Status of the positron beam line at MAMI (X1)

TECHNO-CLS

JG|U

2024.2.28

Ground plan of MAMI

Harmonic Douple Sided Microtron: 1.6 GeV

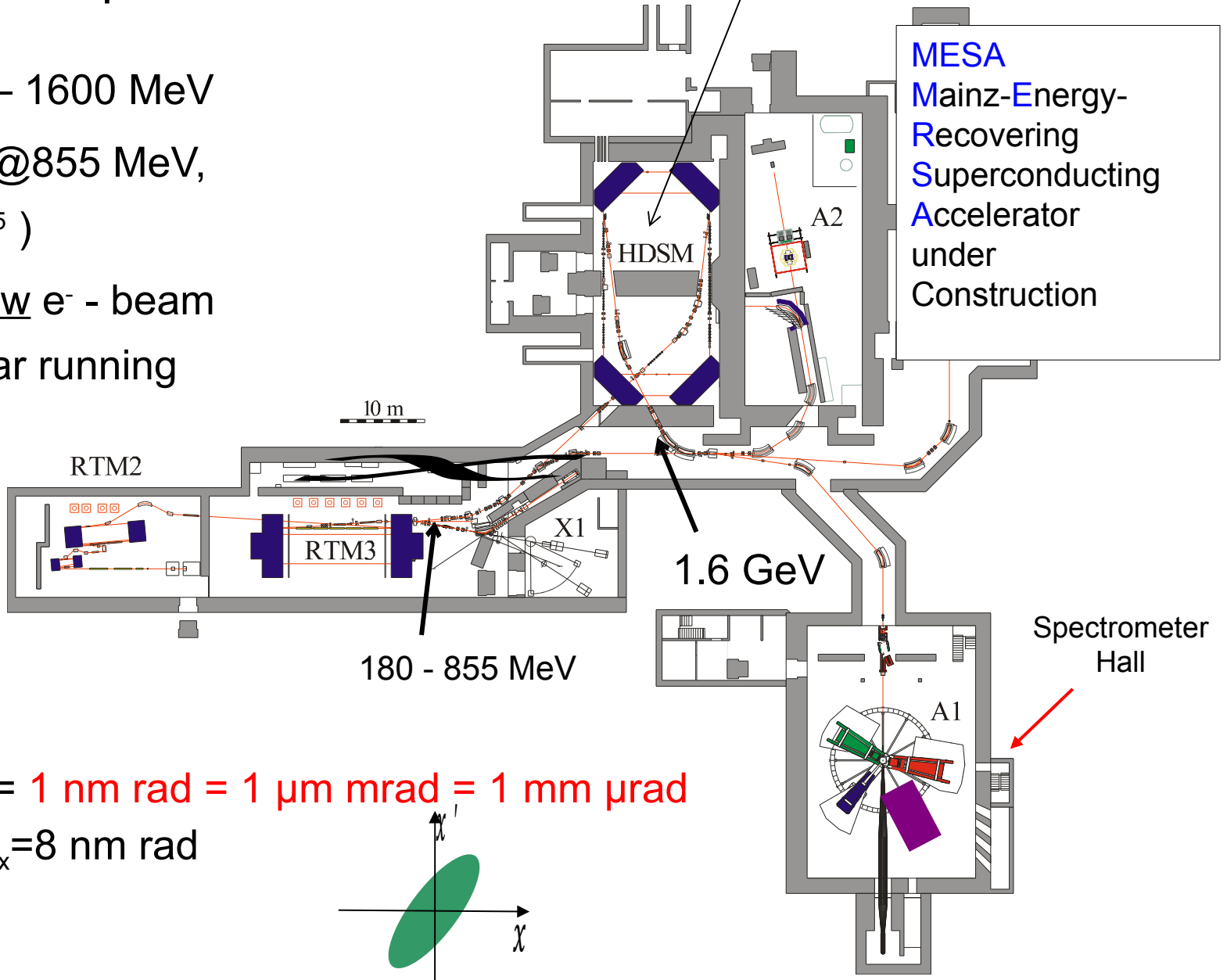
E= 180 MeV – 1600 MeV

ΔE = 13 keV @855 MeV,

$\Delta E/E = (2 \cdot 10^{-5})$

max. 100μA cw e^- - beam

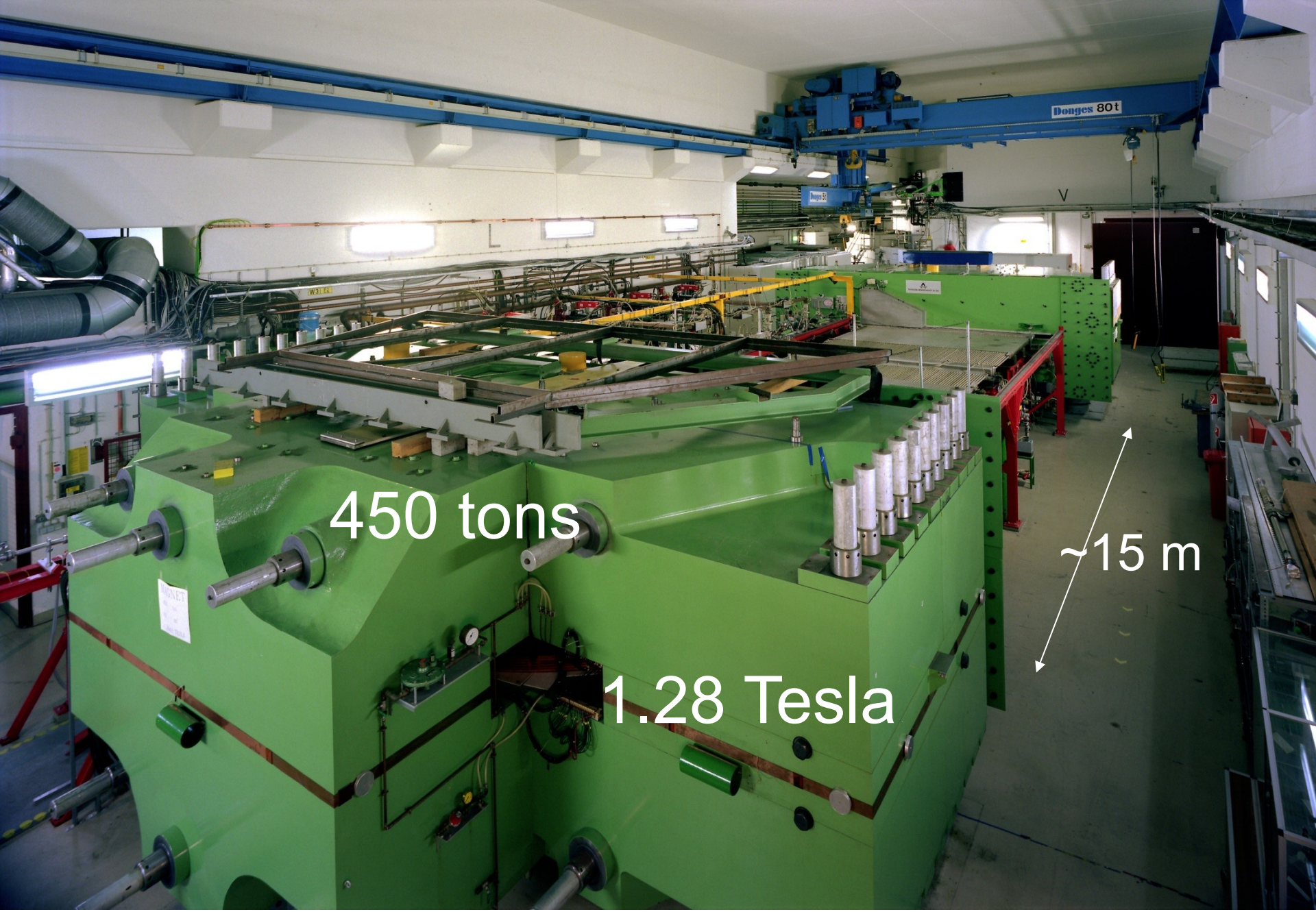
~ 7000 h / year running

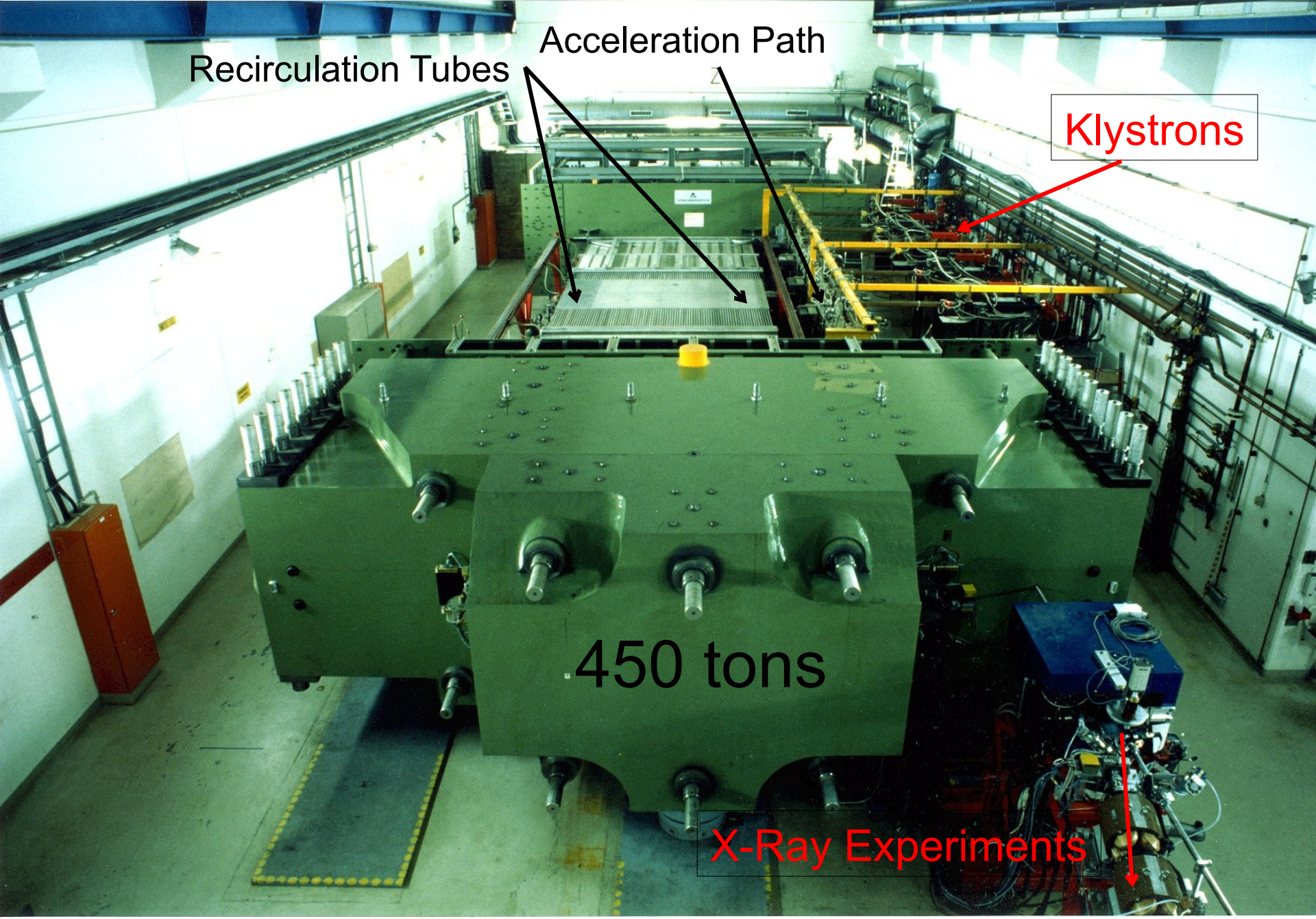


Emittance:

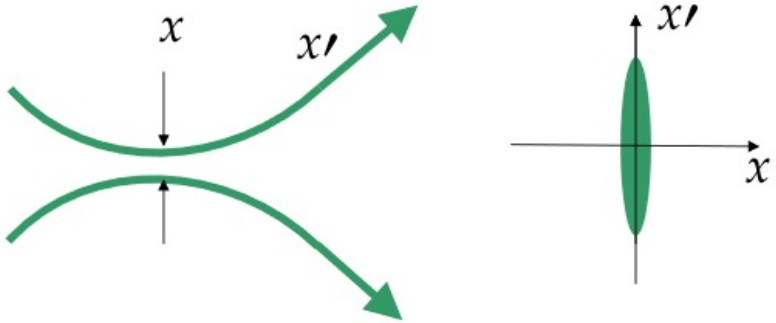
Vertical : ε_y= 1 nm rad = 1 μm mrad = 1 mm μrad

Horizontal: ε_x=8 nm rad


Donges 80t
450 tons
~15 m
1.28 Tesla


Recirculation Tubes
Acceleration Path
Klystrons
450 tons
X-Ray Experiments

High quality Positron beam @ MAMI



vertical

MAMI: $\varepsilon_x = x \cdot x' = 1\ mm \cdot \mu rad = 10\ \mu m \cdot 0.1 mrad$

Emittance $\varepsilon_x = x \cdot x' = \frac{F}{\pi} = const$

Thin target for Positron production

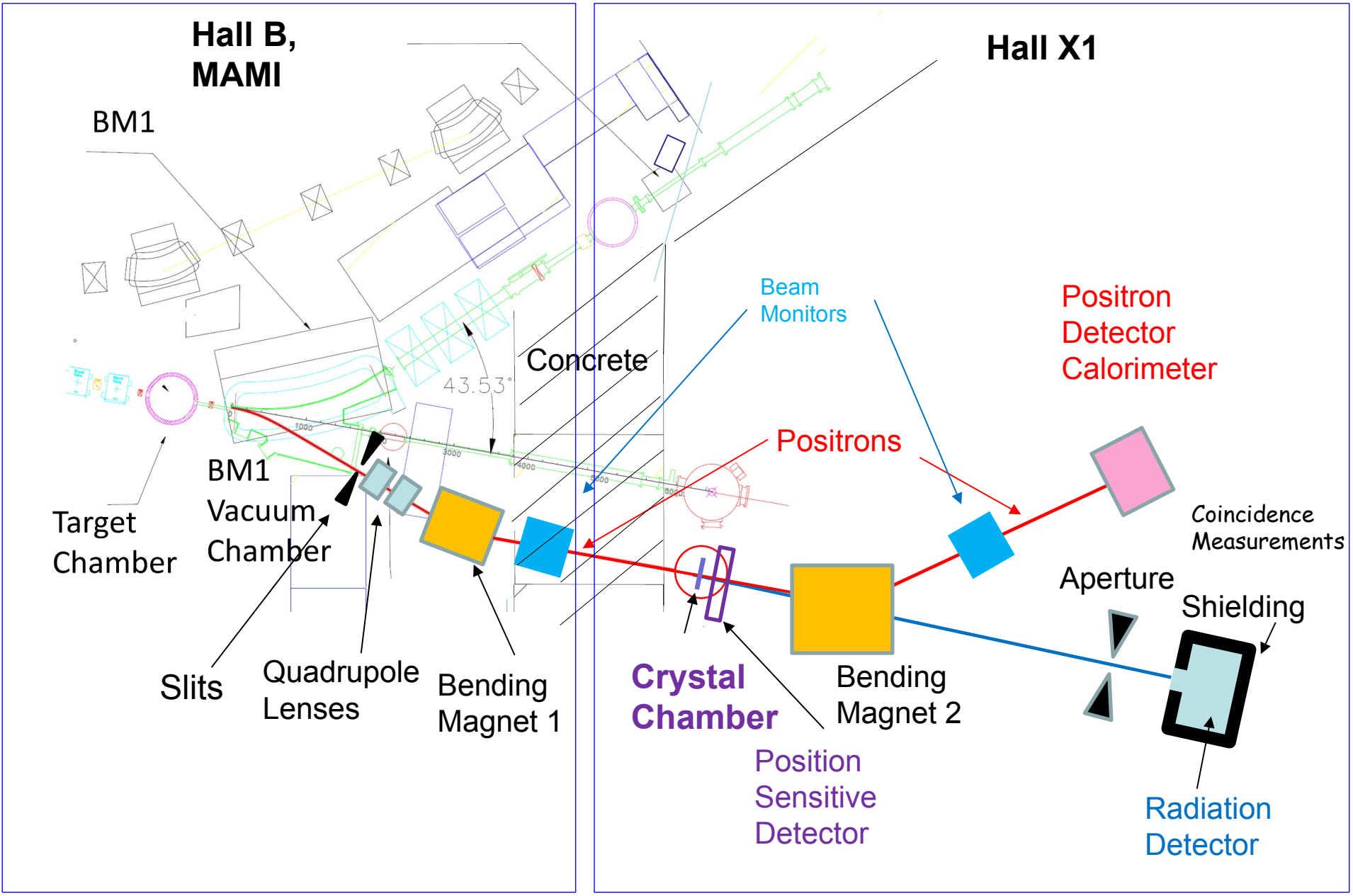
$10\ \mu m\ \ W \rightarrow Scattering\ \sigma_S = 0.94$ mrad

$\sigma_p = \cong \frac{1}{\gamma} = 1$ mrad @500MeV

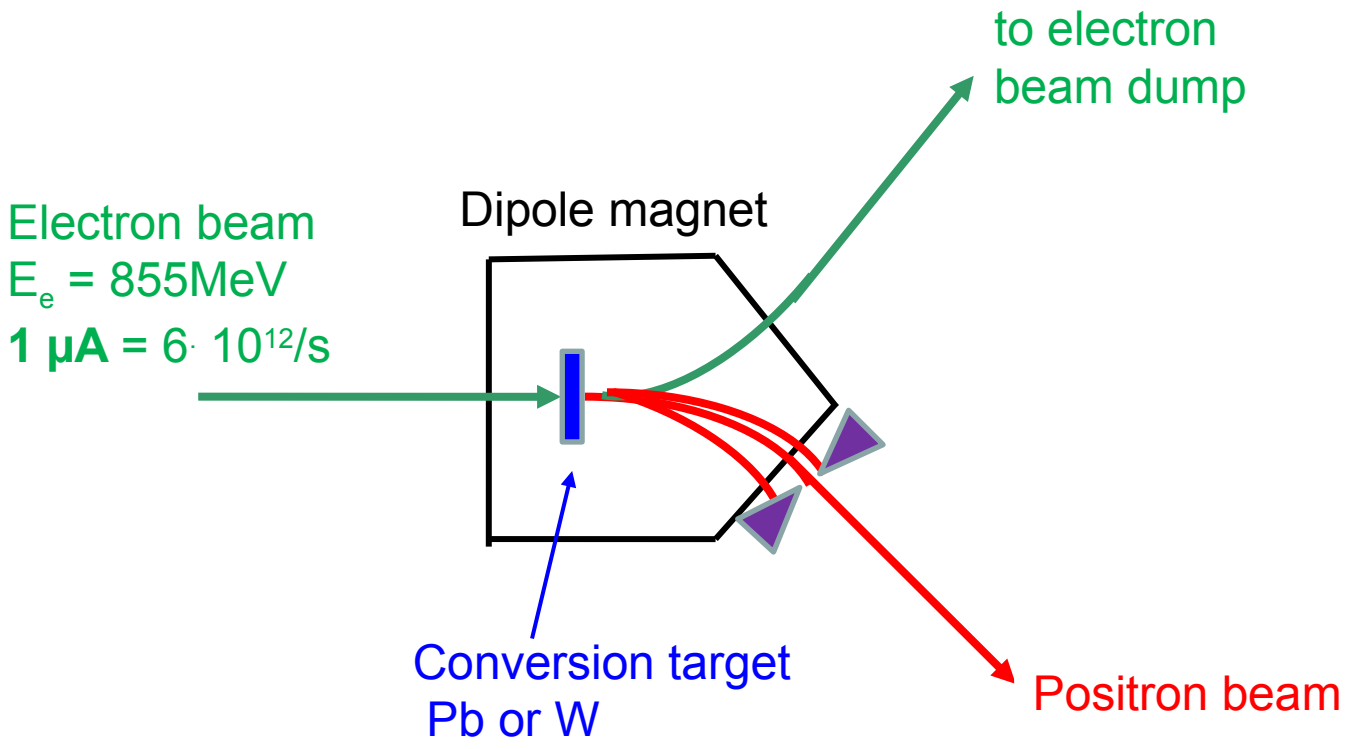
Emittance of Positrons:

$\varepsilon_{e+} = 10\ \mu m \cdot 1.4\ mrad = 1mm \cdot 0.014\ mrad$

Overview Positron production



Pair production with the MAMI beam in combination with a monochromator



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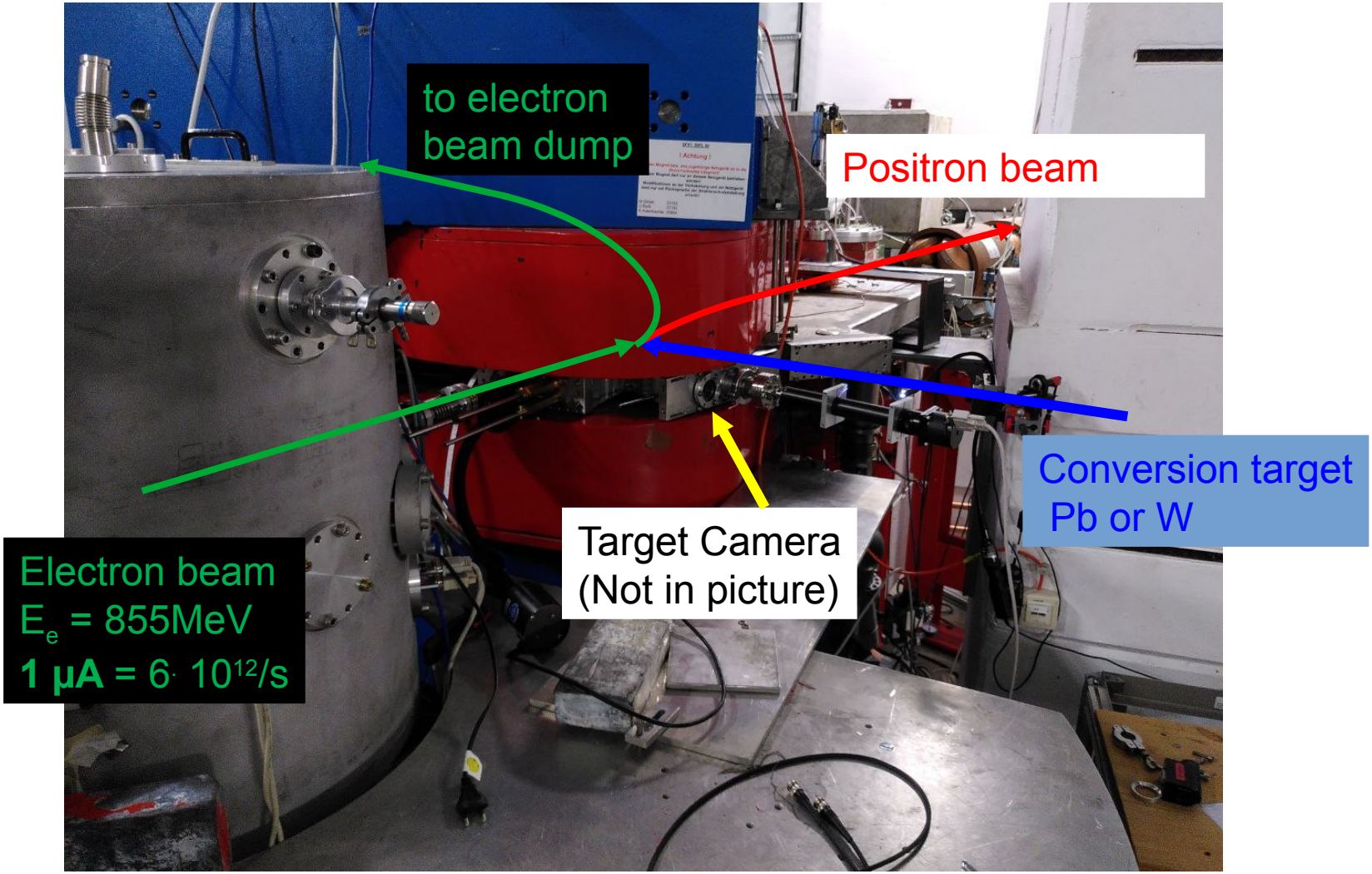
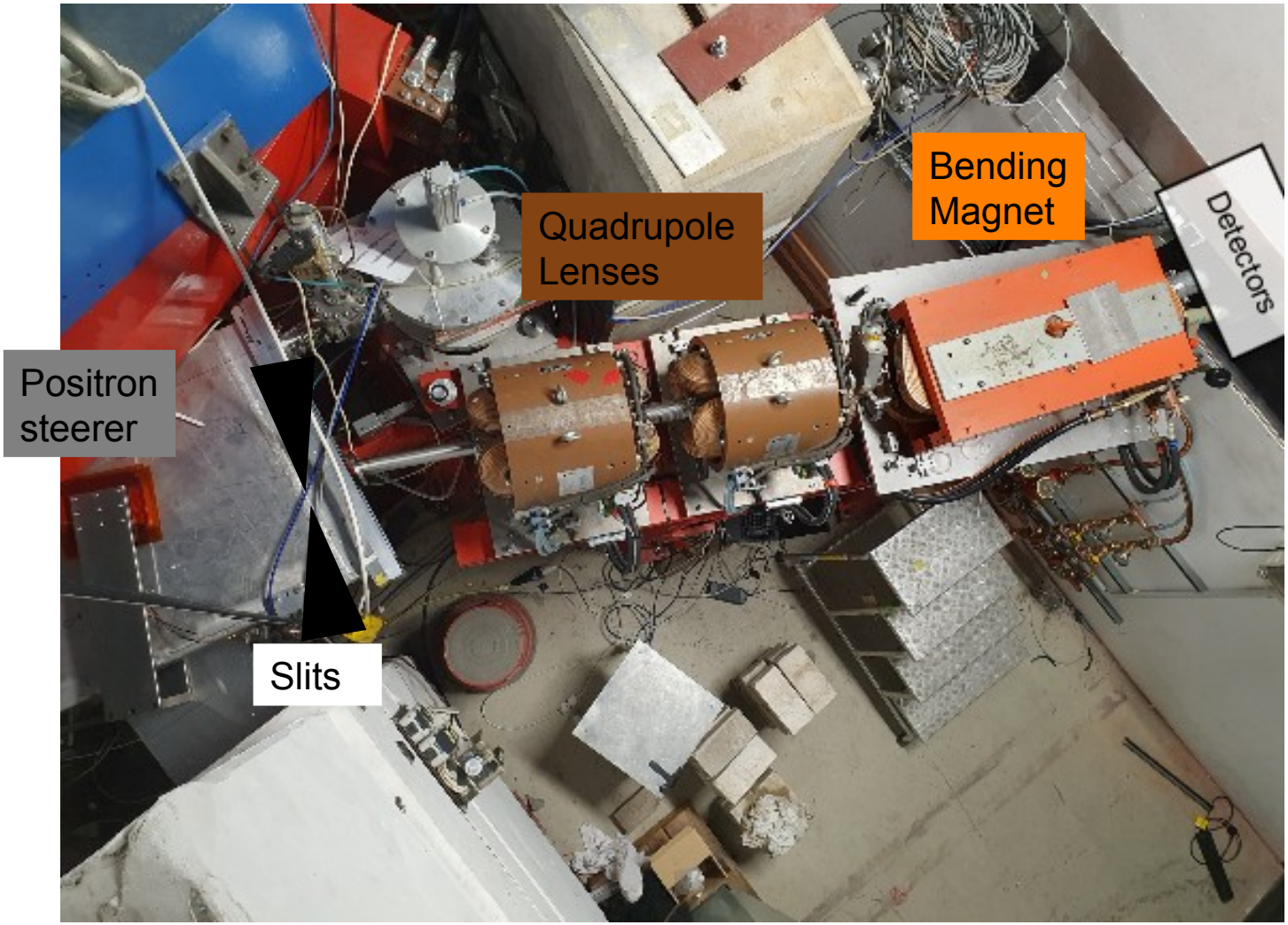
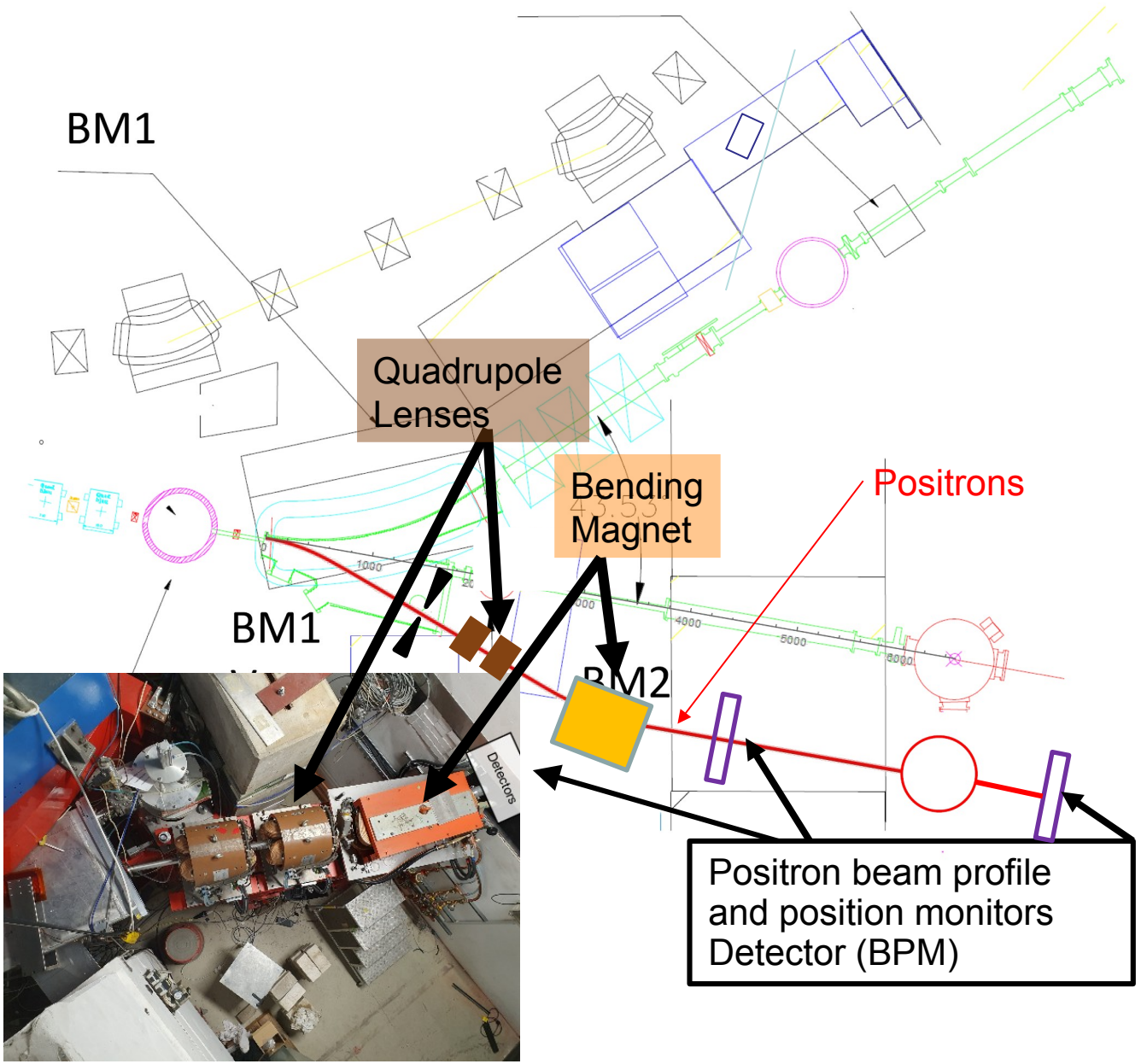


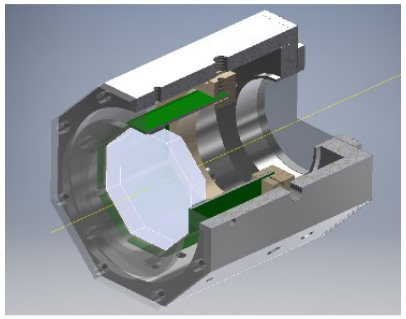
Pair production with the MAMI beam in combination with a monochromator

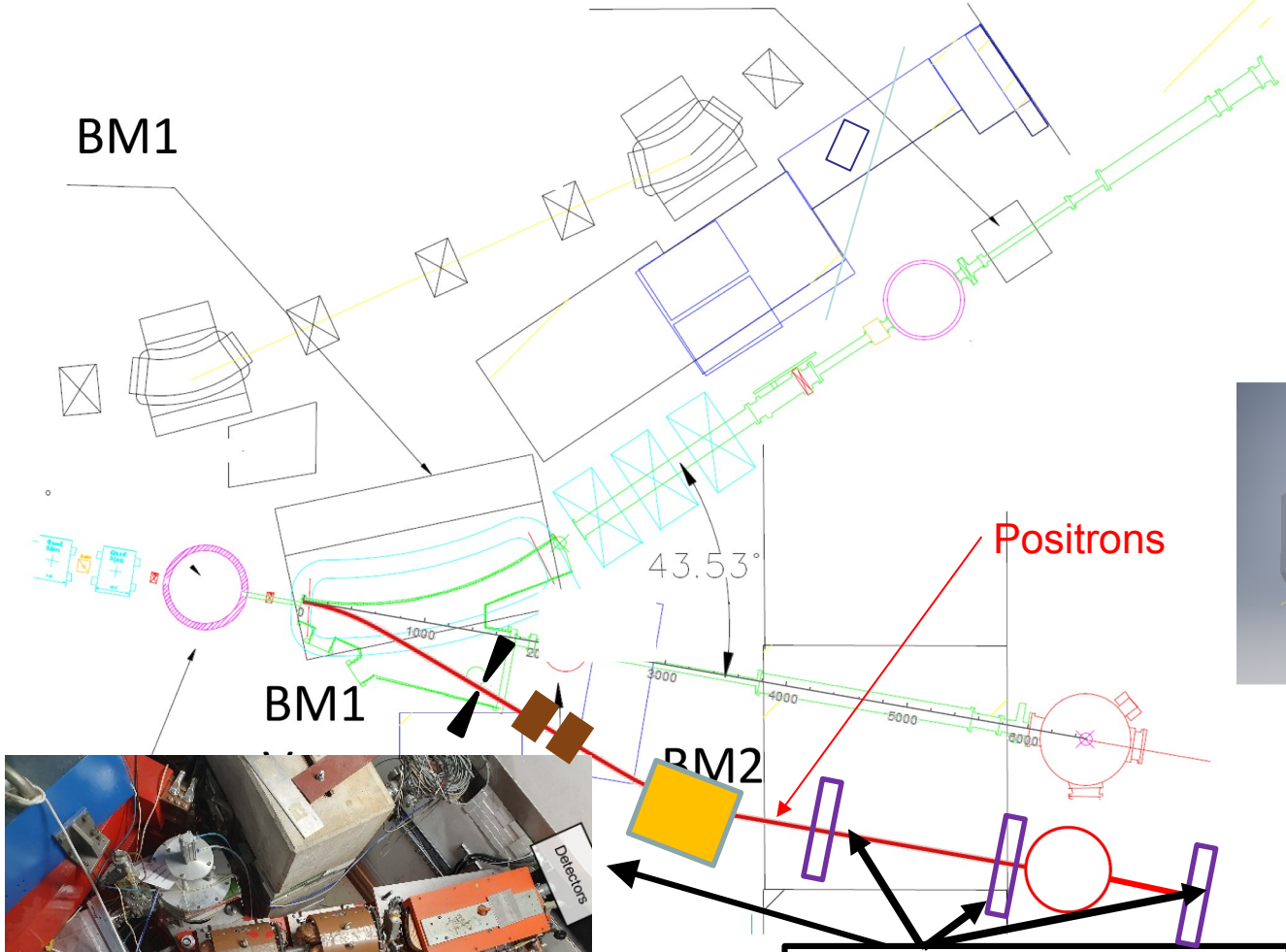


Overview Positron production

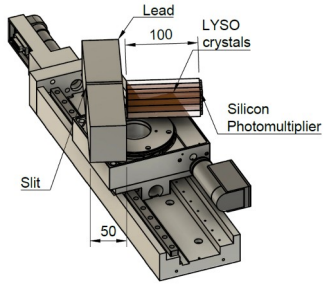


Overview Positron production



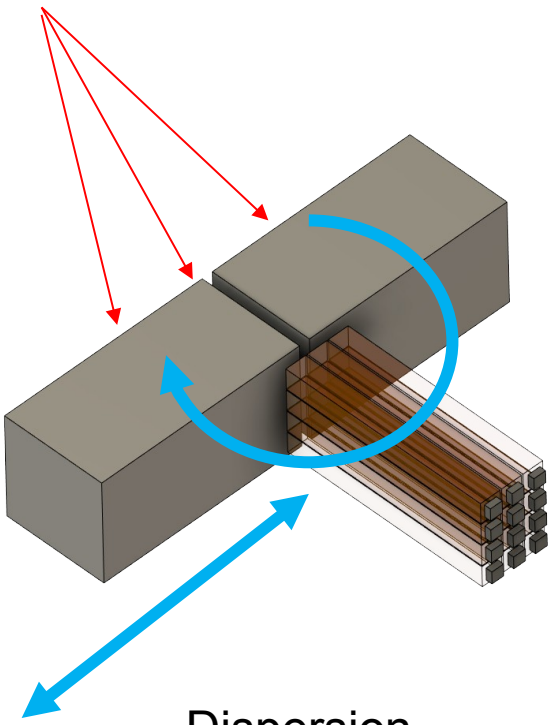


Positron beam profile and position monitors Detector (BPM)

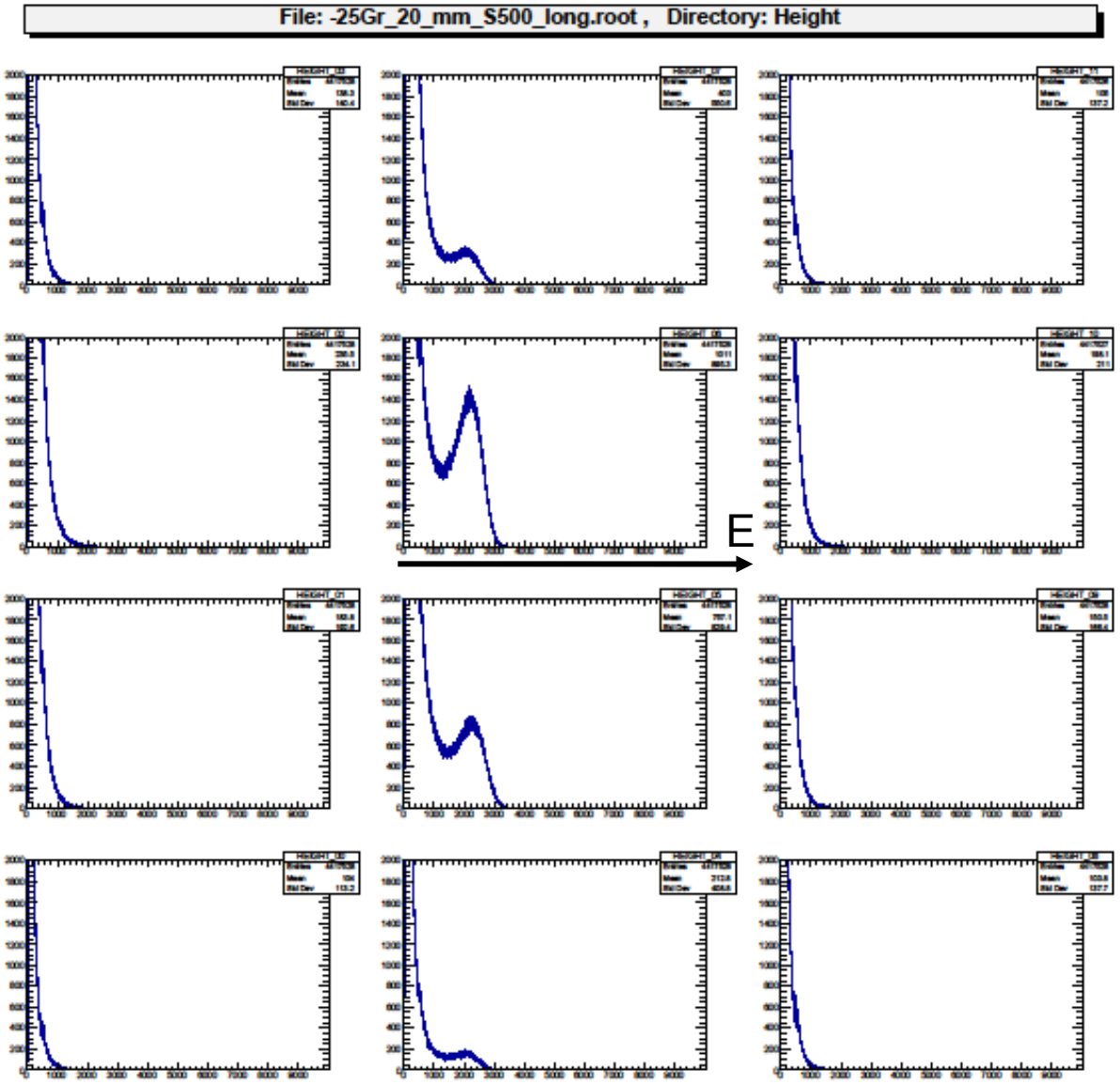


Positron Spectra

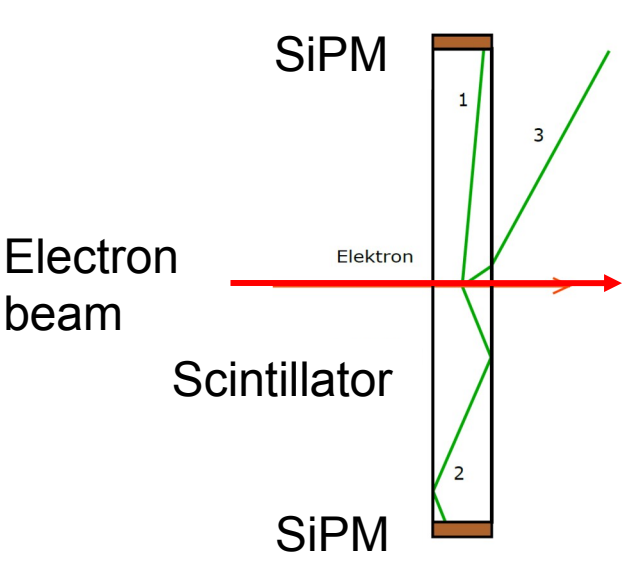
Positrons from
Conversion Target

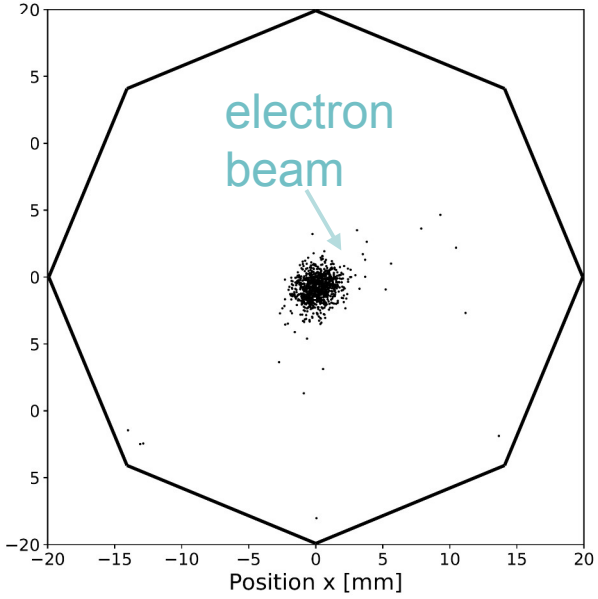


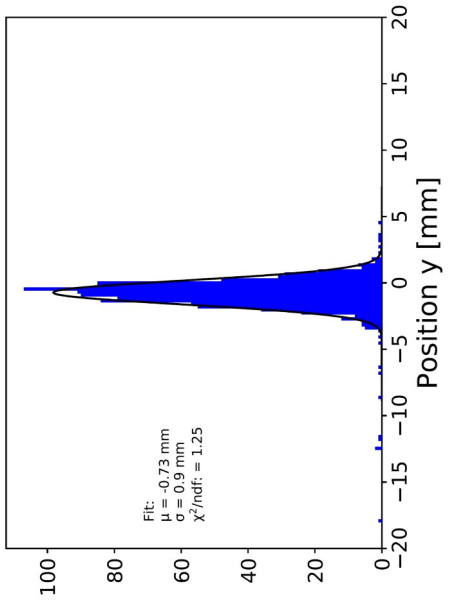
Dispersion
Direction

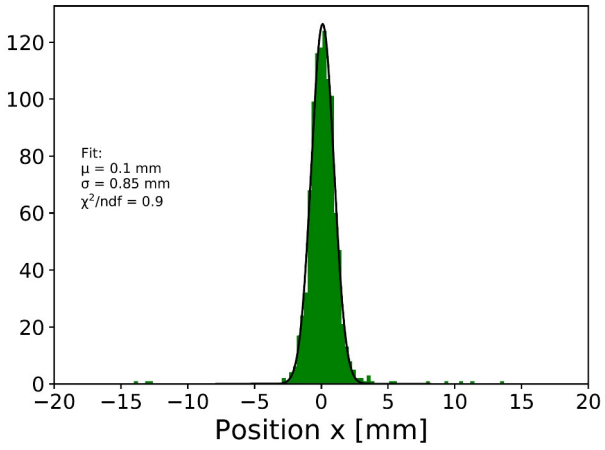


Beam Monitoring



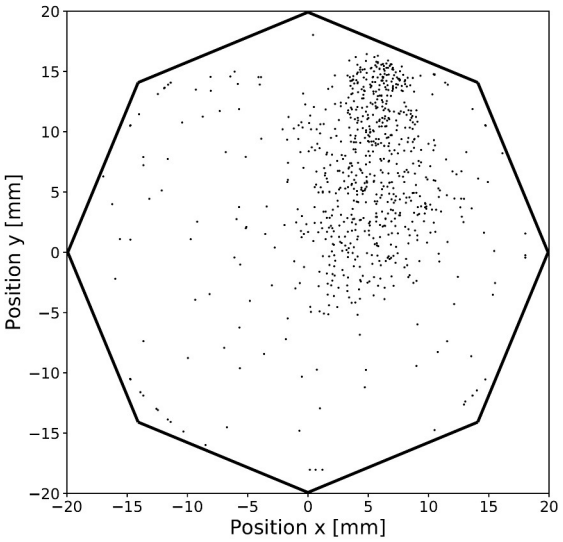




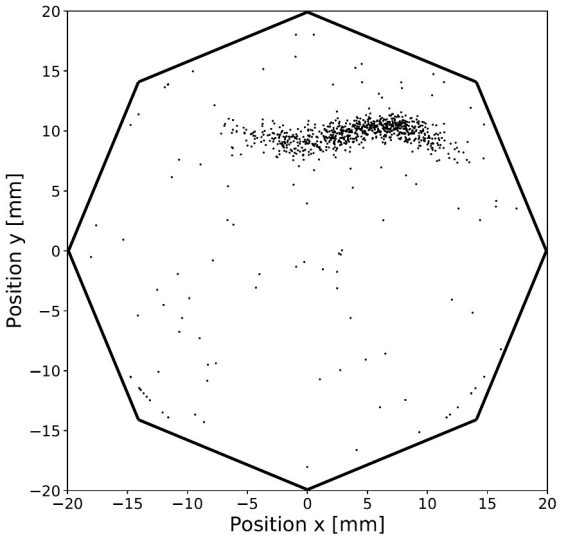


Beam profile measurements
Variation of Quadrupoles

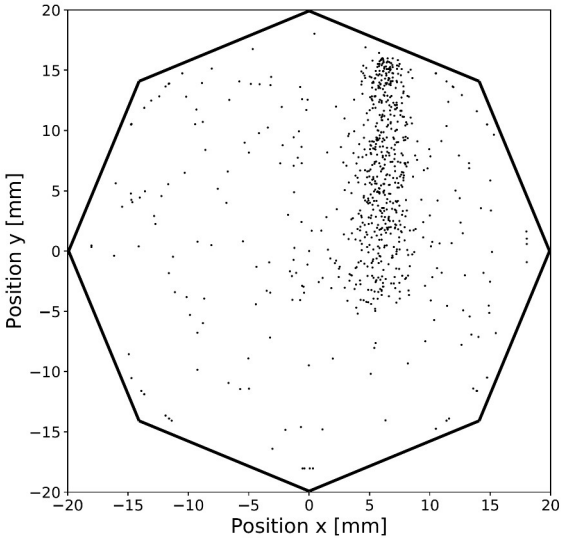
Q1 = 6 A
Q2 = 5 A



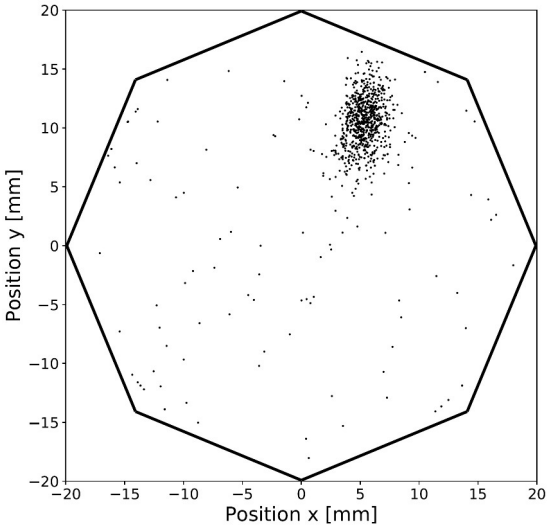
Q1 = 16 A
Q2 = 5 A



Q1 = 2 A
Q2 = 10 A

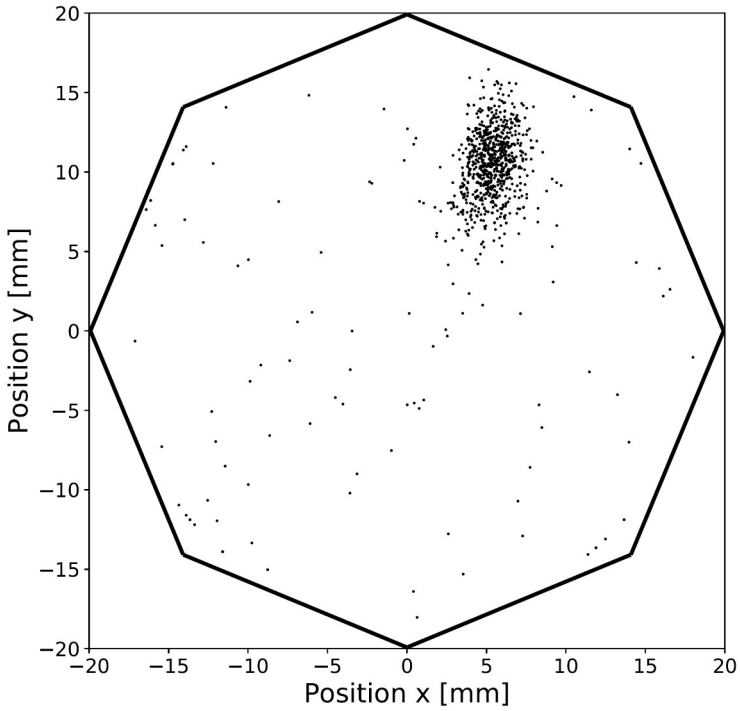


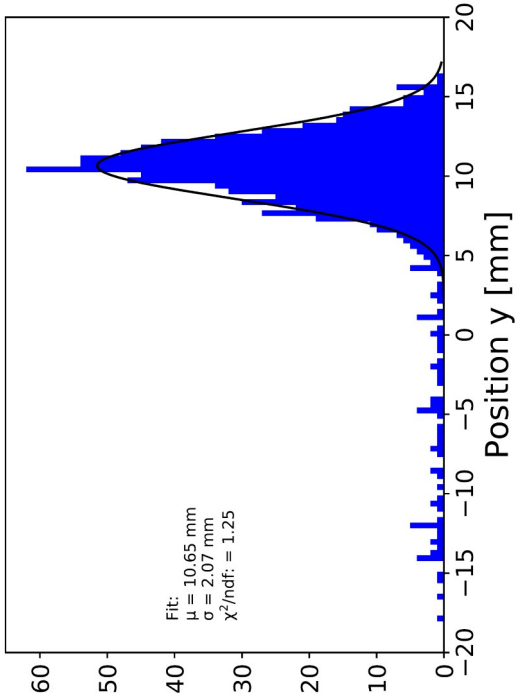
Q1 = 20 A
Q2 = 20 A

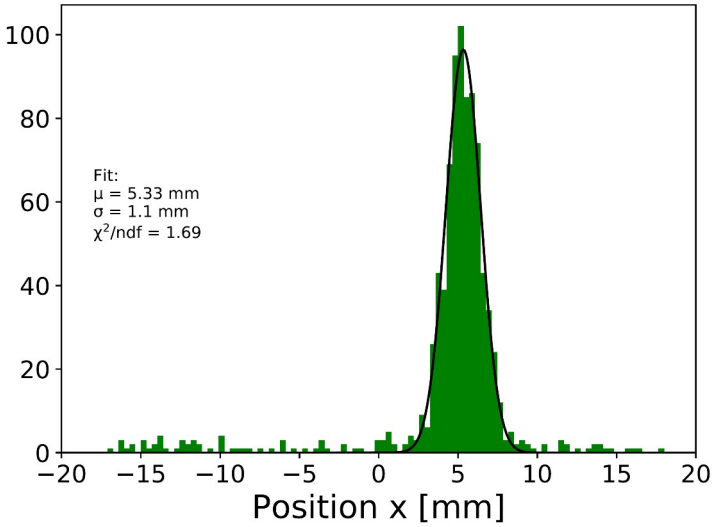


Beam profile measurements

Q1 = 20 A
Q2 = 20 A

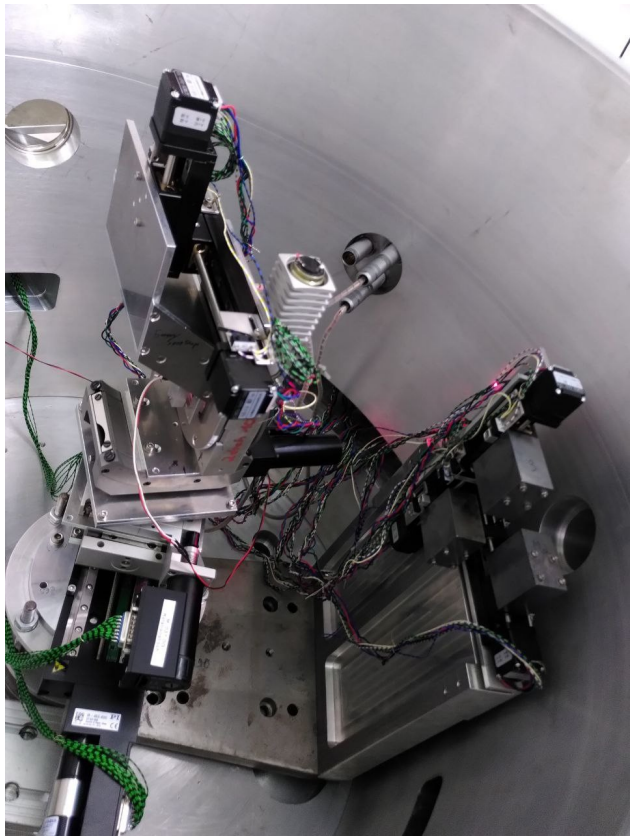


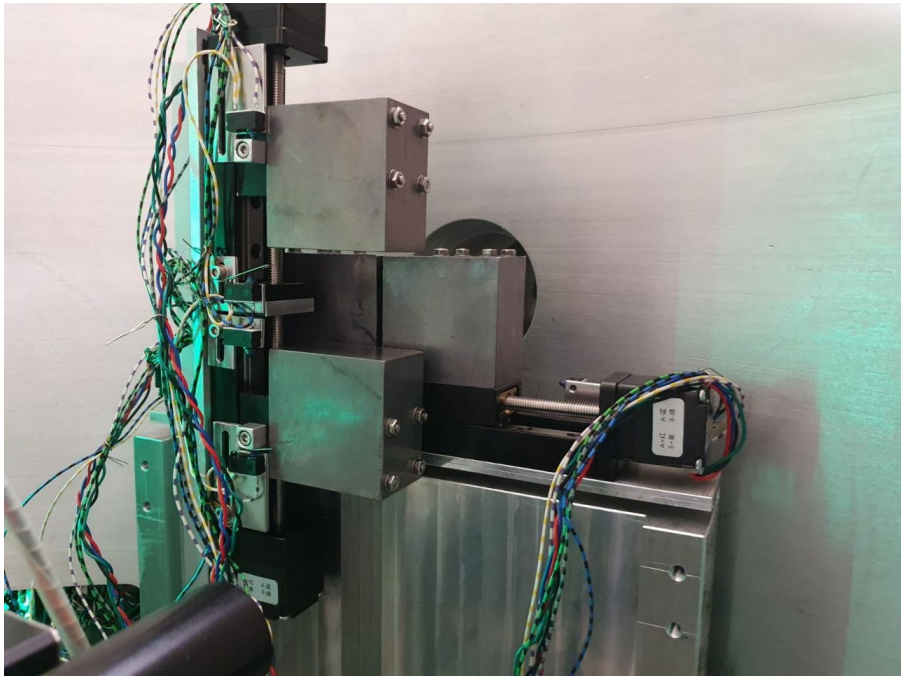




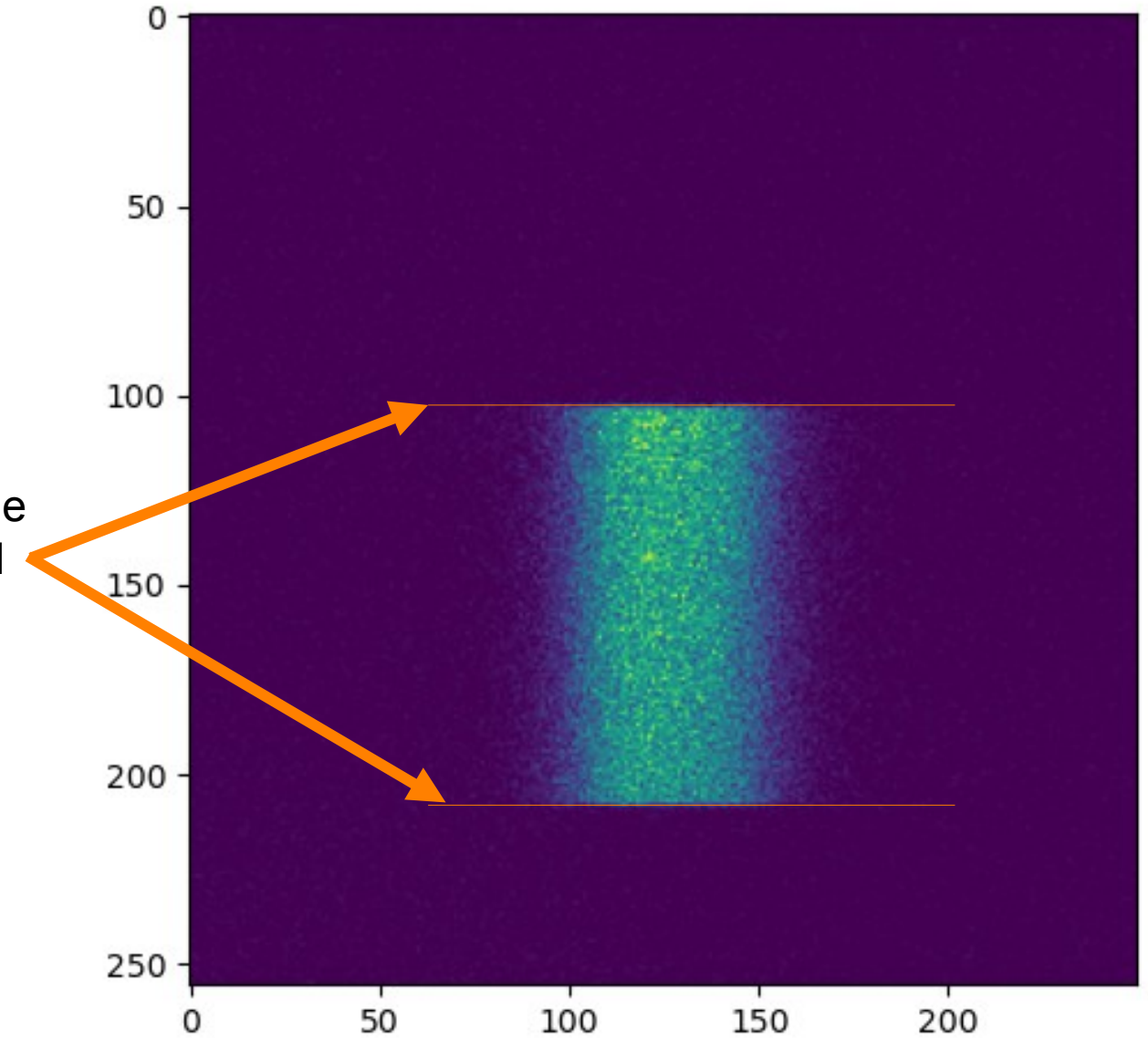
Setting up the crystal chamber and the goniometer

Setting up the crystal chamber and the goniometer



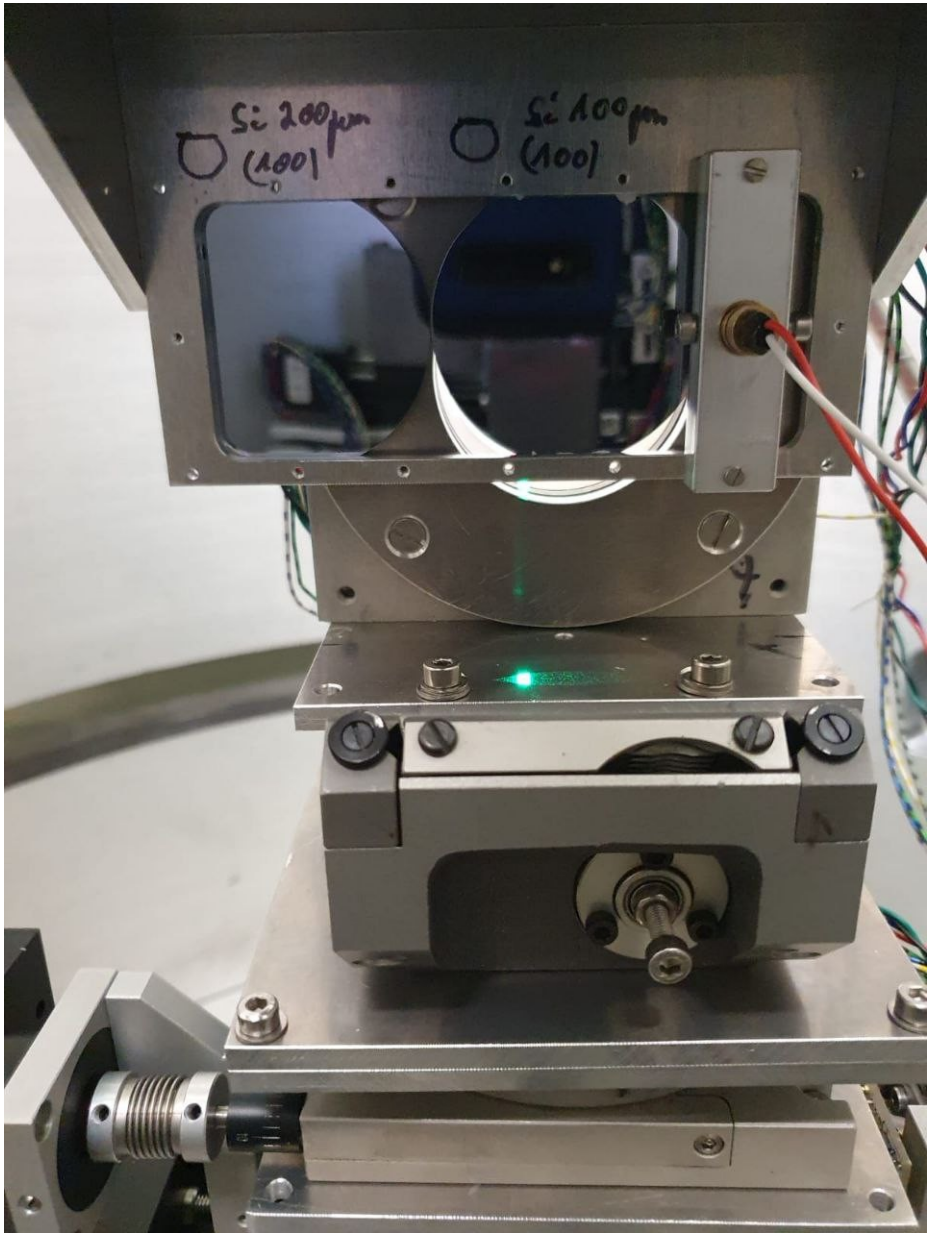


Vignetted positron beam after the chamber

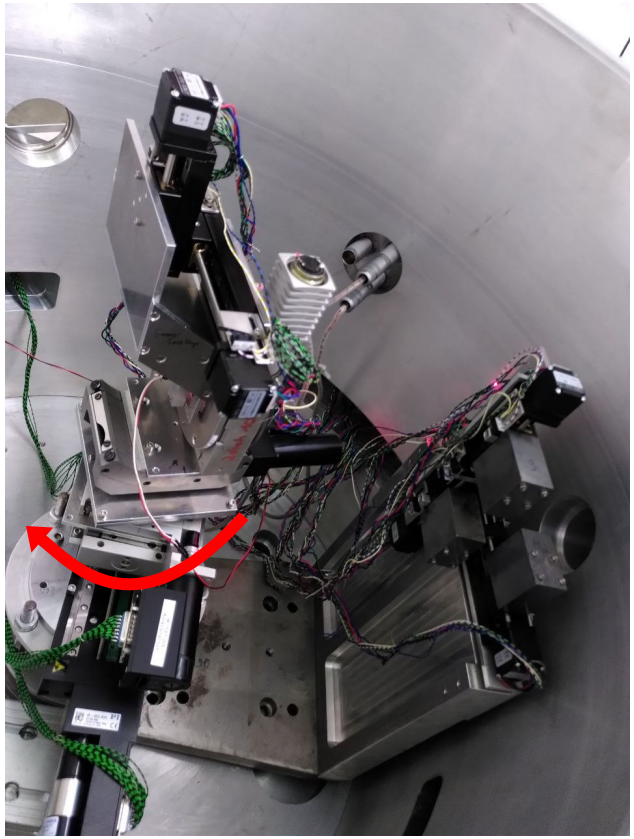


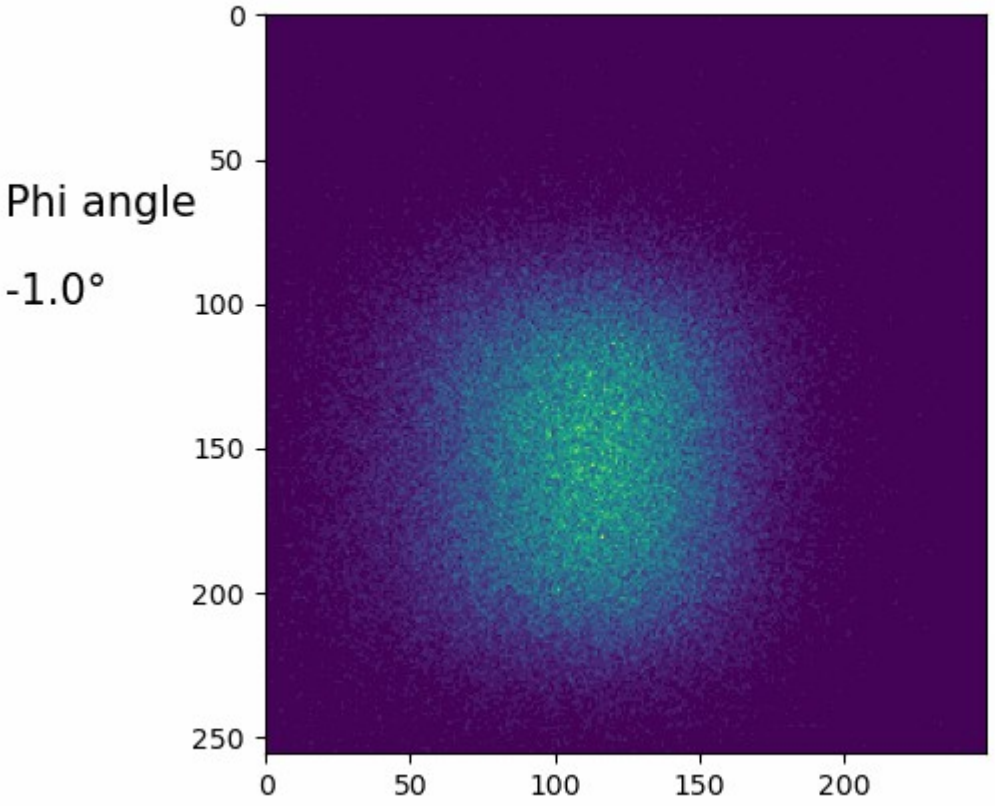
Edges due to vertical aperture

Inserting the Silicon crystals (100)

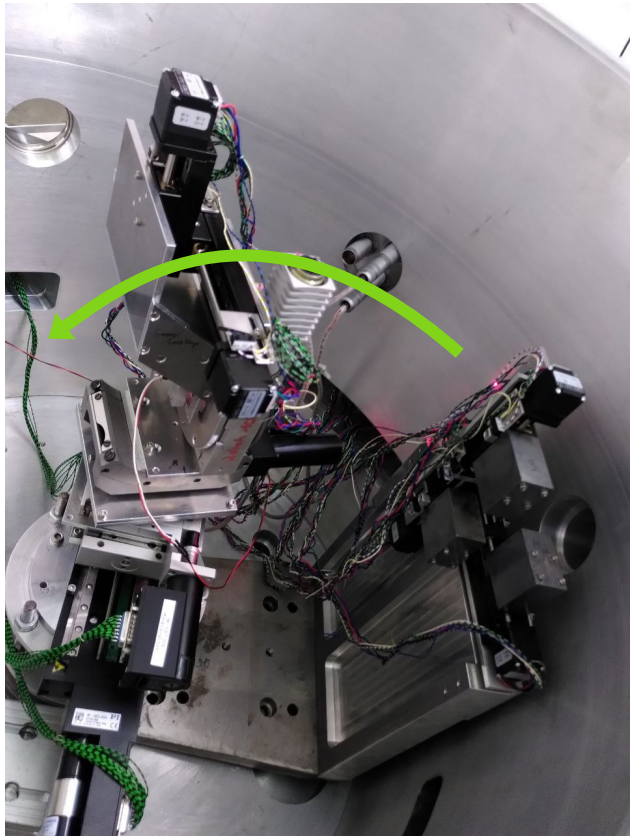


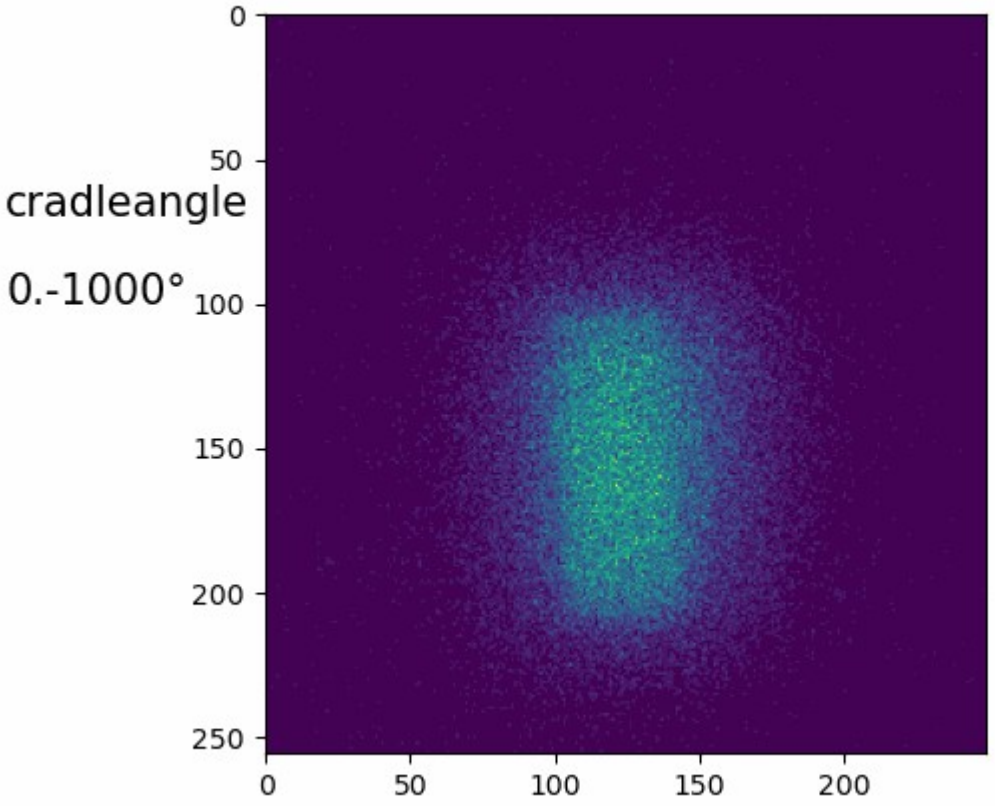
Searching for crystal planes



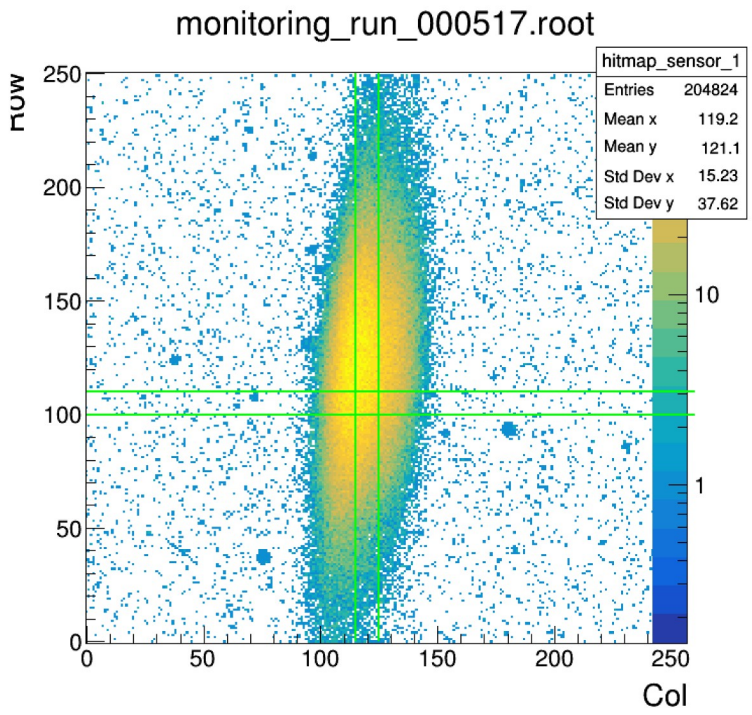


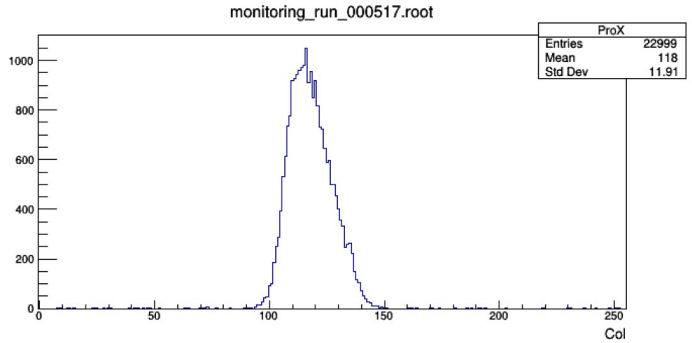
Searching for crystal planes

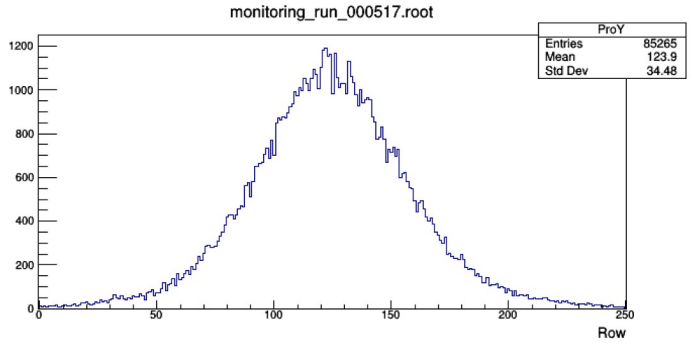




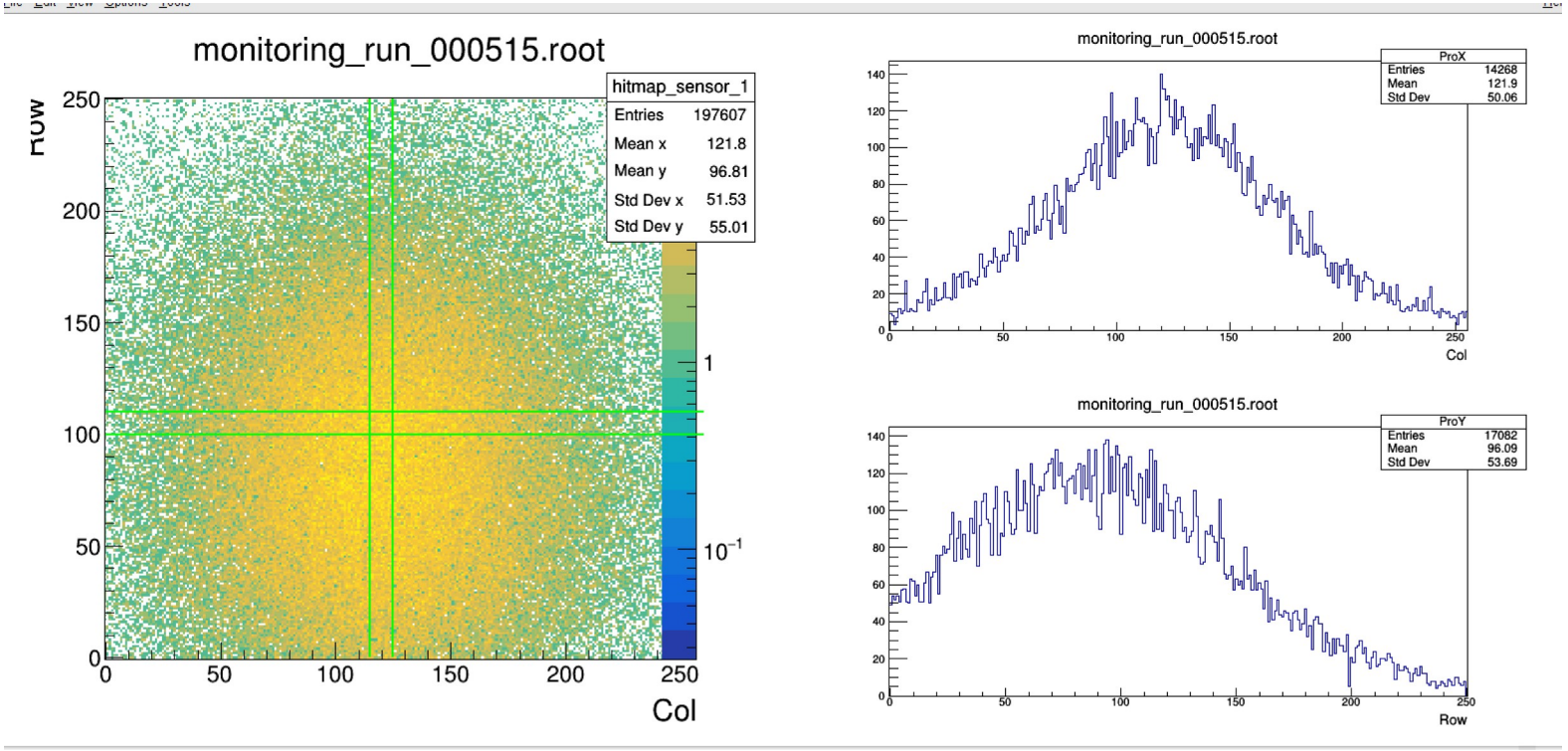
Positron beam without crystal



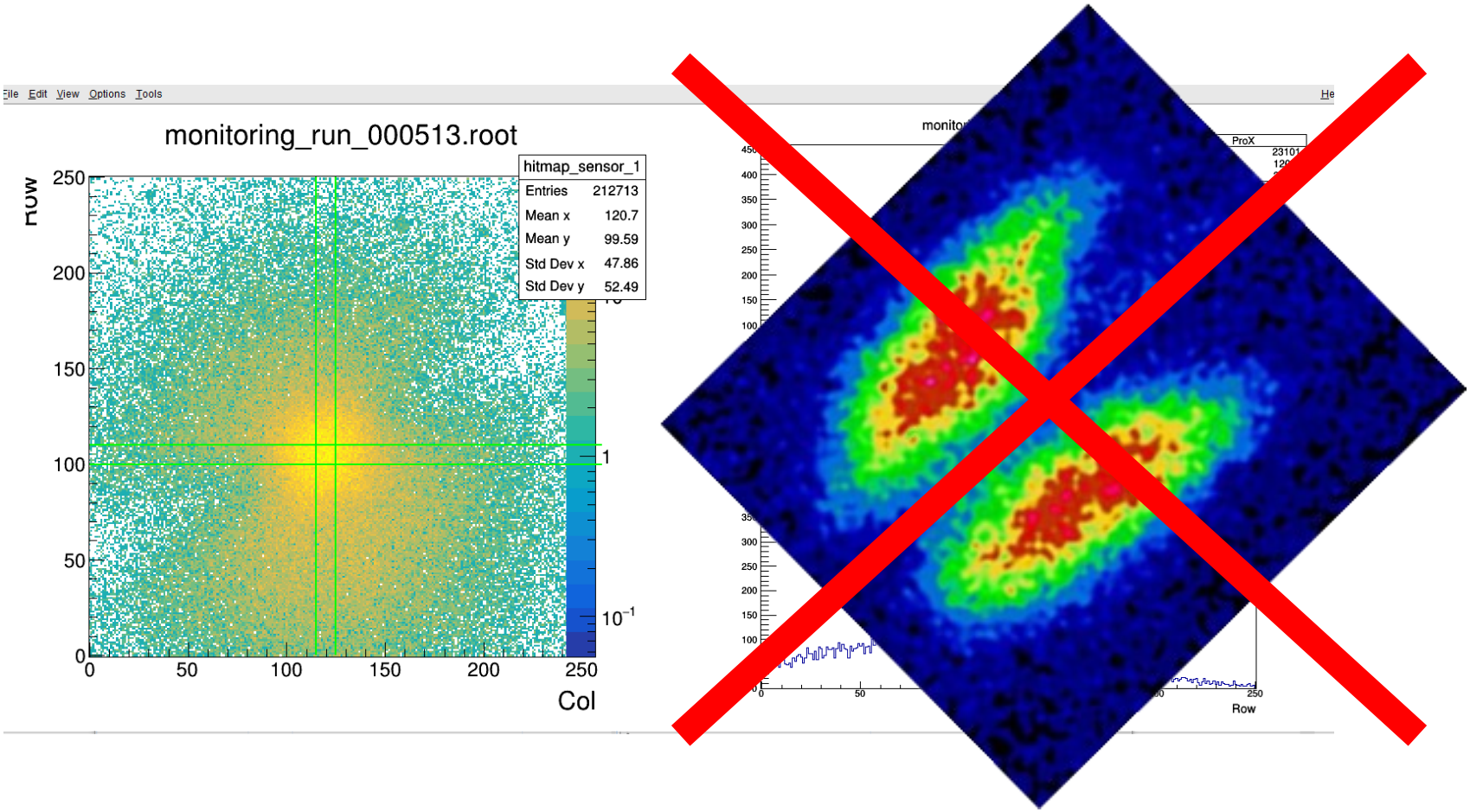




Crystal inserted (100µm Si)

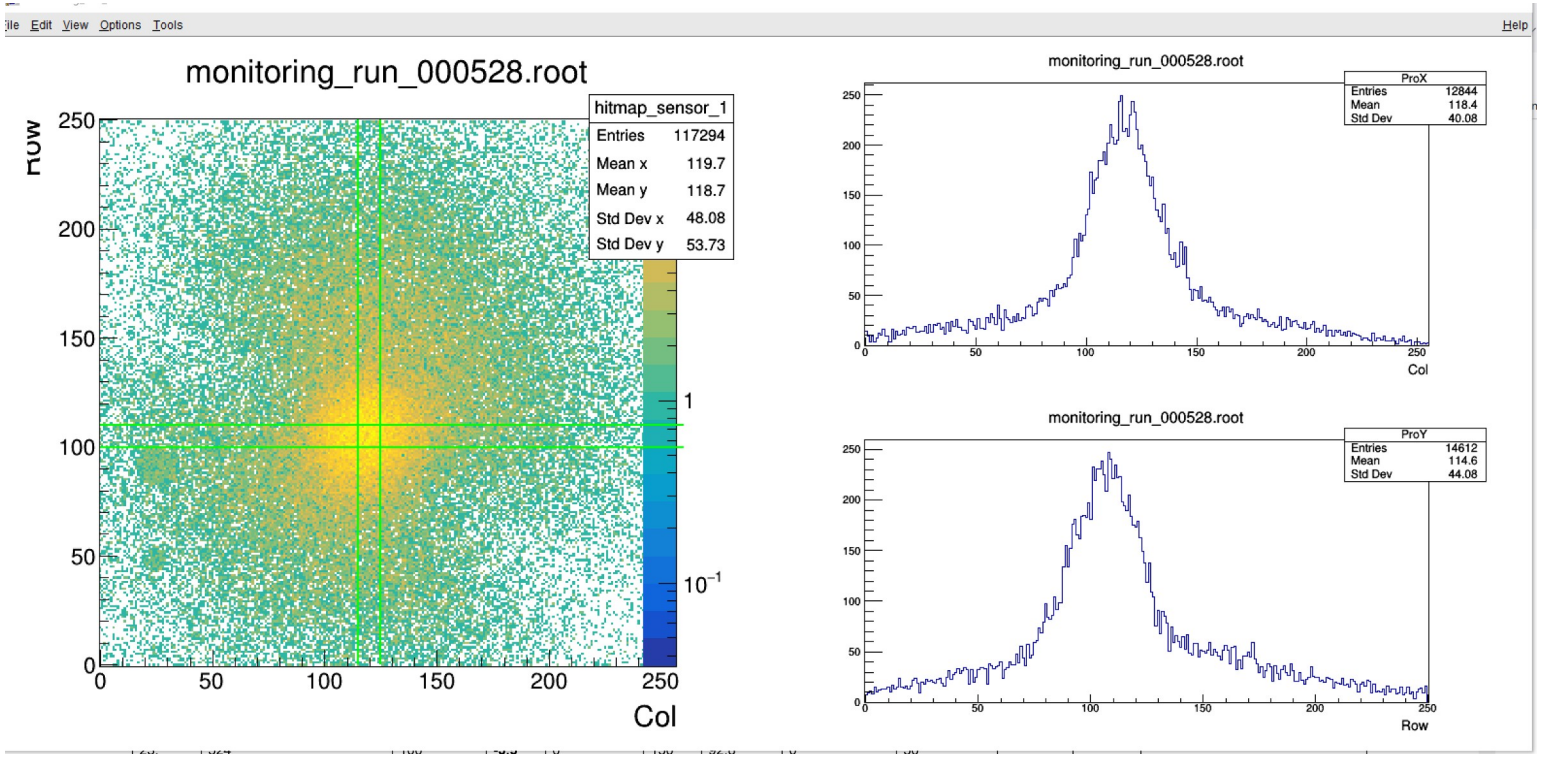


Searching for crystal planes



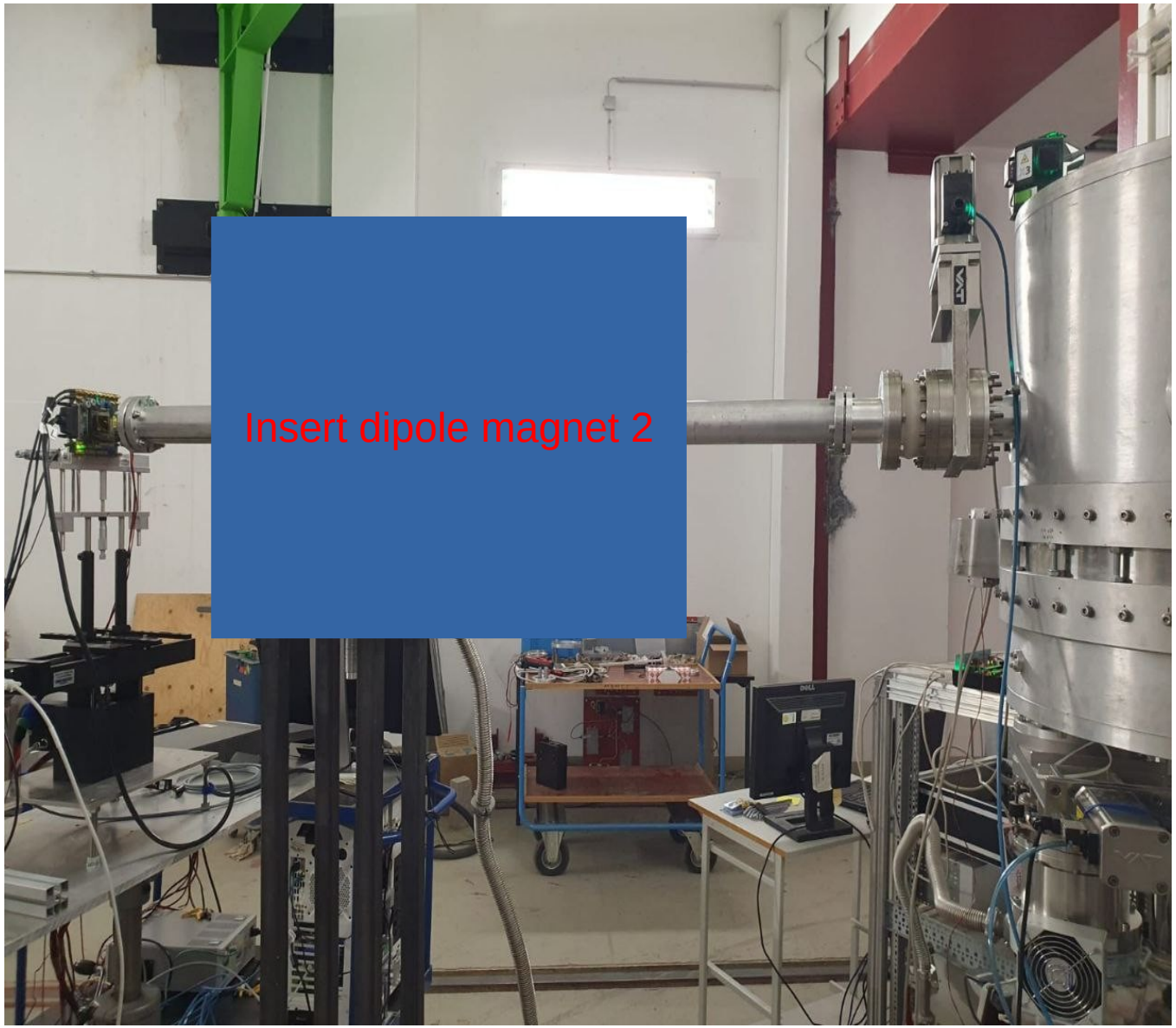
Source of Thyroid: Automatic differentiation of thyroid scintigram by deep convolutional neural network: a dual center study https://doi.org/10.1186/s12880-021-00710-4

Searching for crystal planes



Next steps

Next steps



Thank you for your attention