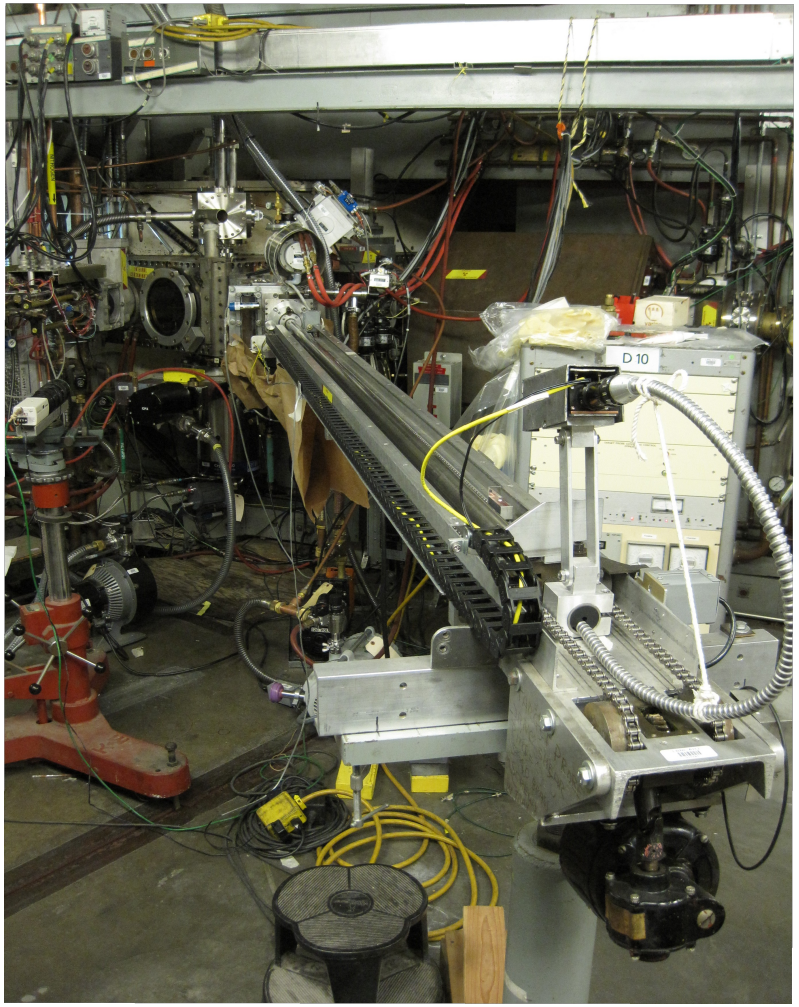
Markus Strohmeier

# A Scintillator Probe Based on Fiber Optics for Ion Beam Diagnostics at the 88-Inch Cyclotron.

# Outline

- Introduction
- Hardware Design
- Calibration
- Initial Data
- Summary & Outlook



# Introduction

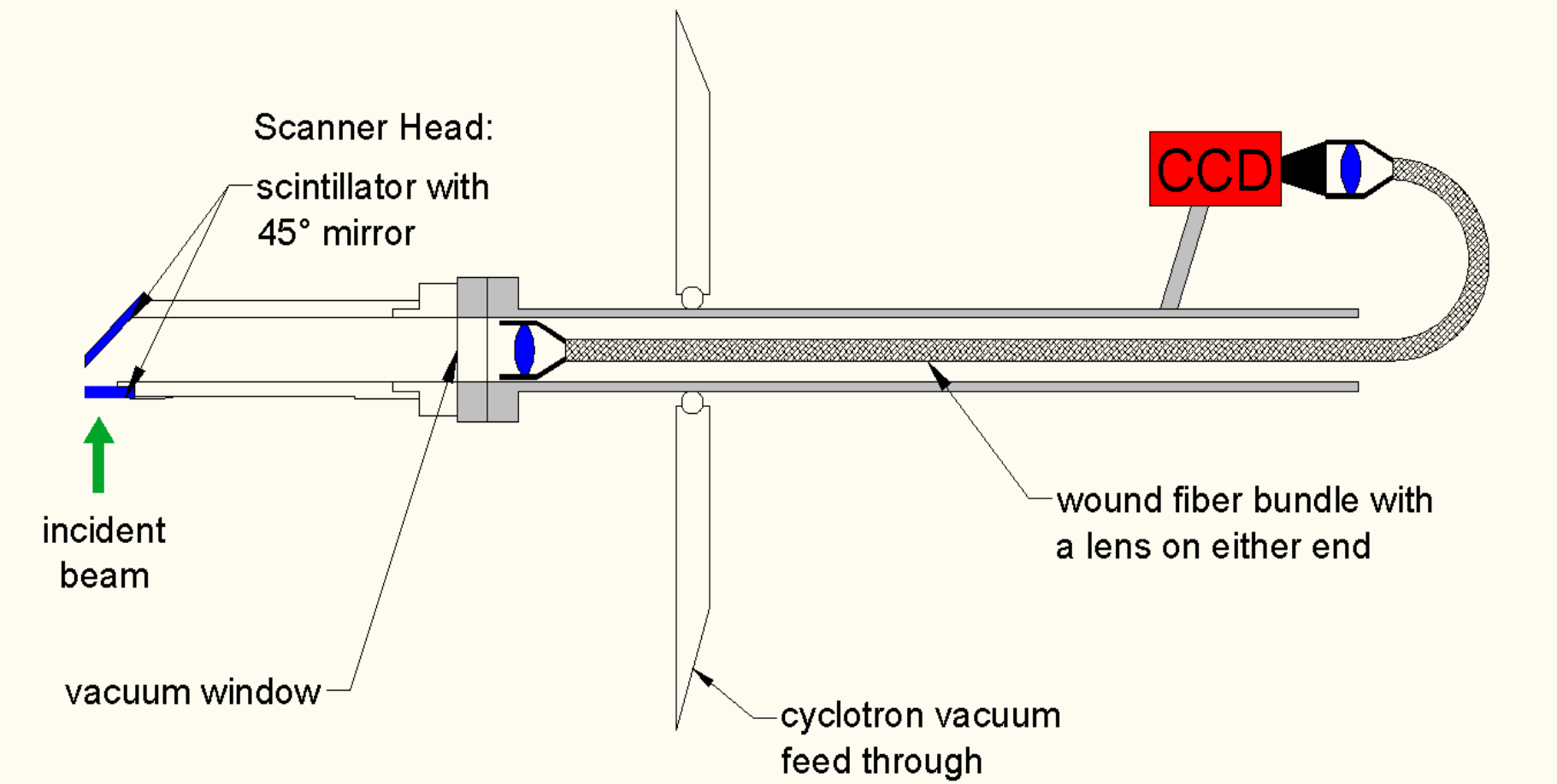
- At the 88-Inch Cyclotron, a number of high intensity beams have been recently requested. - *see Damon Todd (MO2PB02) and Ken Y. Franzen (TUPPT015).*

- To meet these requirements, the cyclotron needed better diagnostics than what was available in order to identify losses and increase transmission.

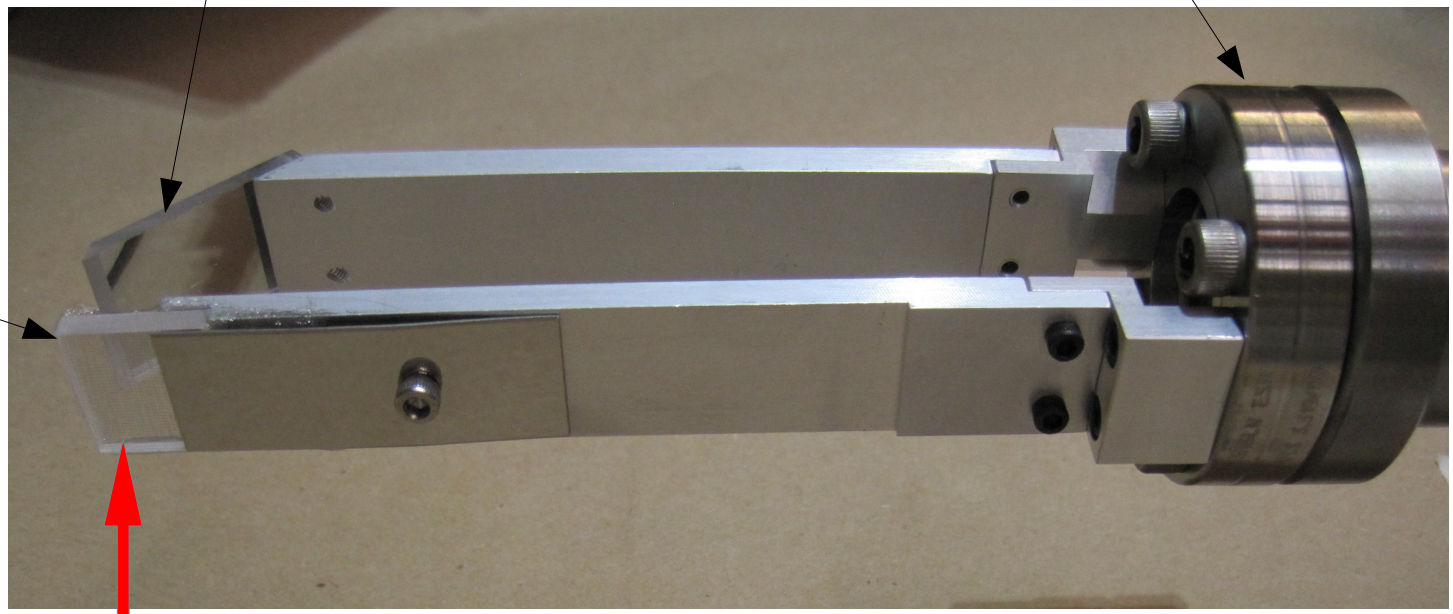
→ Scintillator probe was designed to replace the 3-finger probe

# Design of the Probe (1)

We used the existing motion system from the previously installed 3-finger probe:

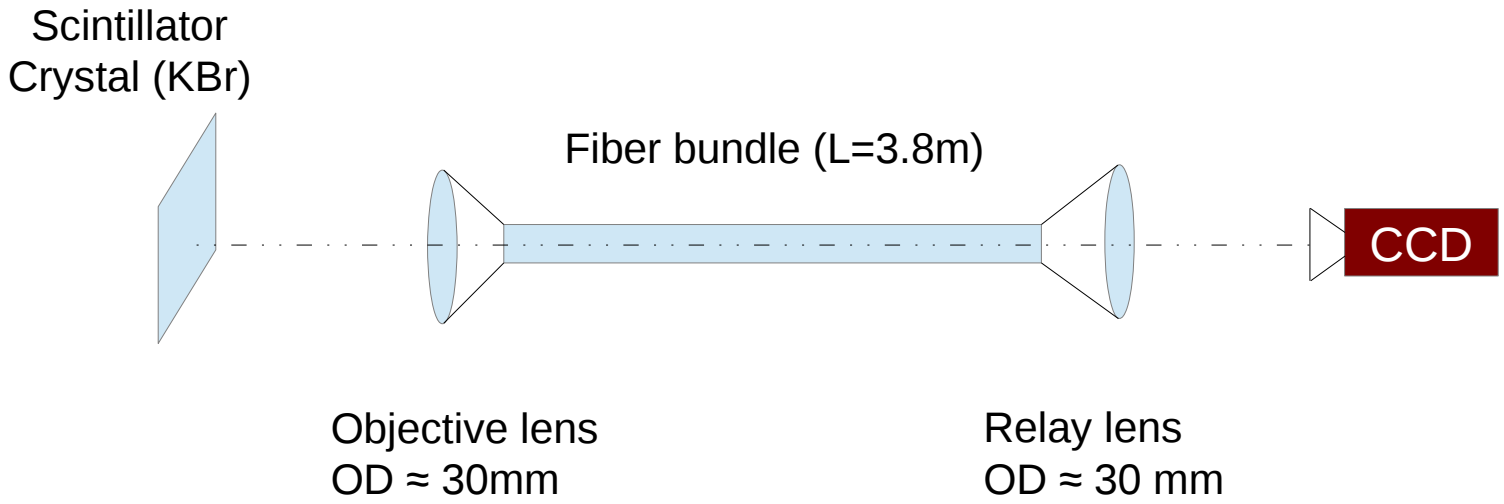


# Design of the Probe (2)




- All parts are made of non-magnetic materials
- Metal mesh around the crystal allows charge neutralization and provides mechanical support in case the crystal shatters.

# Design of the Probe (3)




Camera specifications:

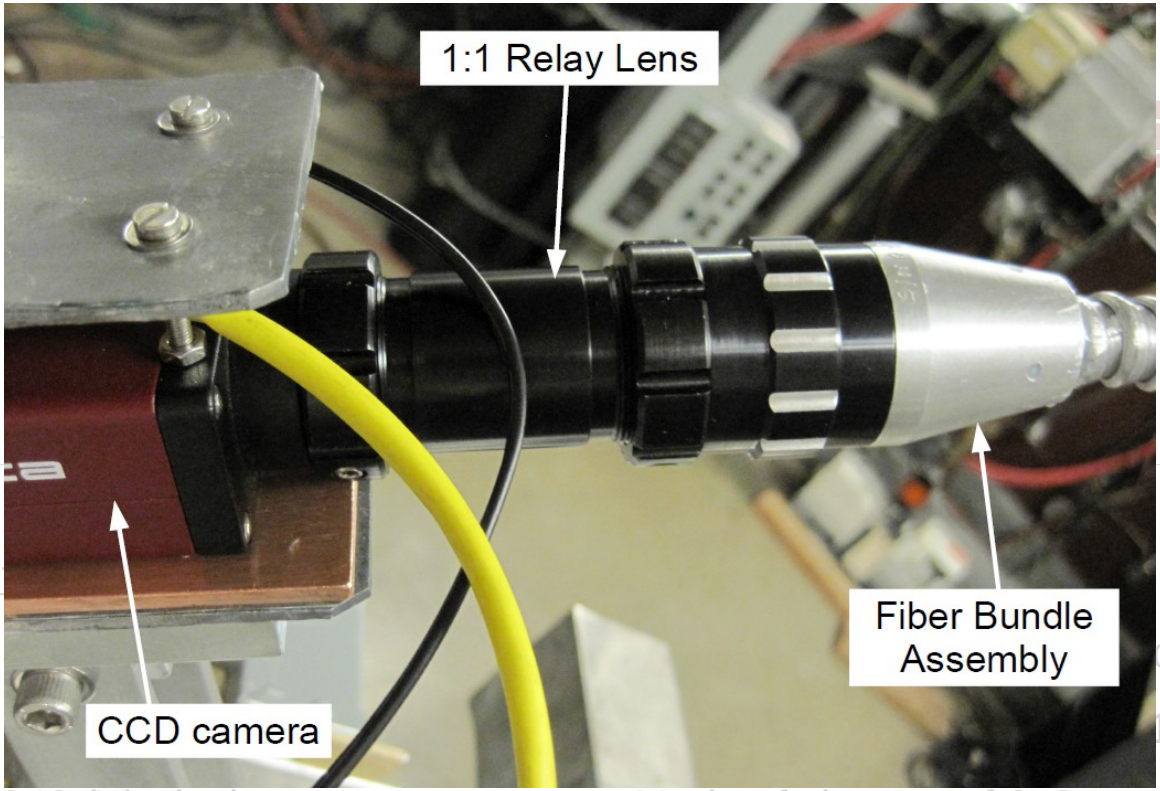
- Allied Vision Technologies
  GigE Manta (1/2” CCD chip)
- 4.6 μm x 4.6 μm pixel size
- 1392 (H) x 1040 (V) pixels

Fiber bundle specifications:

- SCHOTT North America, Inc.
- Aspect ratio according to the chip size
- Made of clusters of 6x6 mono-fibers
  with 10μm per fiber

# Design of the Probe (4)

Scintallator crystal




CCD

Camera speci

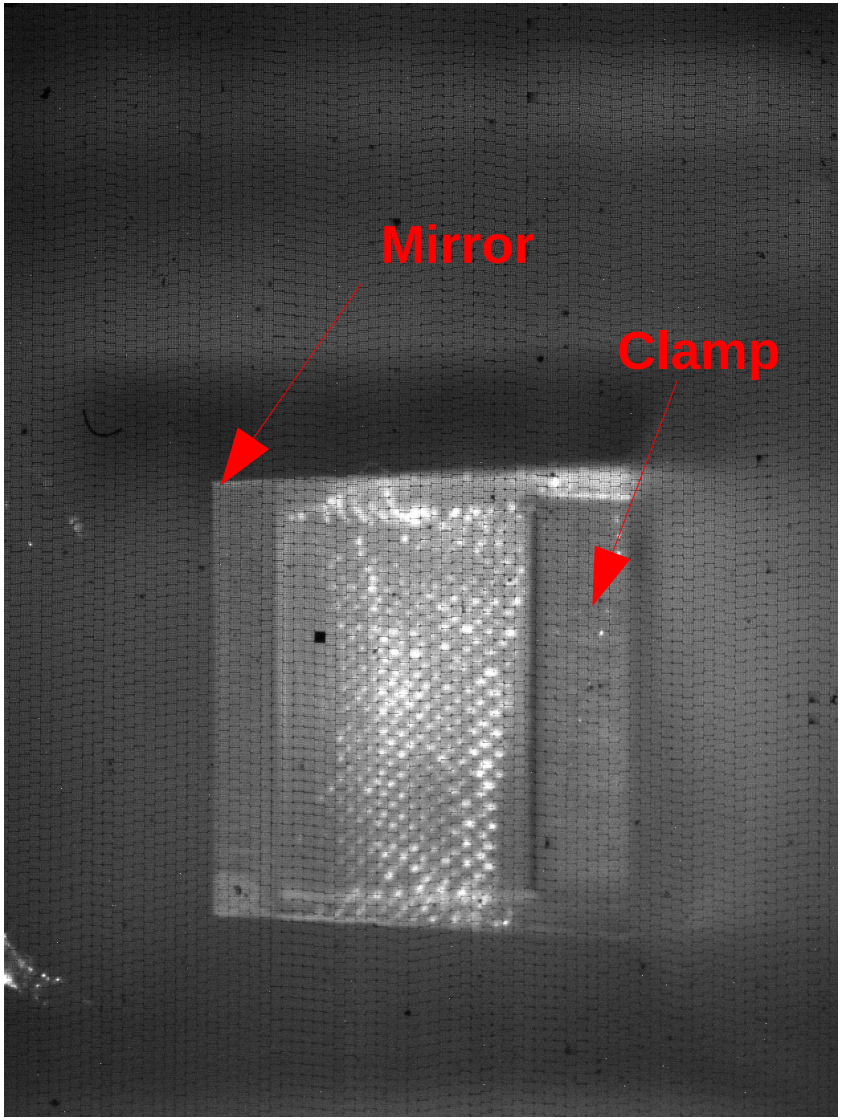
- AVT GigE M
- 4.6 µm x 4.6
- 1392 (H) x 1040 (V) pixels
- C - mount connector for lens

c.

1/2" CCD chip

- Made of clusters of 6x6 monofibers with 10µm per fiber

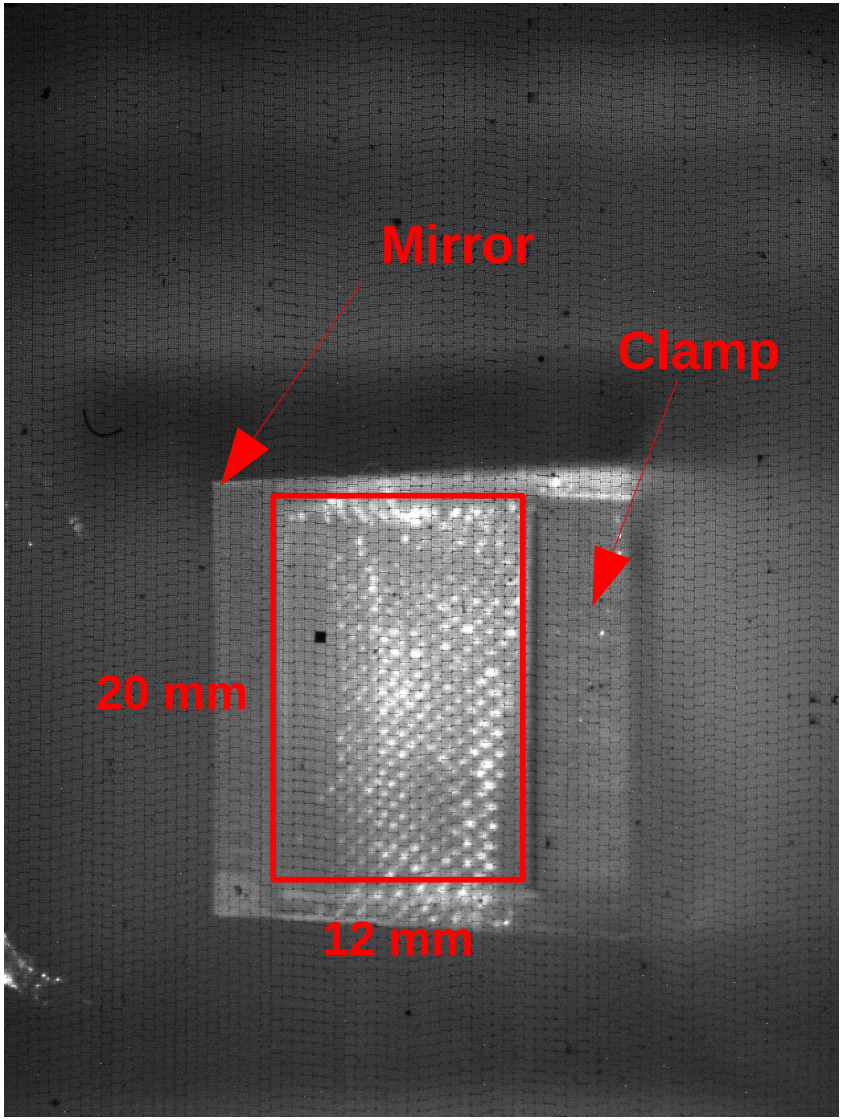
# Optical Calibration




1) Location of the scintillator edges on the image needs to be known.

2) Pixel resolution must be known to get physical dimensions

# Optical Calibration

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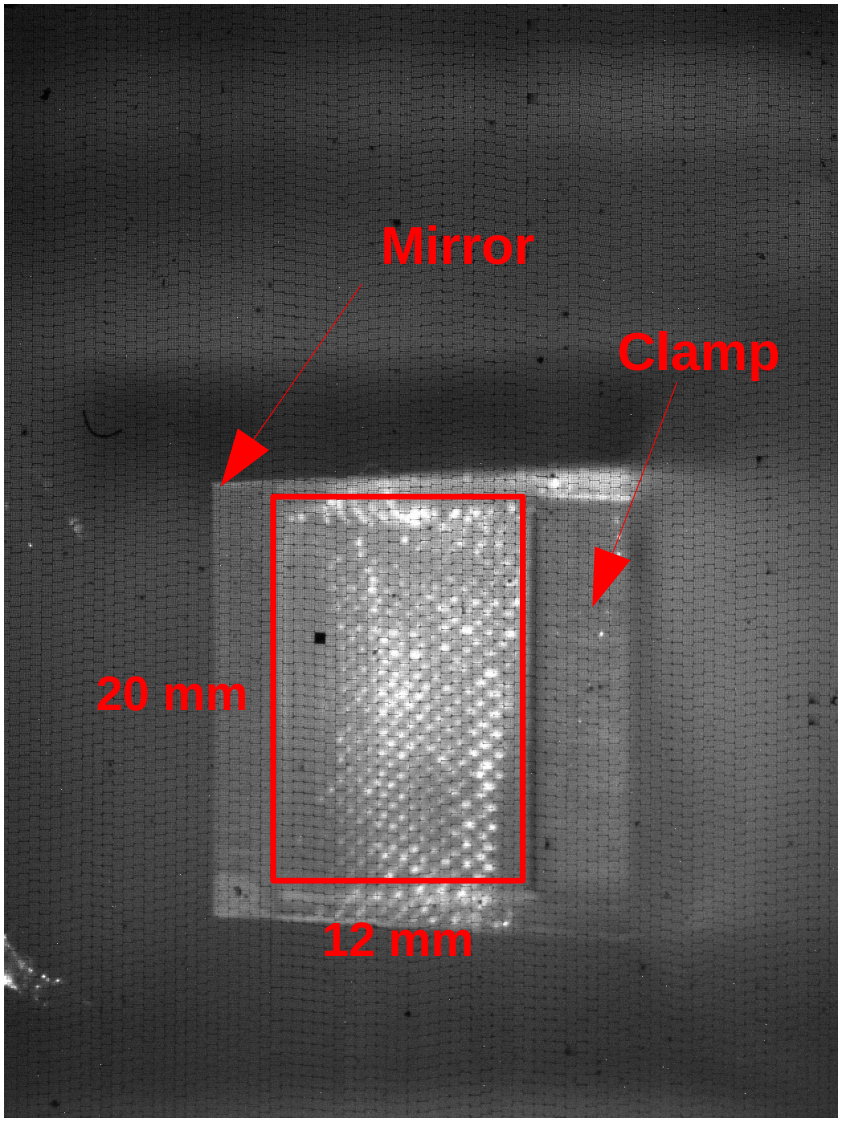
# Optical Calibration




1) Location of the scintillator edges on the image needs to be known.

2) Pixel resolution must be known to get physical dimensions

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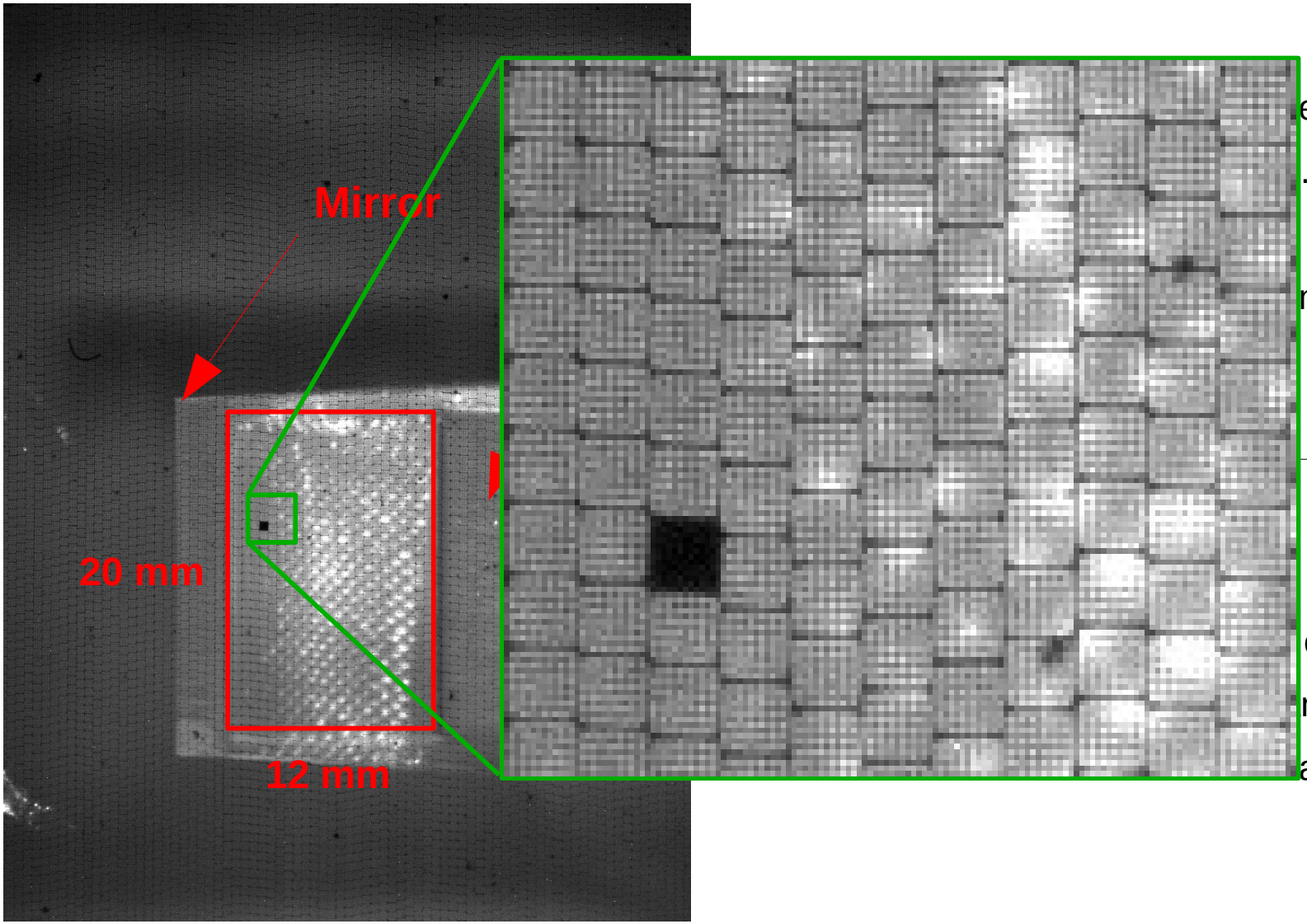
A python script processes the captured images to crop them, remove noise, smooth images and overlays the reference marks on the final image.

# Optical Calibration

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captured

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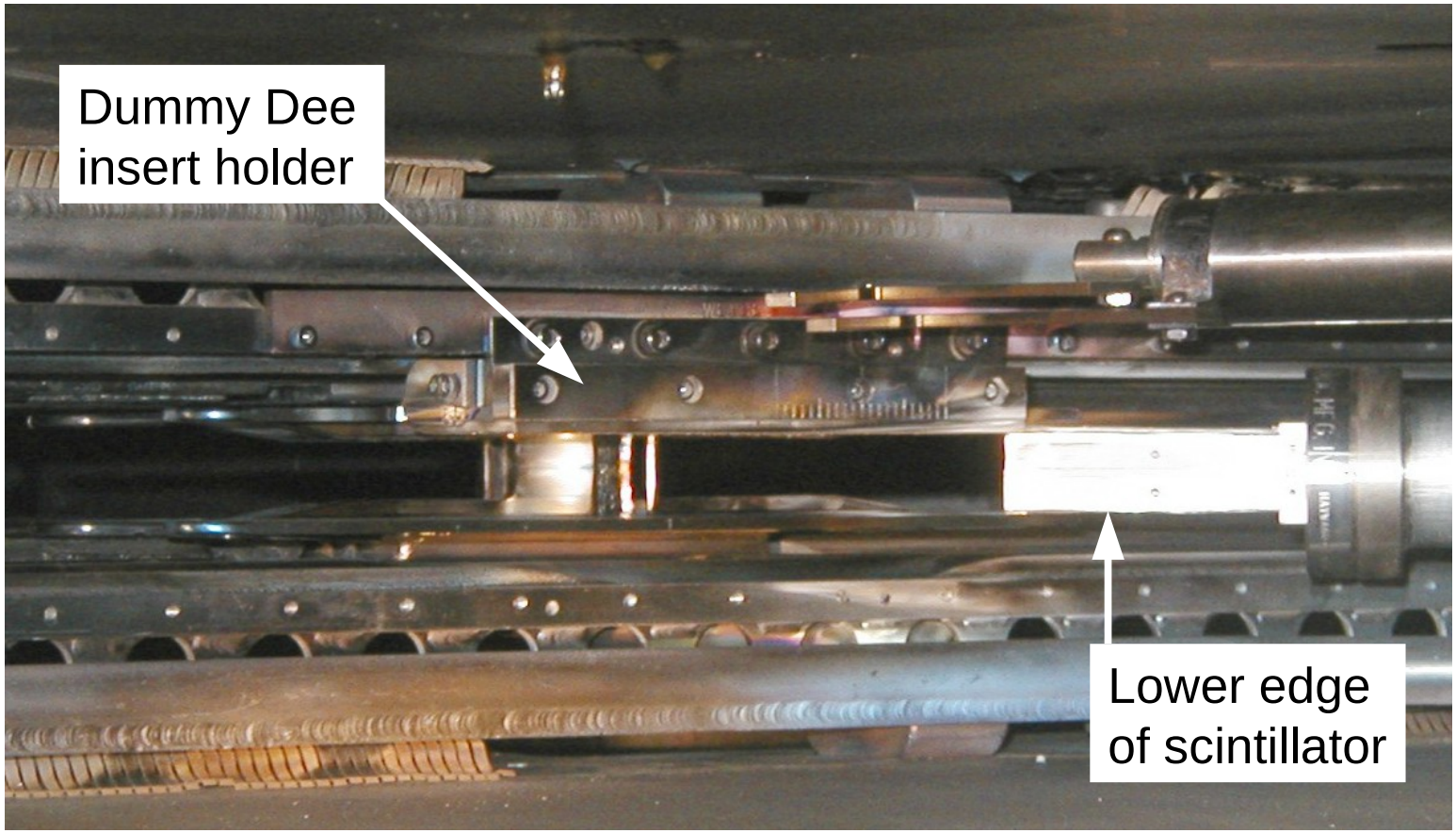
al image.

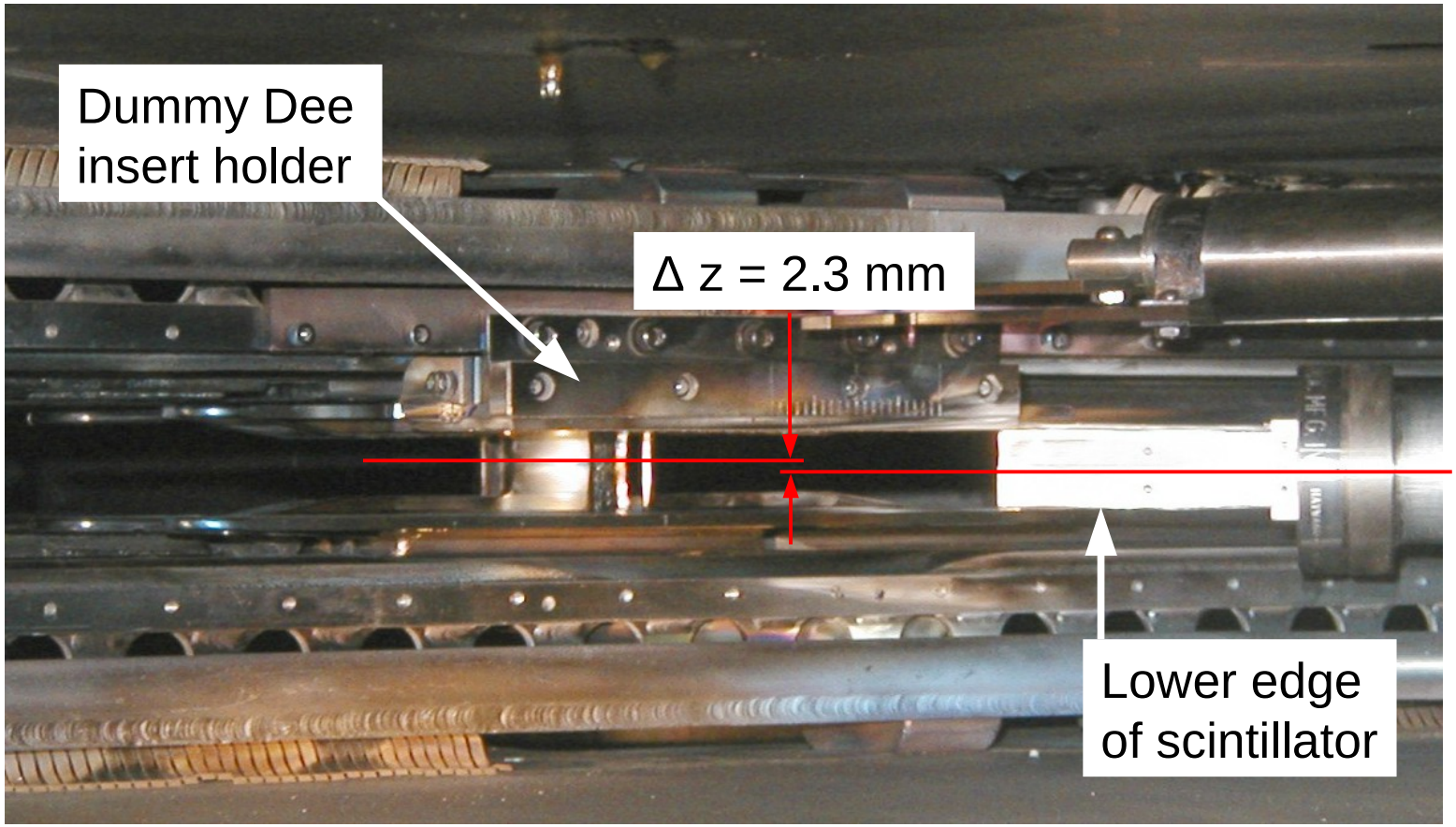
# Axial Calibration

The axial position of the scintillator must be known to measure the height of the beam:

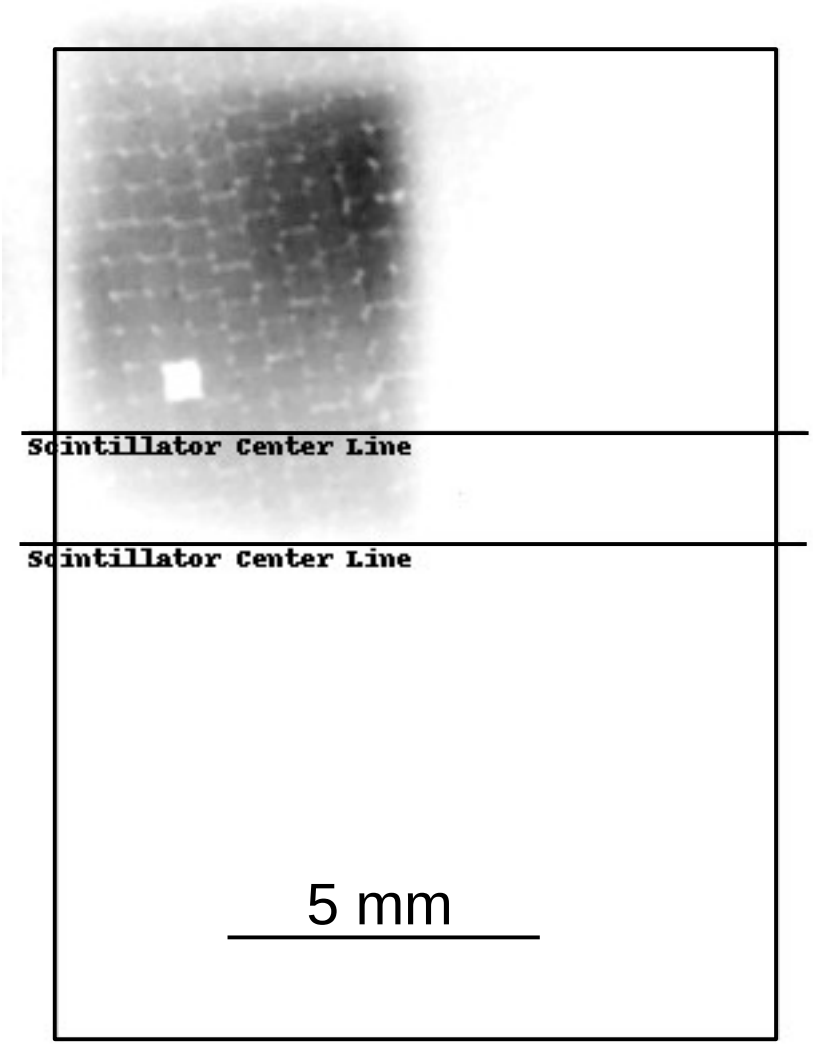


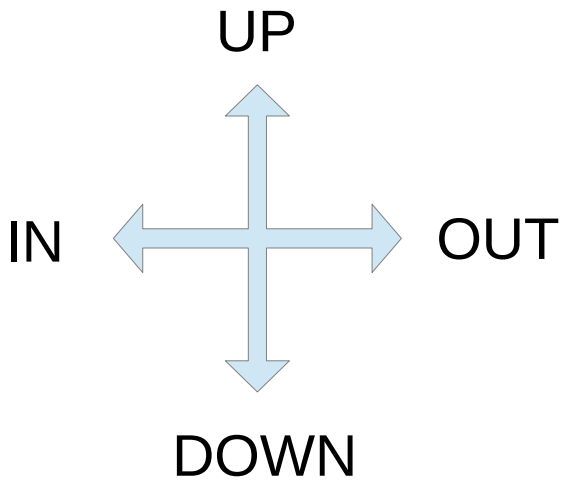
# Axial Calibration

The axial position of the scintillator must be known to measure the height of the beam:



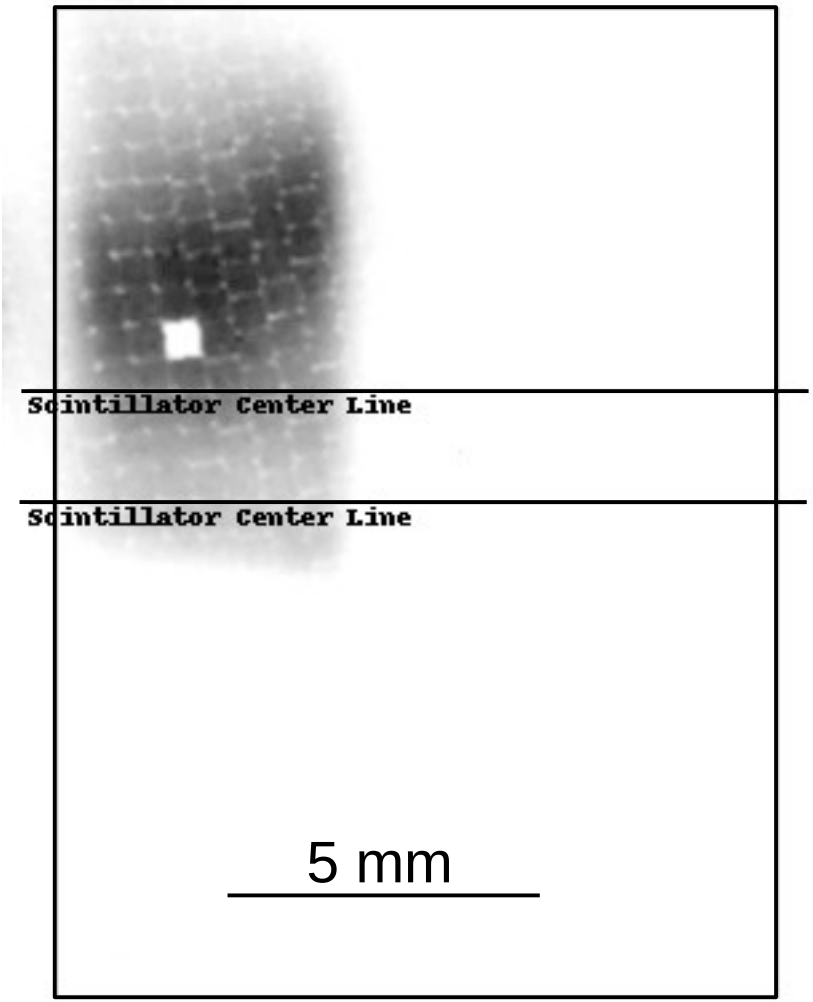
# Initial Data

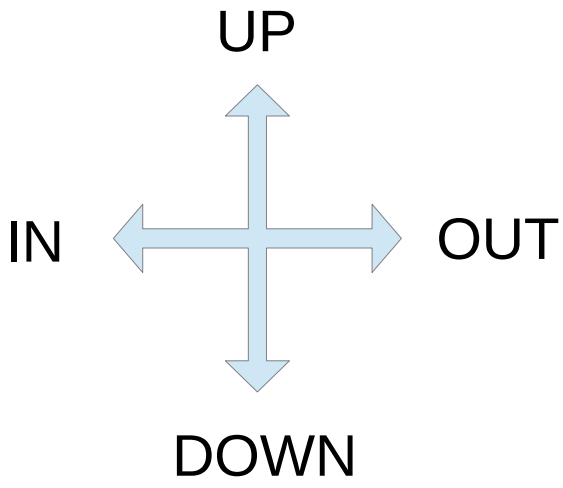



R ≈ 10 cm

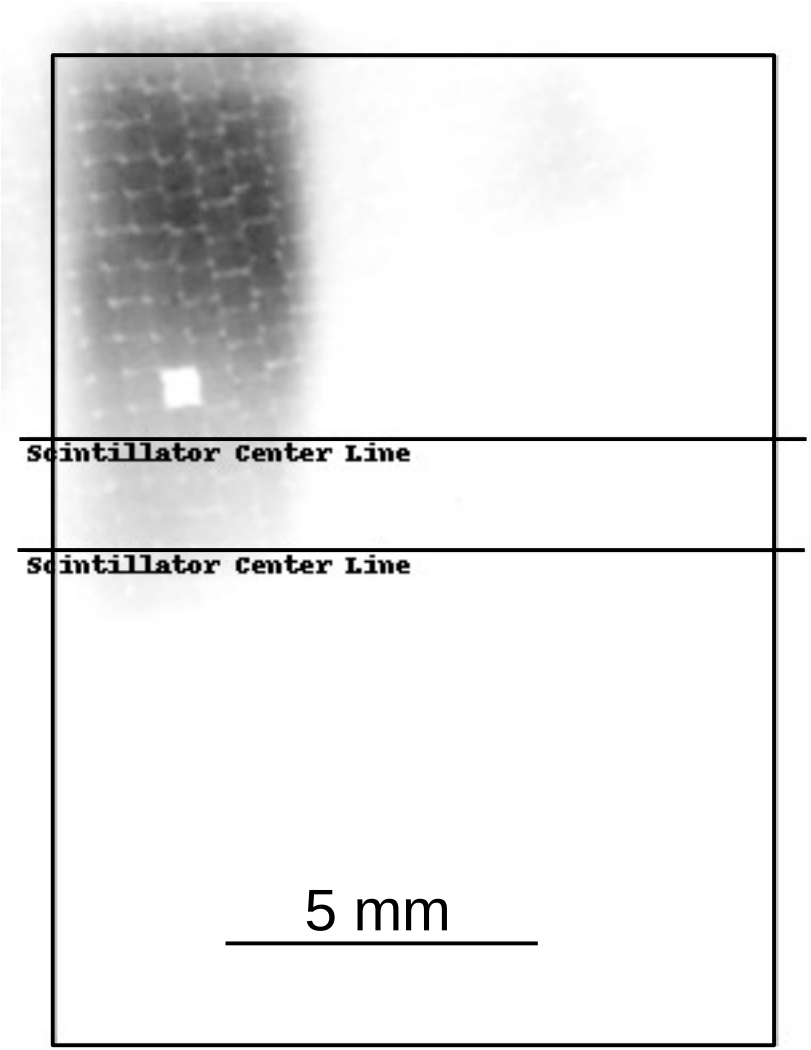
# Initial Data

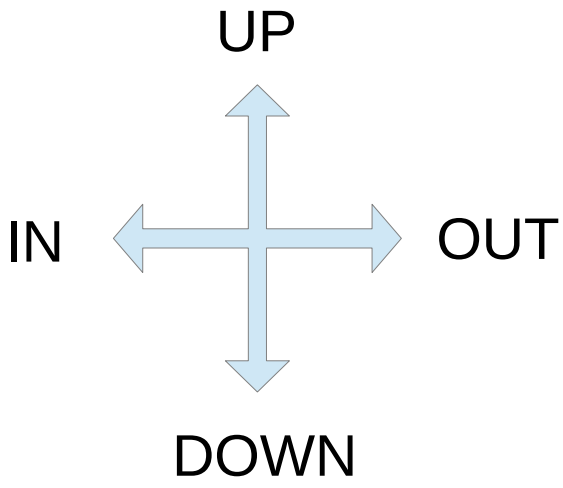



R ≈ 13 cm

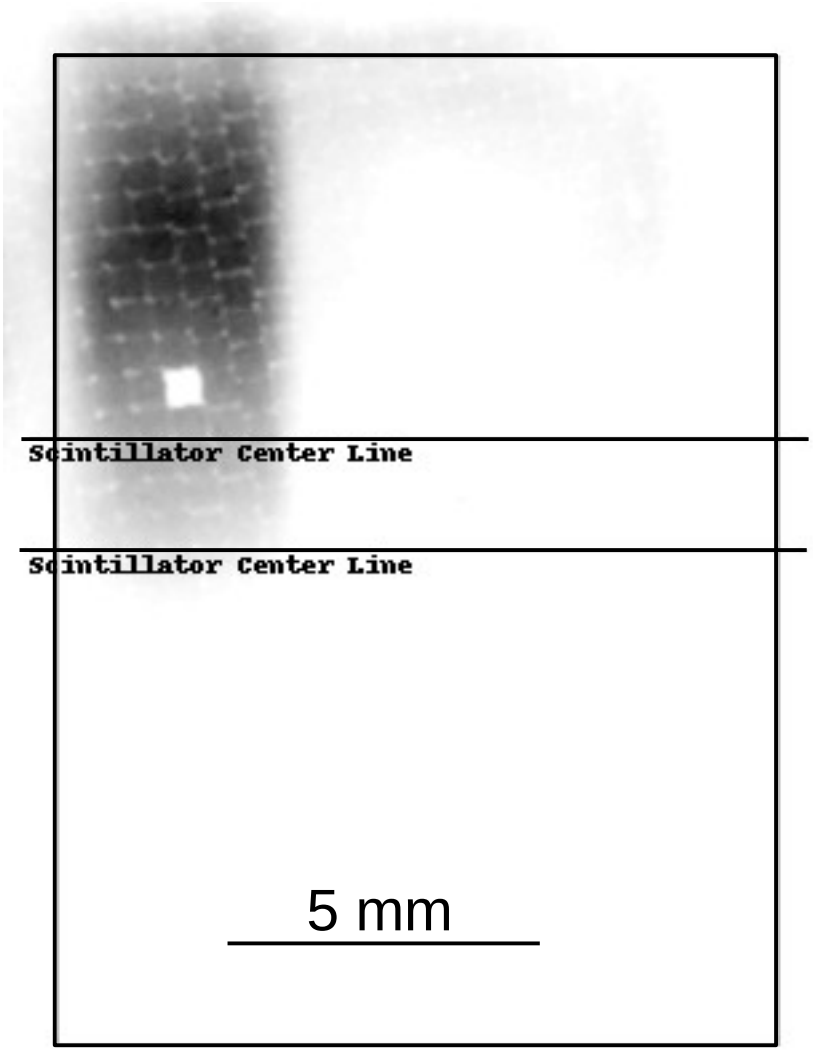
# Initial Data

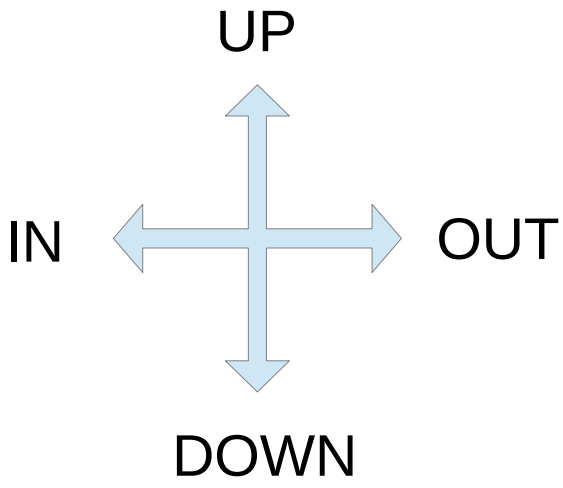



R ≈ 15.5 cm

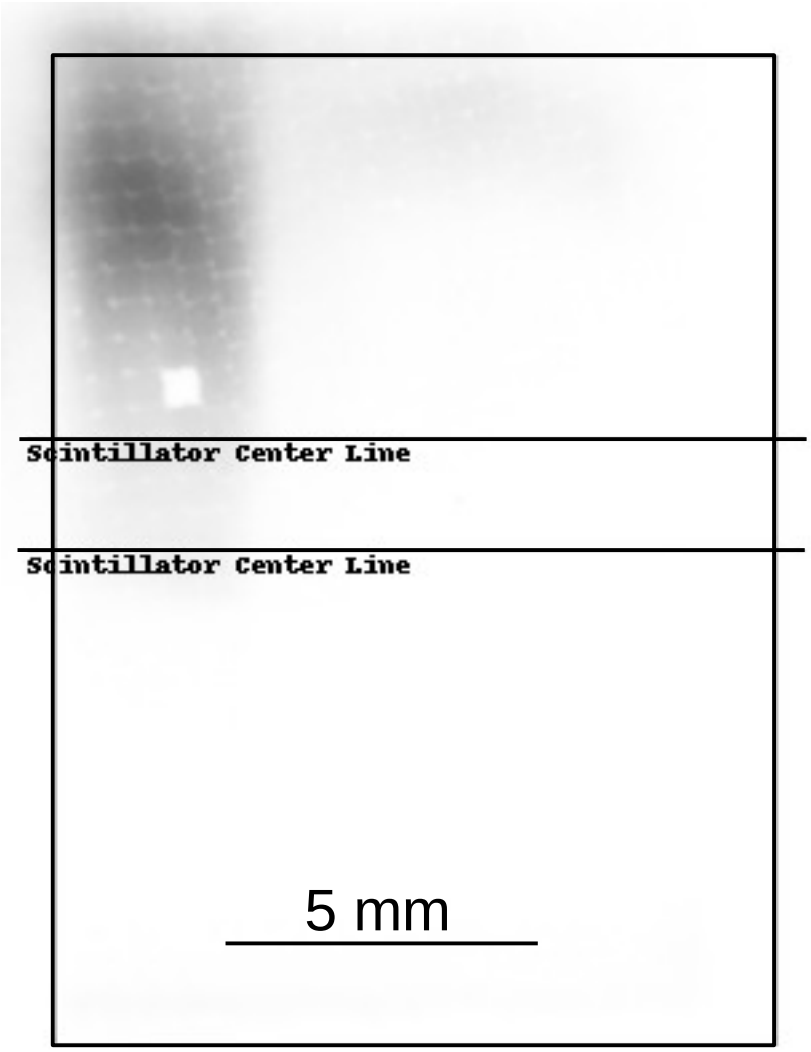
# Initial Data

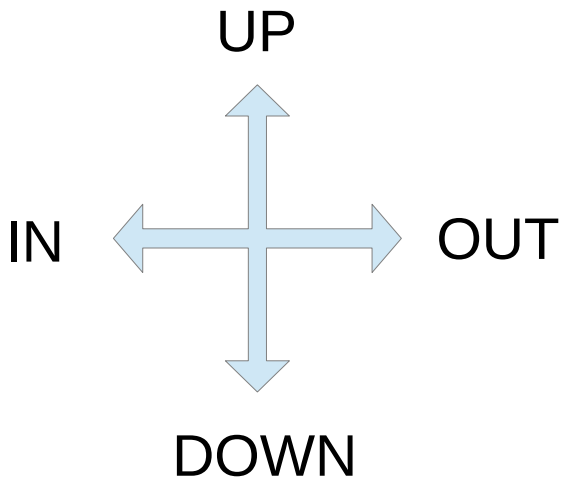



R ≈ 18 cm

# Initial Data

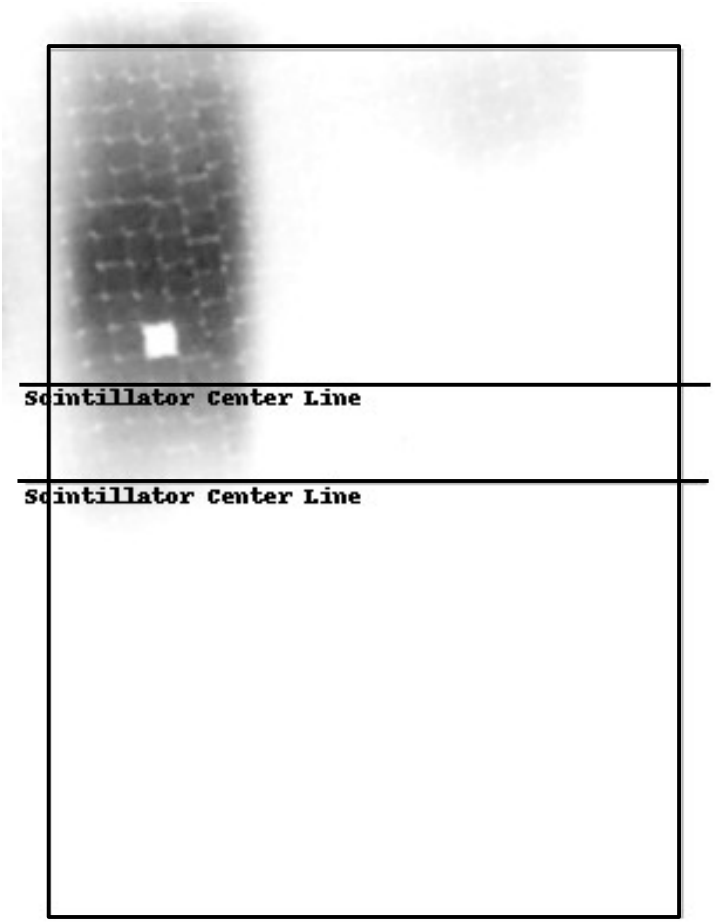


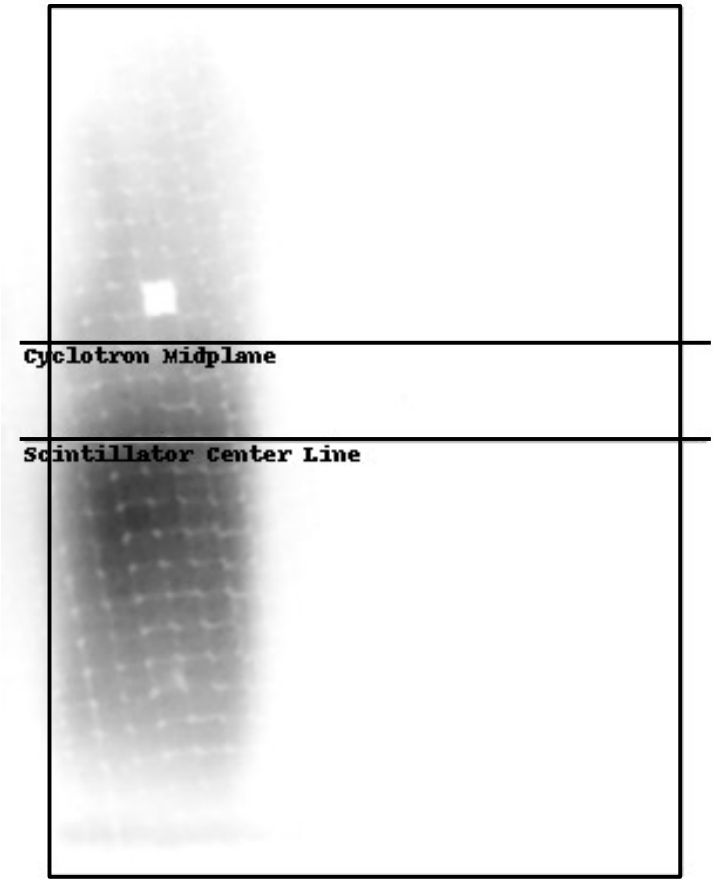

R ≈ 21 cm

# Unbalancing Data

*...see Michele Kireeff-Covo (TUPSH016)*




R ≈ 20 cm




TC 1 in balanced mode
(356 A)

TC 1 in unbalanced mode
(193 A shunted from bottom)

# Summary & Outlook

- We successfully designed and commissioned a beam profile viewer for the 88-Inch Cyclotron and confirmed an axial misalignment of the beam.
- Via unbalancing TC 1, we could correct for that offset while watching the beam which increased transmission of the machine by several percent.

<u>Room for improvement:</u>

- Expanding the probe to a pepper-pot emittance scanner by adding a hole mask.
- Upgrade radial motion system to have better resolution.

# Markus Strohmeier

Thank you for

your attention!