

# Development of a Geant4 simulation platform of the HollandPTC R&D proton beamline for radiobiological studies

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# Outline of today's talk

HollandPTC

Aim

Development of a  
Simulation Platform

Conclusion

1. Geometry & Physics

2. Training phase

3. Testing phase

# Holland Proton Therapy Center, Delft, the Netherlands

- One of three proton facilities in NL
- Experimental room with a fixed horizontal beamline, 70-250 MeV energy range
- Performance of pre-clinical studies to prove the clinical value of proton radiotherapy



# Experimental room of Holland Proton Therapy Center, Delft



# Aim

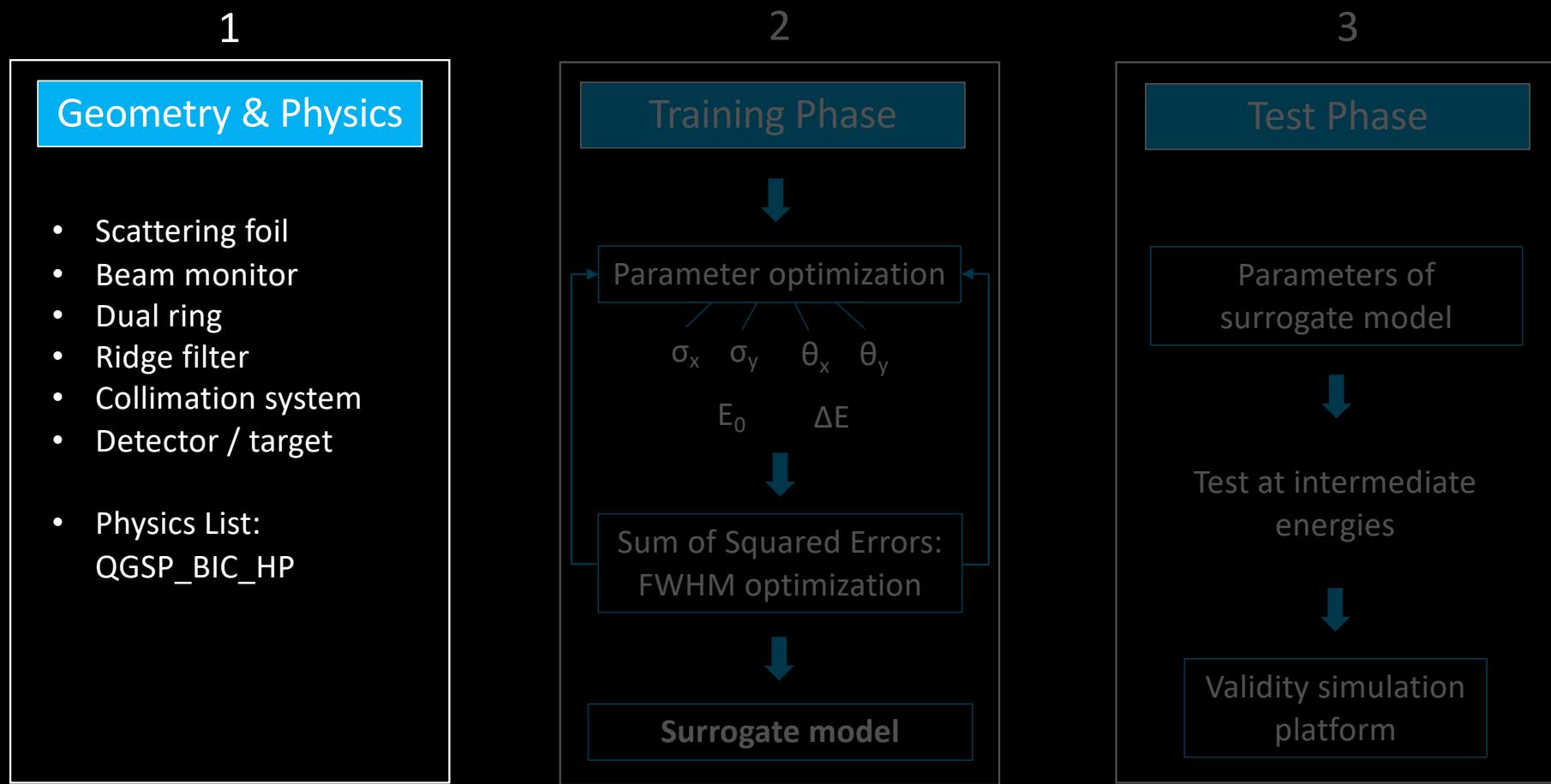
*Study the biological variability between proton  
and photon radiotherapy in head and neck cancer  
to improve patient selection*

Development of a Geant4 simulation platform



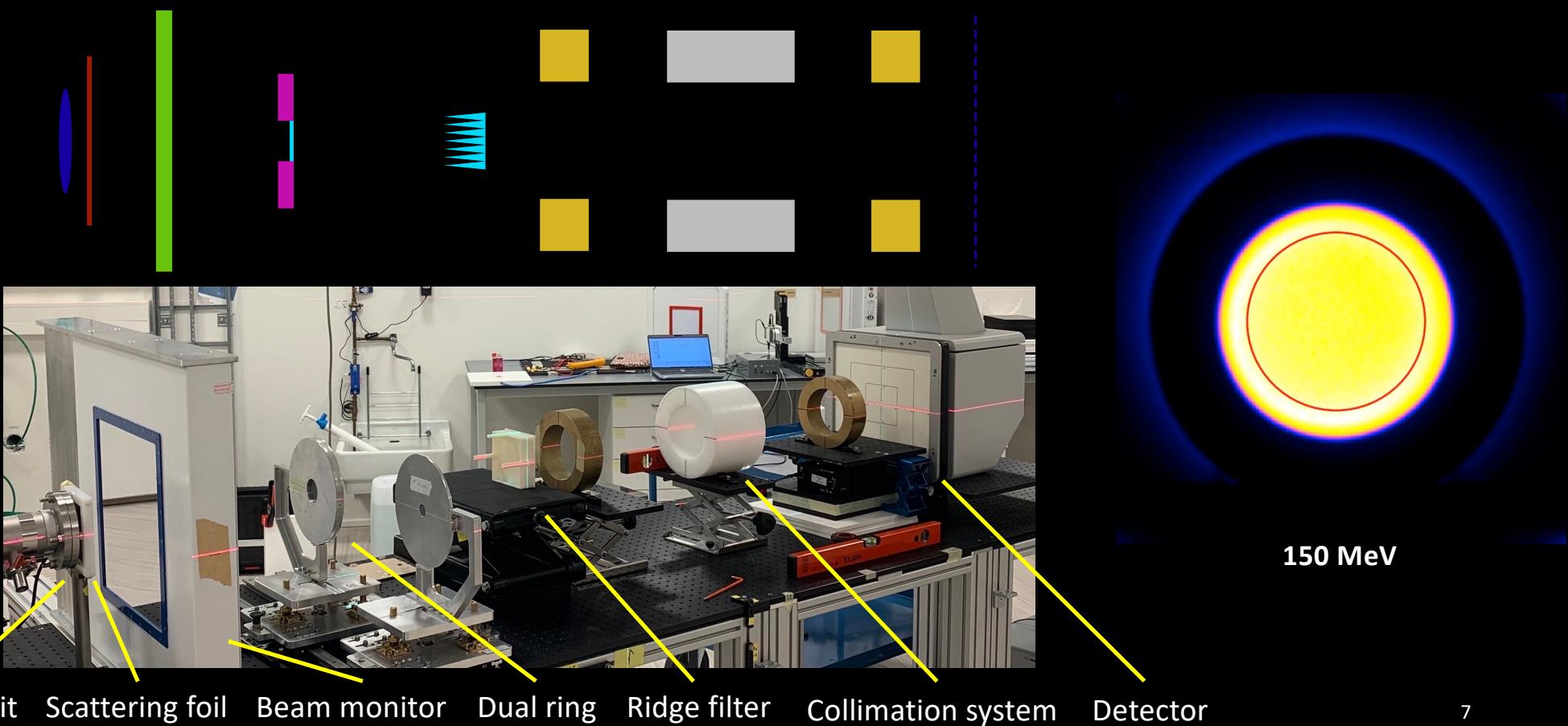
To optimize and plan radiobiological experiments

# Workflow Simulation Platform Development

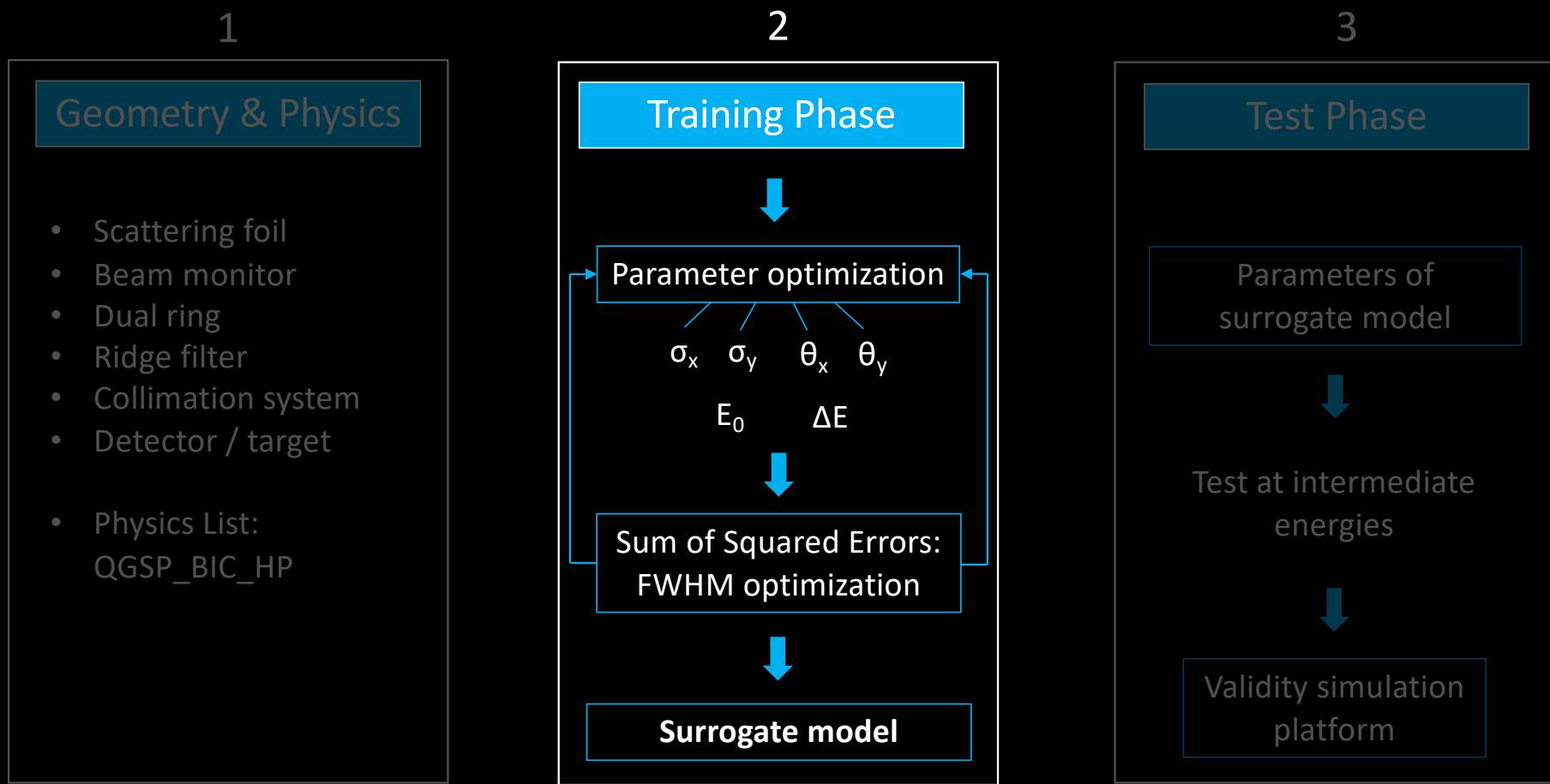


# 1. Geometry and physics

Passive scattering system to create a large field ( $d=10\text{cm}$ )



# Workflow Simulation Platform Development



## 2. Training phase

Parameter optimization

### **At 70, 150 and 240 MeV**

- 1. Lateral spread distribution
- 2. Angular spread distribution
- 1. Initial energy
- 2. Energy spread

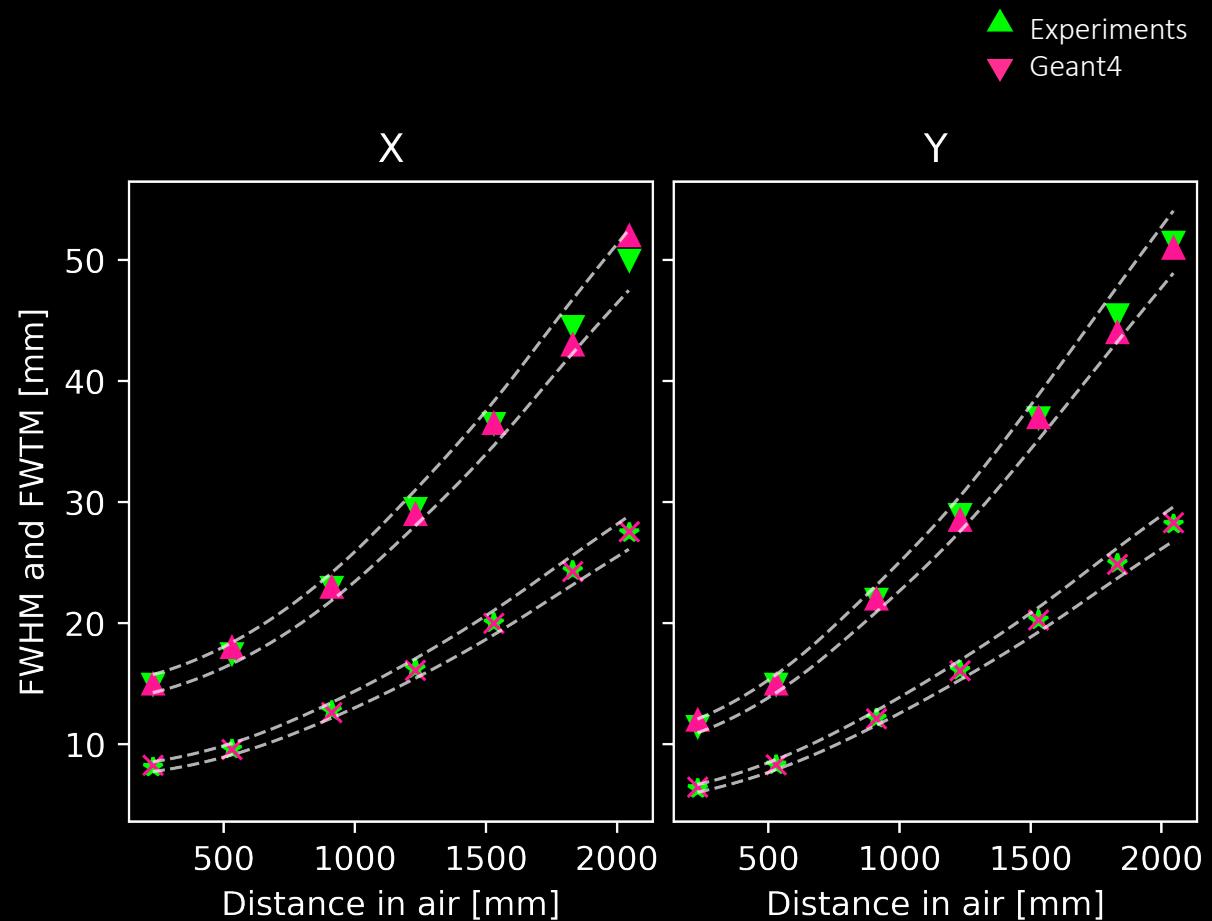
Beam envelope (FWHM)

Depth dose profiles

## 2. Results training phase

Beam envelope:  
FWHM and FWTM

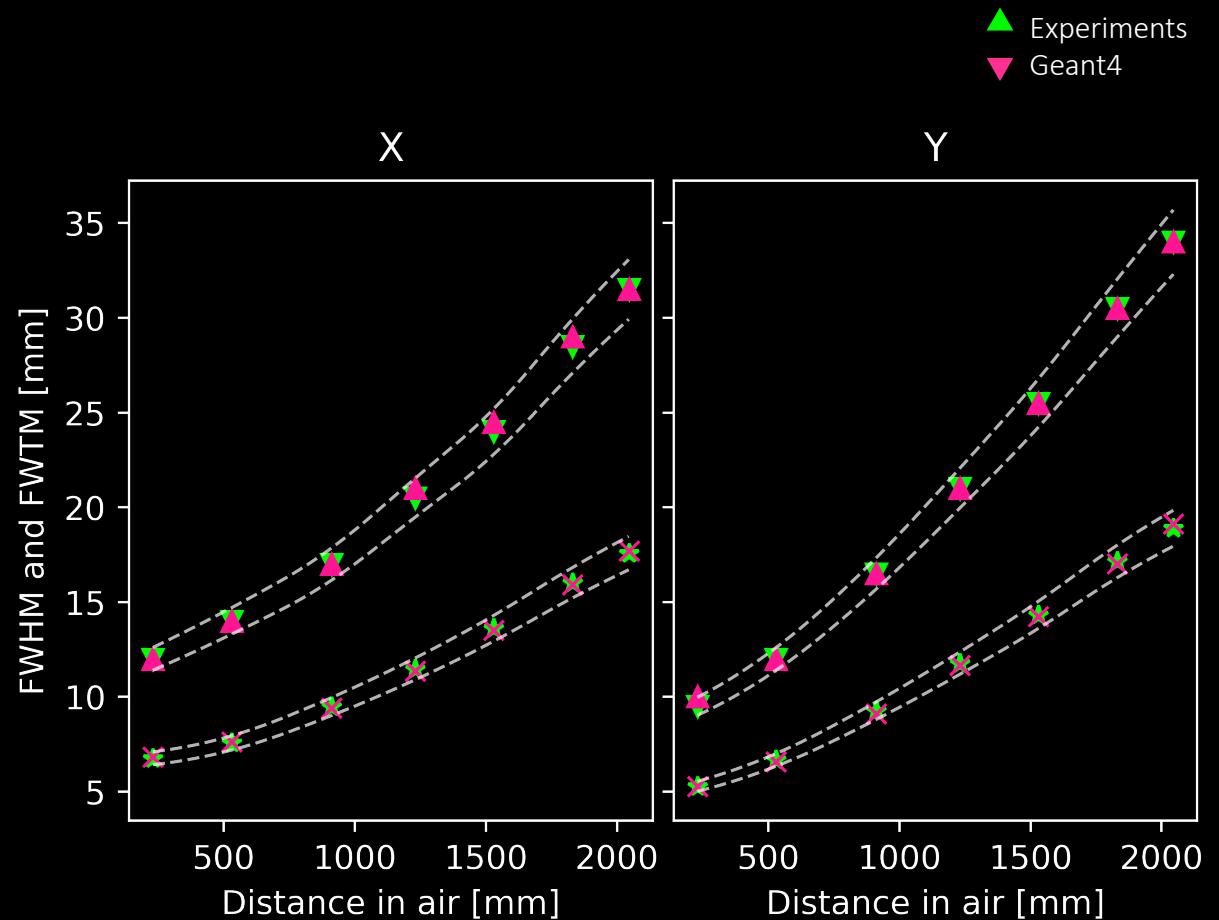
- 70 MeV



## 2. Results training phase

Beam envelope:  
FWHM and FWTM

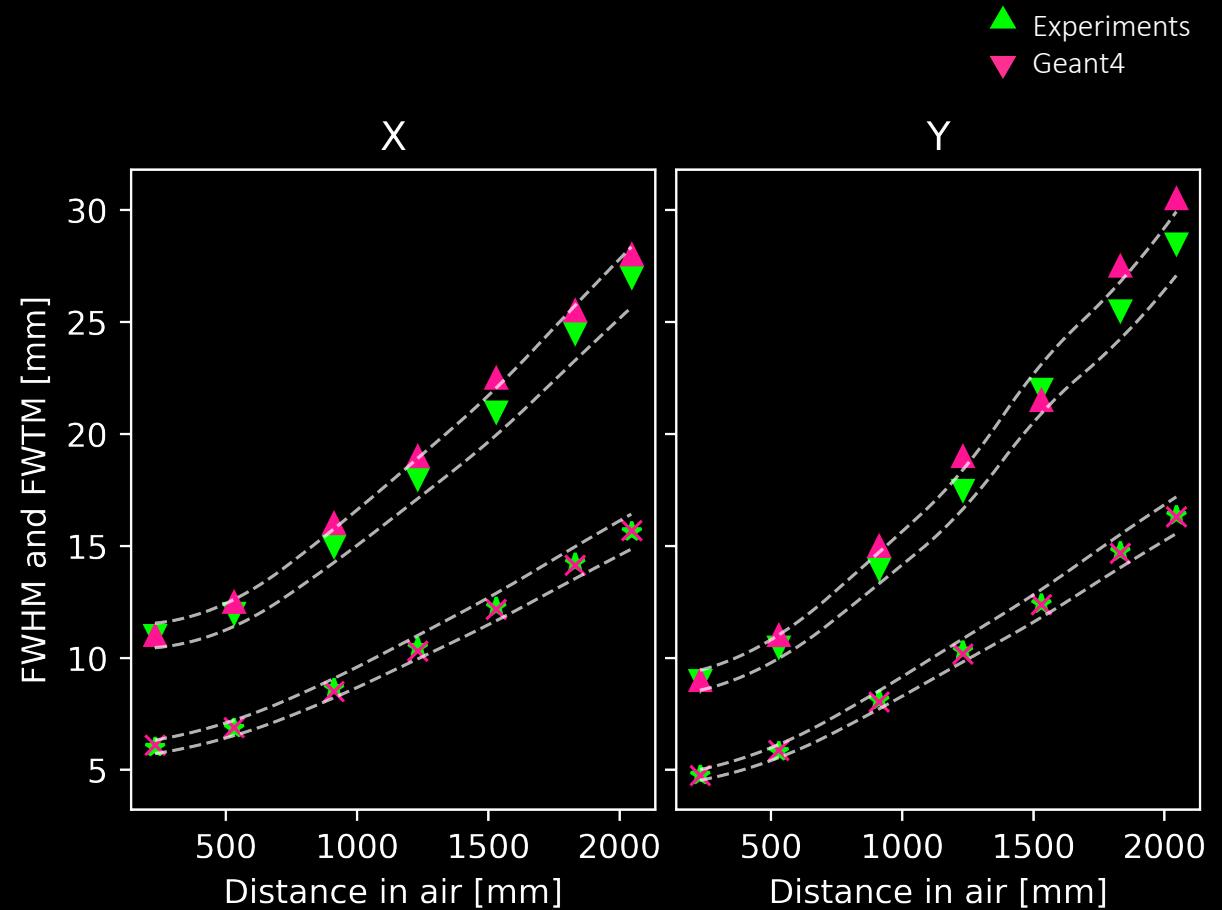
- 150 MeV



## 2. Results training phase

Beam envelope:  
FWHM and FWTM

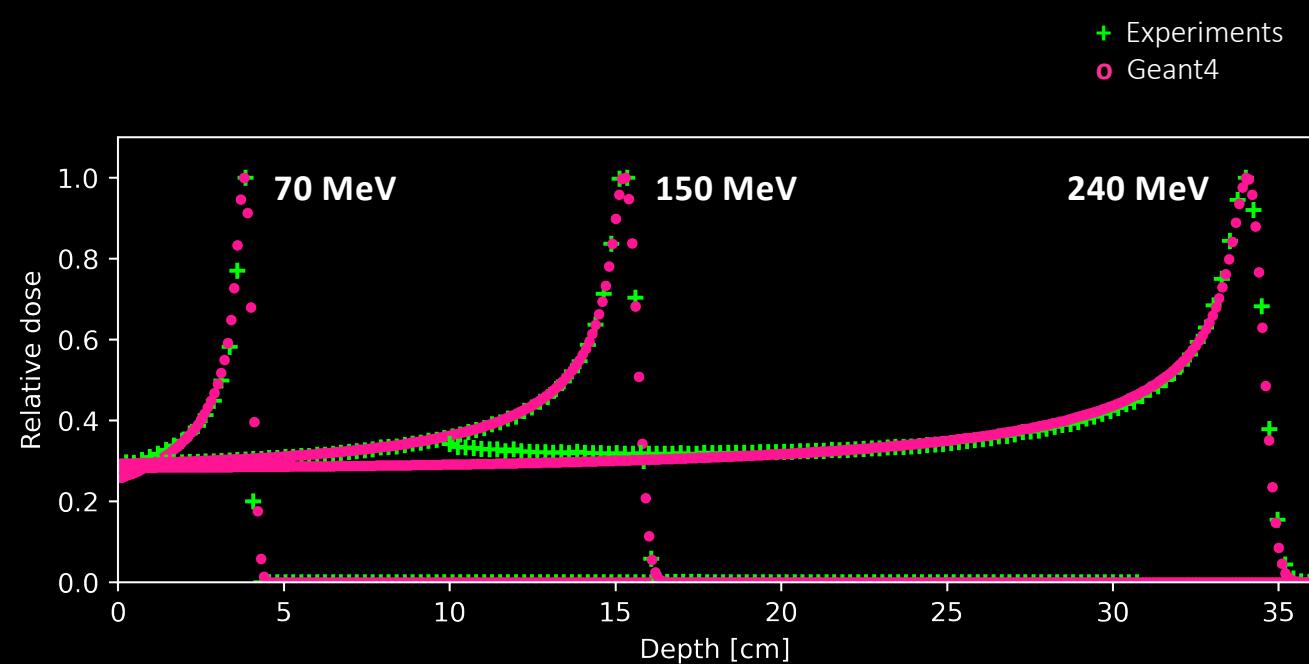
- 240 MeV



## 2. Results training phase

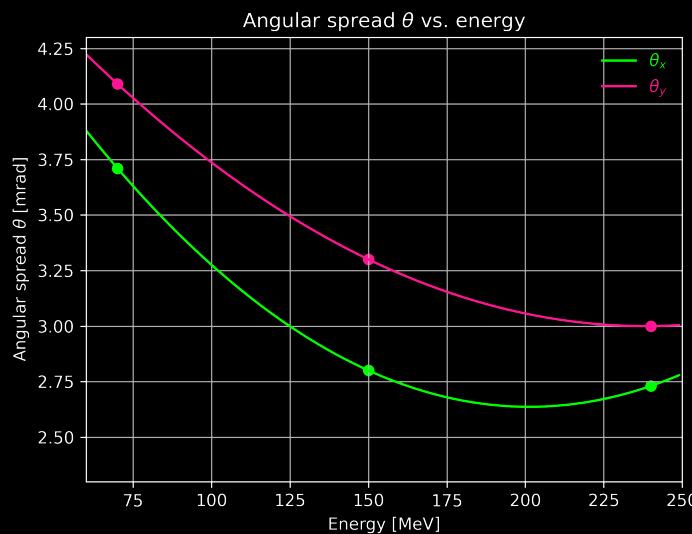
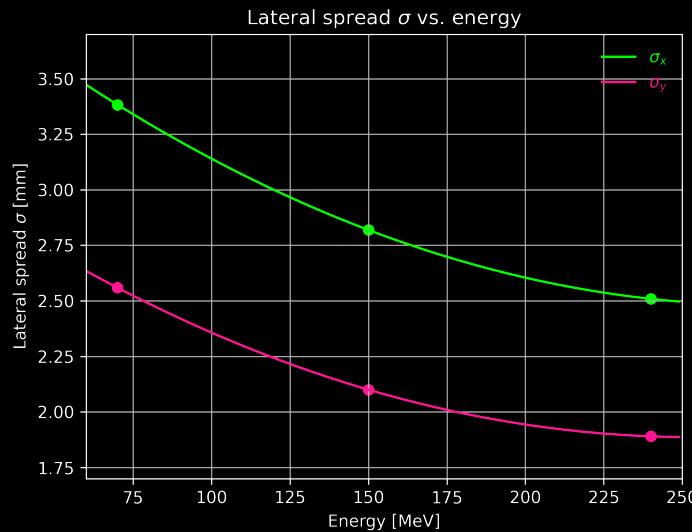
### Depth dose profiles

- 70, 150, 240 MeV

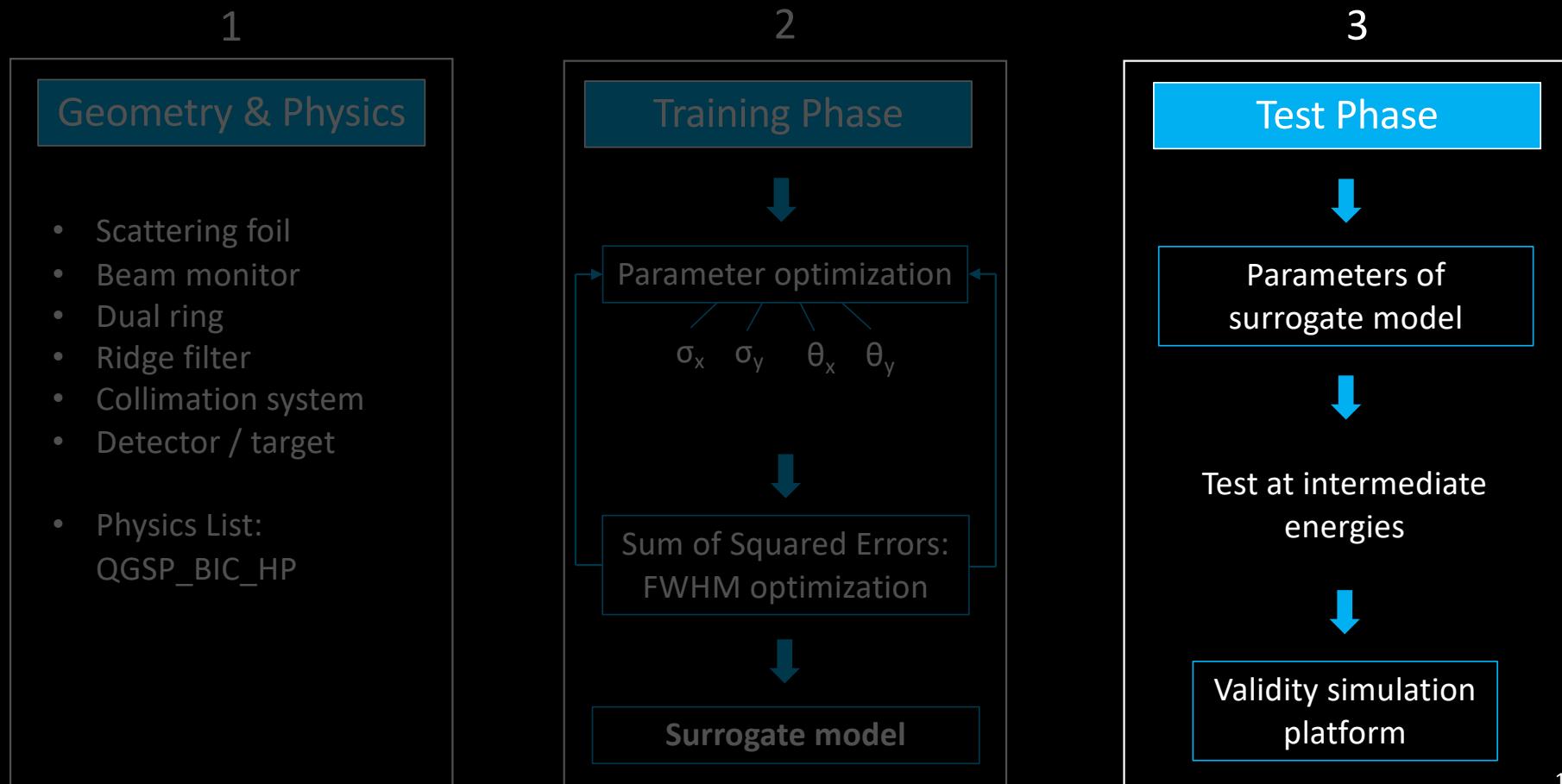


## 2. Results training phase

### Surrogate model



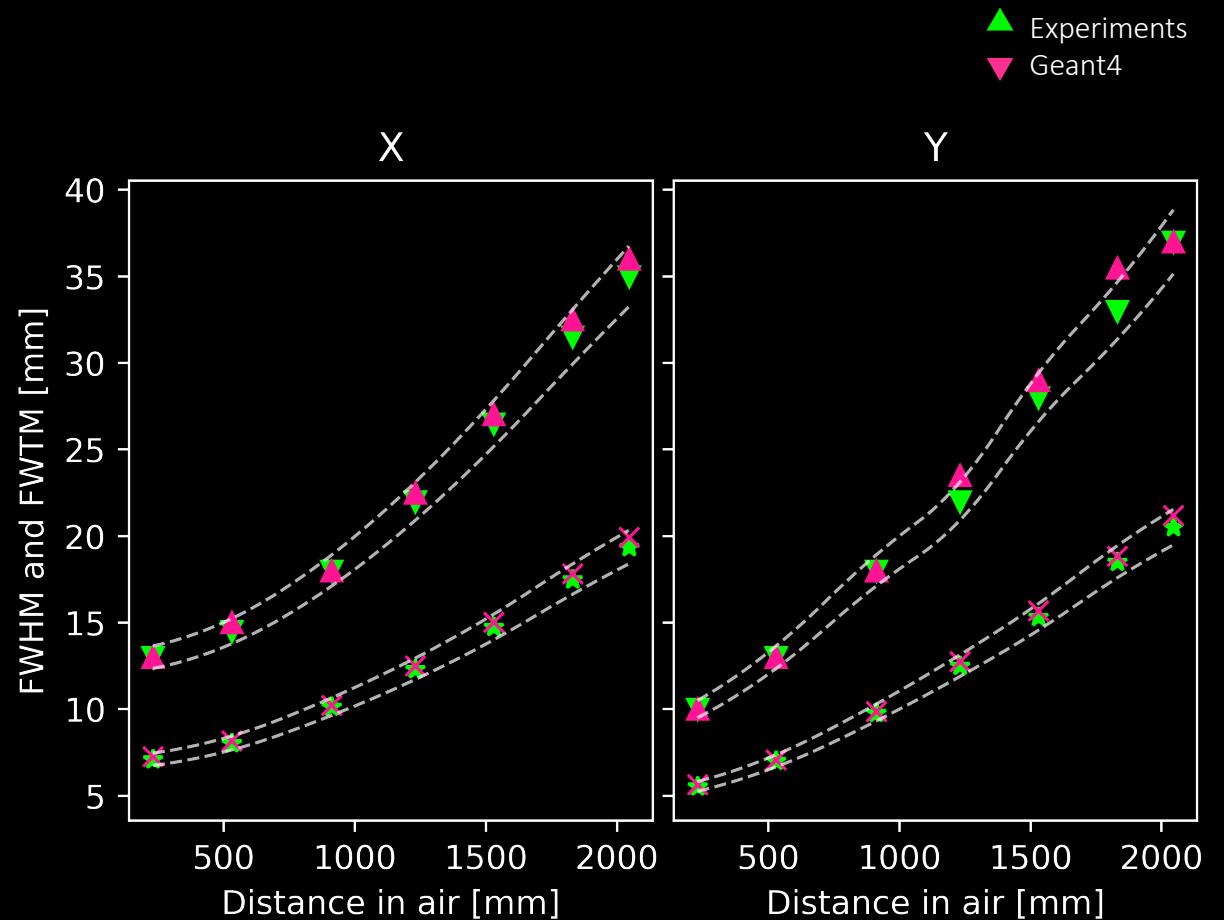
# Workflow Simulation Platform Development



### 3. Results testing phase

Beam envelope:  
FWHM and FWTM

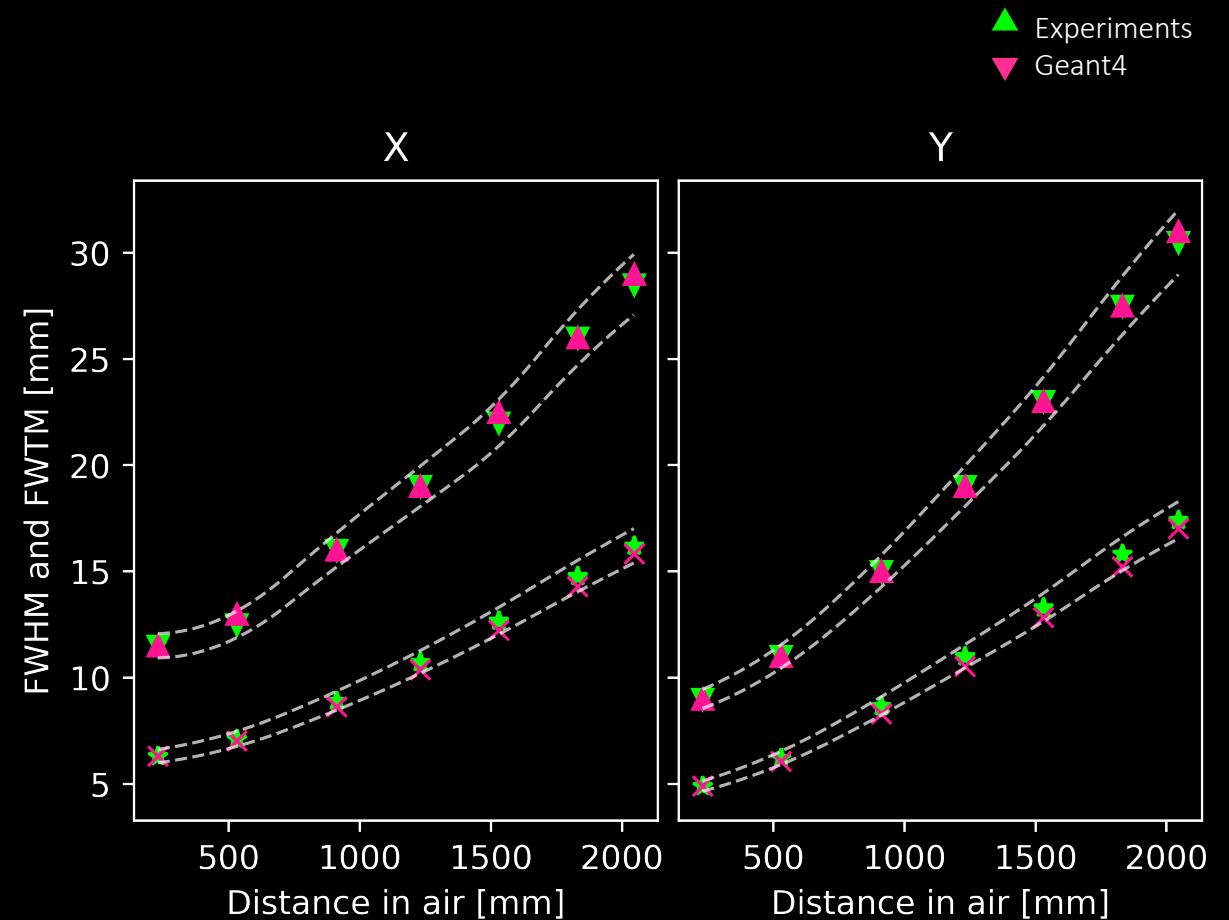
- 120 MeV



### 3. Results testing phase

Beam envelope:  
FWHM and FWTM

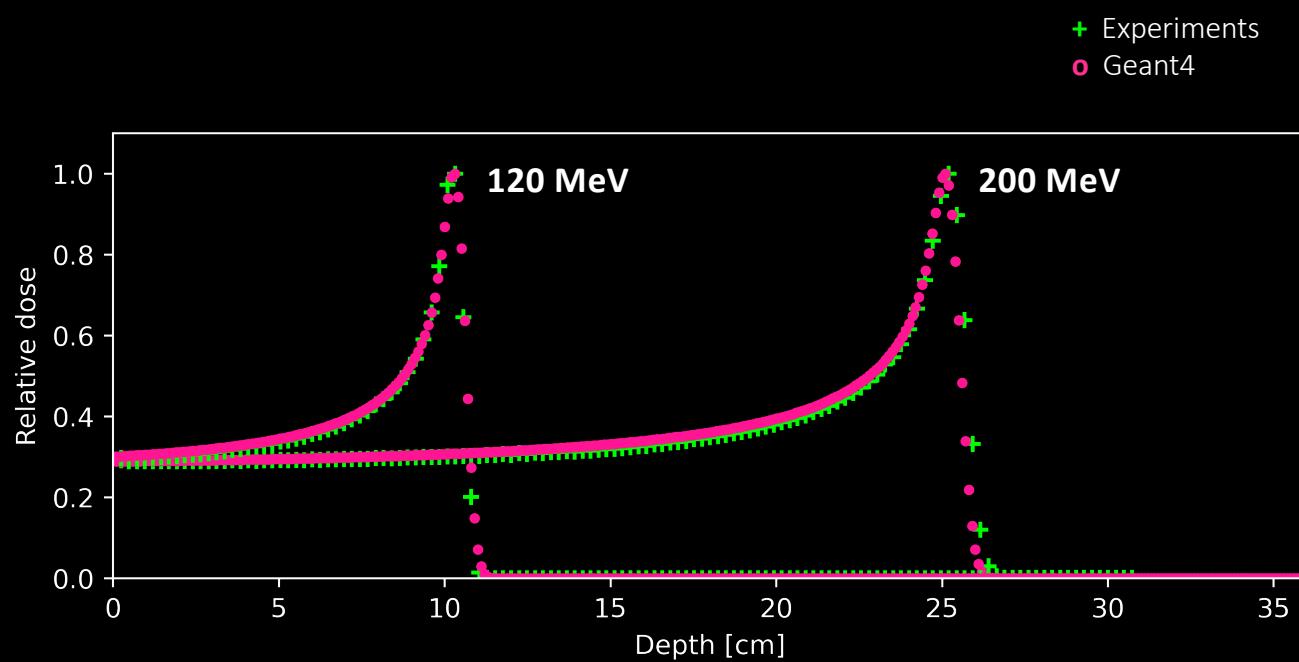
- 200 MeV



### 3. Results testing phase

#### Depth dose profiles

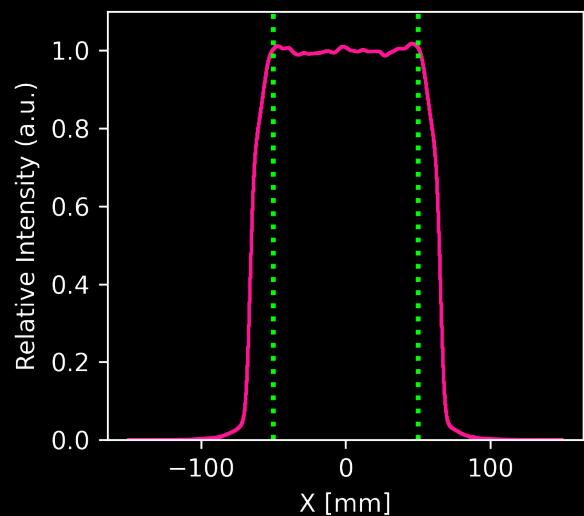
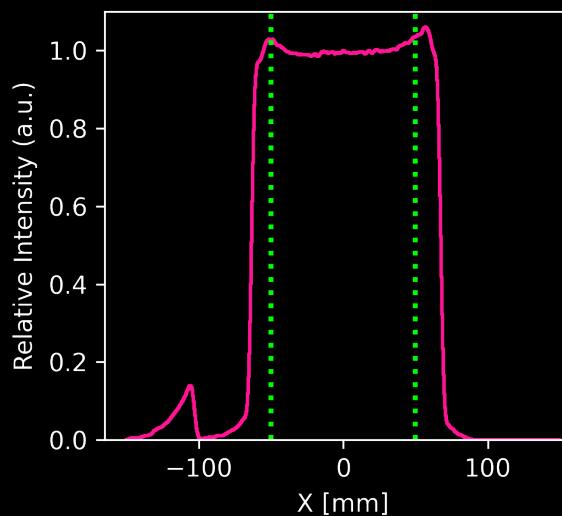
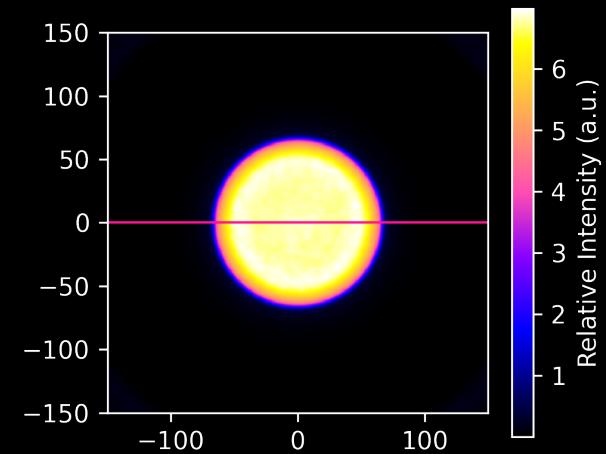
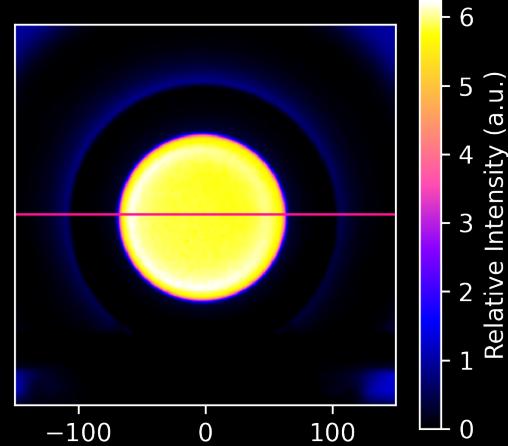
- 120 and 200 MeV



### 3. Results testing phase

Large field

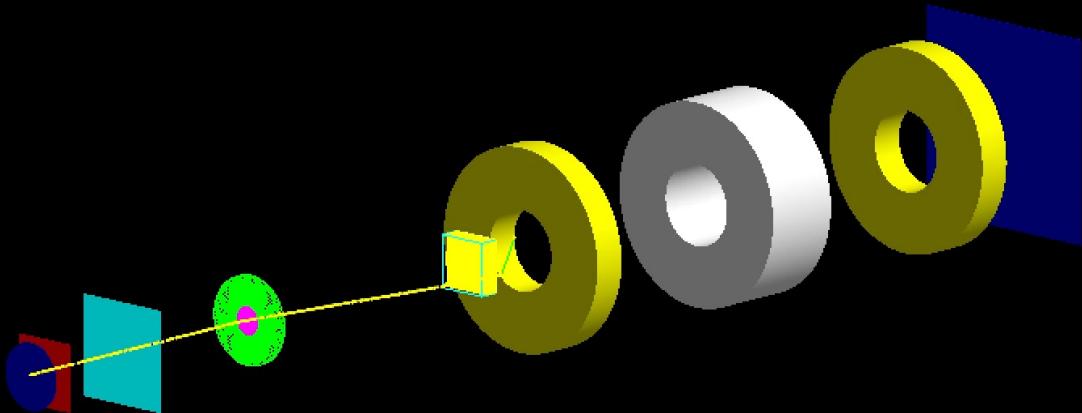
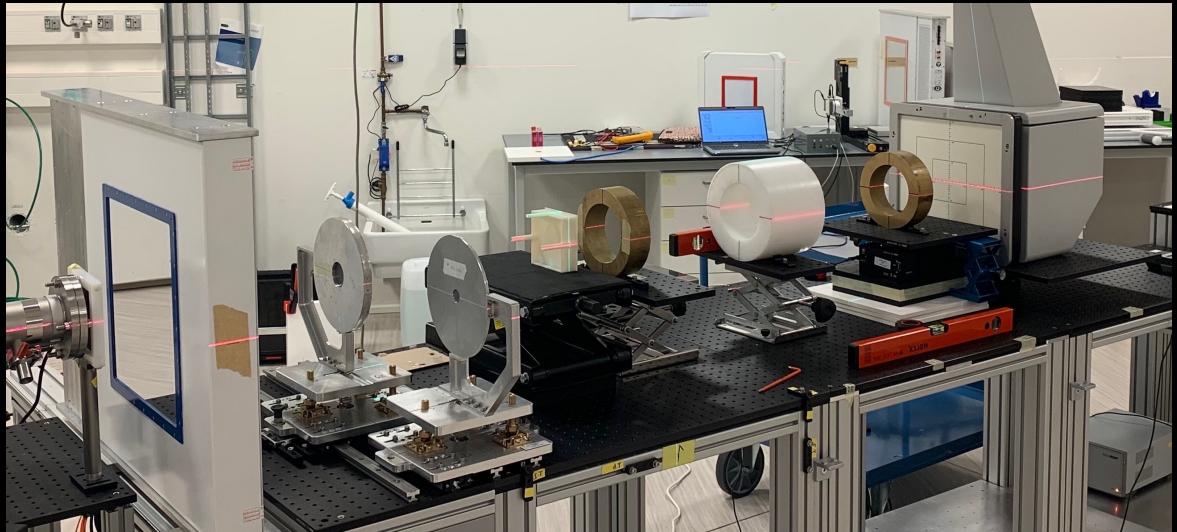
- 150 MeV



# Conclusion & future plans

Up next:

- LET simulations
- Geant4-DNA to assess DNA damage complexity



# Acknowledgements

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## ANSTO

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Thank you for your attention!

Questions?

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