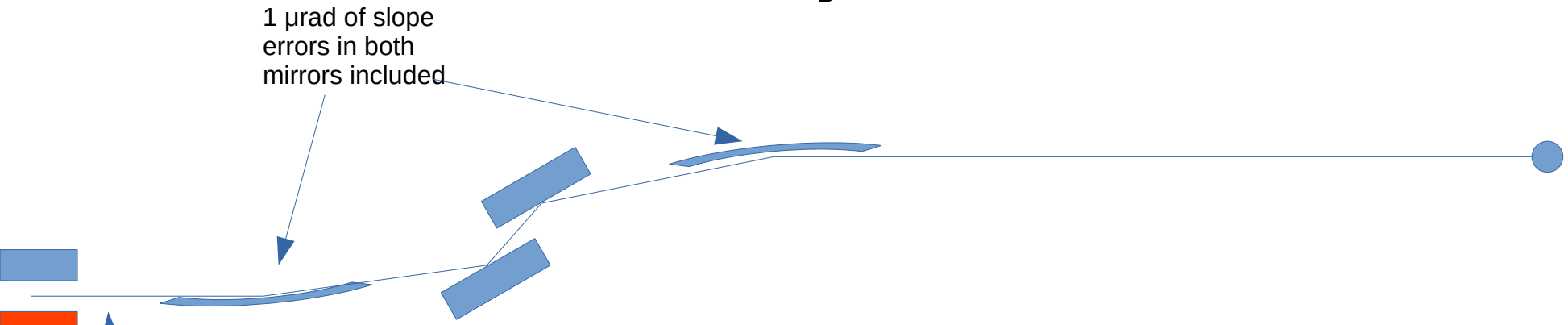
BM SAXS beamline

November 16, 2023
Annex: Focusing in different locations

Layout



Front end takes 0.75 mrad out of the radiation cone.

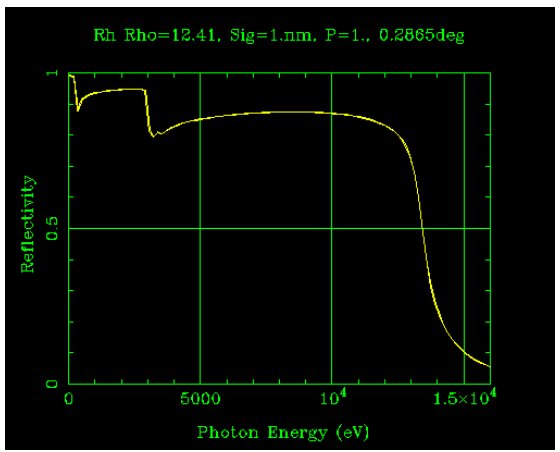
0.5 mm of Be included in calculations

(This distances ale slightly changed, was 11.5 and 13)

Layout

1. Toroidal mirror

- Vertically collimating
- Horizontally focusing
- 10 m from source
- Rhodium coated
- θ = 5 mrad
- R = 400000 cm
- ρ = 7.62 cm
- L = 60 cm



Cuts off above 14 keV

2. Double crystal/multilayer monochromator

- 12 m from source

DCM- Si(111)
DMM:
e.g. Mo/B_4C
N = 250 bilayers
d = 22 Å
X = 1cm
Y = 10 cm

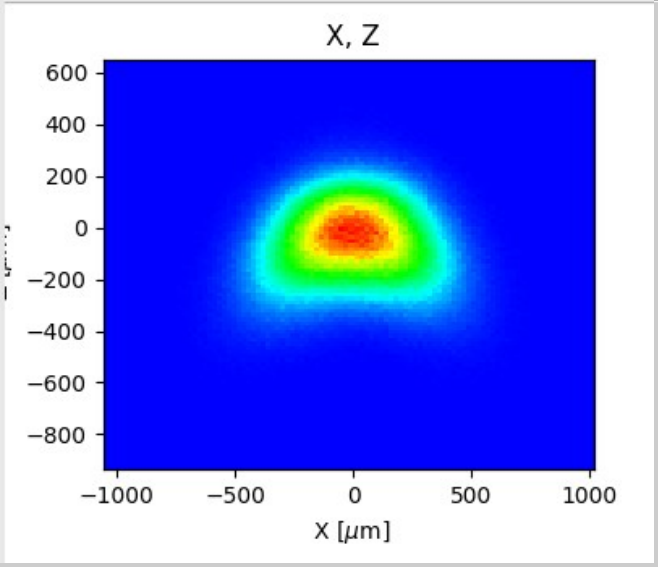
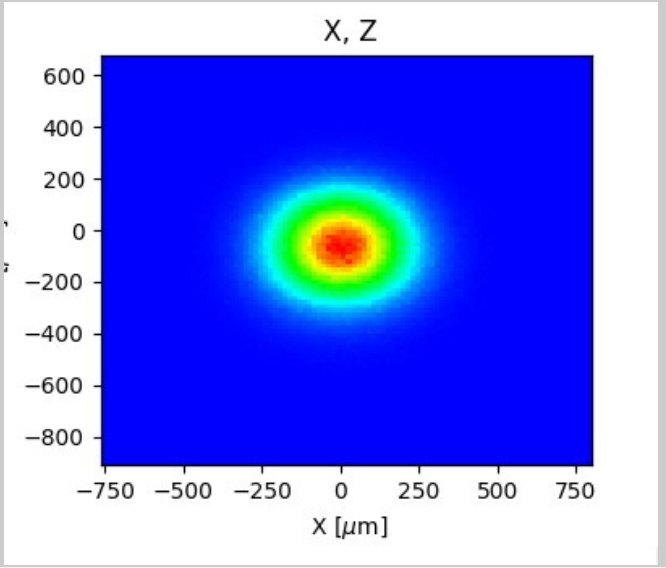
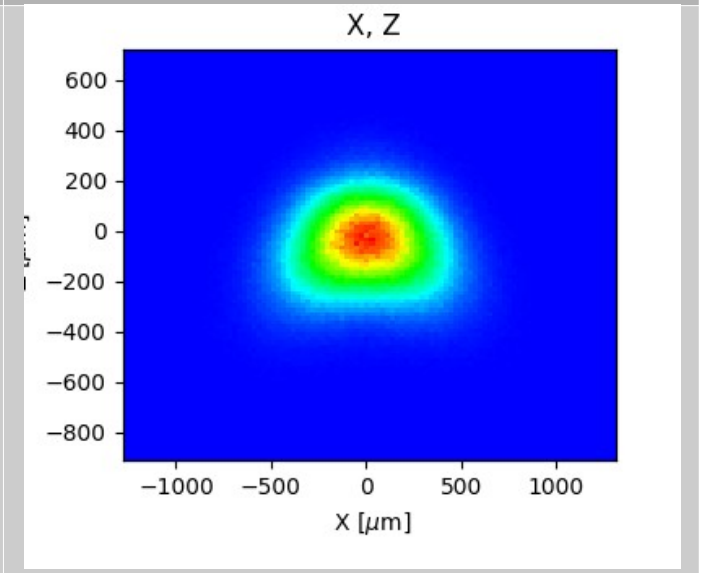
3. Cyllindrical mirror

- Vertically focusing
- 14 m from source

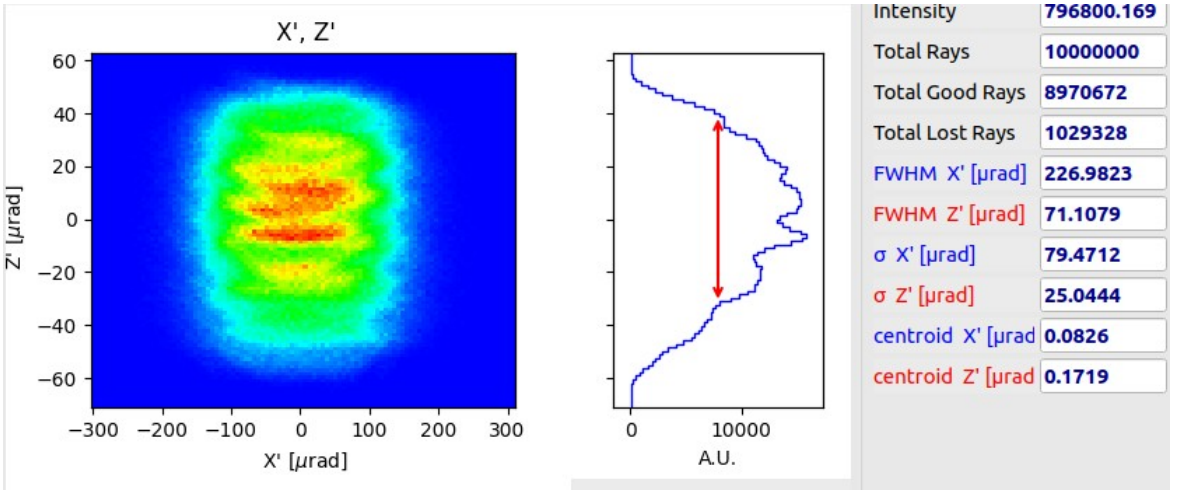
Rhodium coated
- θ = 5 mrad
- R = 1120005 cm
- L = 60 cm

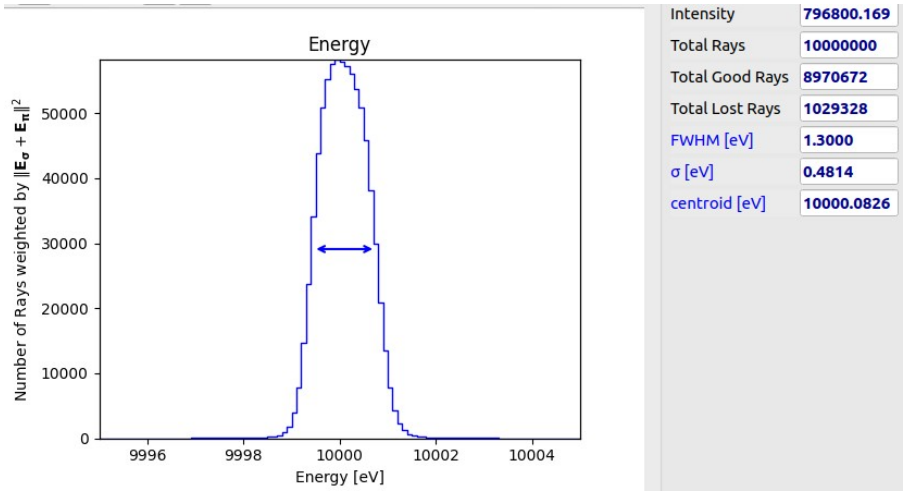
This layout focuses in the middle of the tube (42 m)

10 keV, DCM, focus at the middle full beam

Sample 39.5	Middle of tube 42 m	Detector 44.5 m
		
560 μm x 350 μm	330 μm x 301 μm	622 μm x 343 μm

10 keV, DCM, focus at the middle



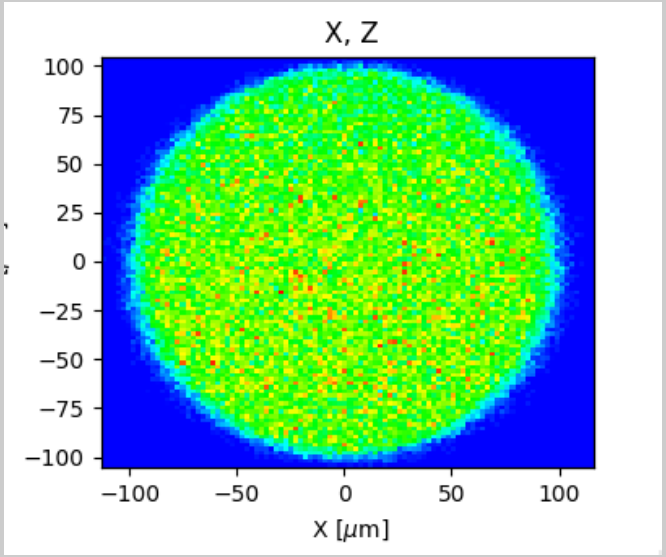
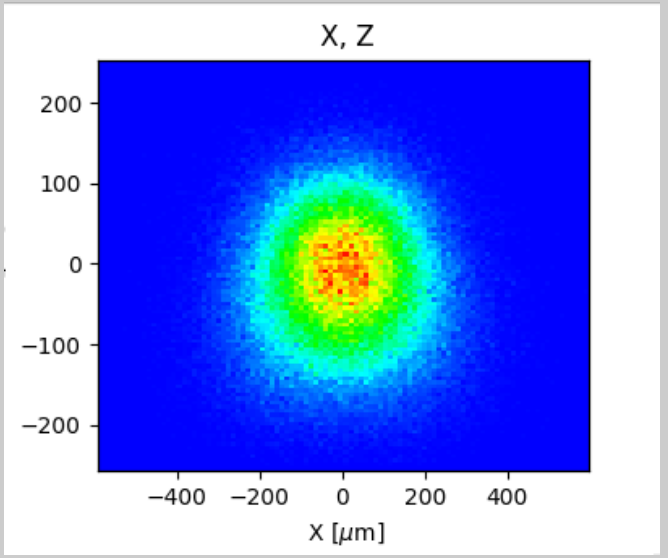
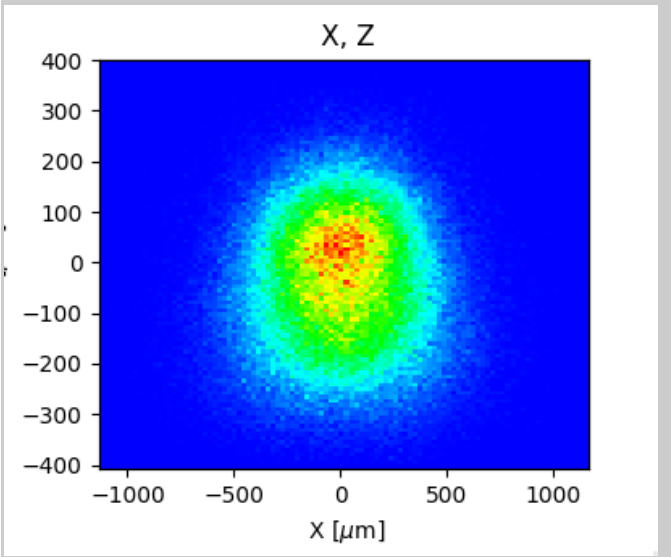


Angular divergence 227 μrad x 71 μrad

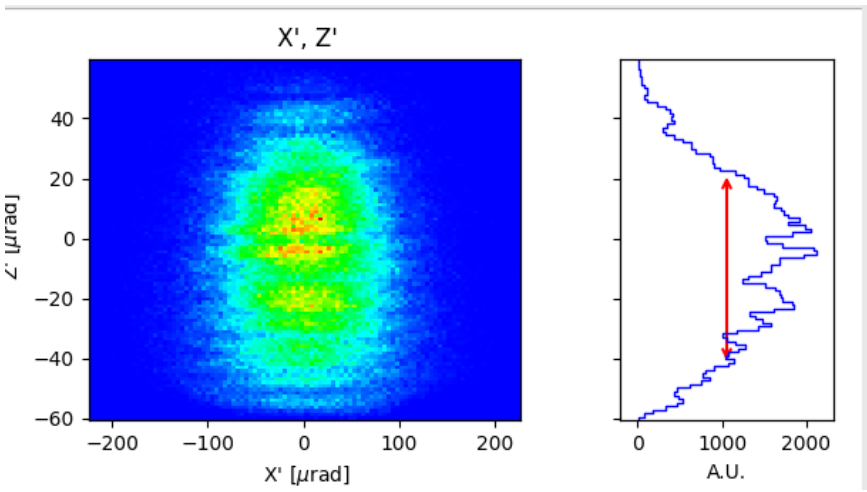
dE = 1.3 eV

Integrated flux 2.1e+10 ph/s

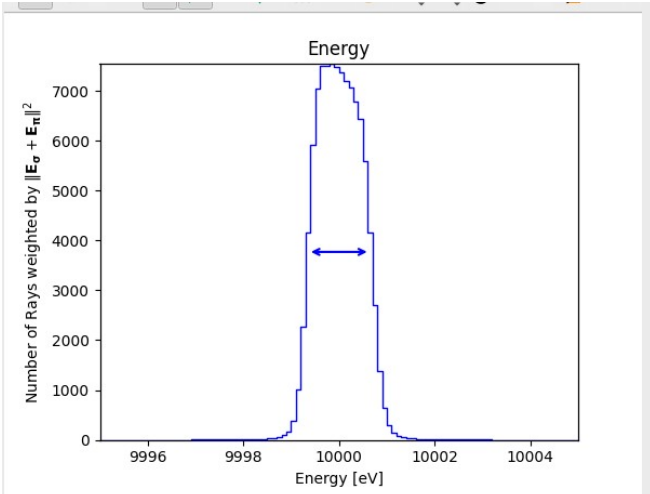
10 keV, DCM, focus at the middle
200 µm pinhole 10 cm before sample

Sample 39.5	Middle of tube 42 m	Detector 44.5 m
		
165 µm x 160 µm (full width!)	297 µm x 173 µm	597 µm x 324 µm

10 keV, DCM, focus at the middle
200 µm pinhole 10 cm before sample



Intensity	101496.504
Total Rays	10000000
Total Good Rays	1140047
Total Lost Rays	8859953
FWHM X' [µrad]	121.7851
FWHM Z' [µrad]	63.8520
σ X' [µrad]	52.3525
σ Z' [µrad]	23.8403
centroid X' [µrad	1.1144
centroid Z' [µrad	-7.0909



Intensity	101496.504
Total Rays	10000000
Total Good Rays	1140047
Total Lost Rays	8859953
FWHM [eV]	1.3000
σ [eV]	0.4519
centroid [eV]	10000.0012

Angular divergence 122 µrad x 64 µrad

dE = 1.3 eV

Integrated flux 2.7e+9 ph/s

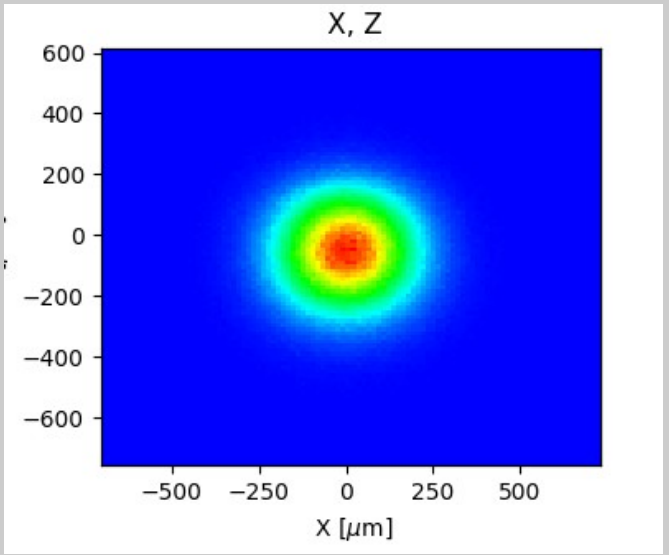
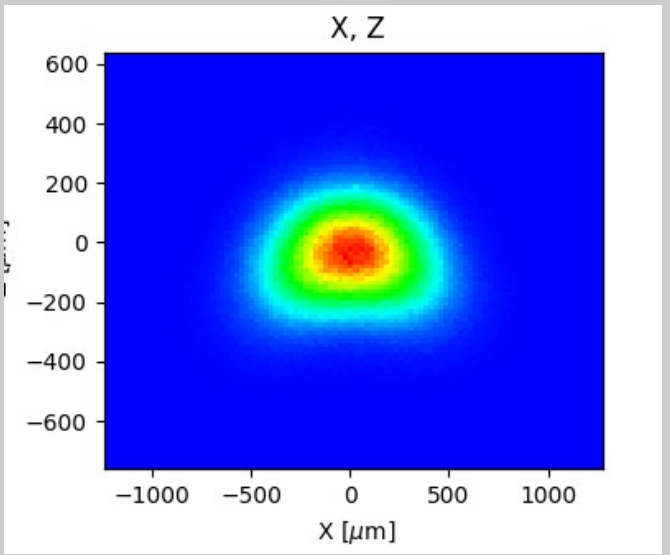
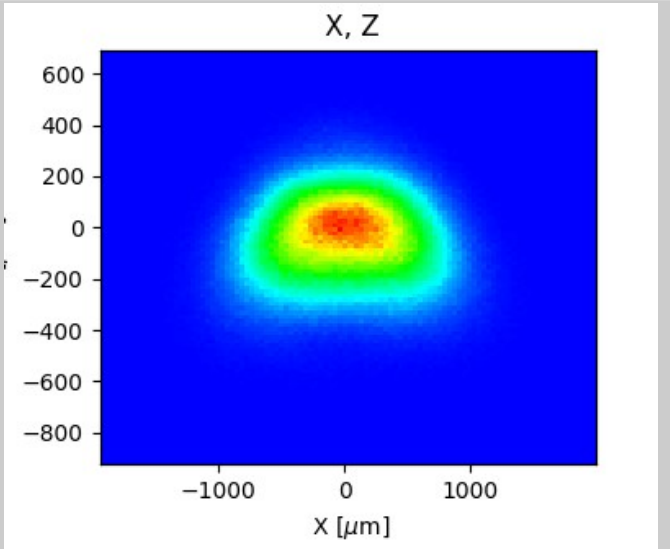
10 keV, DCM, focus at the sample

To change the focus to the sample position (39.5 m) we change

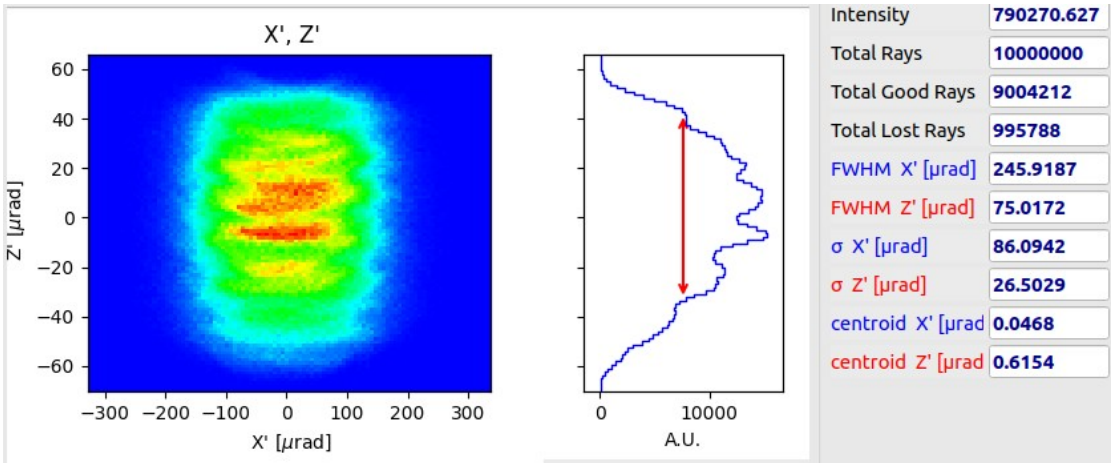
M1: θ = 5.1 mrad

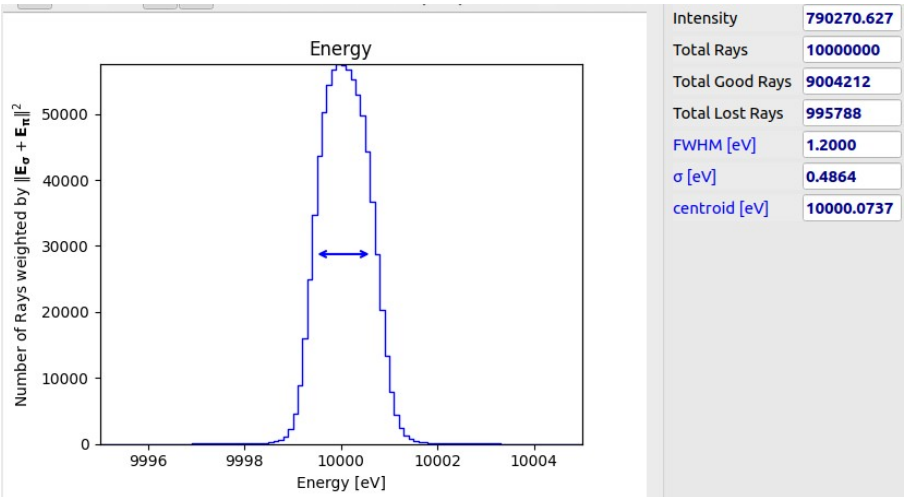
M2: θ = 5.1 mrad (to maintain horizontal propagation)
R = 1000000 cm (bend the mirror to obtain best focus)

10 keV, DCM, focus at the sample
Full beam

Sample 39.5	Middle of tube 42 m	Detector 44.5 m
		
301 μm x 302 μm	656 μm x 308 μm	1221 μm x 372 μm

10 keV, DCM, focus at the sample
Full beam



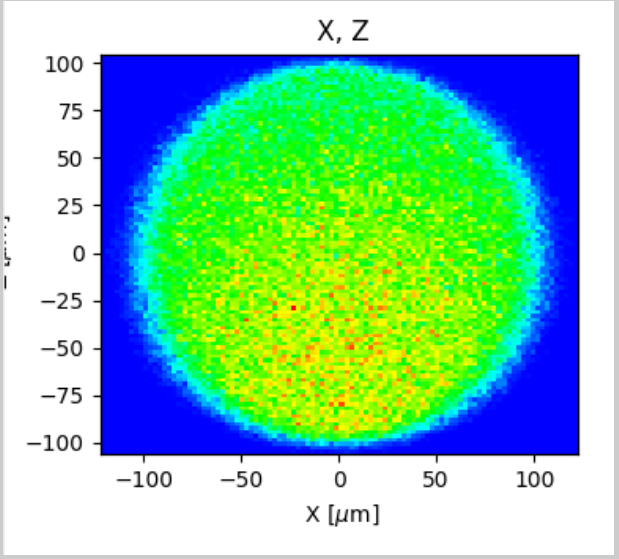
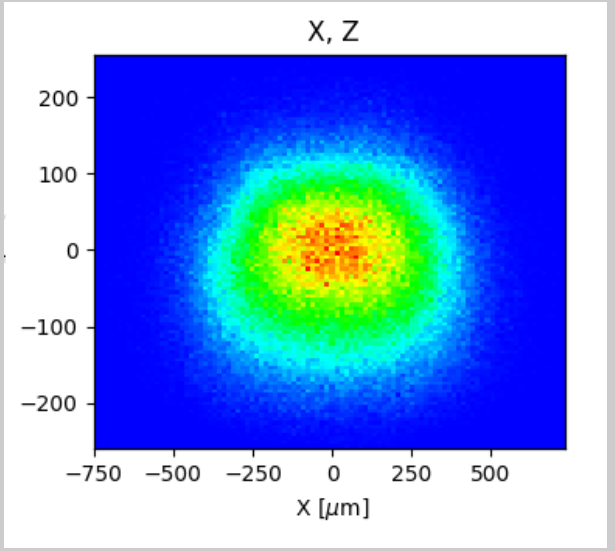
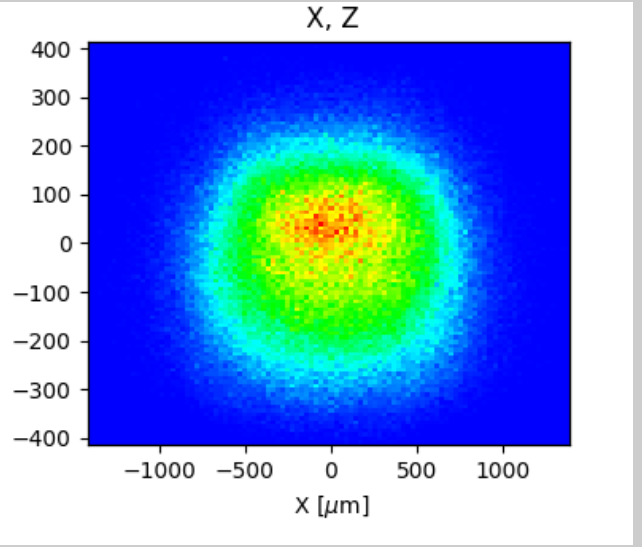


dE = 1.3 eV

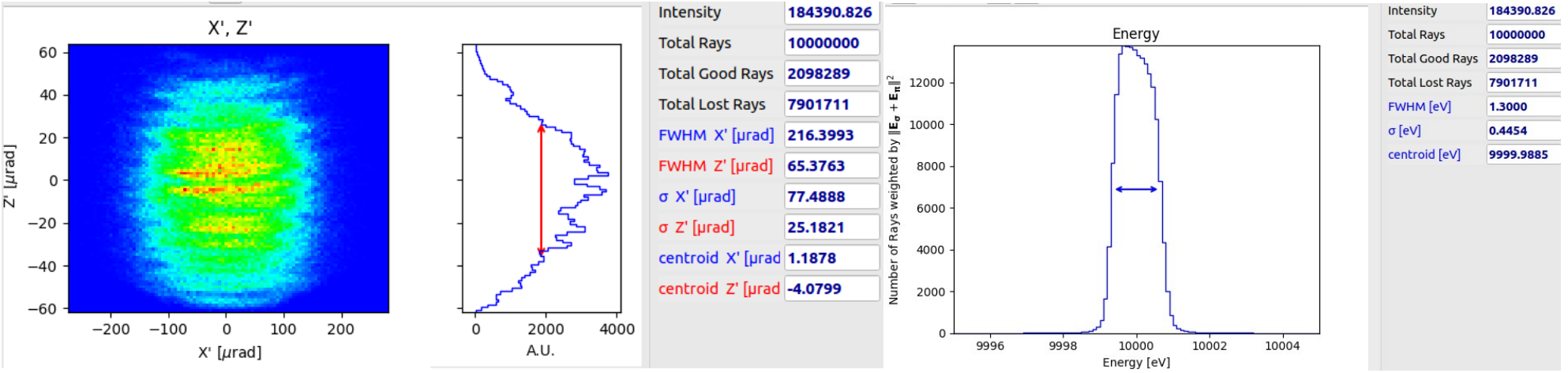
Angular divergence 245 μrad x 75 μrad

Integrated flux 2.1e+10 ph/s

10 keV, DCM, focus at the sample
200 µm pinhole 10 cm before sample

Sample 39.5	Middle of tube 42 m	Detector 44.5 m
		
159 x 158 (full width)	578 µm x 191 µm	1094 µm x 340 µm

10 keV, DCM, focus at the sample
200 µm pinhole 10 cm before sample



dE = 1.3 eV

Angular divergence 216 µrad x 65 µrad

Integrated flux 4.9e+9 ph/s

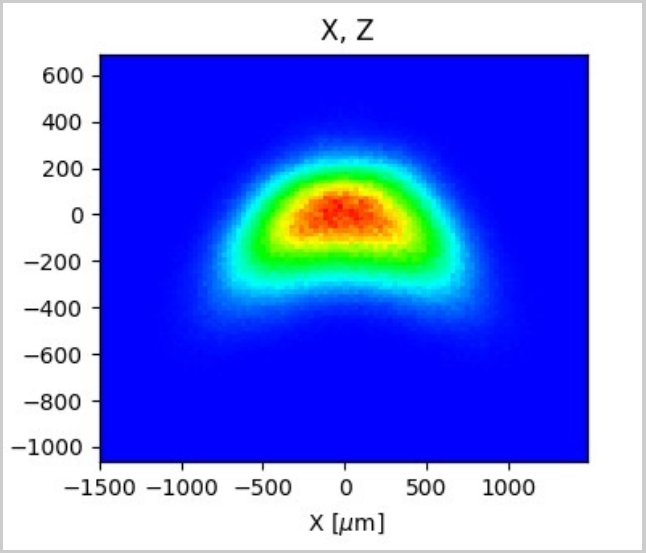
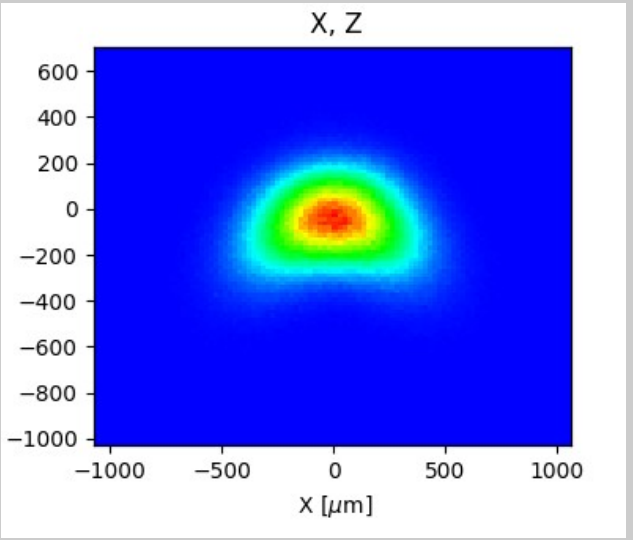
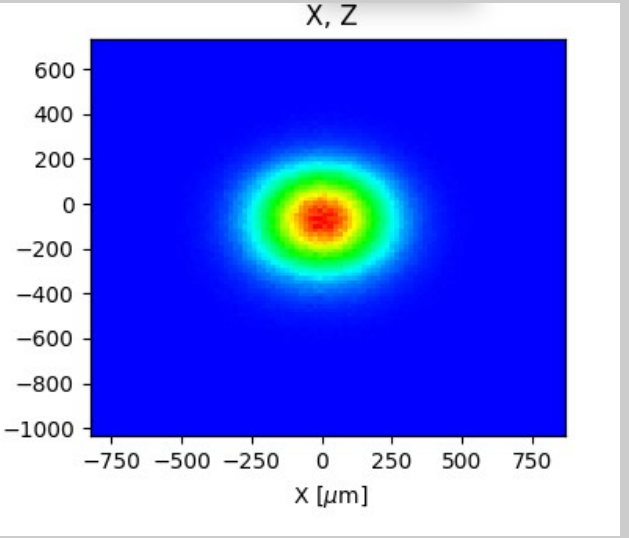
10 keV, DCM, focus at the detector

To change the focus to the detector position (44.5 m) we change

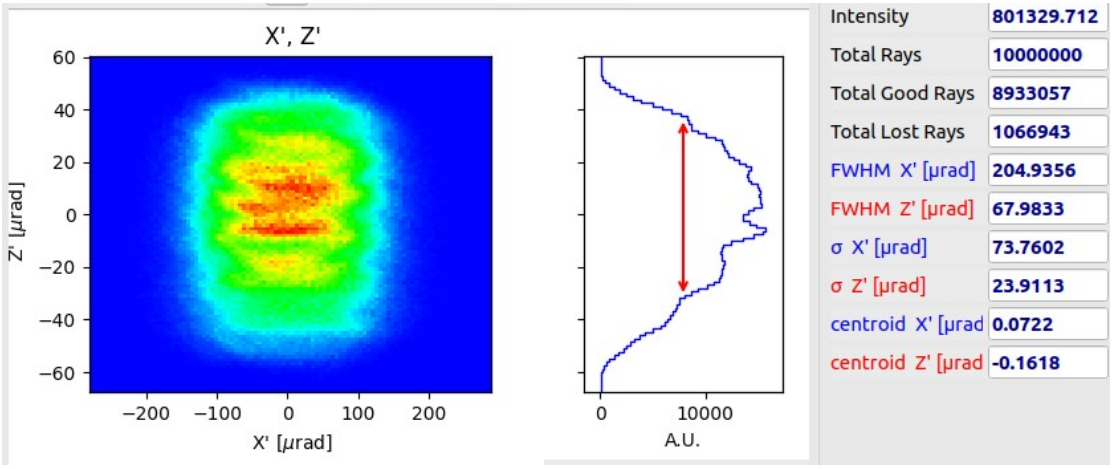
M1: θ = 4.914 mrad

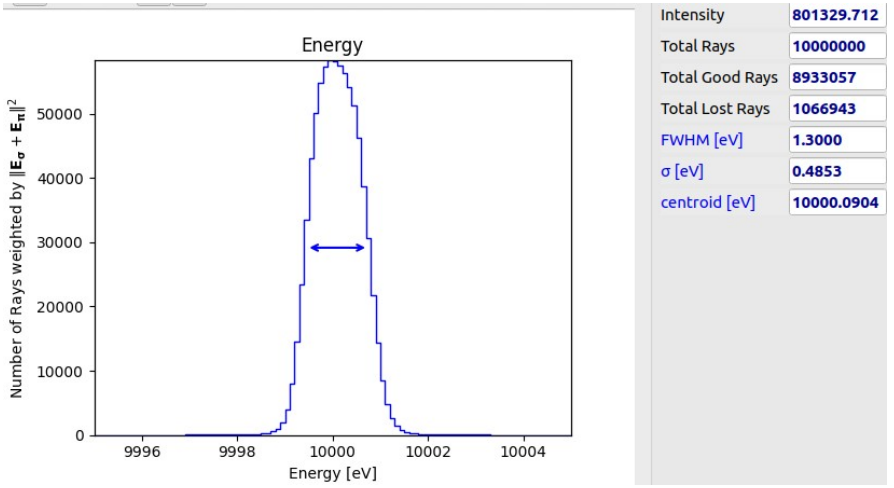
M2: θ = 4.914 mrad (to maintain horizontal propagation)
R = 1241426 cm (relax the mirror to obtain best focus)

10 keV, DCM, focus at the detector
Full beam

Sample 39.5	Middle of tube 42 m	Detector 44.5 m
		
1046 μm x 386 μm	554 μm x 330 μm	356 μm x 337 μm

10 keV, DCM, focus at the detector
Full beam



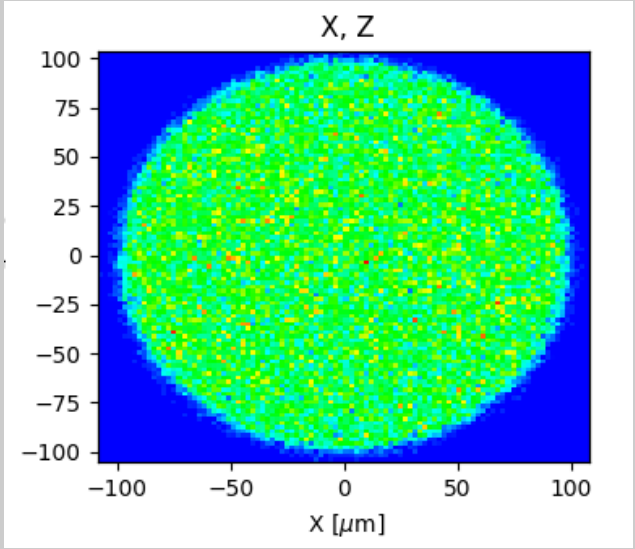
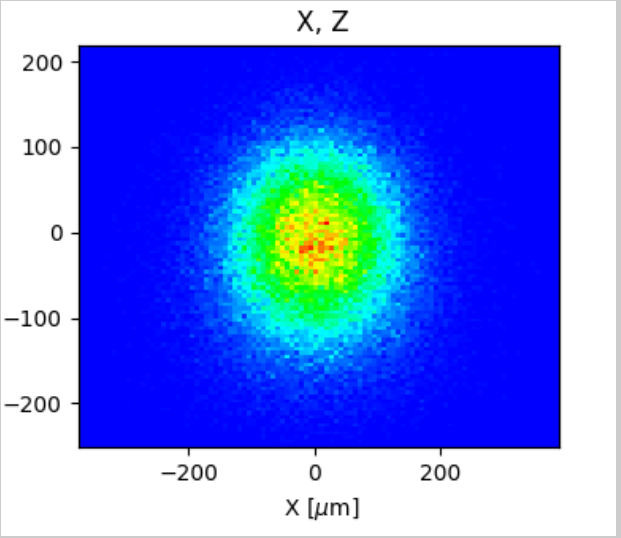
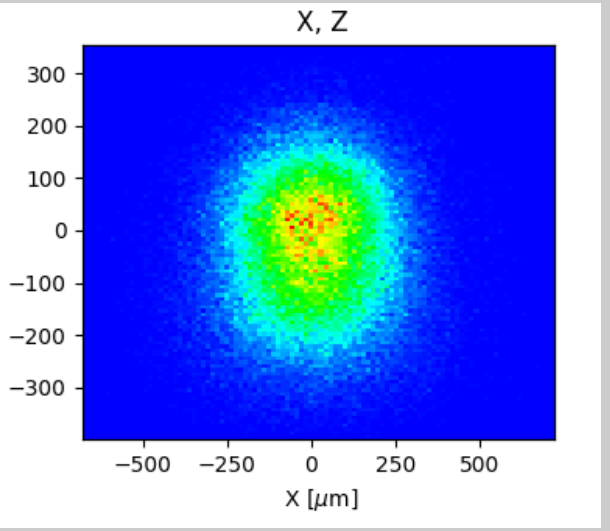


Angular divergence 205 μrad x 68 μrad

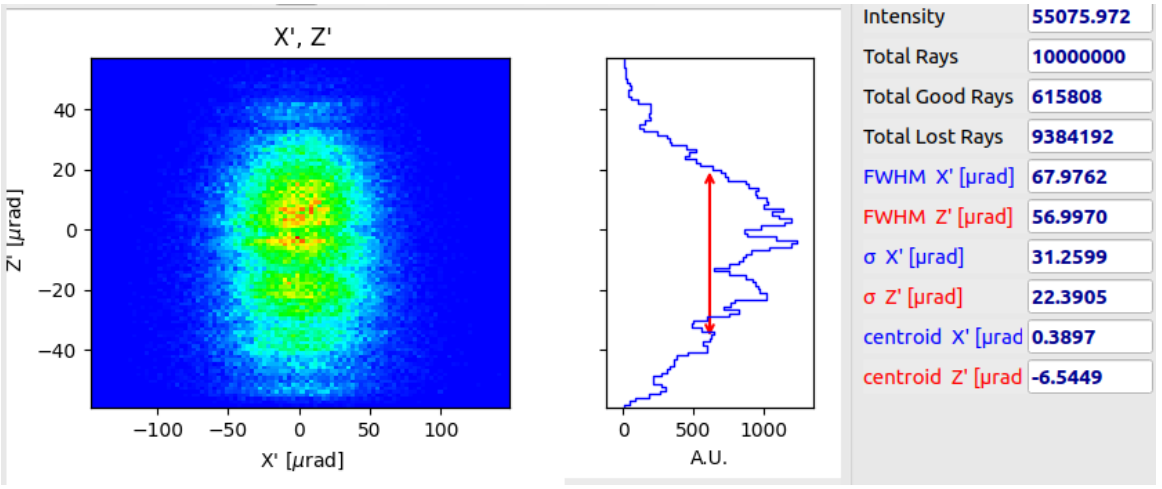
dE = 1.3 eV

Integrated flux 2.1e+10 ph/s

10 keV, DCM, focus at the detector
200 µm pinhole 10 cm before sample

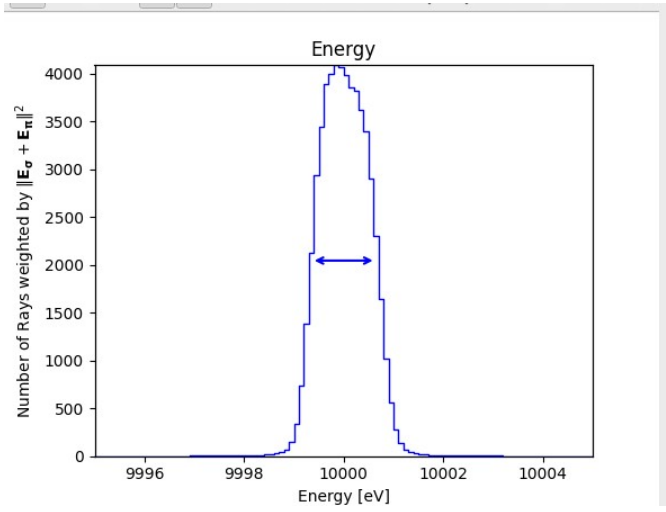
Sample 39.5	Middle of tube 42 m	Detector 44.5 m
		
167 µm x 159 µm (full width!)	183 µm x 155 µm	337 µm x 279 µm

10 keV, DCM, focus at the detector
200 µm pinhole 10 cm before sample



Intensity	55075.972
Total Rays	10000000
Total Good Rays	615808
Total Lost Rays	9384192
FWHM X' [µrad]	67.9762
FWHM Z' [µrad]	56.9970
σ X' [µrad]	31.2599
σ Z' [µrad]	22.3905
centroid X' [µrad	0.3897
centroid Z' [µrad	-6.5449

Angular divergence 68 µrad x 57 µrad



Intensity	55075.972
Total Rays	10000000
Total Good Rays	615808
Total Lost Rays	9384192
FWHM [eV]	1.3000
σ [eV]	0.4693
centroid [eV]	10000.0138

dE = 1.3 eV

Integrated flux 1.5e+9 ph/s