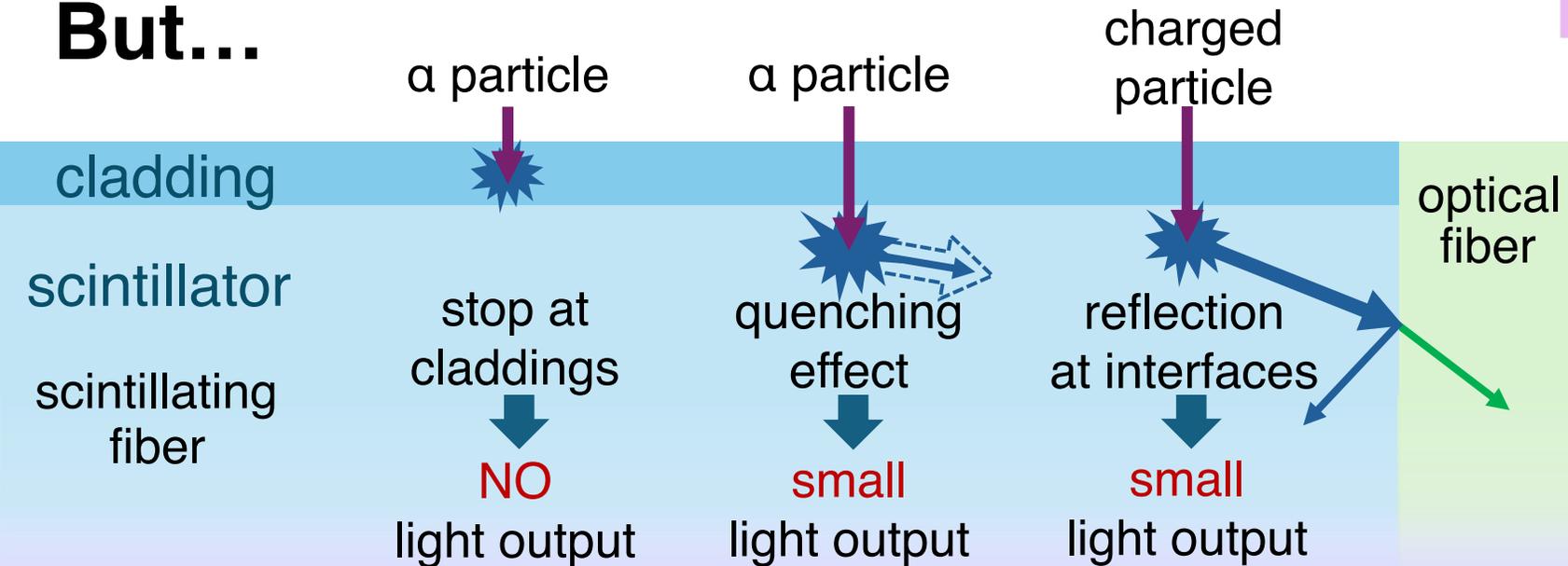


Focal Plane Detector

Focal Plane Detector Setup
 Scintillating Fiber (Kuraray Fiber)
 + Optical Fiber (clear / wavelength shifting fiber)
 + Multi-Anode Photo Multiplier Tube
 (ex. Hamamatsu H13700)



But...



light yield test

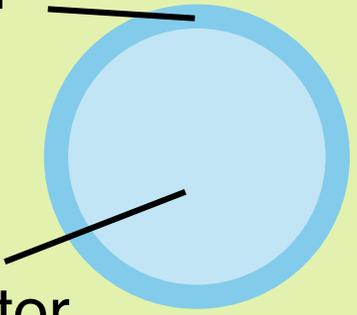
- type of scintillating fiber
- optical fiber
- α particles / MIP (β)

Scintillating Fibers Test

Types of Scintillating Fiber

*scintillating fibers provided by Kuraray

conventional fiber



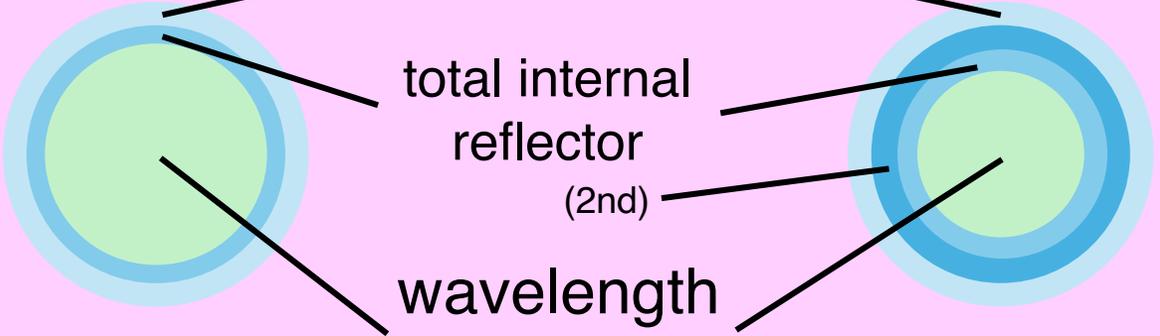
total internal reflector

scintillator

SQuared
SCSF-78SQJ

Round
SCSF-78DJ

Outer-Layer Scintillating (OLS) fiber



scintillator

total internal reflector

total internal reflector (2nd)

wavelength shifter

thick scintillator
OLS-P01

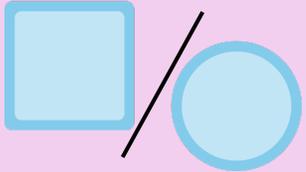
thin scintillator
OLS-3

long decay time WLS
OLS-8

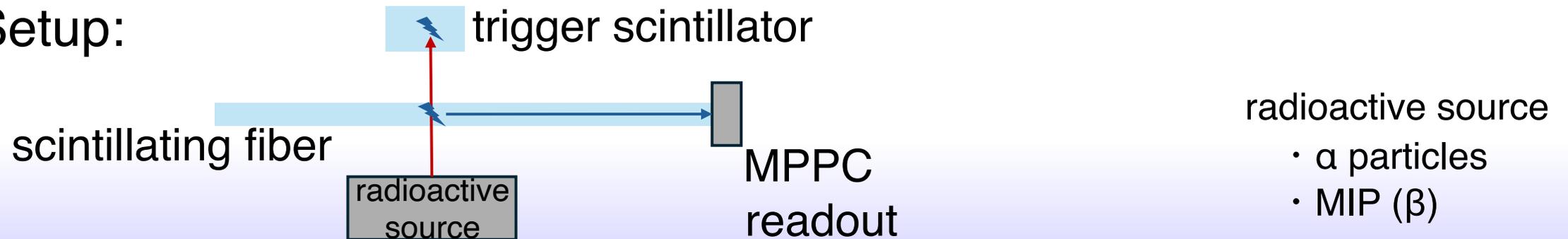
short decay time WLS
OLS-14

Scintillating Fiber Test

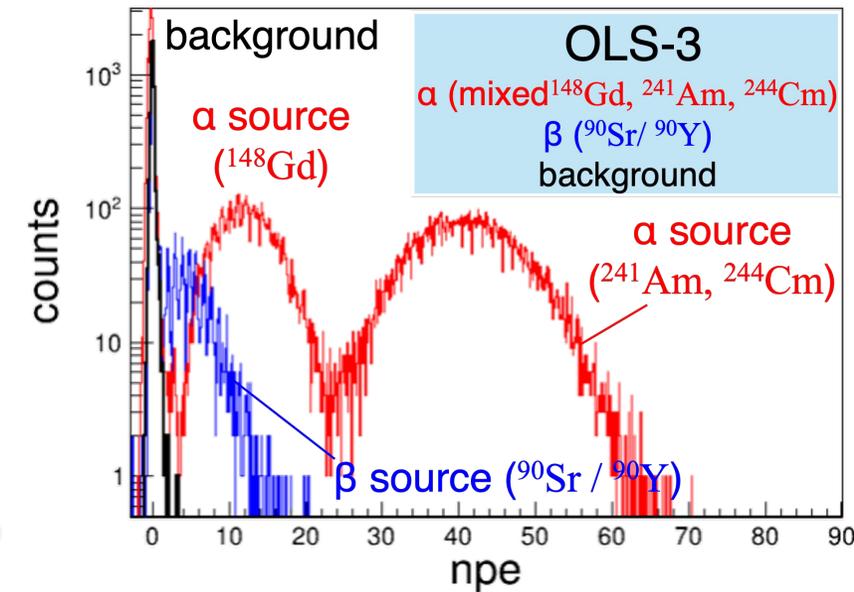
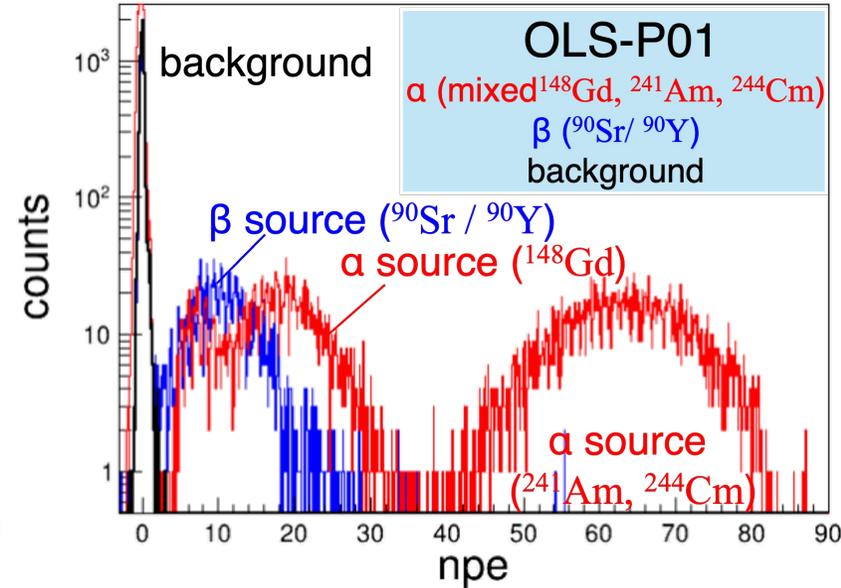
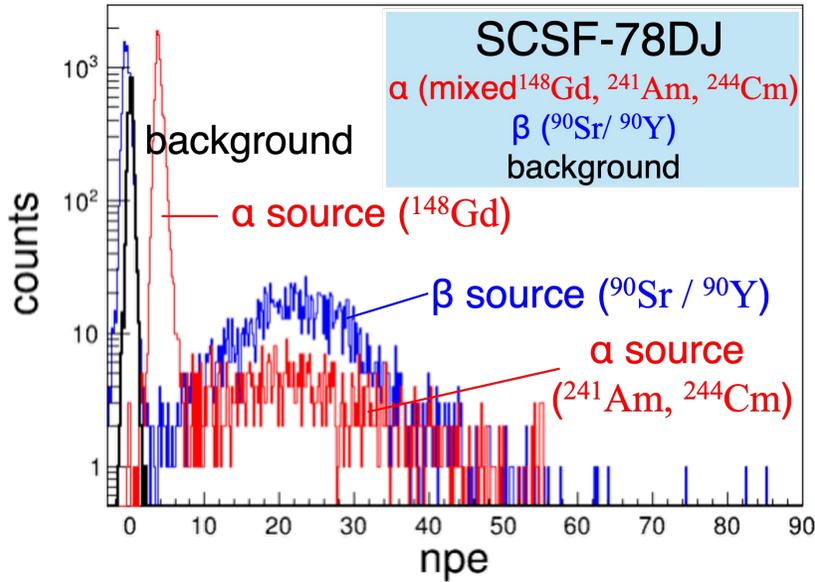
*scintillating fibers provided by Kuraray

Product name	Shape	Core Layer Size		Outer Layer Size	
			(mm)		(μm)
SCSF-78SQJ		scintillator	0.96	total internal reflector	20
SCSF-78DJ		scintillator	0.96	total internal reflector	20
OLS-P01		long decay WLS (Y-11)	0.68	scintillator	140
OLS-3		long decay WLS (Y-11)	0.89	scintillator	27
OLS-8		long decay WLS (Y-11)	0.8	scintillator	25
OLS-14		short decay WLS (YS-4)	0.8	scintillator	25

Setup:



Comparison of Detected Light Yield



 conventional round scintillating fiber

 OLS fiber

thick sci

thin sci

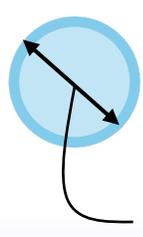
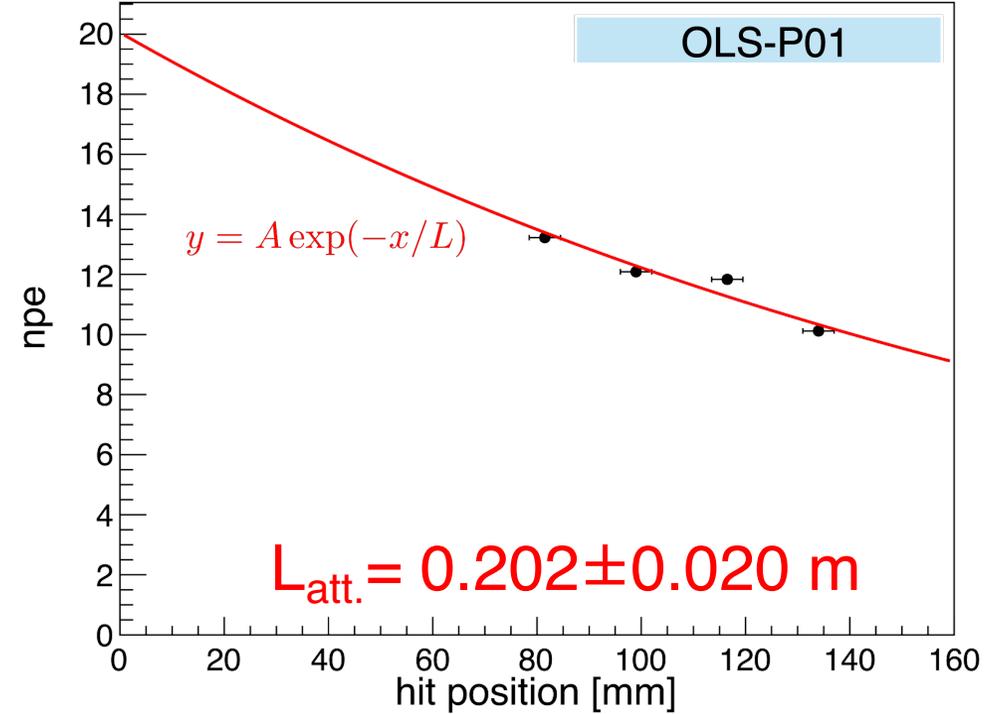
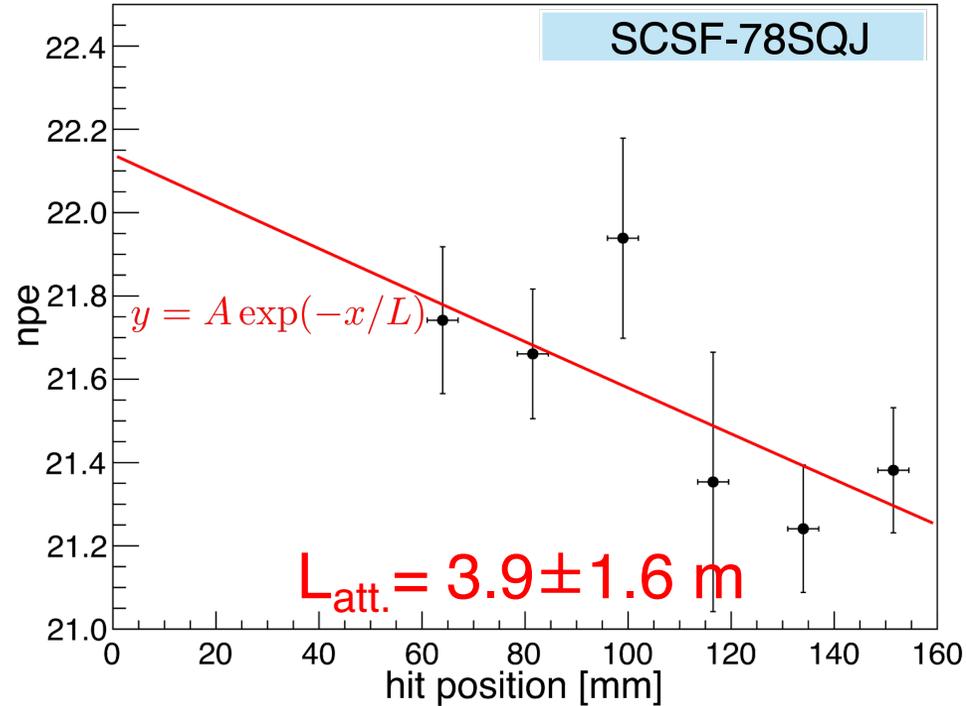
* ^{148}Gd : 3.2 MeV, ^{241}Am : 5.5 MeV, ^{244}Cm : 5.8 MeV

Comparison of Detected Light Yield

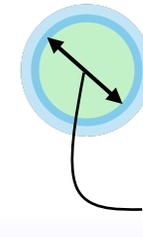
Scintillating Fiber		α Source (^{148}Gd) (npe)	α Source (^{241}Am , ^{244}Cm) (npe)	β Source (^{90}Sr / ^{90}Y) (npe)
SCSF-78SQJ	(conventional / squared)	3.1 ± 0.5	12.7 ± 0.6	18.6 ± 0.6
SCSF-78DJ	(conventional / round)	3.8 ± 0.5	19.6 ± 1.5	22.2 ± 0.5
OLS-P01	(OLS / 3 layers / thick sci)	18.5 ± 0.1	63.6 ± 0.2	10.6 ± 0.1
OLS-3	(OLS / 3 layers / thin sci)	12.0 ± 0.1	40.9 ± 0.1	4.8 ± 0.5
OLS-8	(OLS / 4 layers / long decay WLS)	8.7 ± 0.1	25.4 ± 0.2	5.2 ± 0.5
OLS-14	(OLS / 4 layers / short decay WLS)	12.3 ± 0.1	39.0 ± 0.1	4.2 ± 0.5

* ^{148}Gd : 3.2 MeV, ^{241}Am : 5.5 MeV, ^{244}Cm : 5.8 MeV

Attenuation Length



conventional round
scintillating fiber
1mm *catalog data : 4.0 m



OLS fiber
(OLS / 3 layers / thick sci)
0.72mm

Fibers Connection Effect Test

Fibers Connection Effect

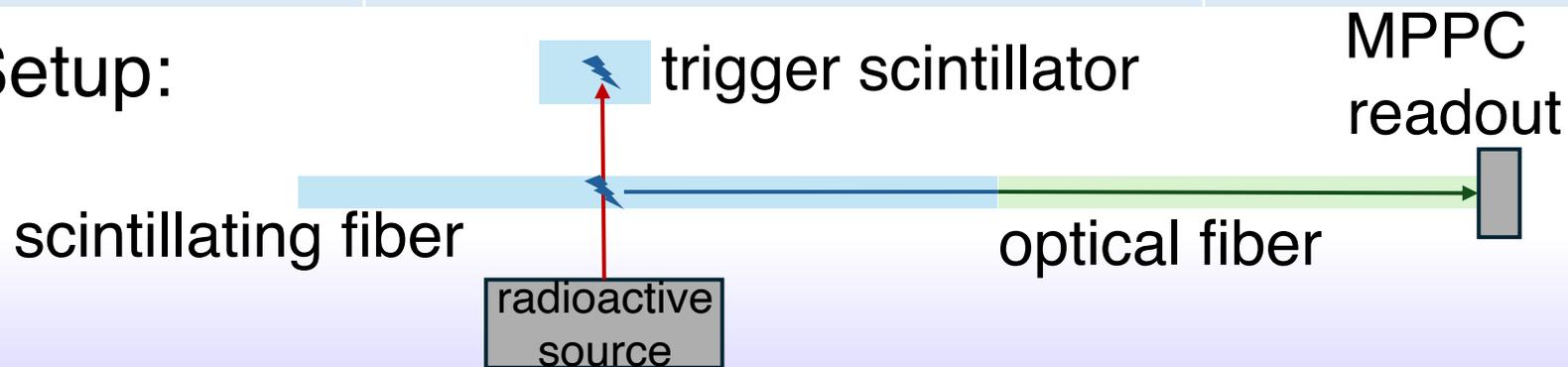
 OLS-P01 fiber (OLS / 3 layers / thick sci)

+

Optical Fibers

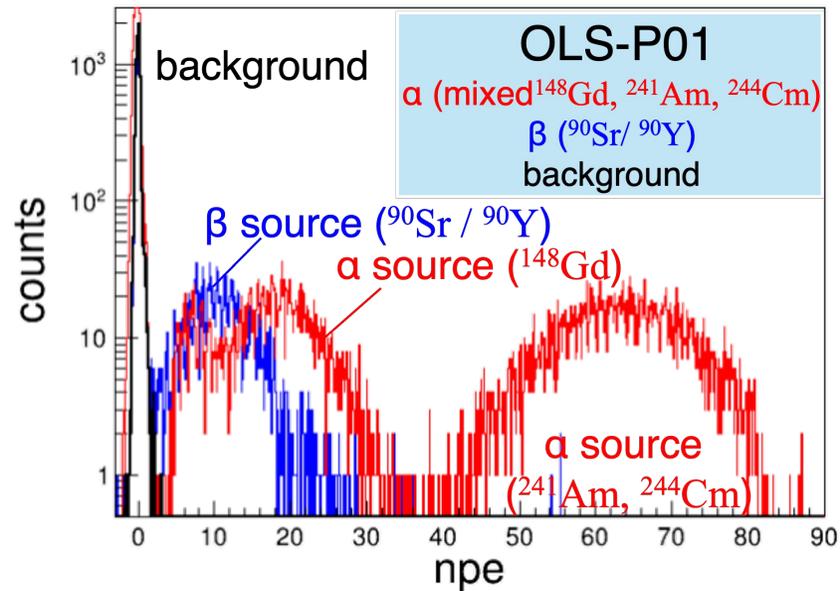
Product name	Shape	Core
CLEAR-PSSJ	 Clear Fiber	Polystyrene
Y-11DJ	 Wavelength shifting fiber	WLS (Y-11)

Setup:

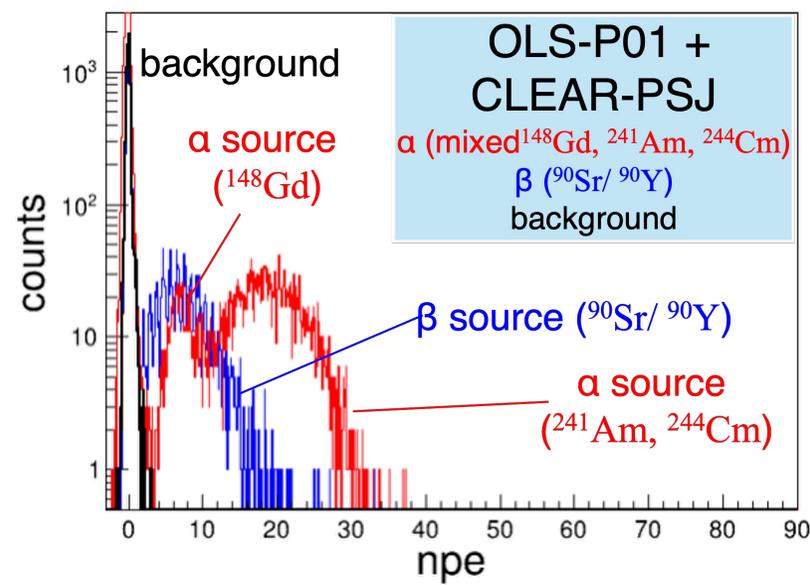


Comparison of Detected Light Yield

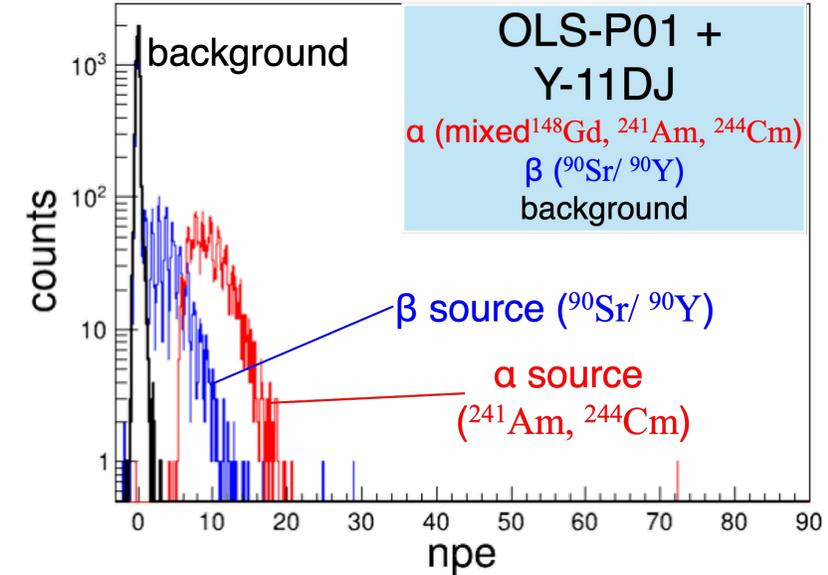
 OLS-P01 fiber (OLS / 3 layers / thick sci)



non optical fiber



clear fiber



WLS fiber

Comparison of Detected Light Yield

Scintillating fiber + optical fiber		α Source (^{148}Gd) (npe)	α Source (^{241}Am , ^{244}Cm) (npe)	β Source (^{90}Sr / ^{90}Y) (npe)
 OLS-P01 (OLS / 3 layers / thick sci)	non	18.5 ± 0.1	63.6 ± 0.2	10.6 ± 0.1
	CLEAR-PSJ (clear)	6.9 ± 0.1	18.7 ± 0.1	7.1 ± 0.1
	Y-11DJ (WLS)	ND	7.7 ± 0.3	3.2 ± 0.1

* ^{148}Gd : 3.2 MeV, ^{241}Am : 5.5 MeV, ^{244}Cm : 5.8 MeV

ENGE Focal Plane Detector

detectors design based on scintillating fibers

capable of detecting α particles (for momentum calibration) and decay **pions**

Scintillating Fibers Test / Connection Effect Test

The OLS fiber exhibited a high light yield for α particles.

In particular, OLS-P01 (thick scintillator layer OLS fiber) provided

sufficient light yield for both α and β particles.

By guiding the light with a clear fiber,

a practically sufficient light yield was achieved.

Combination of Fibers for ENGE Focal Plane Detector



OLS-P01 (OLS / 3 layers / thick sci) + clear fiber