

# LION Beamline Experiment Data Analysis

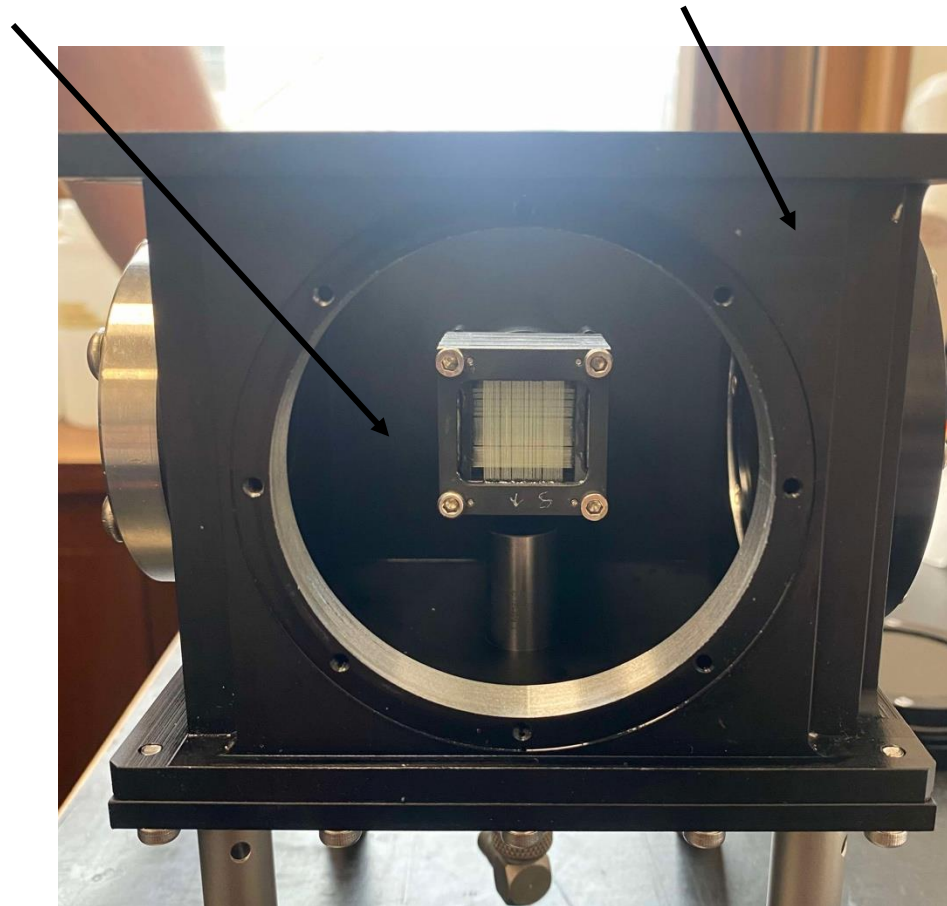
5/11/2024

# Day 1: Scintillating Fibre Detectors

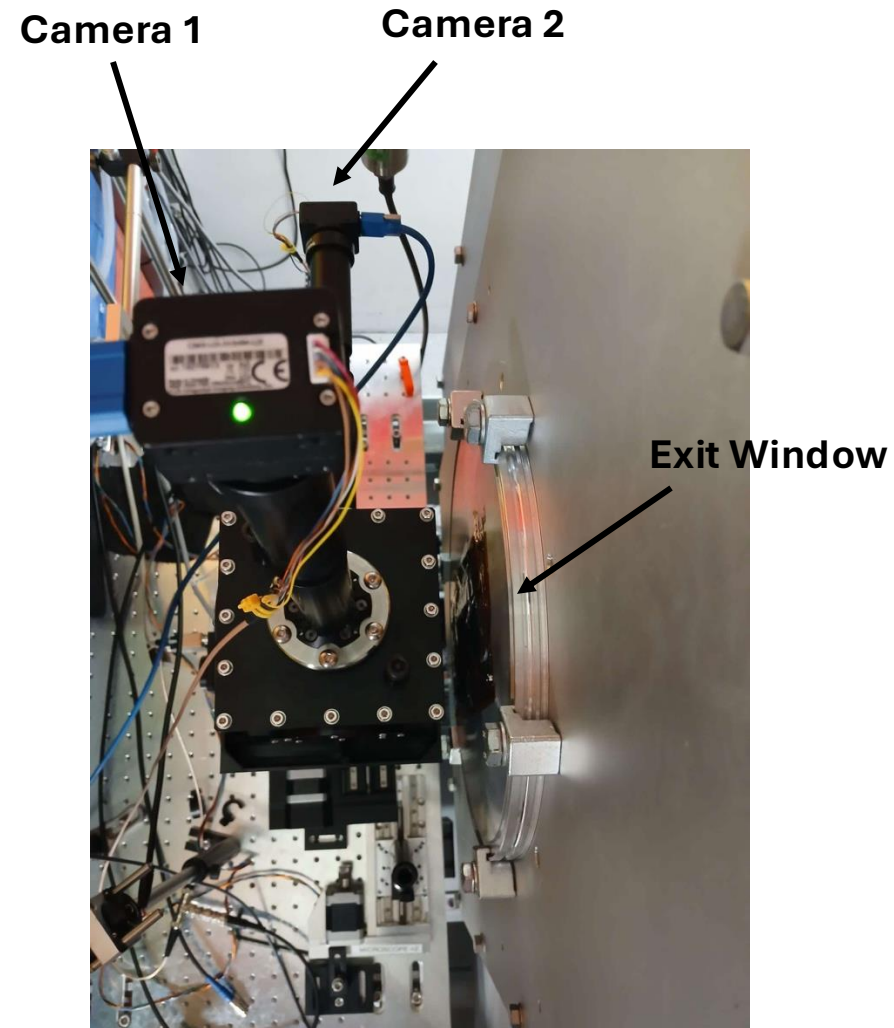
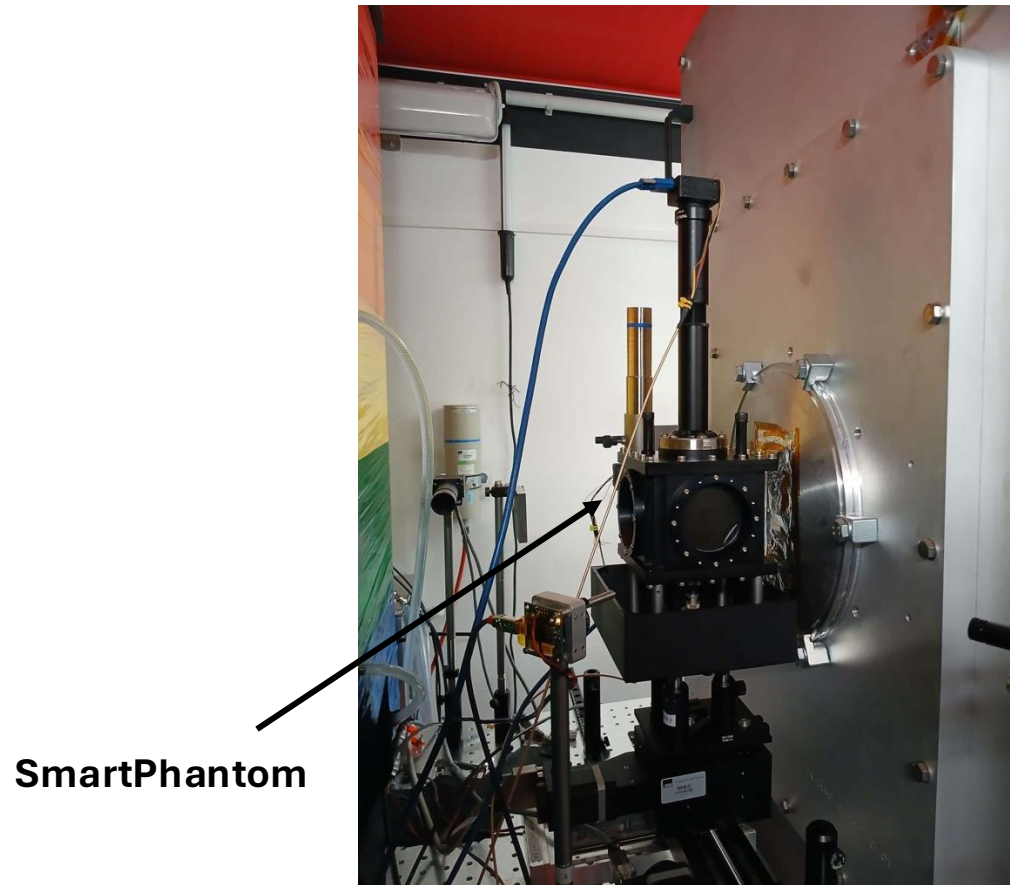
**Scintillating Fibre Detectors**



**SmartPhantom**



# Day 1: Scintillating Fibre Detectors



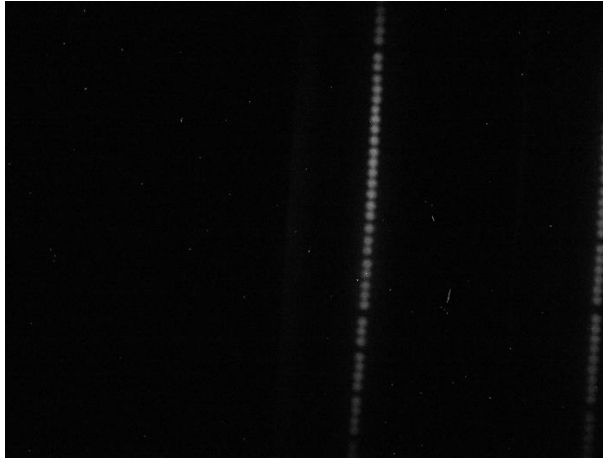
# Day 1: Scintillating Fibre Detectors

## 20 MeV: Lateral Scan: Camera 1 (top)

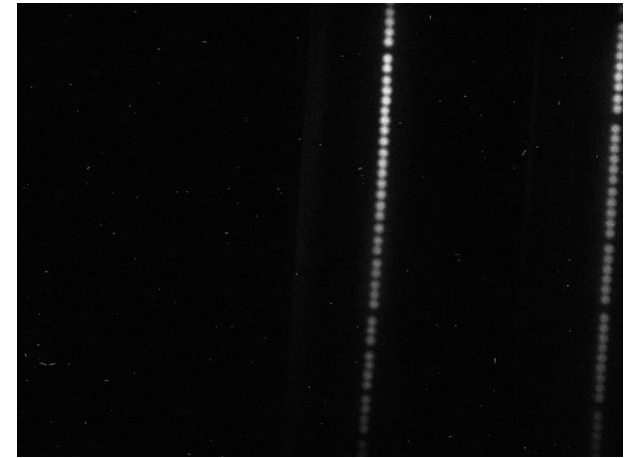
Starting position



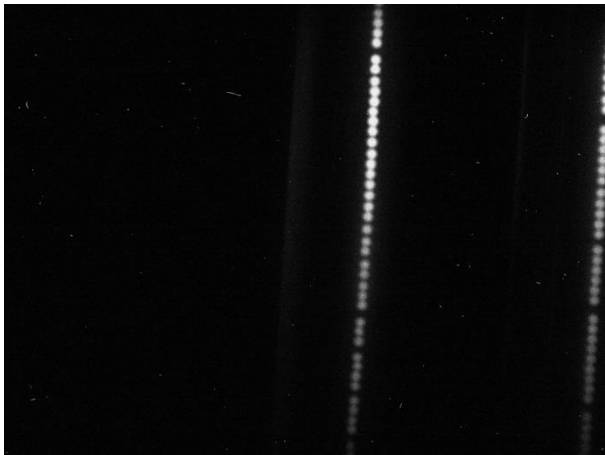
Starting position + 1 mm



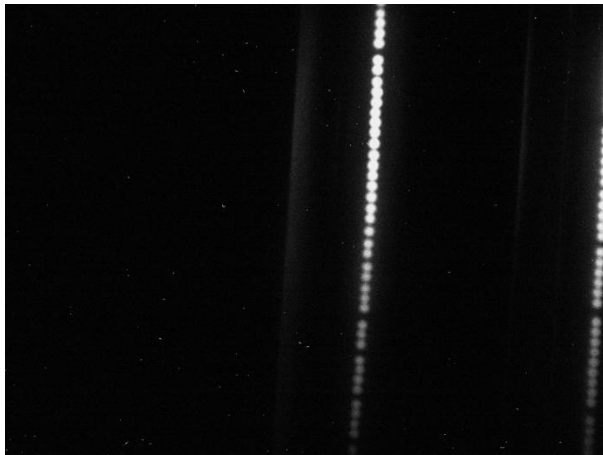
Starting position + 2 mm



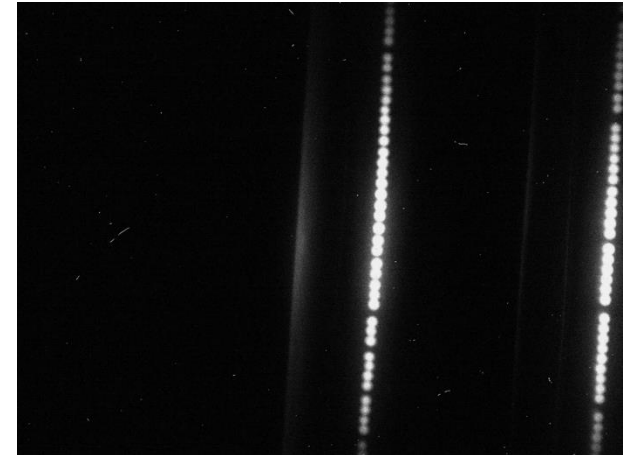
Starting position + 2.4 mm



Starting position + 2.8 mm



Starting position + 3.6 mm



Beam



Beam

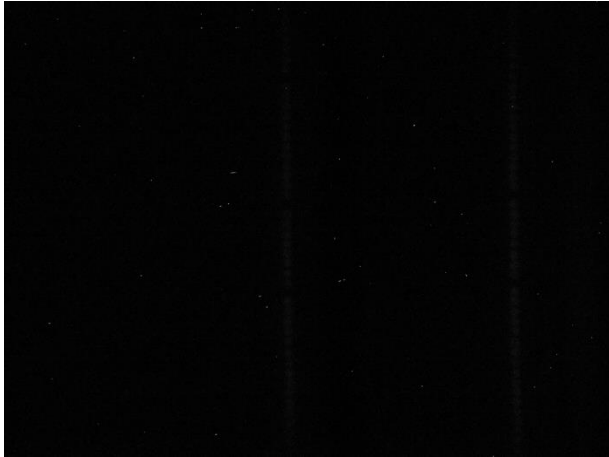




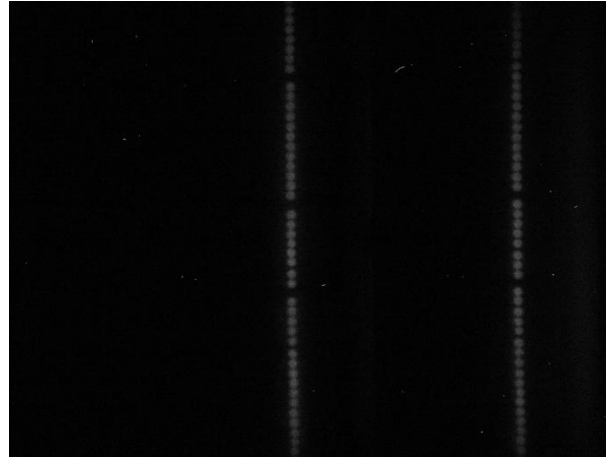
# Day 1: Scintillating Fibre Detectors

## 20 MeV: Lateral Scan: Camera 2 (side)

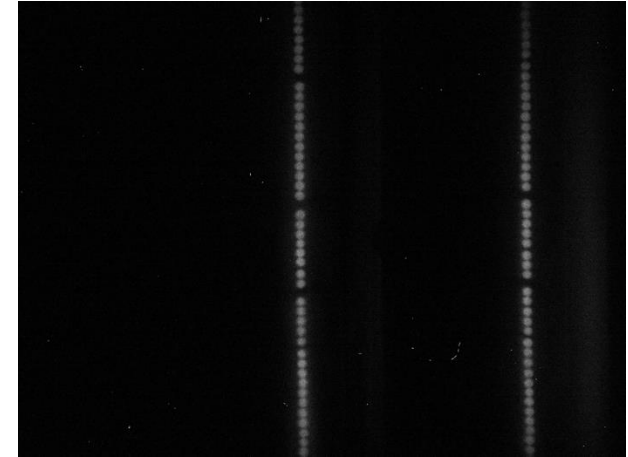
Starting position



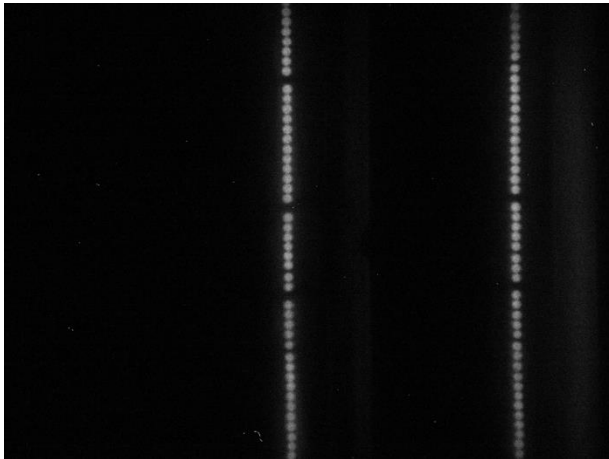
Starting position + 1 mm



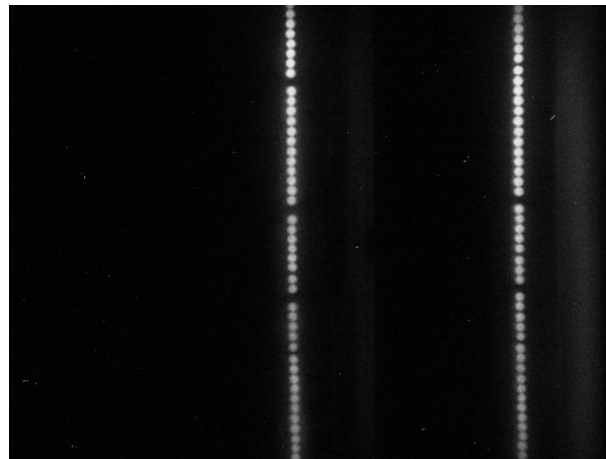
Starting position + 2 mm



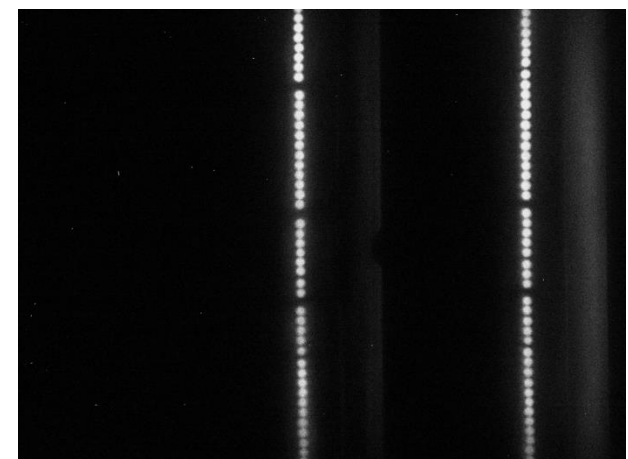
Starting position + 2.4 mm



Starting position + 2.8 mm



Starting position + 3.6 mm



Beam

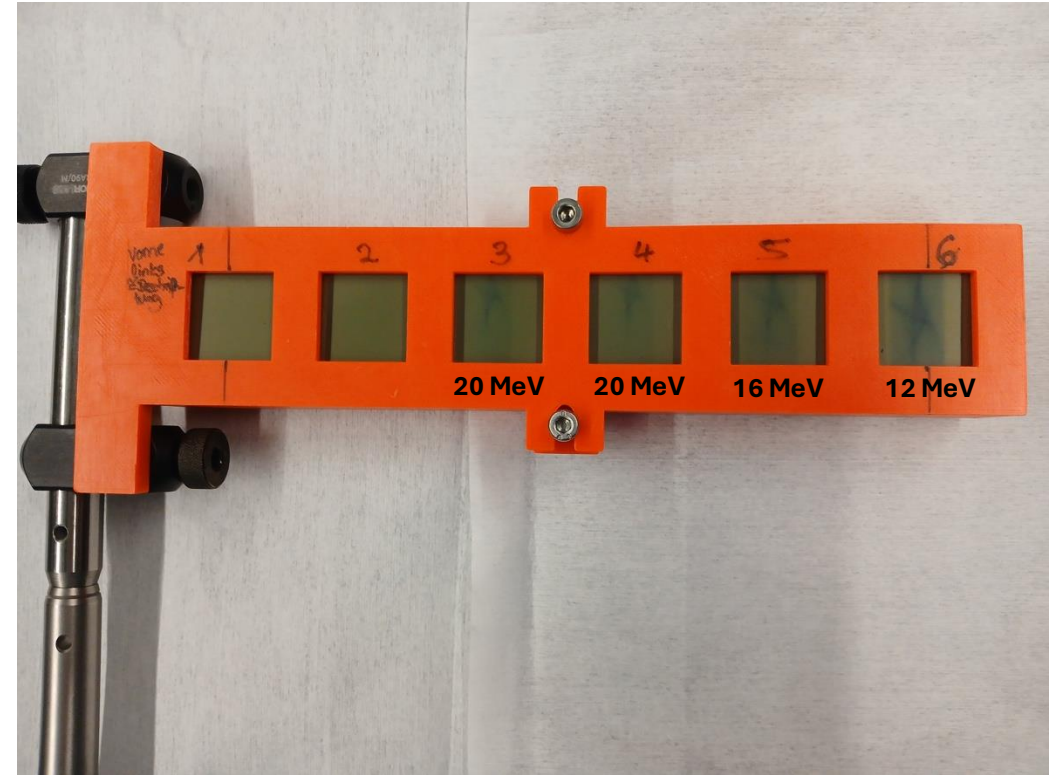
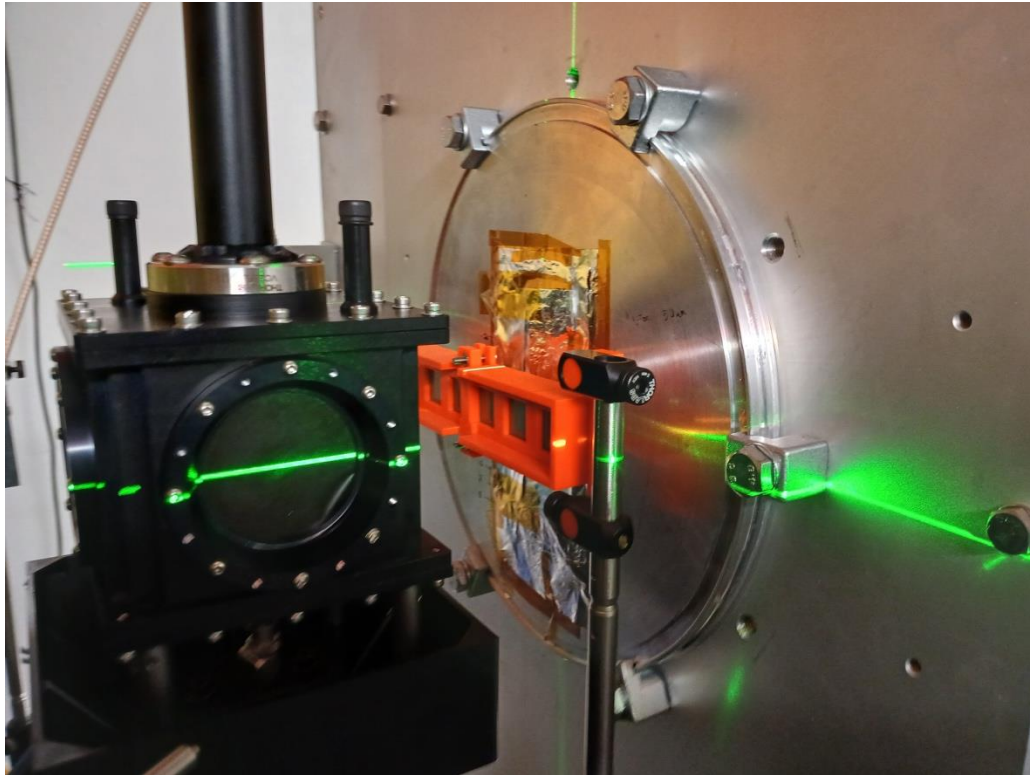


Beam



# Day 1: Scintillating Fibre Detectors

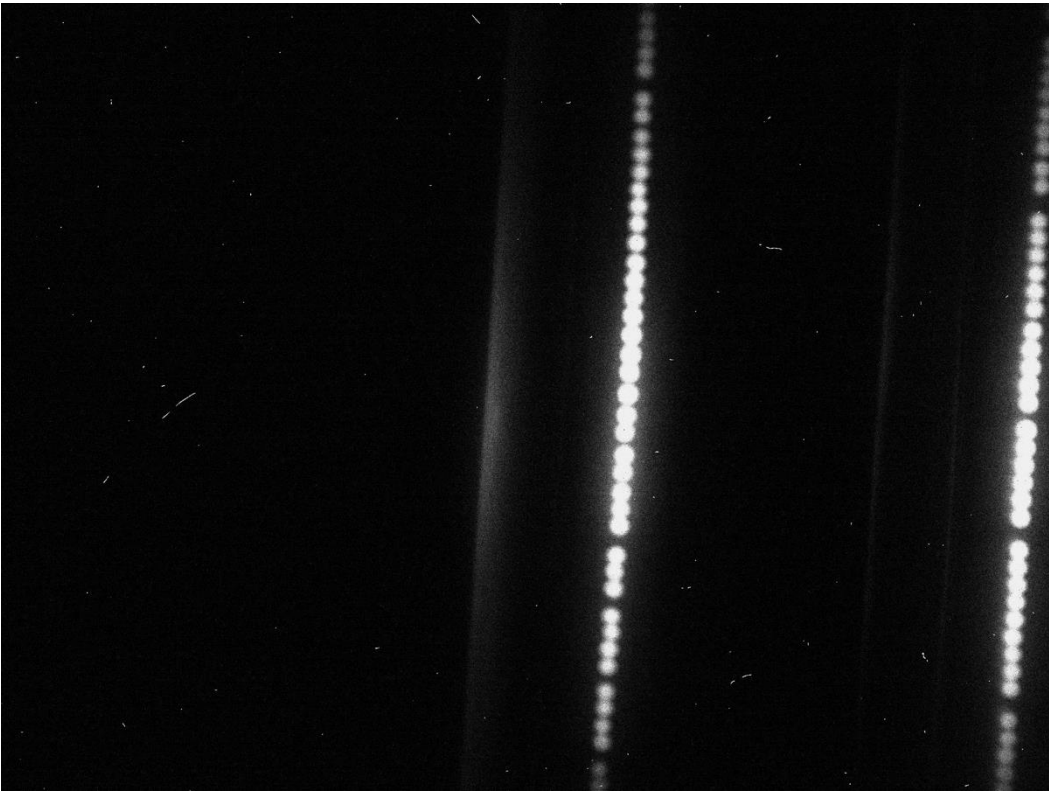
## RCF Stacks



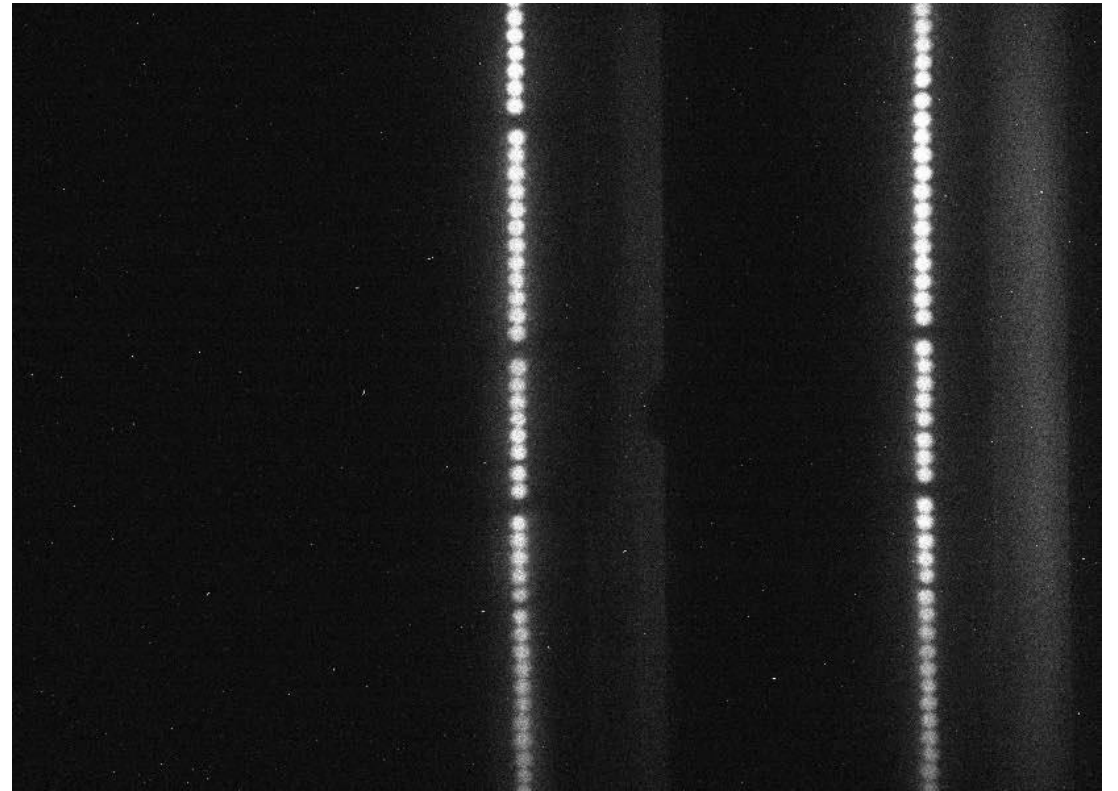
# Day 1: Scintillating Fibre Detectors

## Energy Scan

Camera 1: Top



Camera 2: Side



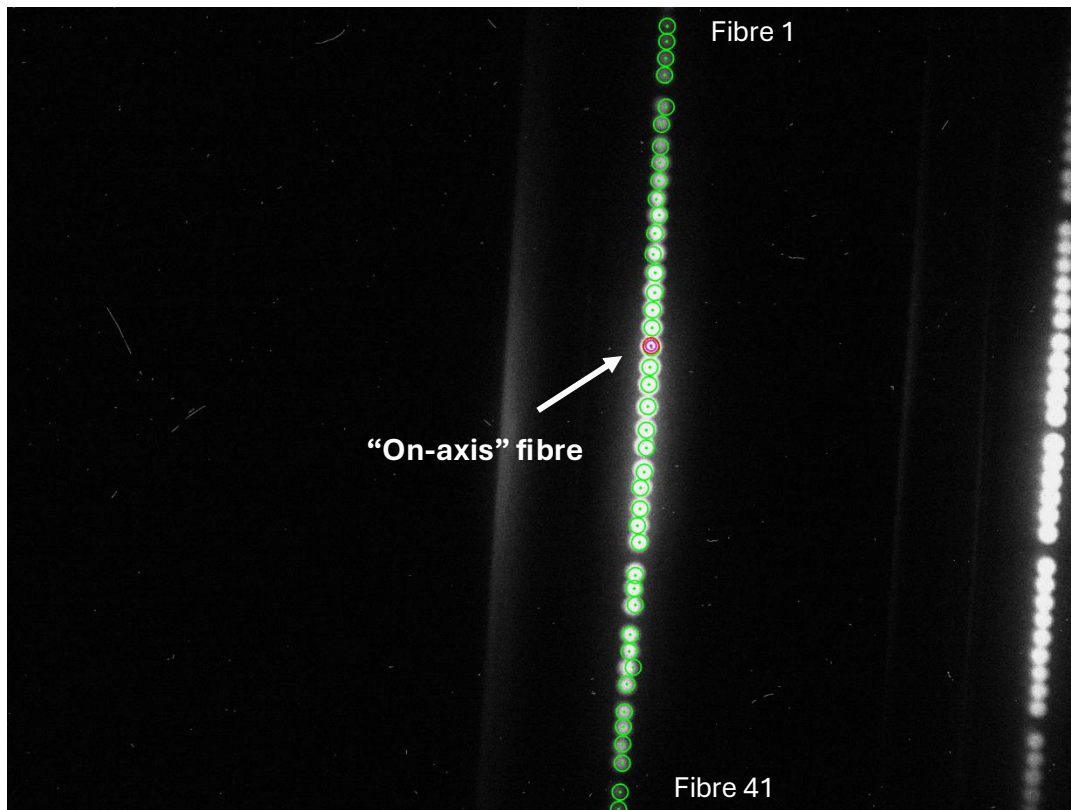
20 MeV example



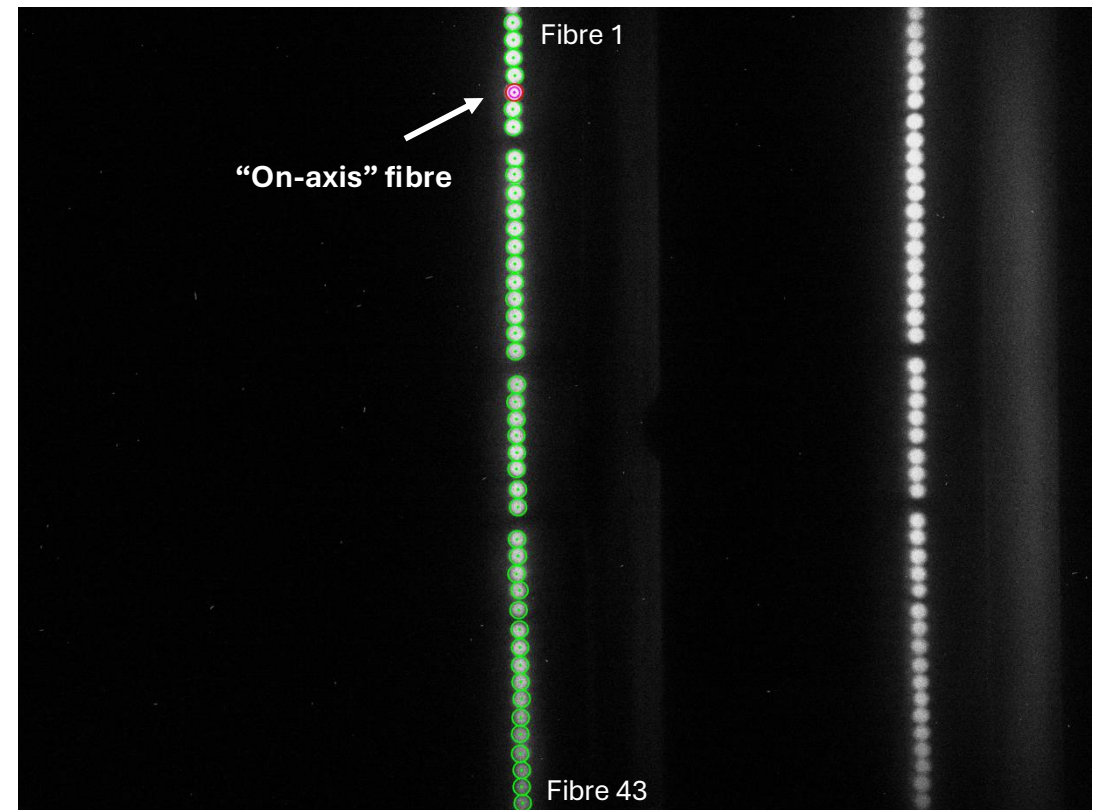
# Day 1: Scintillating Fibre Detectors

## Background Correction & Fibre Detection

Camera 1: Top



Camera 2: Side



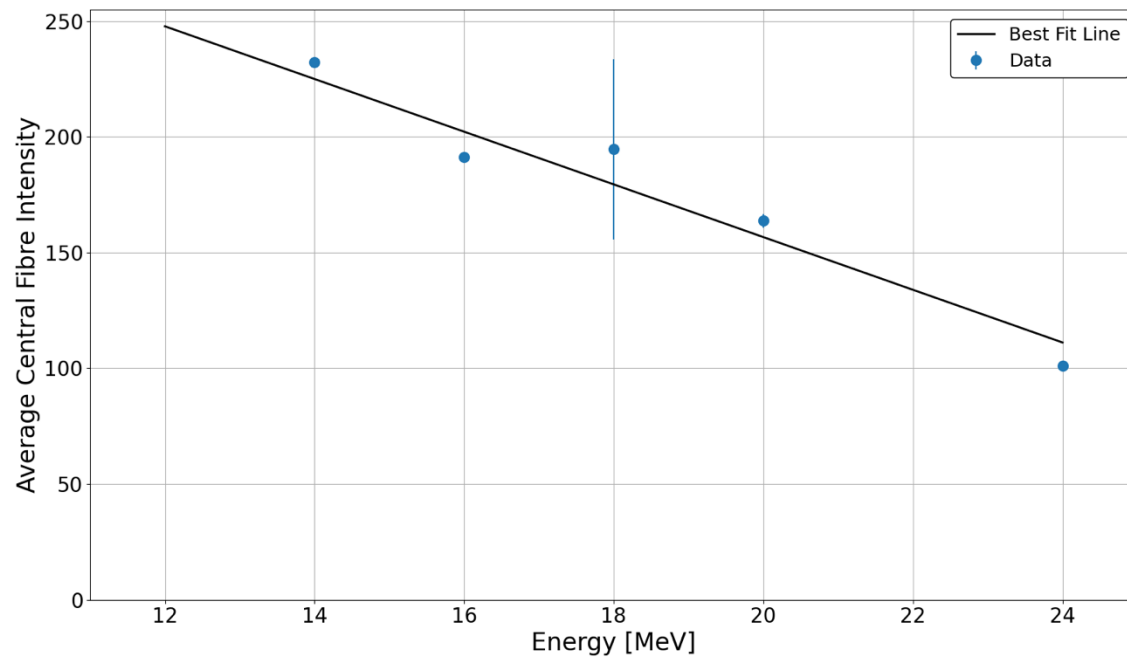
20 MeV example



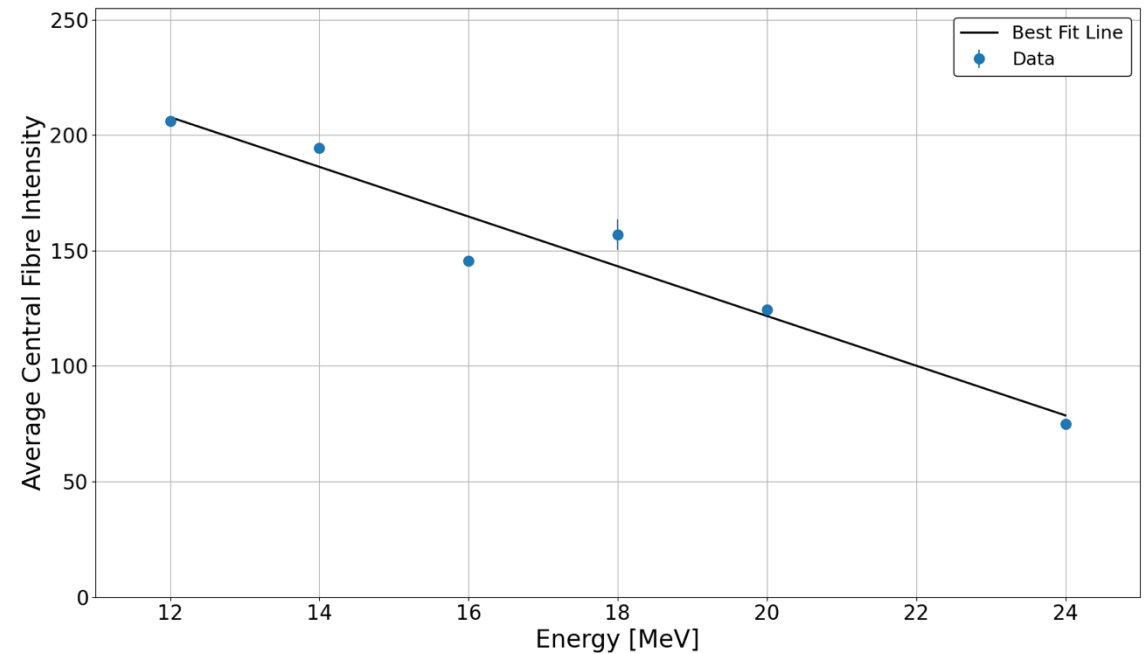
# Day 1: Scintillating Fibre Detectors

## Central Fibre intensities

**Camera 1: Top**



**Camera 2: Side**

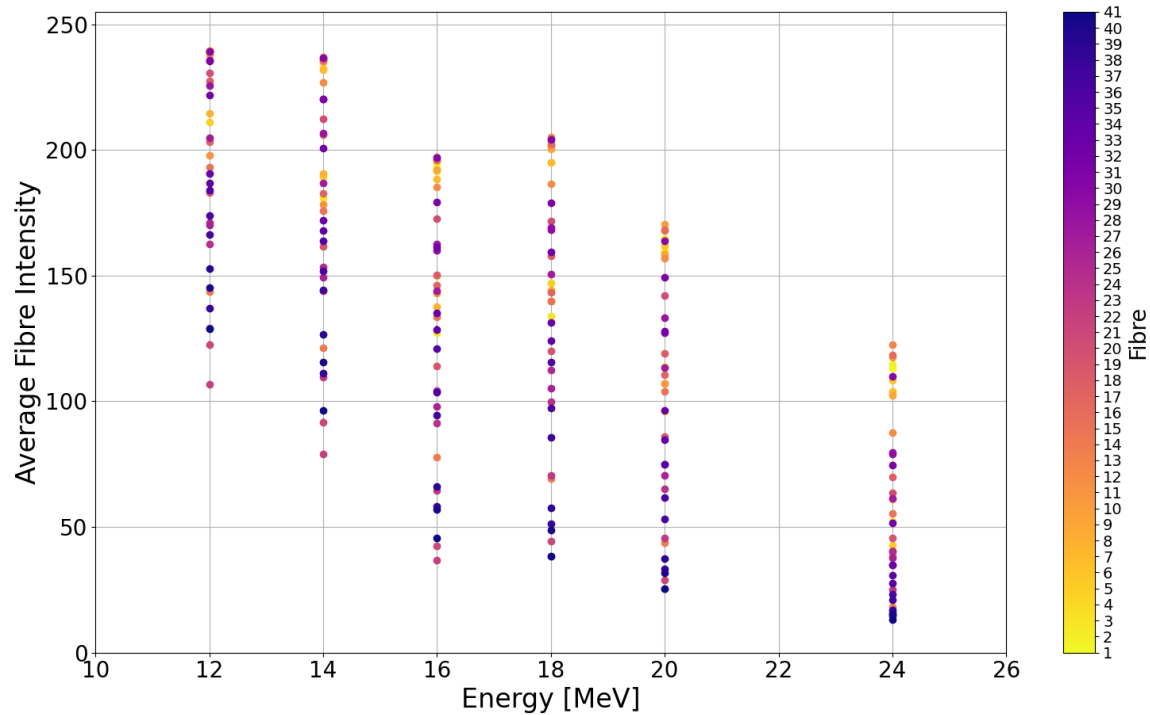


*Number of particles decreases linearly with focused energy*

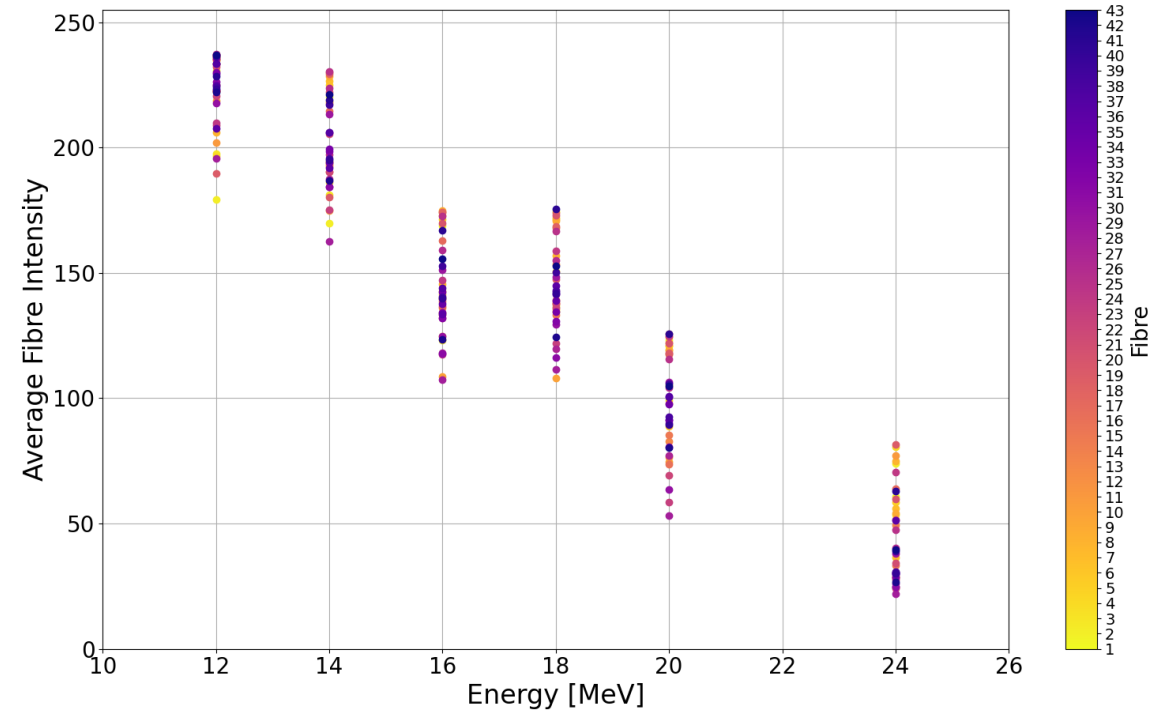
# Day 1: Scintillating Fibre Detectors

## All Fibre Intensities

Camera 1: Top



Camera 2: Side

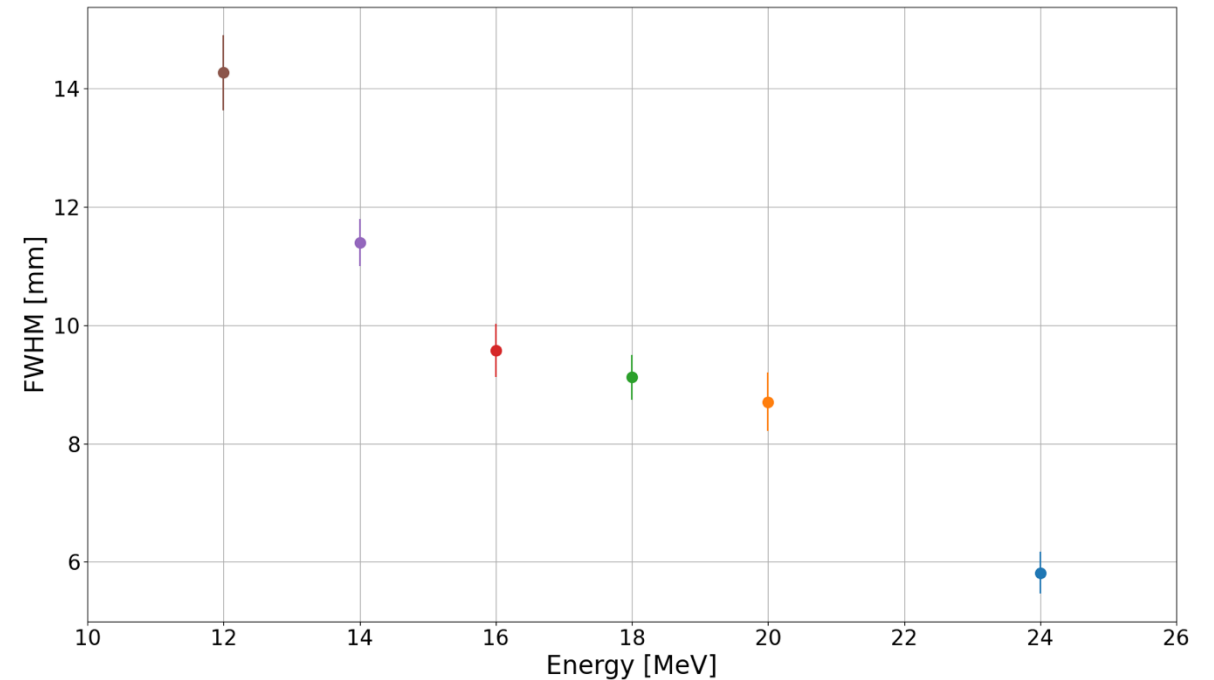
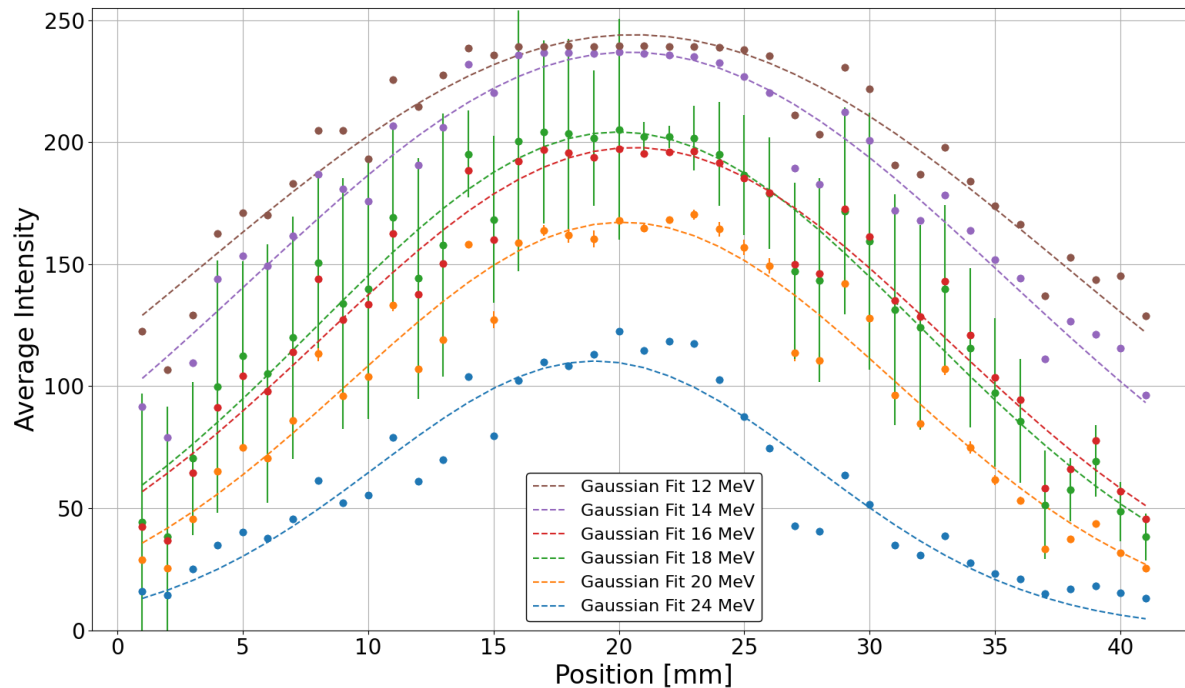


# Day 1: Scintillating Fibre Detectors

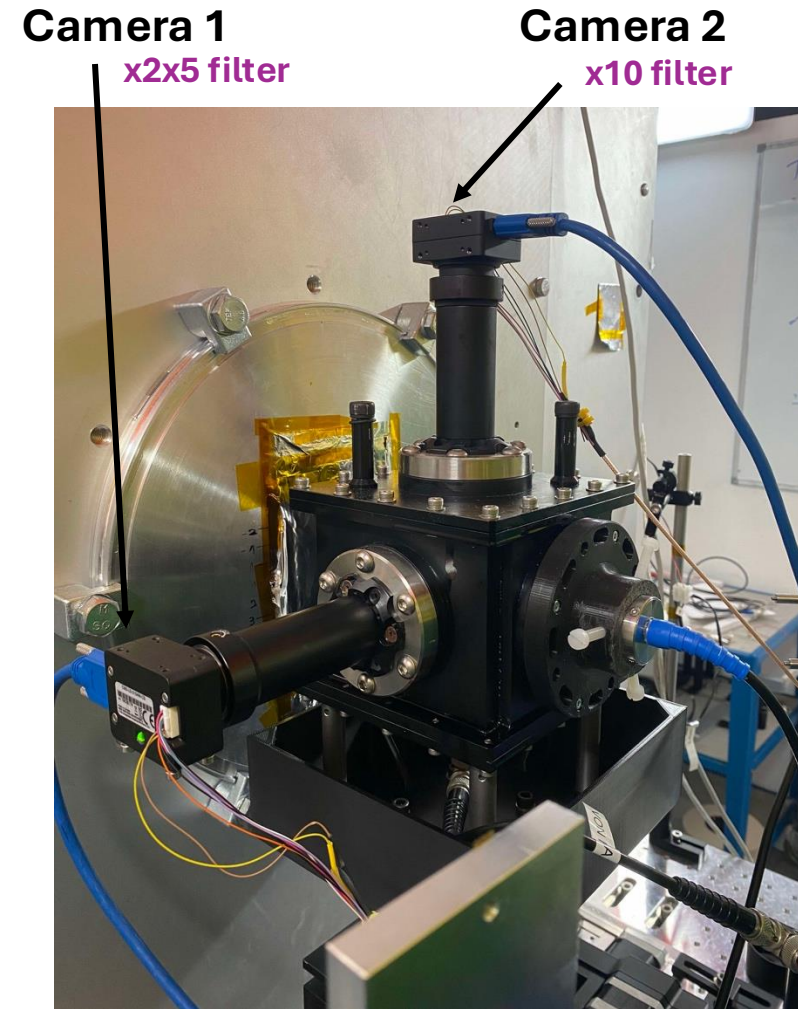
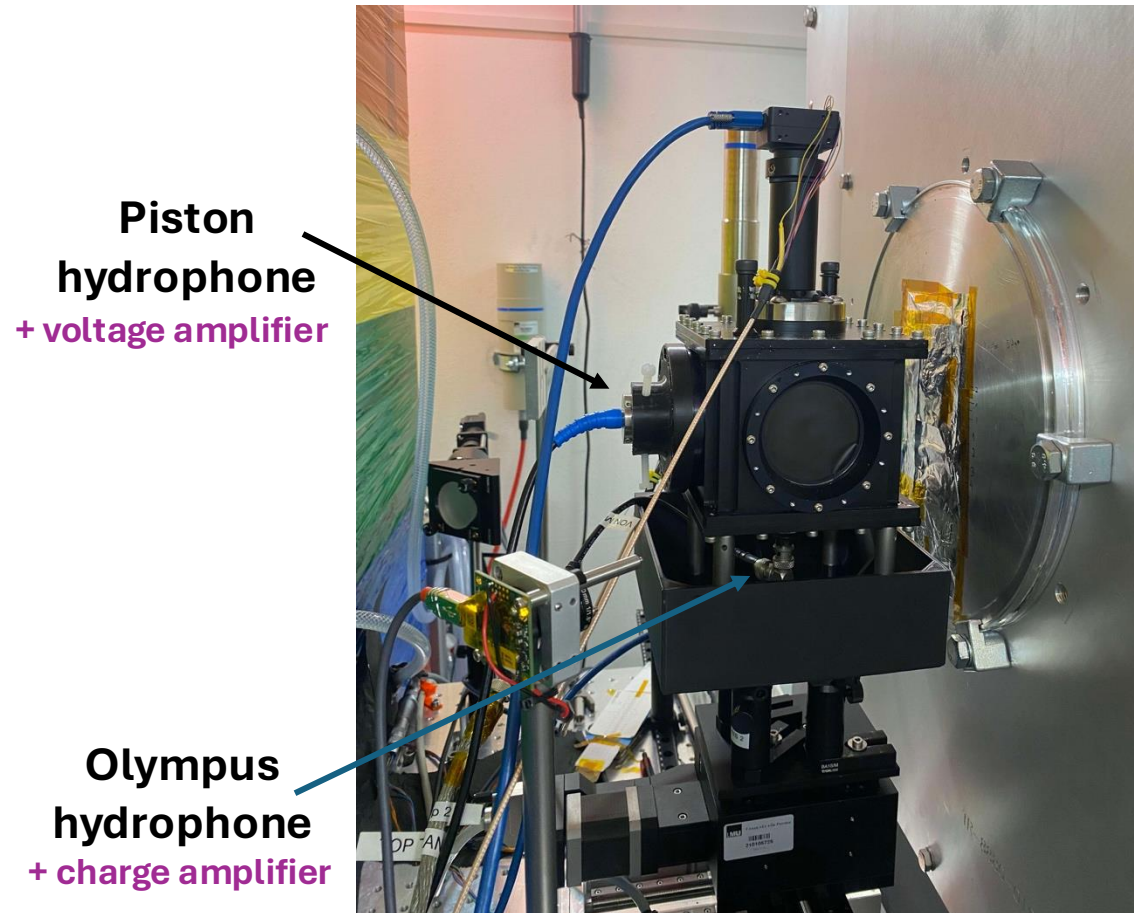
## Beam Profiles: Gaussian fit & mm conversion

### Camera 1: Top

(camera 2 data are insufficient to plot a beam profile)

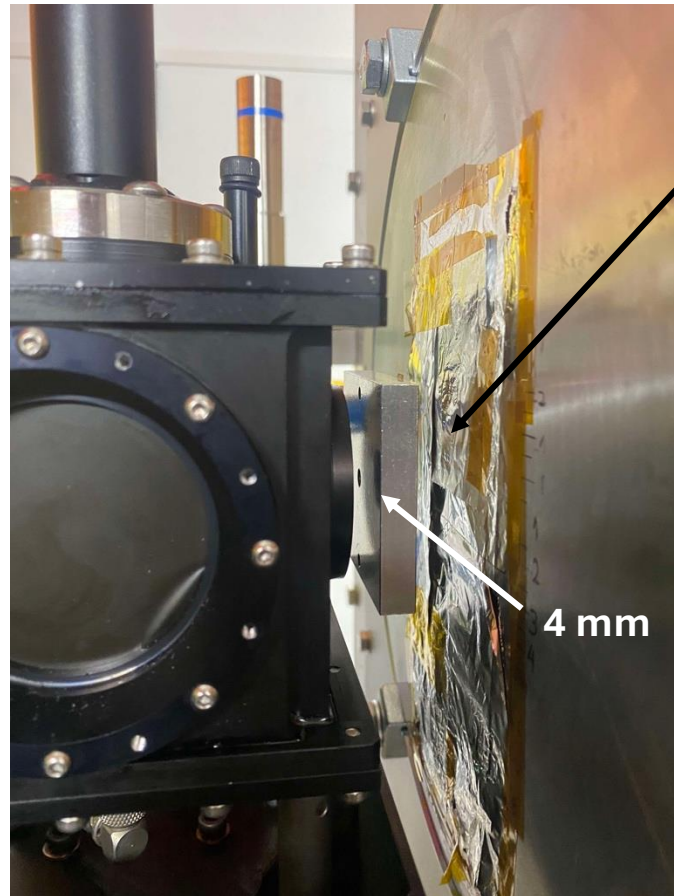


# Day 2 & 3: Liquid Scintillator & Transducers



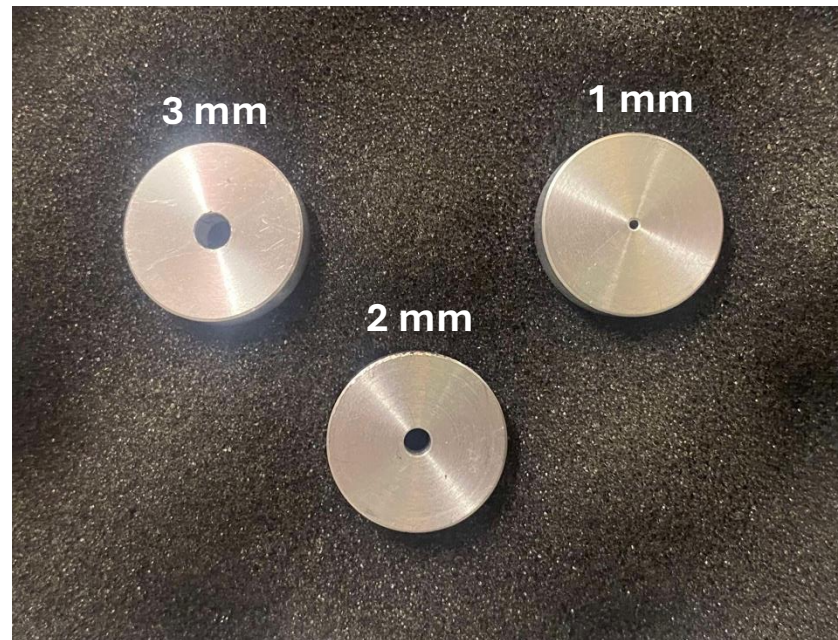


# Day 2 & 3: Liquid Scintillator & Transducers Collimators



Exit window

Collimators

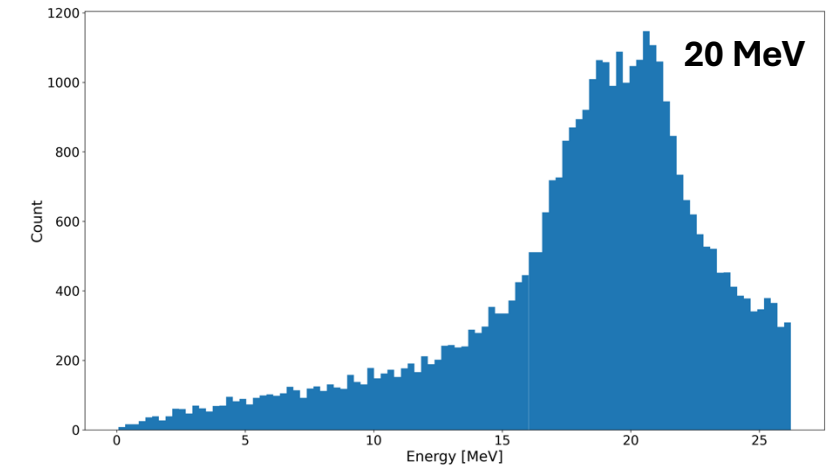
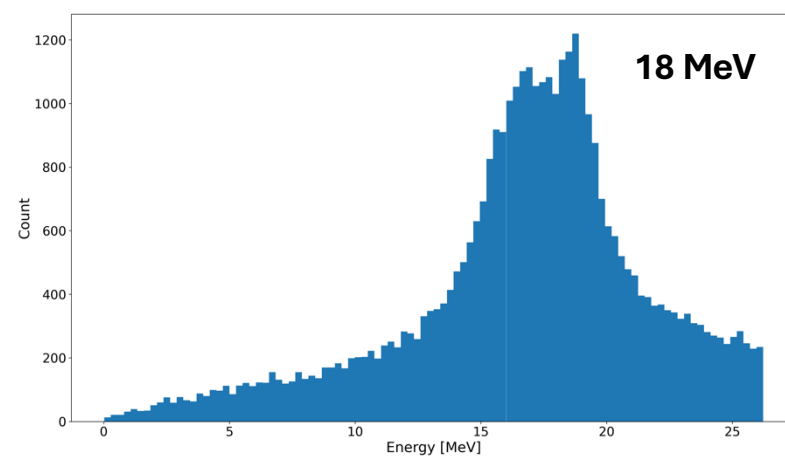
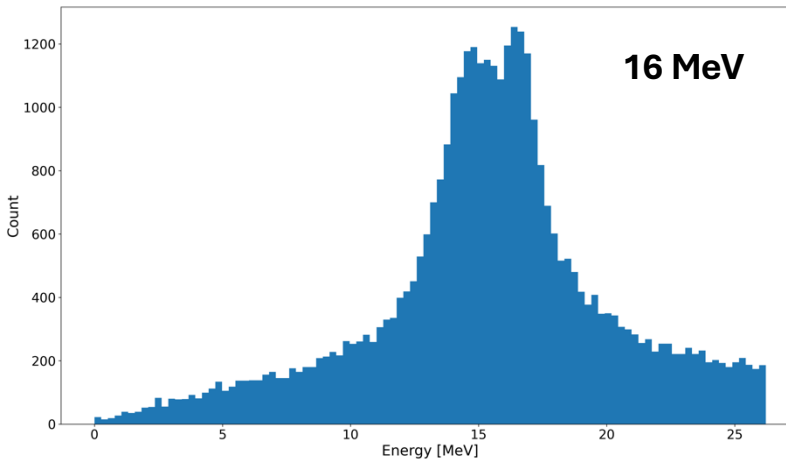
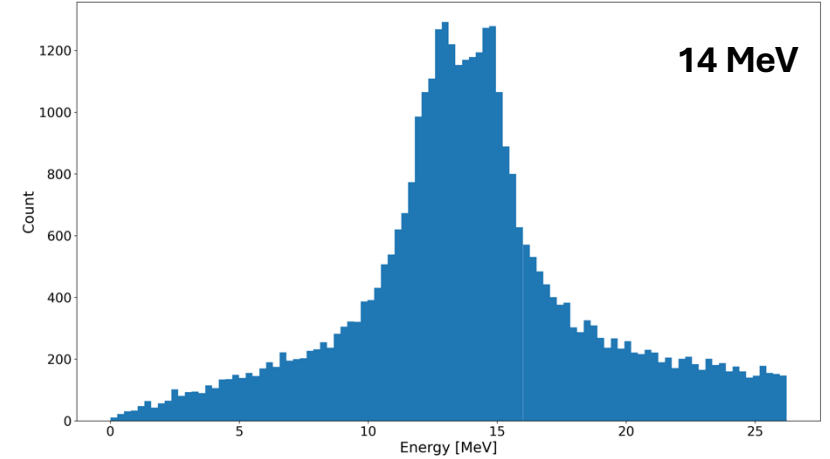
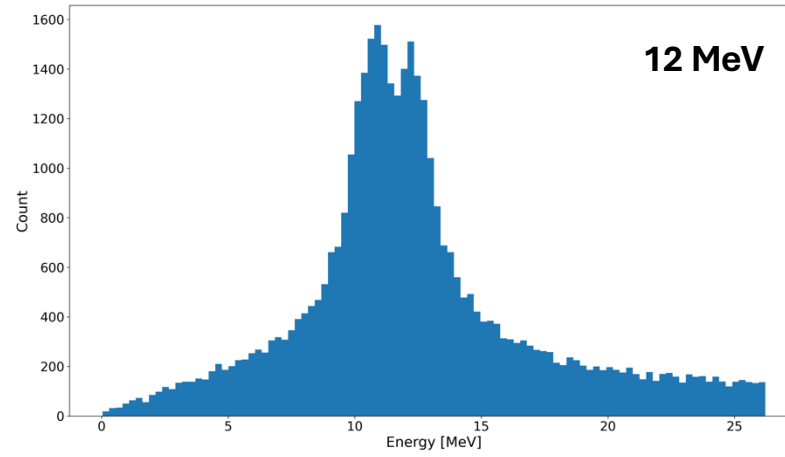
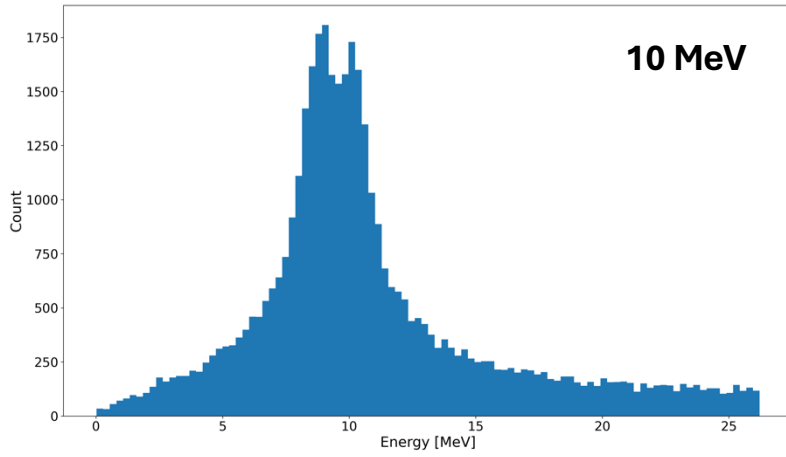


# Simulations

Energy [MeV]	Drift 1 [mm]	Drift 2 [mm]	Drift 3 [mm]
10	42.28	27.22	1805.20
12	46.94	32.33	1795.40
14	51.23	37.12	1865.83
16	55.23	41.65	1865.01
18	58.99	45.97	1769.74
20	62.5	50.11	1762.04



# Simulations



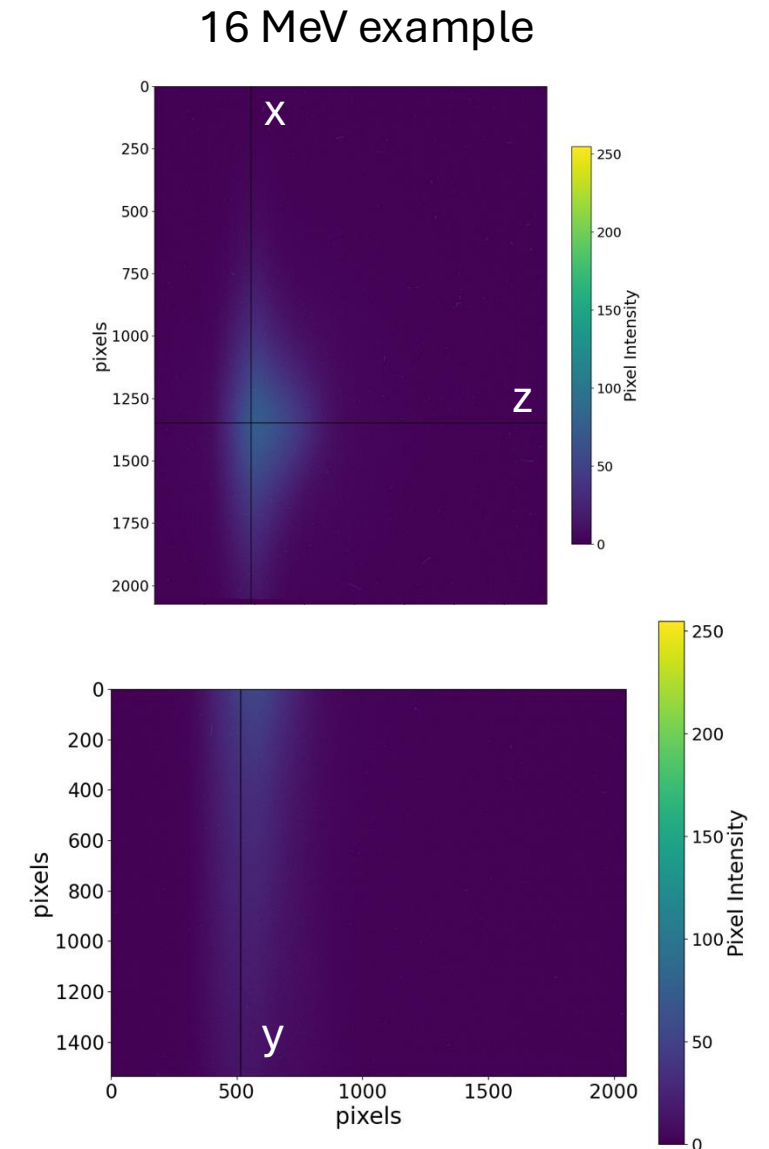
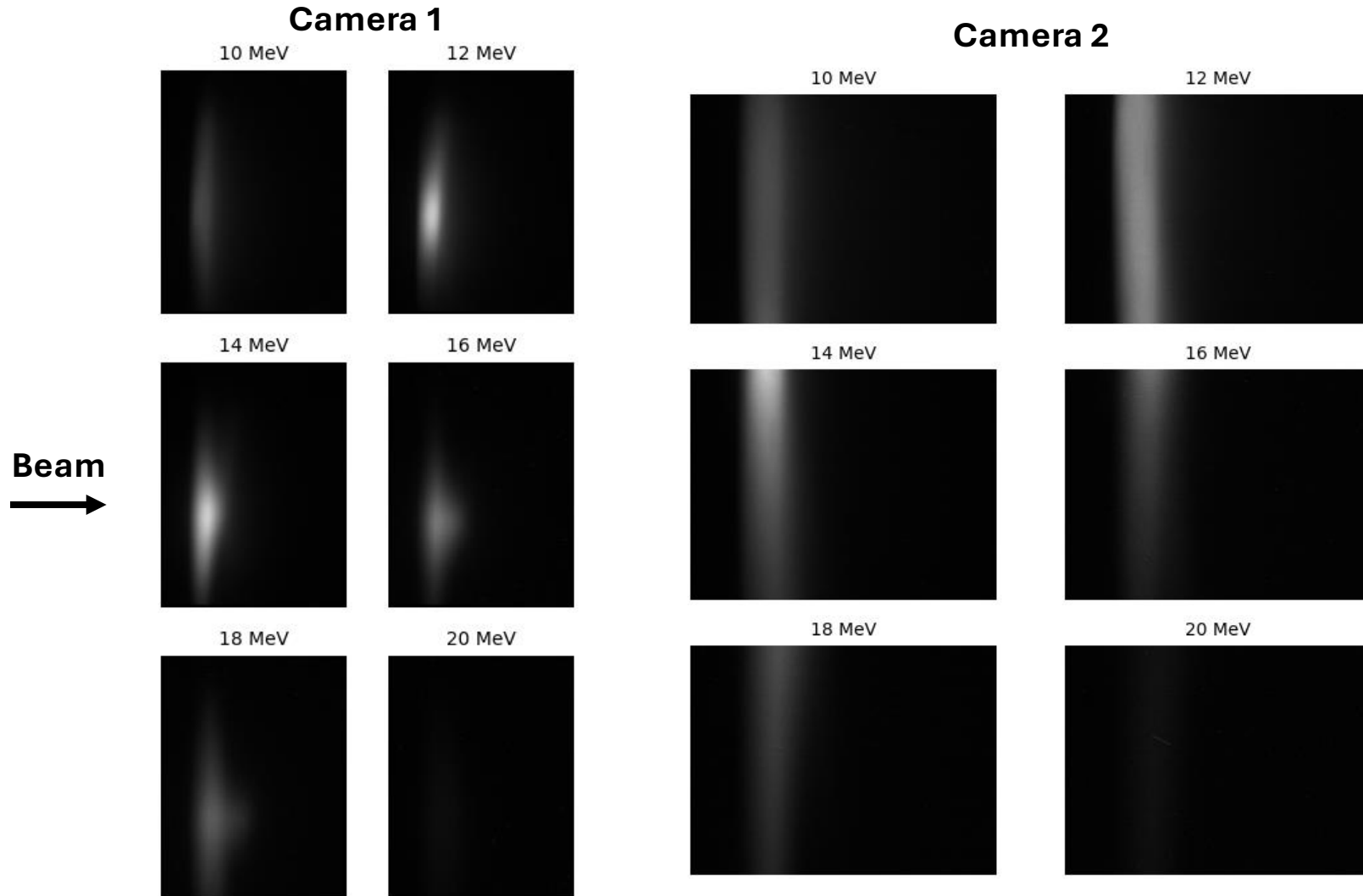
# Day 2 & 3: Liquid Scintillator Data

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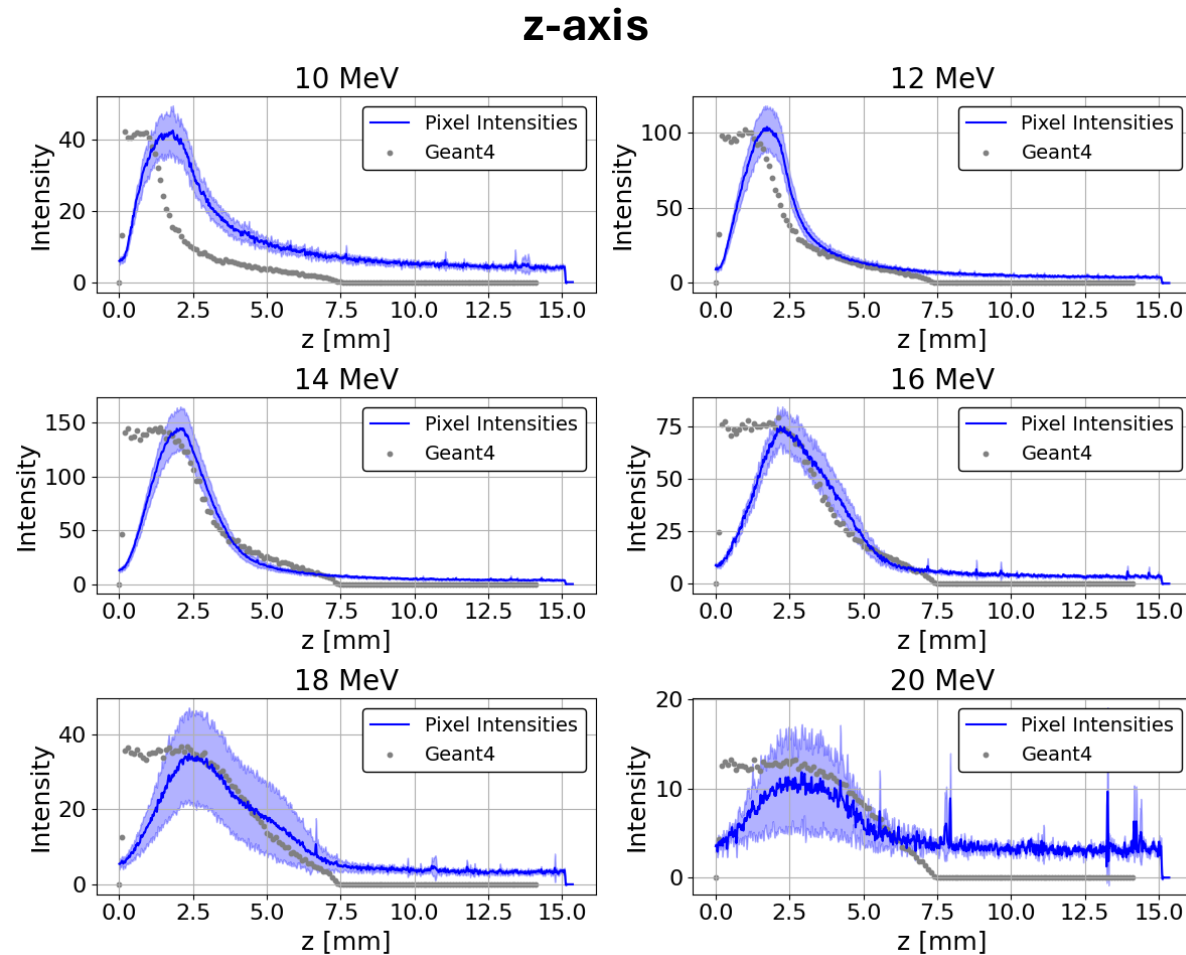
# Day 2 & 3: Liquid Scintillator

## Example image: No collimator



# Day 2 & 3: Liquid Scintillator

## Energy Scan **No Collimator**

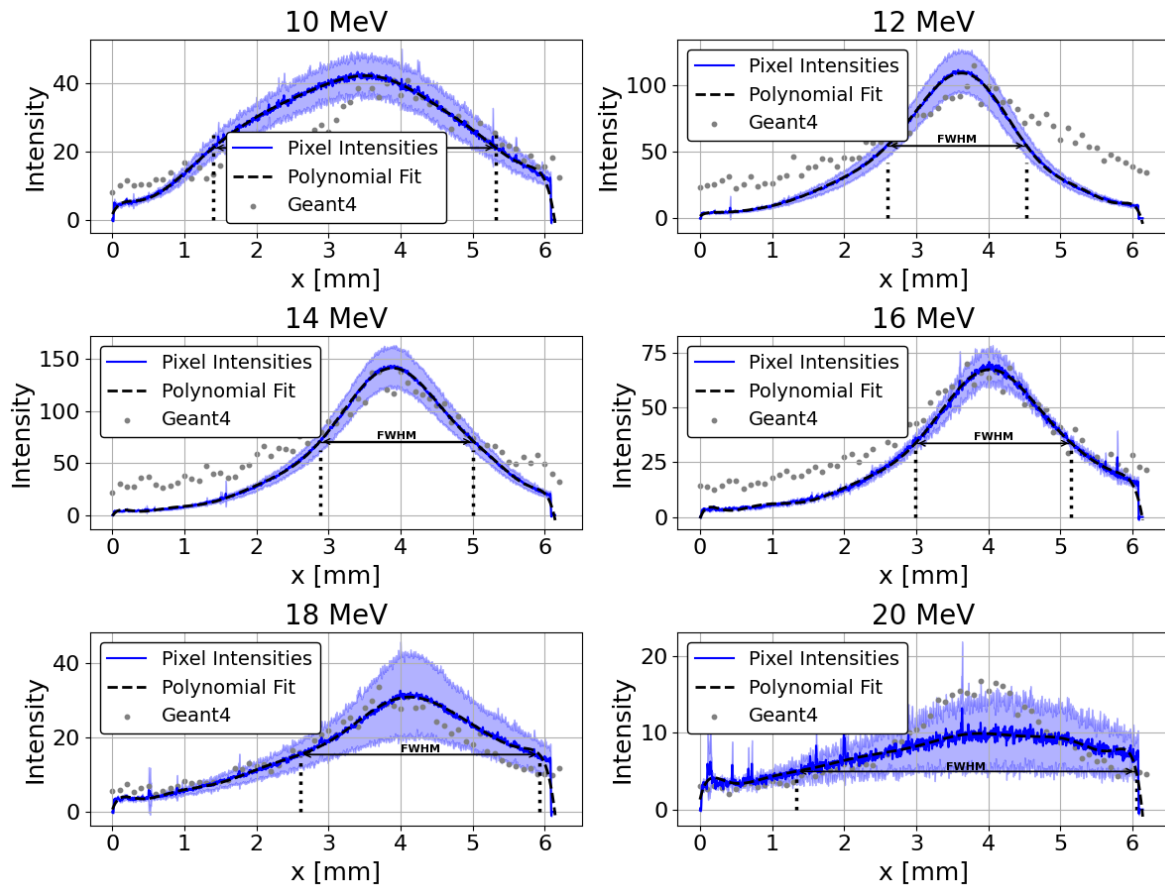


Average over 60 pixels

# Day 2 & 3: Liquid Scintillator Energy Scan

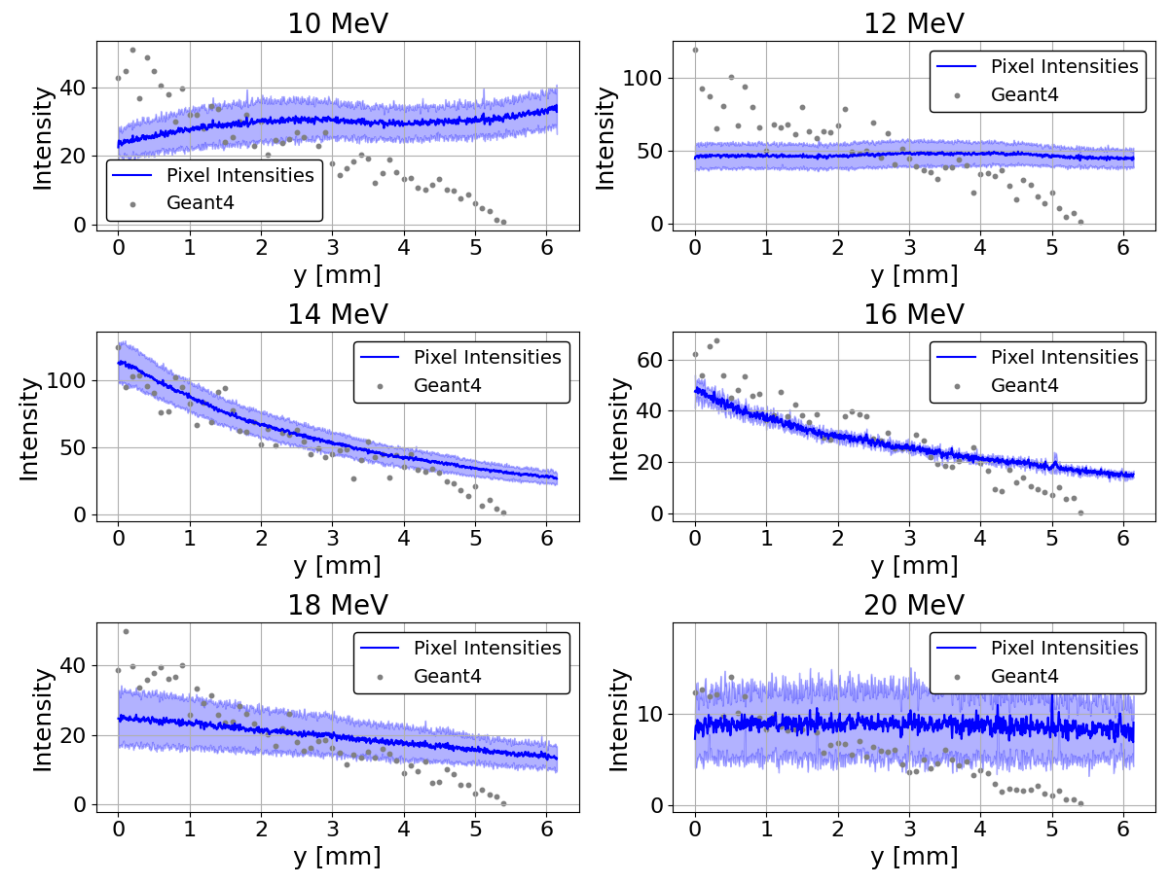
## No Collimator

x-axis



Average over 60 pixels

y-axis



Average over 60 pixels

# Day 2 & 3: Liquid Scintillator

## Example image: 4 mm collimator

Camera 1

Camera 2

10 MeV

12 MeV

10 MeV

12 MeV

14 MeV

16 MeV

14 MeV

16 MeV

18 MeV

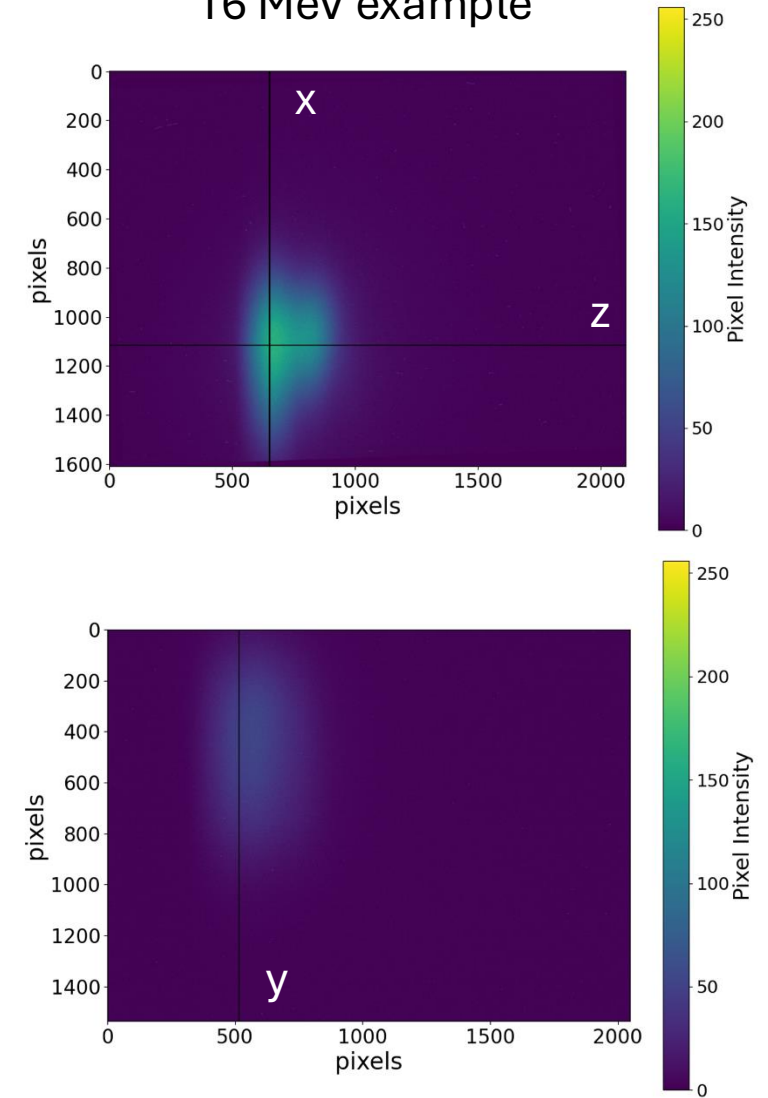
20 MeV

18 MeV

20 MeV

Beam  
→

16 MeV example

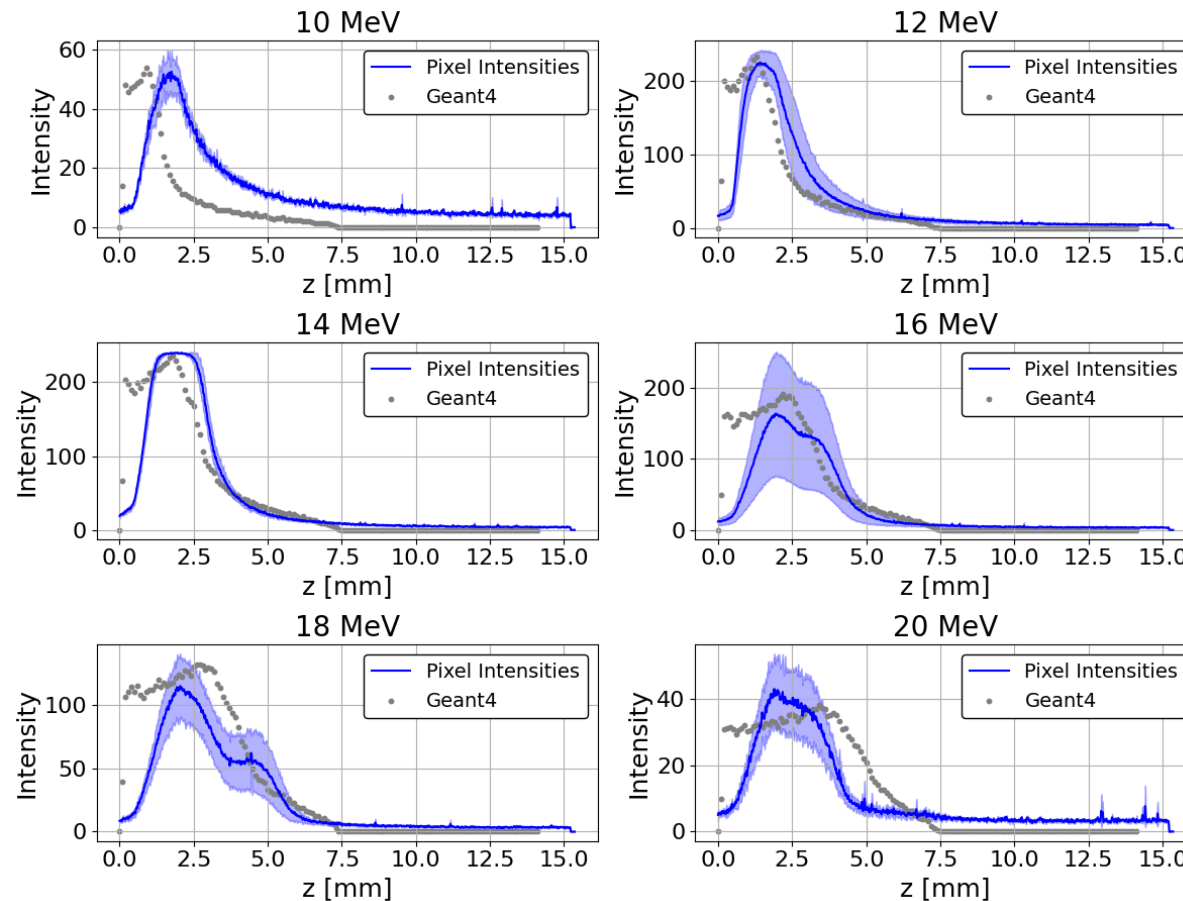




# Day 2 & 3: Liquid Scintillator

## Energy Scan 4 mm Collimator

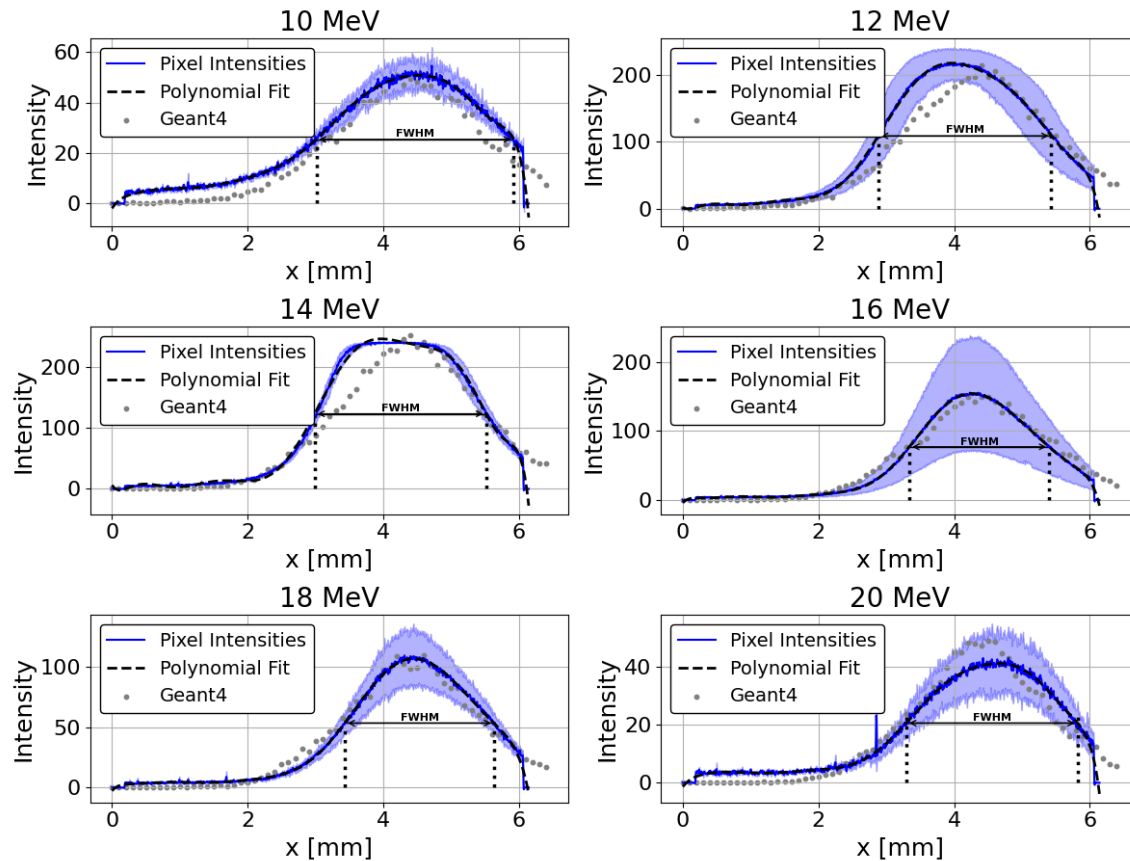
**z-axis**



Average over 60 pixels

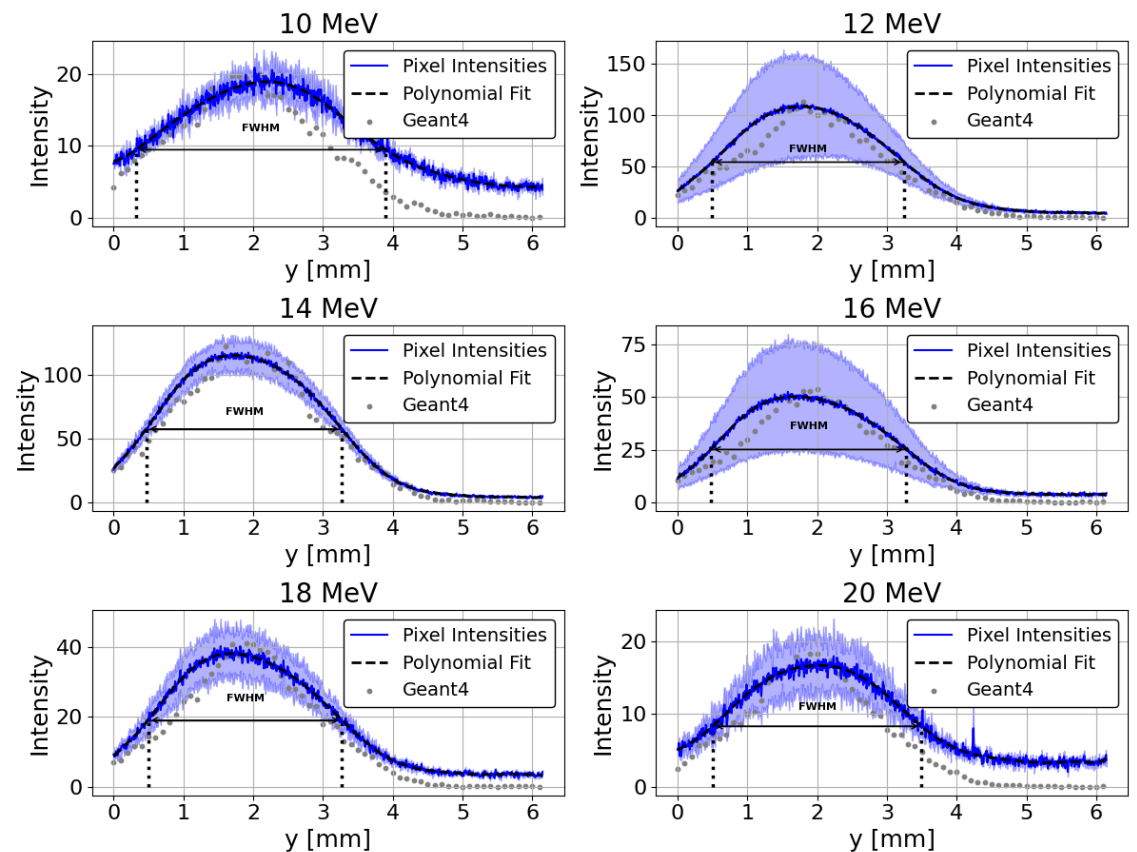
# Day 2 & 3: Liquid Scintillator Energy Scan 4 mm Collimator

x-axis



Average over 60 pixels

y-axis



Average over 60 pixels

# Day 2 & 3: Liquid Scintillator

## Example image: 2 mm collimator

Camera 1

14 MeV



Camera 2

14 MeV



16 MeV

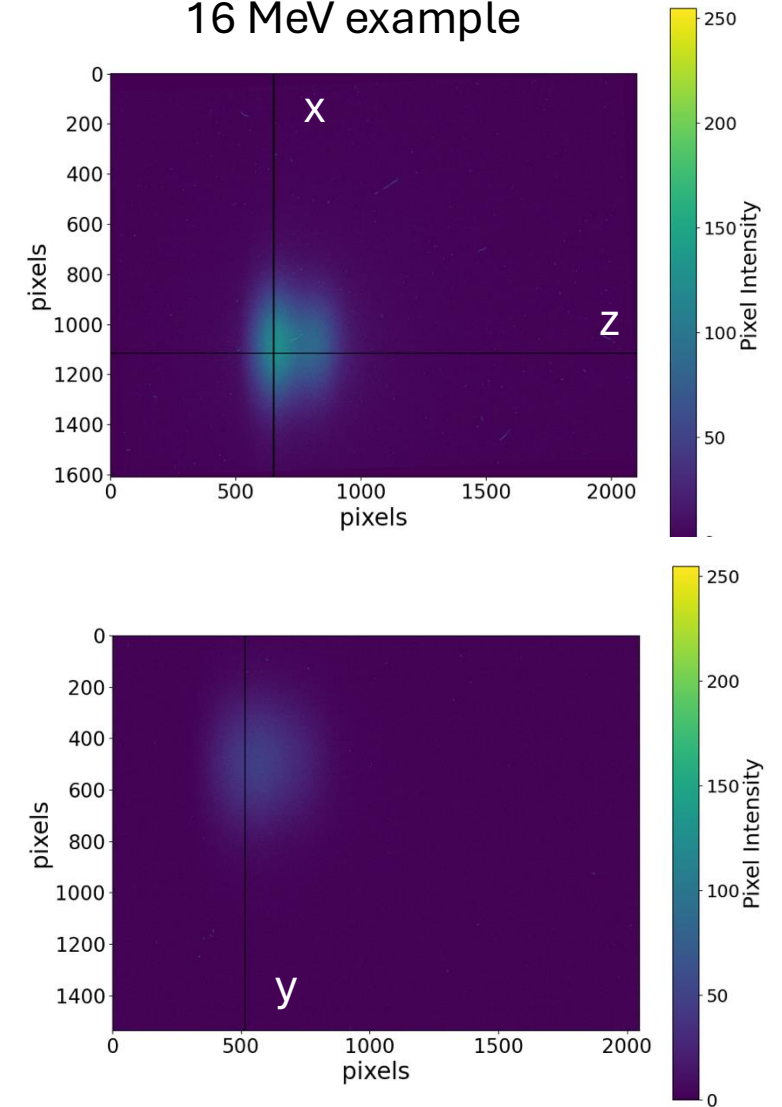


16 MeV



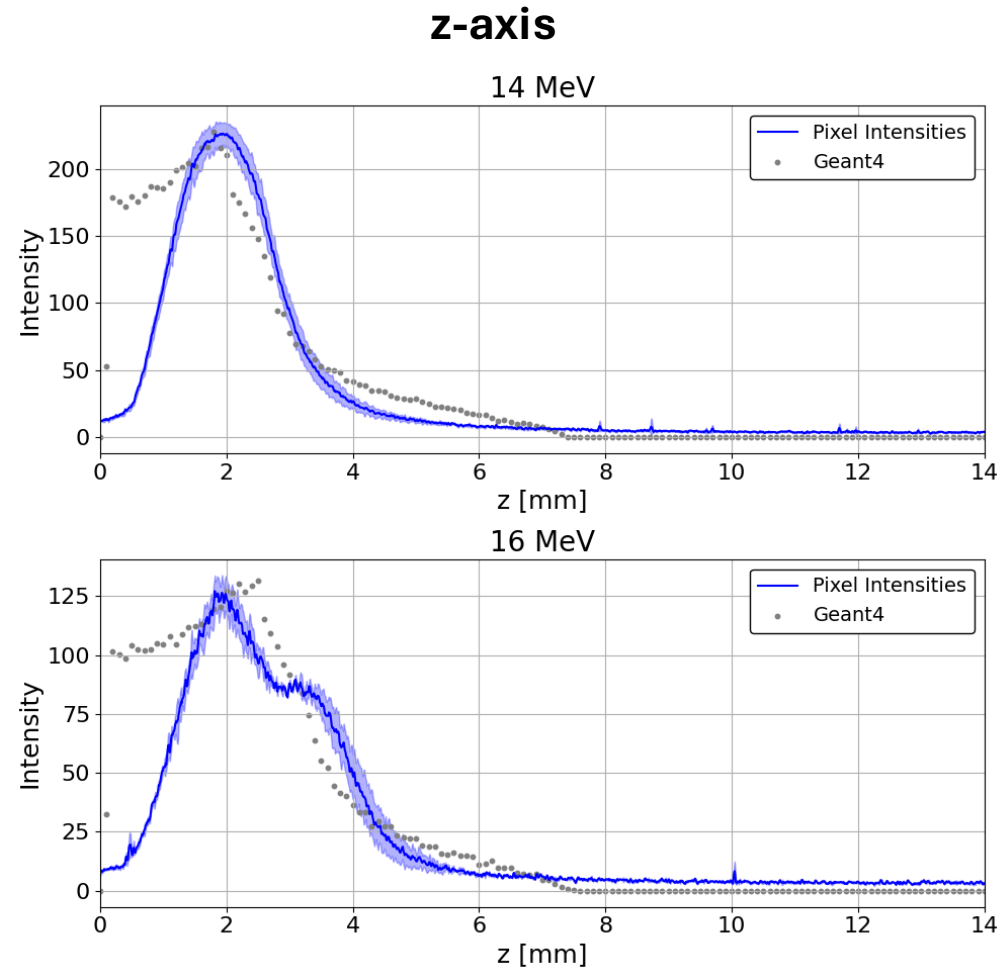
Beam  
→

16 MeV example



# Day 2 & 3: Liquid Scintillator

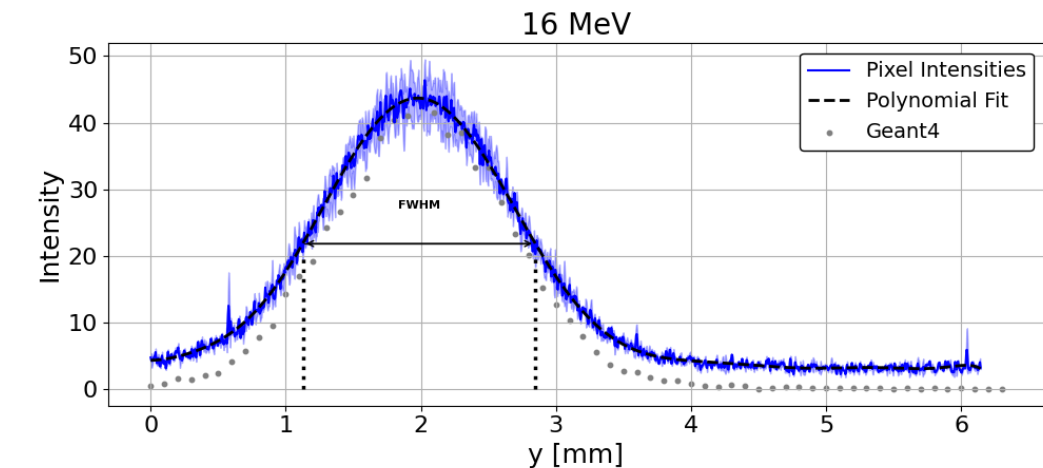
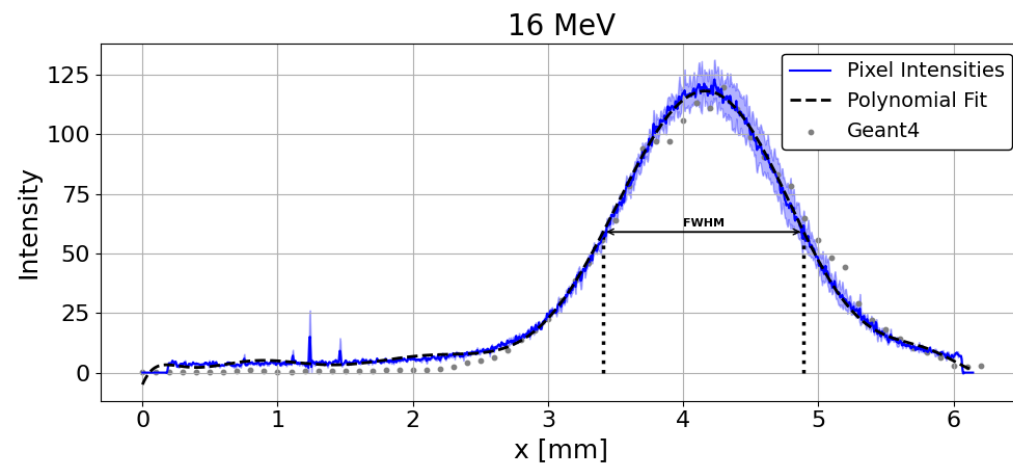
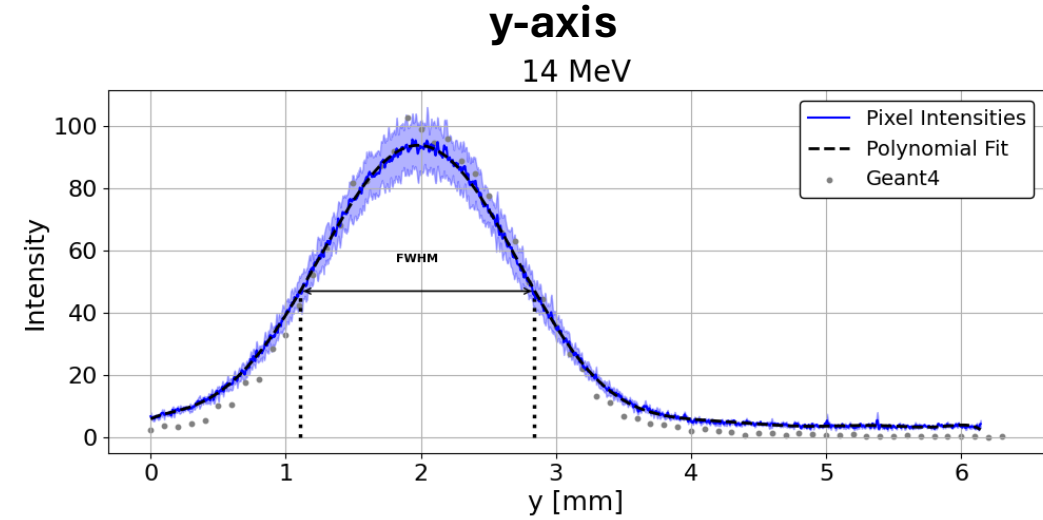
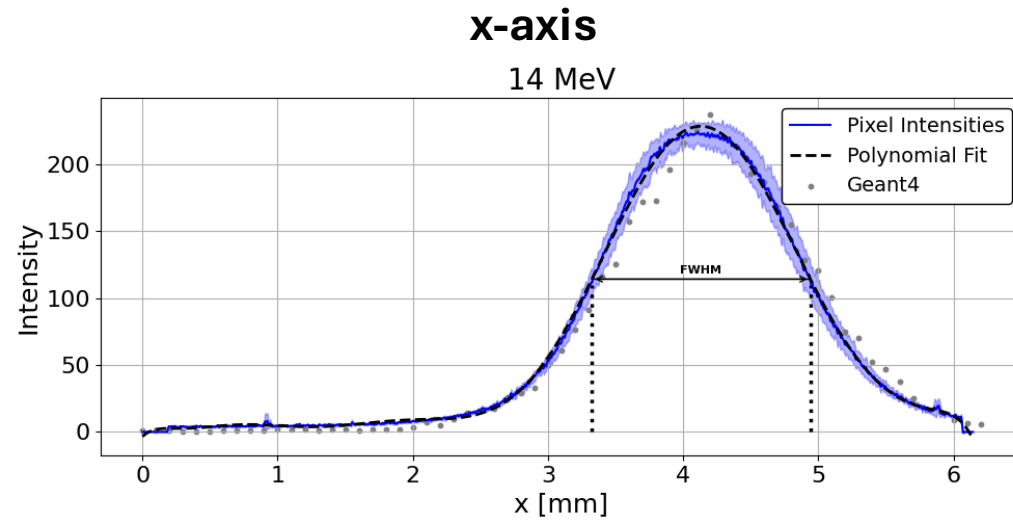
## Energy Scan **2 mm Collimator**



Average over 60 pixels



# Day 2 & 3: Liquid Scintillator Energy Scan **2 mm Collimator**



Average over 60 pixels

Average over 60 pixels

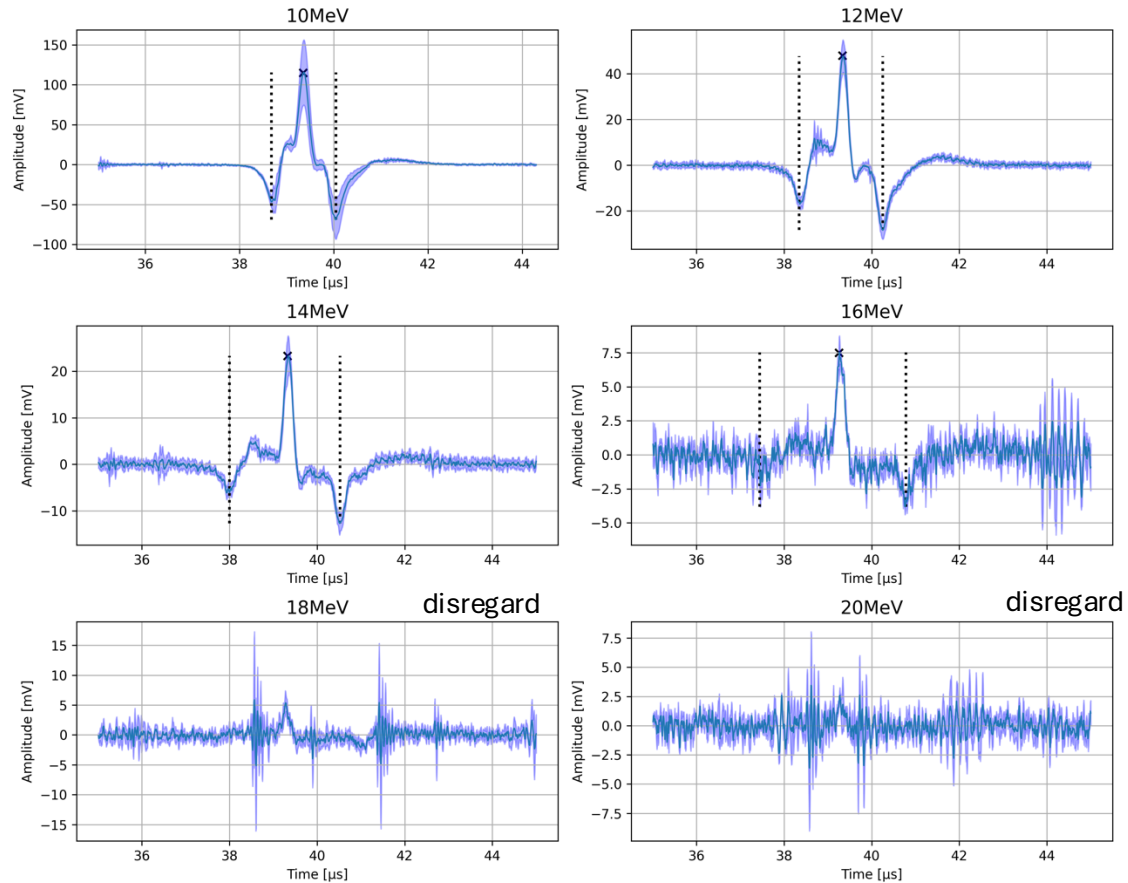
# Day 2 & 3: Piston Hydrophone Data

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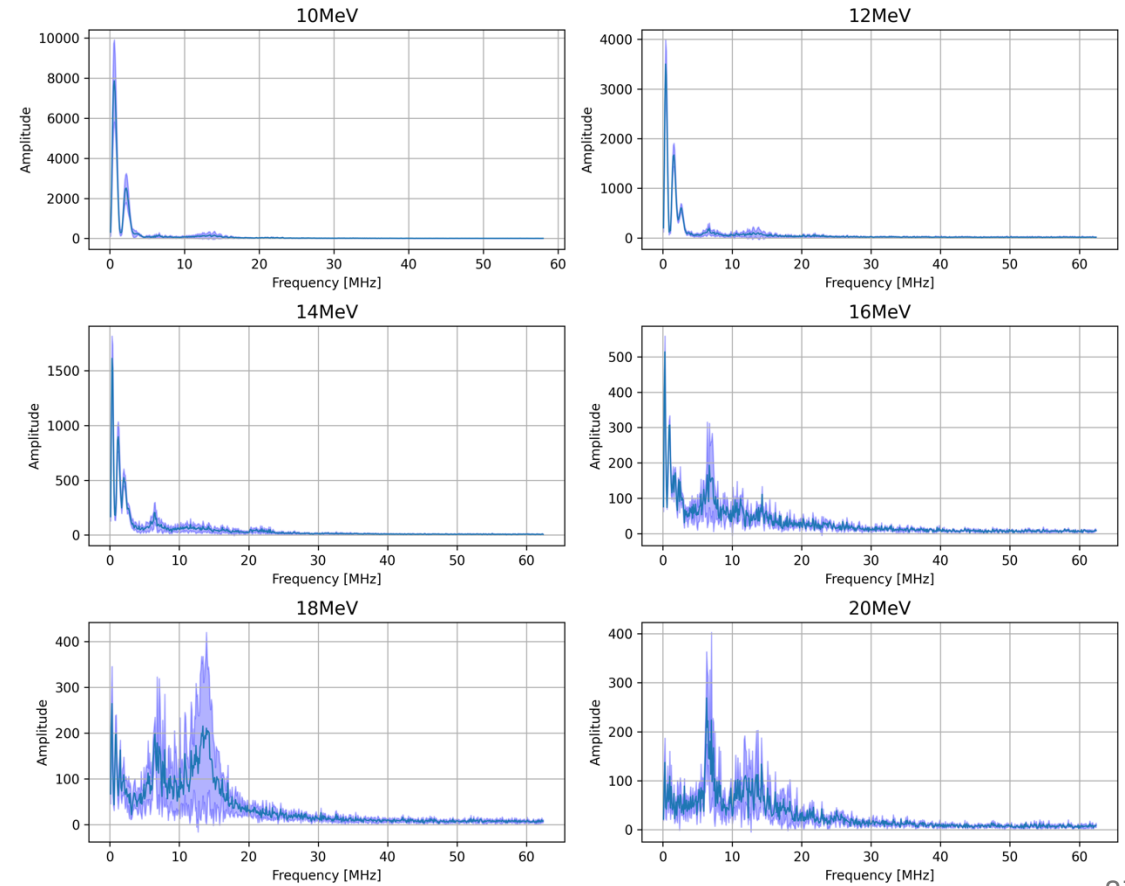
# Day 2 & 3: Piston Hydrophone Energy Scan

No Collimator

## Acoustic Traces



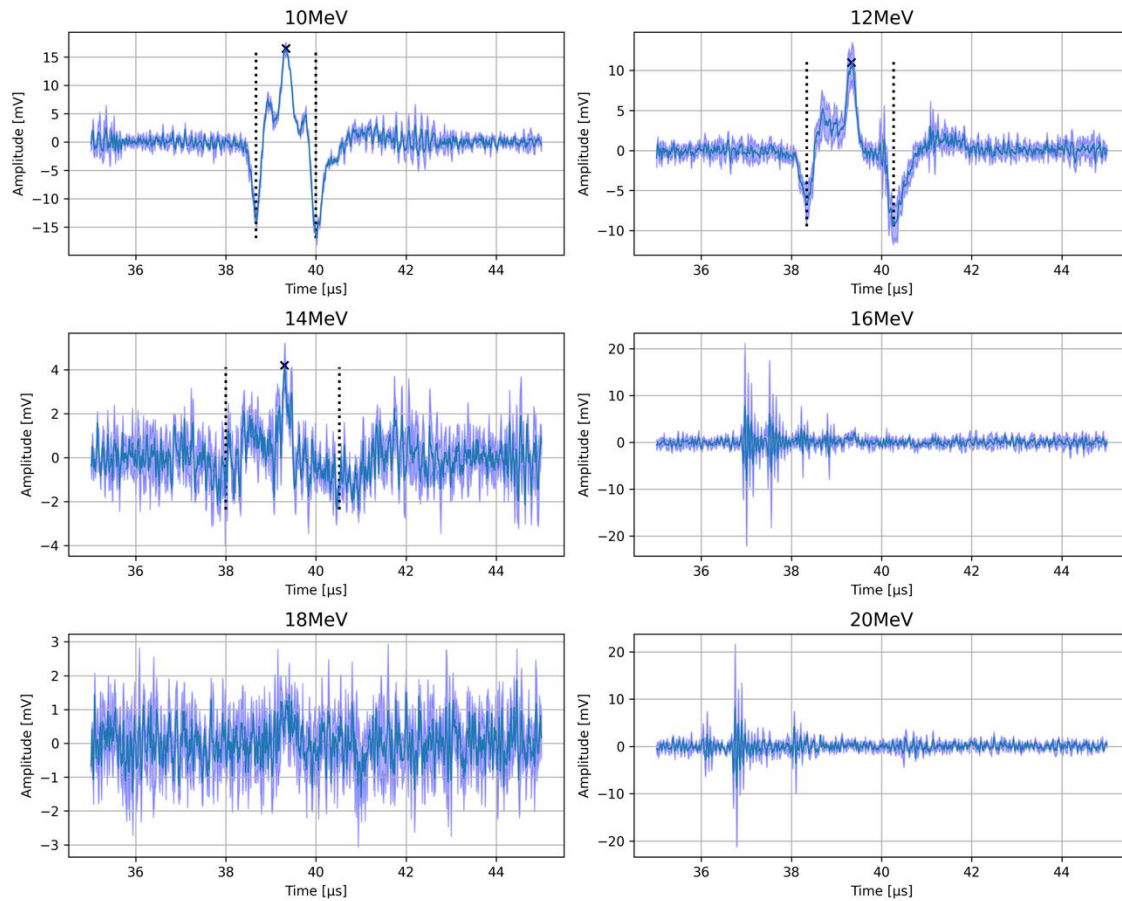
## Frequency Spectra



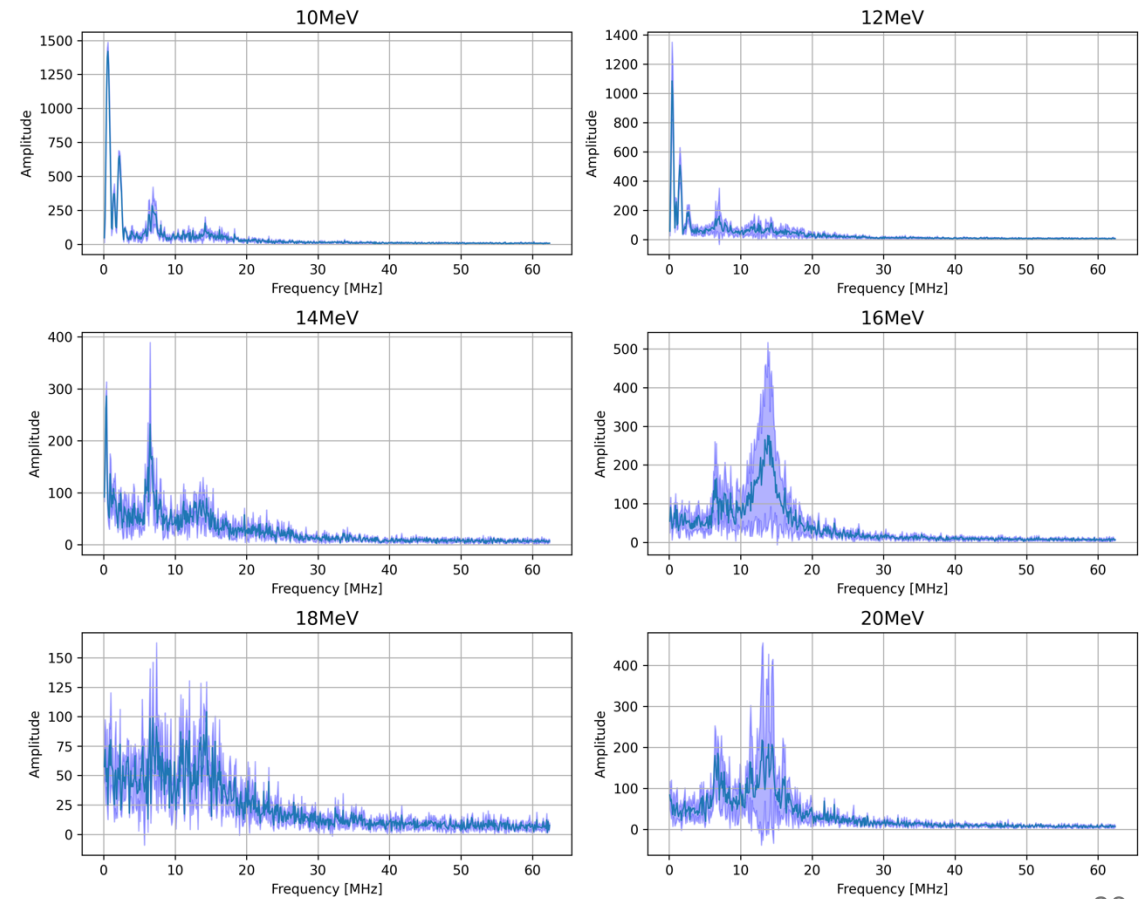
# Day 2 & 3: Piston Hydrophone

## Energy Scan 4 mm Collimator

### Acoustic Traces

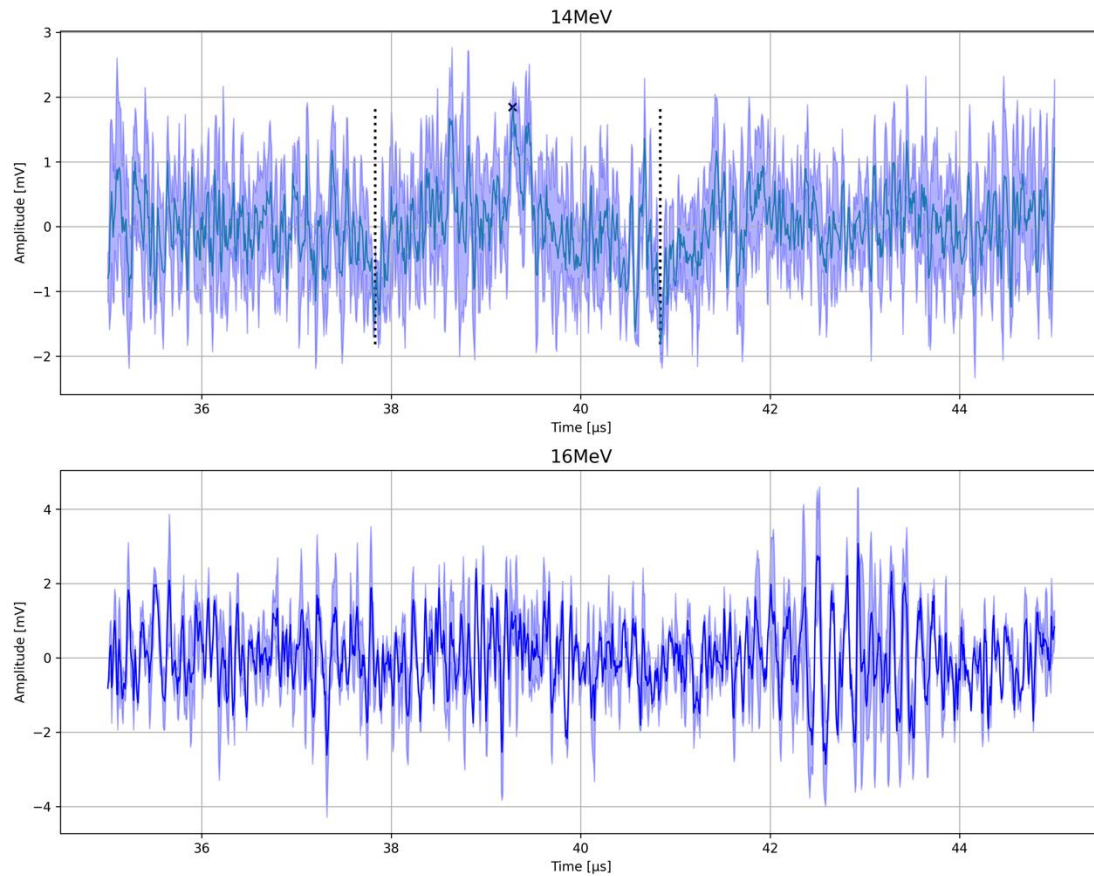


### Frequency Spectra

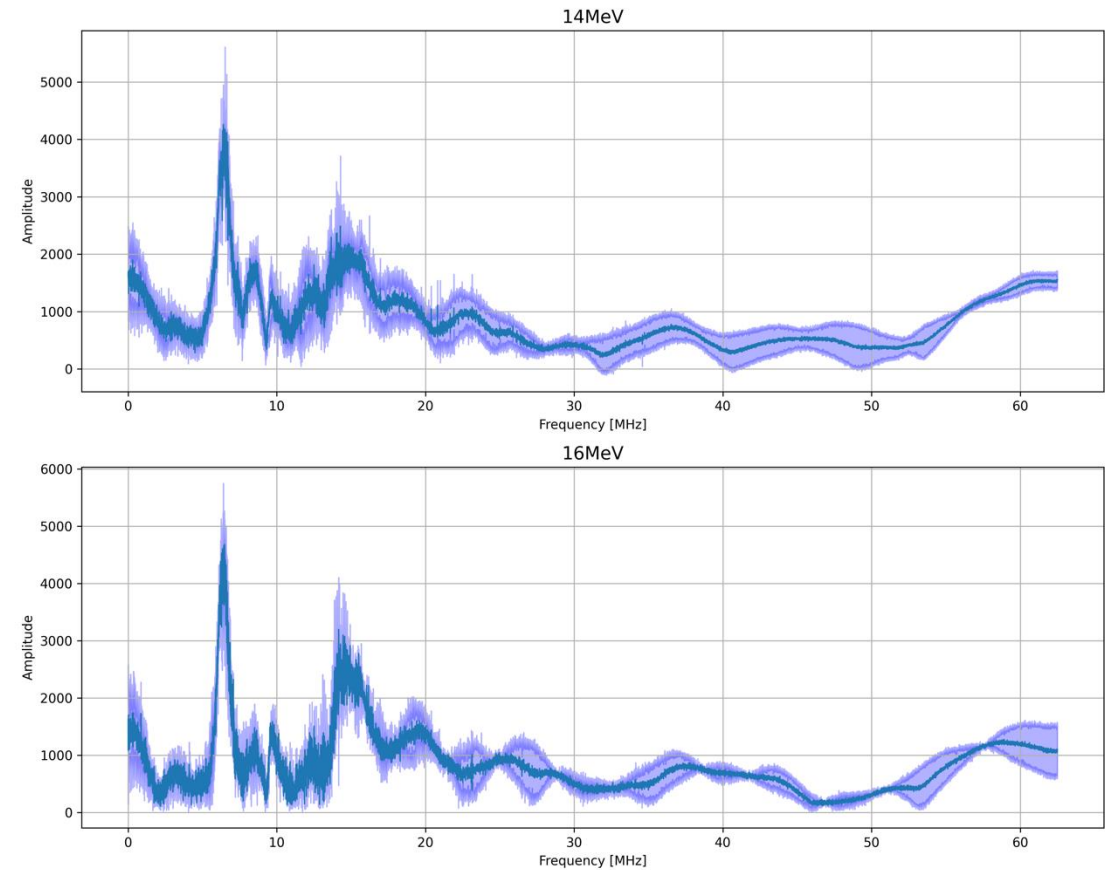


# Day 2 & 3: Piston Hydrophone Energy Scan 2 mm Collimator

## Acoustic Traces



## Frequency Spectra



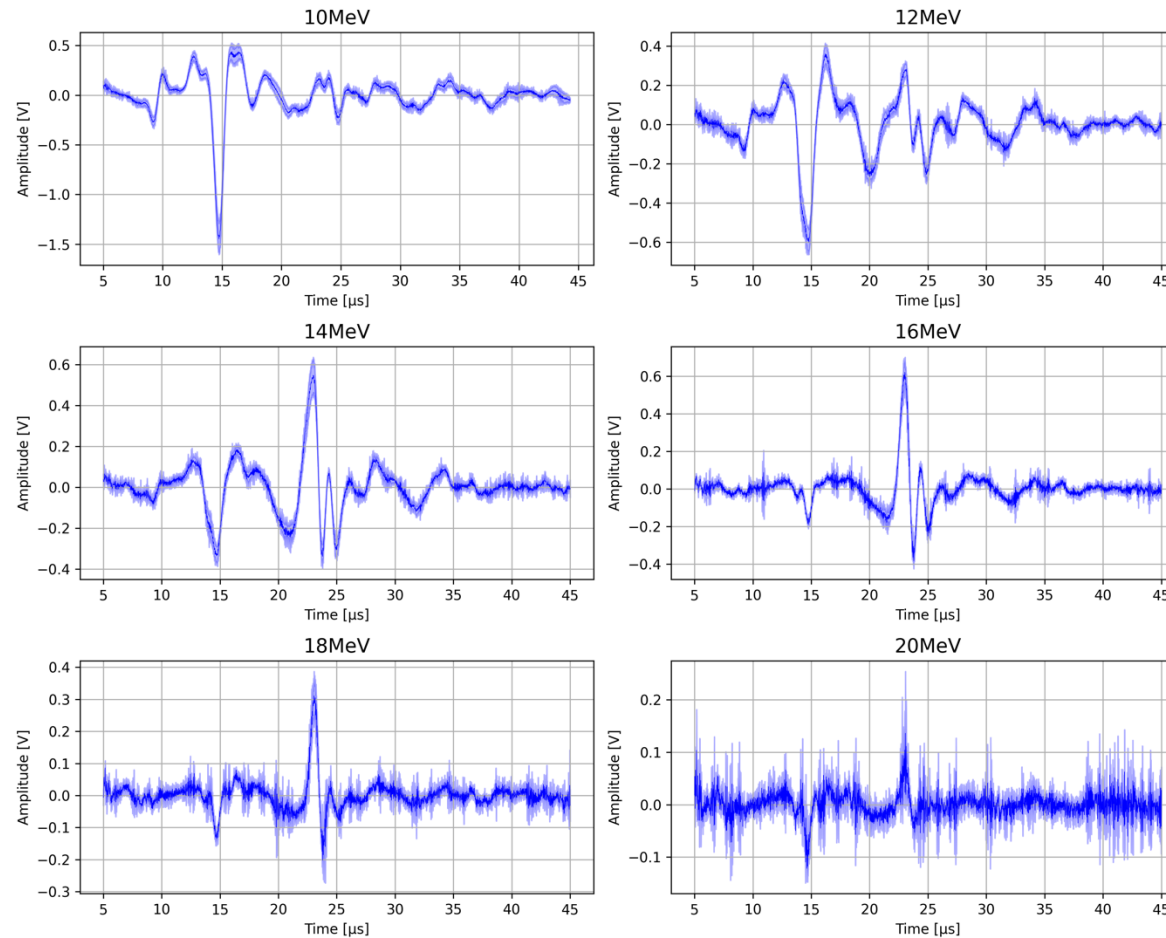


# Day 2 & 3: Olympus Hydrophone Data

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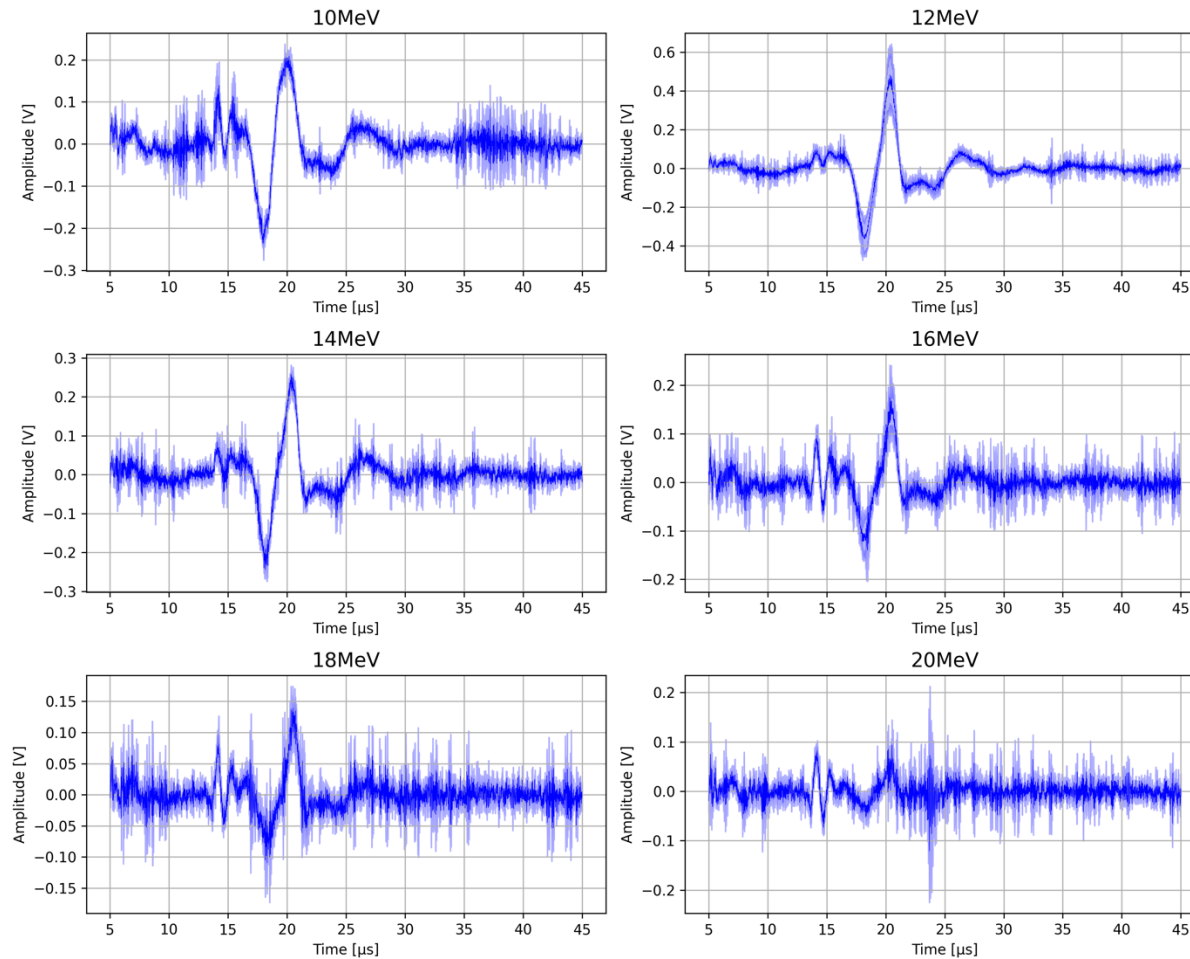
# Day 2 & 3: Olympus Hydrophone

## Energy Scan **No Collimator**



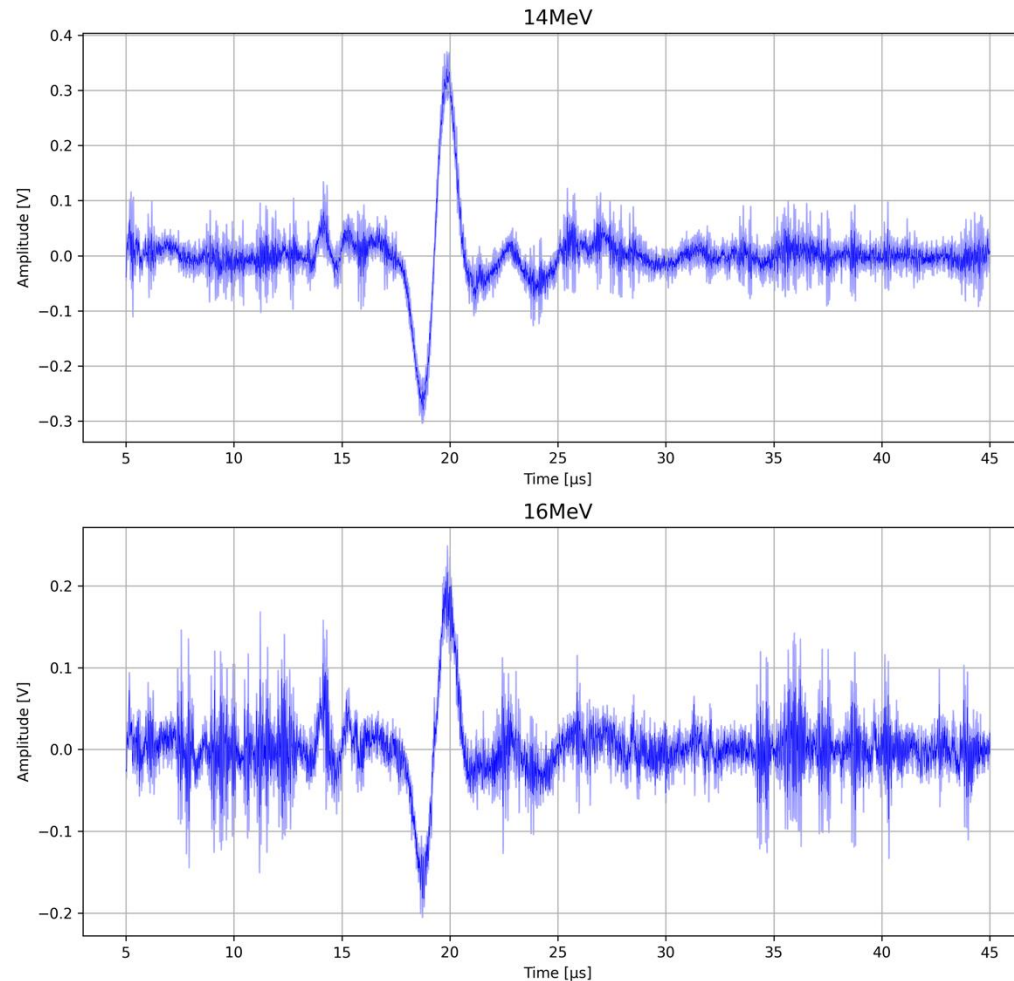
# Day 2 & 3: Olympus Hydrophone

## Energy Scan 4 mm Collimator



# Day 2 & 3: Olympus Hydrophone

## Energy Scan **2 mm Collimator**



# Day 2 & 3: Acoustic & Optical Comparison

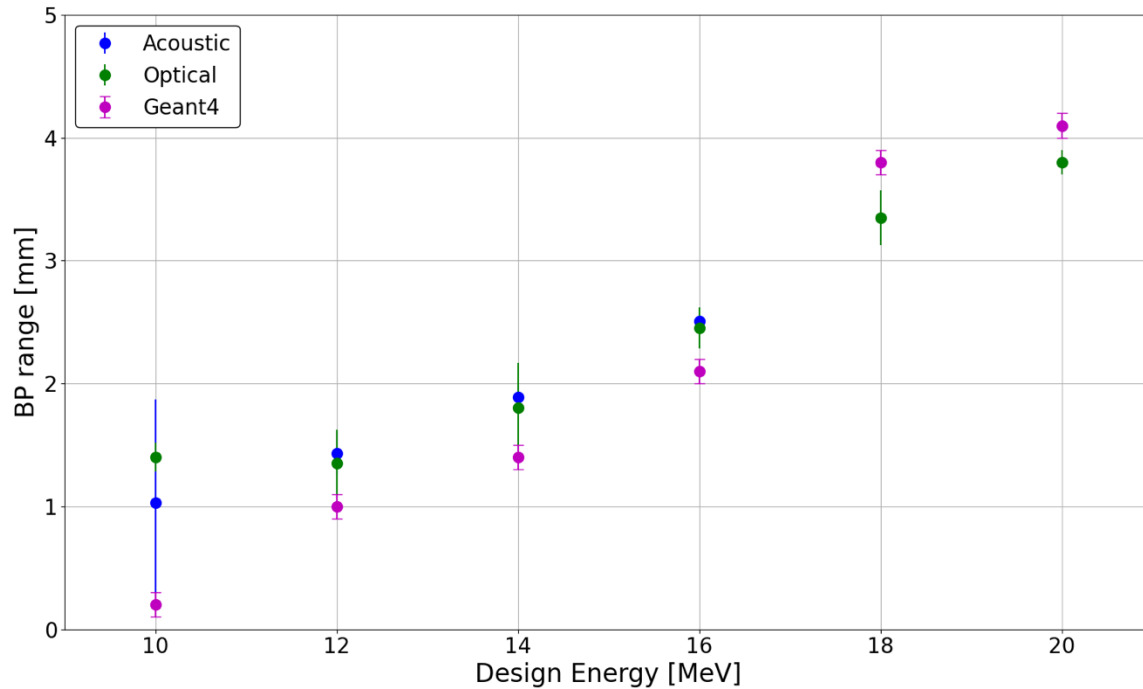
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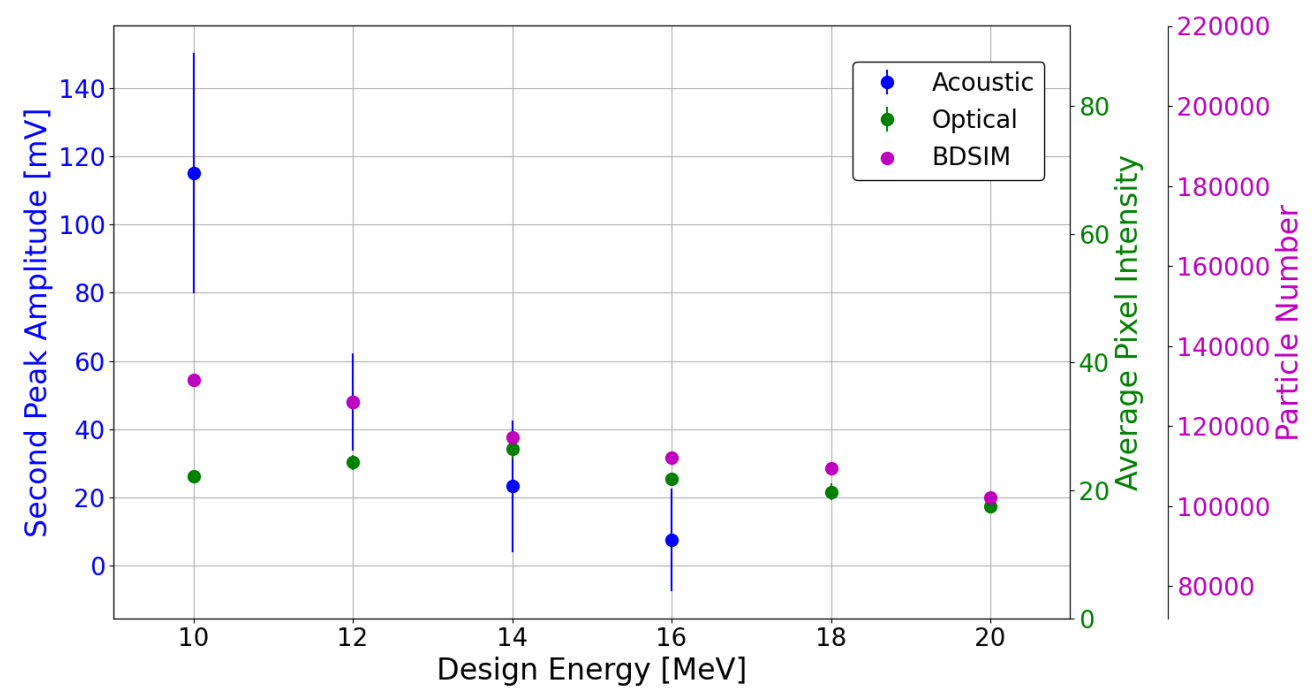
# Day 2 & 3: Optical & Acoustic Comparison

## Energy Scan No Collimator

### BP Range

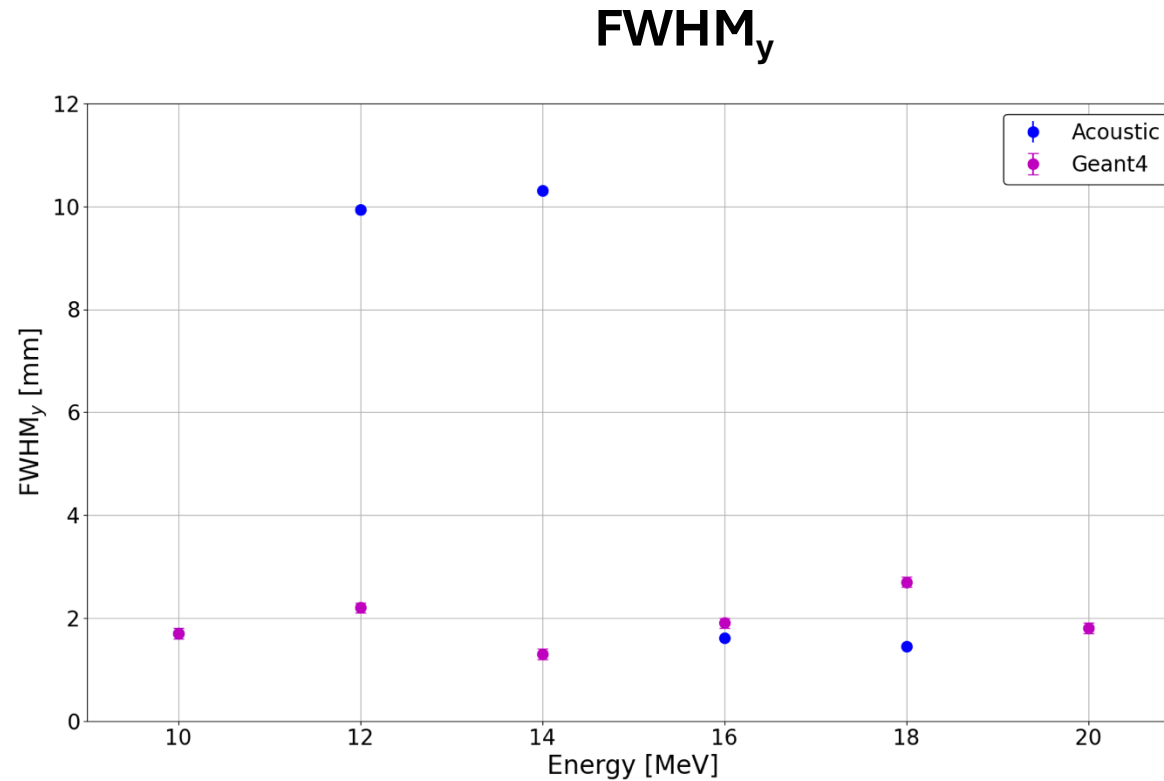


### Particle Number Relation



# Day 2 & 3: Optical & Acoustic Comparison

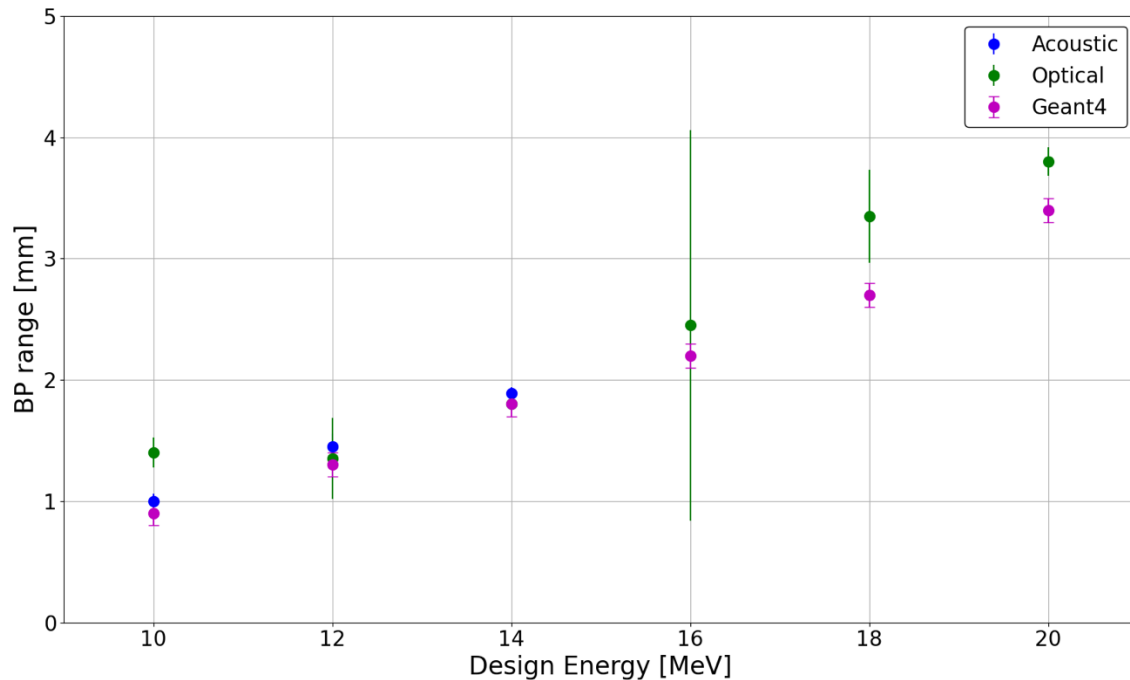
## Energy Scan **No Collimator**



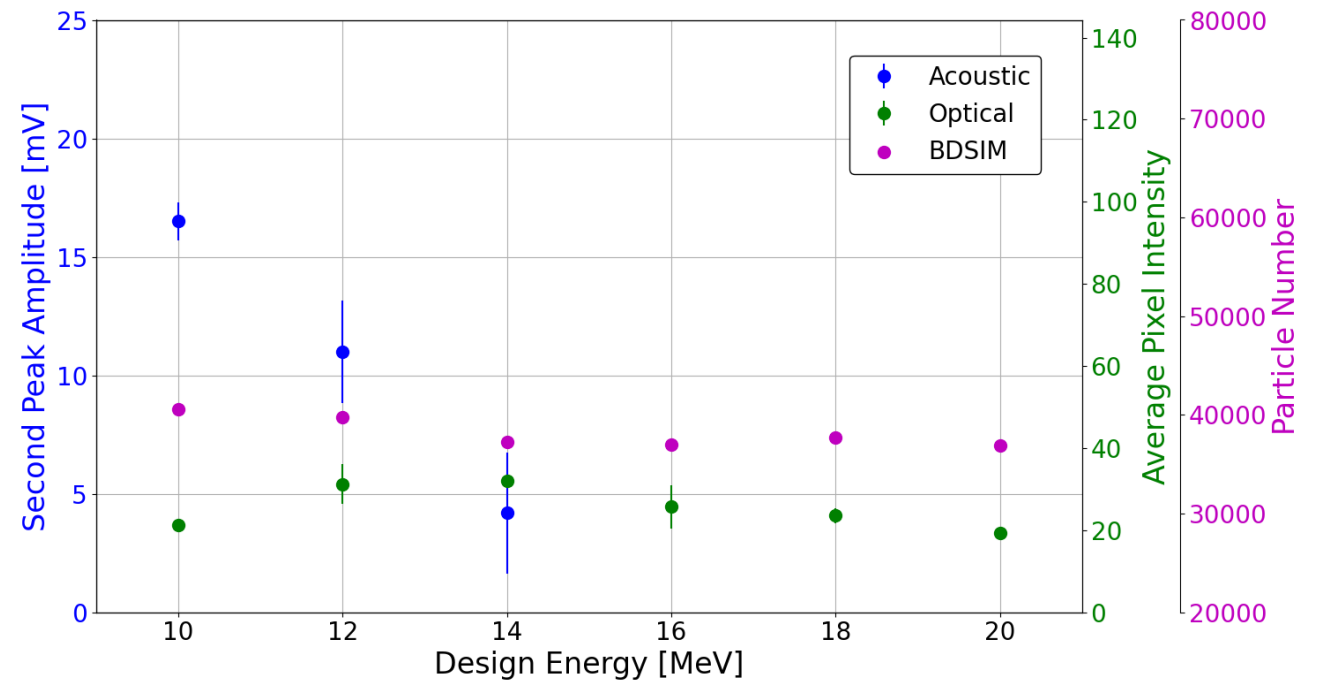
# Day 2 & 3: Optical & Acoustic Comparison

## Energy Scan 4 mm Collimator

### BP Range

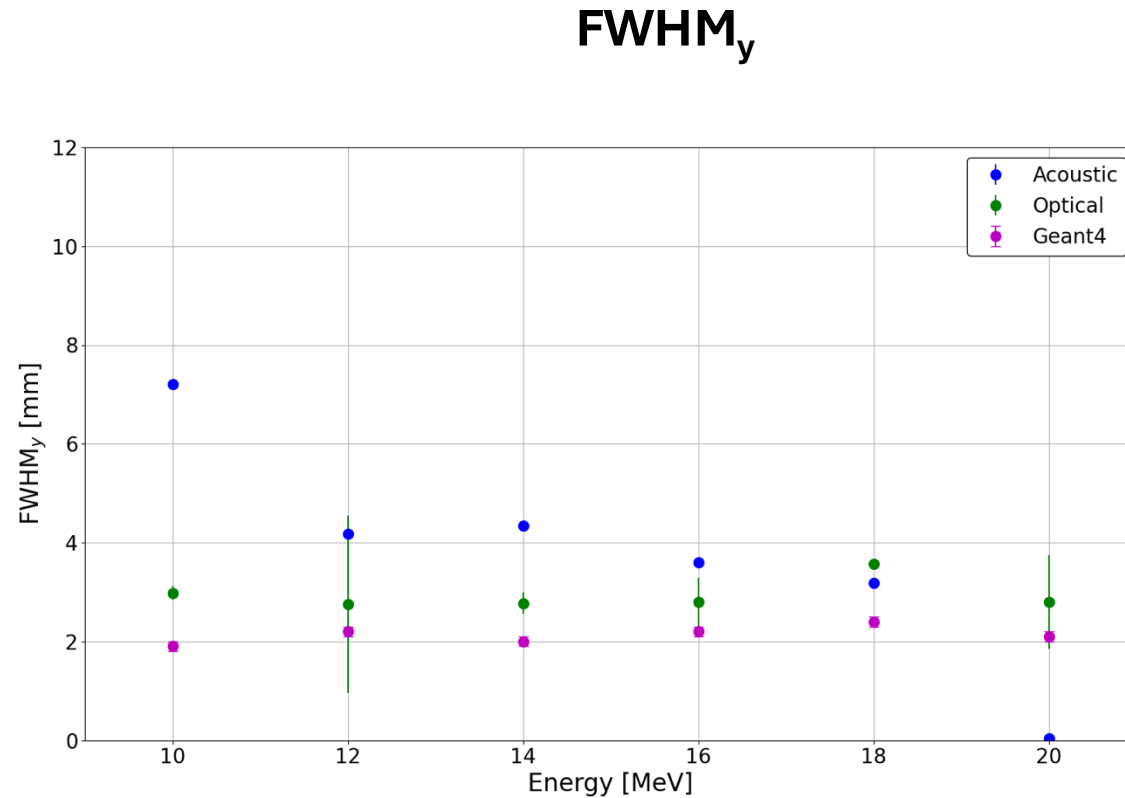


### Particle Number Relation



# Day 2 & 3: Optical & Acoustic Comparison

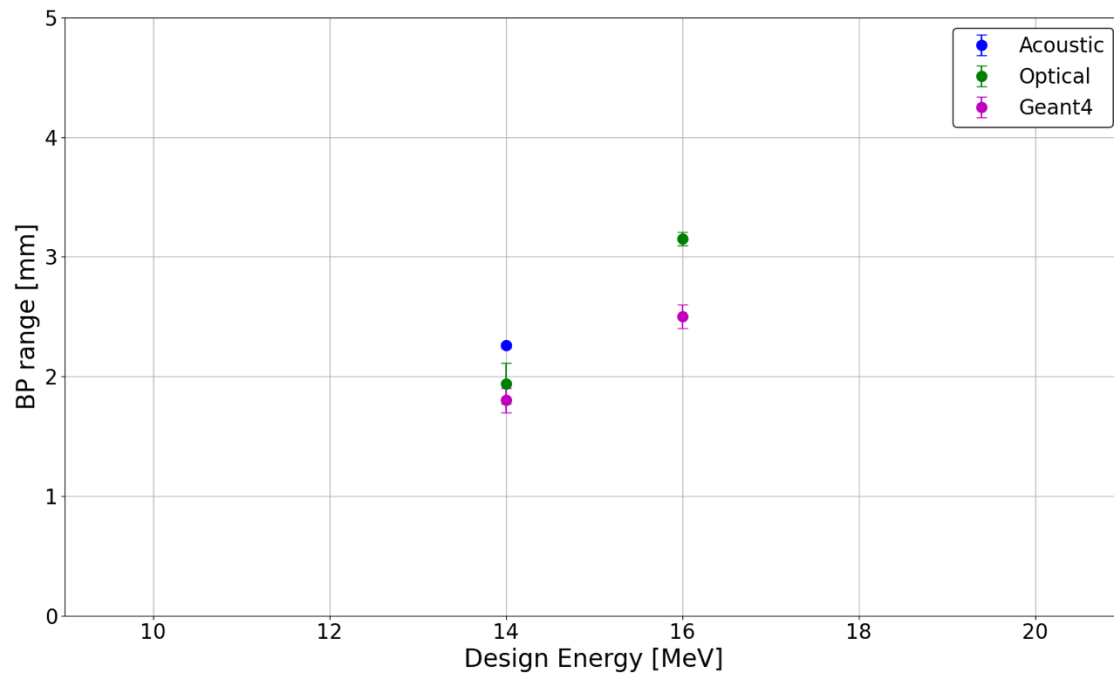
## Energy Scan 4 mm Collimator



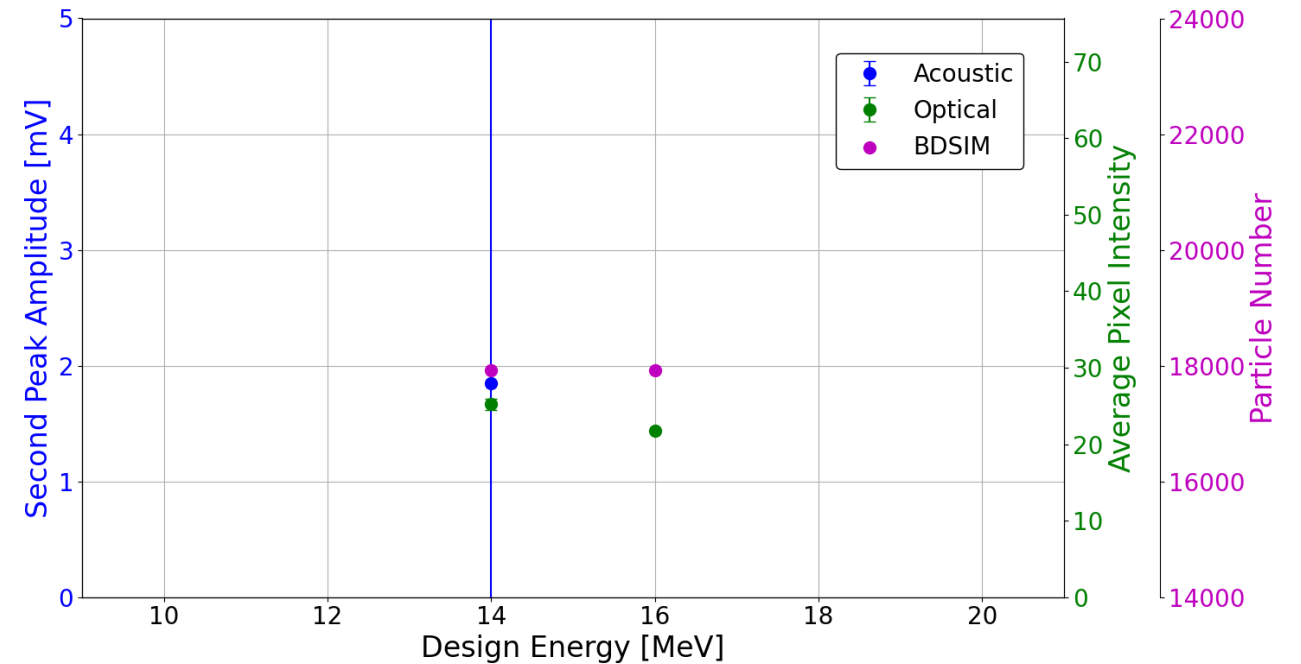
# Day 2 & 3: Optical & Acoustic Comparison

## Energy Scan 2 mm Collimator

### BP Range



### Particle Number Relation





# Day 2 & 3: Optical & Acoustic Comparison

## Energy Scan 2 mm Collimator

