

RAY-UI: A user interface for RAY

In cooperation with the “Beuth Hochschule für Technik Berlin”, Department of Computer and Media, we are currently working on a UI (User Interface) for our ray tracing software “RAY”. Our aims are:

- improving the parameter input and usability
- introduce future-proof and easily extendable software architecture (also for the ray tracing algorithm)
- guarantee as most as possible the reliability of the simulated data
- setting up a team orientated and professional development environment
- giving students the chance to work on a “real” software project

Installing the RAY-UI raytracing program: <https://github.com/hz-b/ray-installers/releases/tag/1.160>

- 1) Install RAY-UI
- 2) Open the X05DA beamline configuration file in Dropbox: X05DA_20m.rml



X05DA Optics beamline at Swiss Light Source

Dipole Dipole			✖
-	-	5000000	
-	-	100.0%	+
-	-	-	
0.888	0.000	0.000	

DCM Crystal			✖
4994040	4368477	625563	
99.9%	87.4%	12.5%	+
7100	-	-	
0.987	0.003	0.005	

Crystal Crystal			✖
625563	147627	477936	
12.5%	2.95%	9.56%	+
10	-	-	
0.987	0.007	0.008	

Aperture Aperture			✖
477936	2	477934	
9.56%	0.000%	9.56%	+
390	-	-	
0.987	0.007	0.008	

Toroid Toroid			✖
477930	41278	436652	
9.56%	0.826%	8.73%	+
250	-	-	
0.987	-0.007	-0.008	

JJ-Xray Slit			✖
436652	360039	76613	
8.73%	7.20%	1.53%	+
4750	-	-	
0.999	0.000	-0.001	

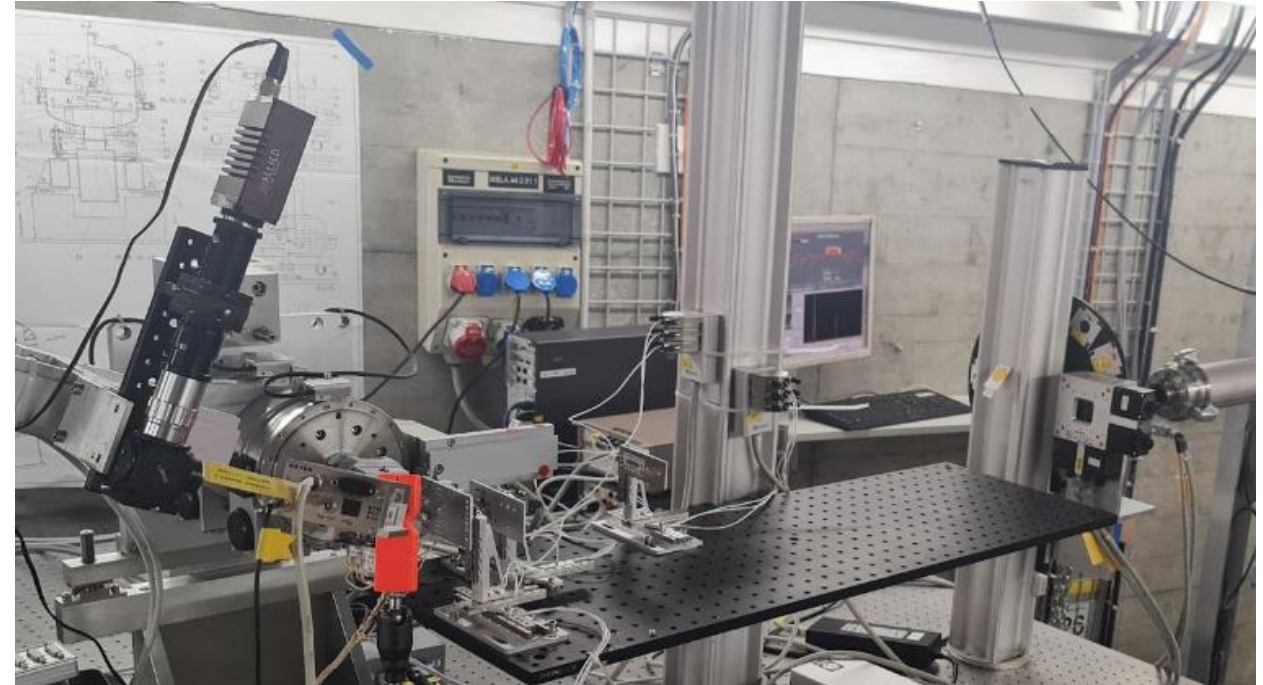
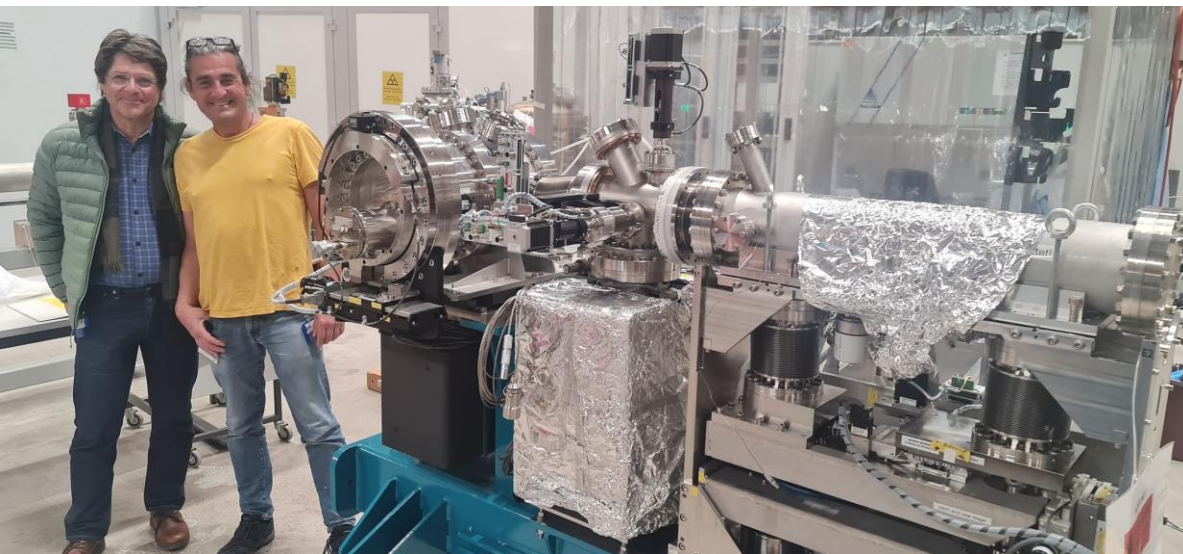
Zoneplate Zoneplate			✖
72117	34821	37296	
1.44%	0.696%	0.746%	+
100	-	-	
0.999	0.000	-0.001	

OSA Slit			✖
37296	28425	8871	
0.746%	0.569%	0.177%	+
46	-	-	
0.999	0.000	-0.001	

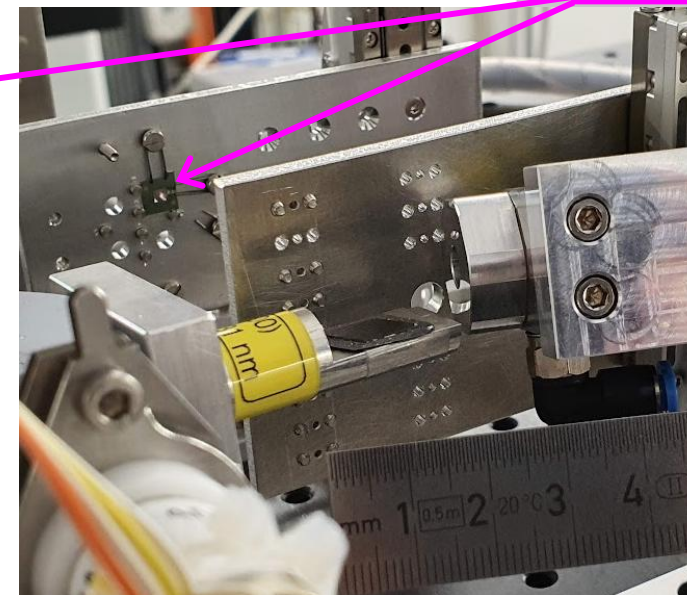
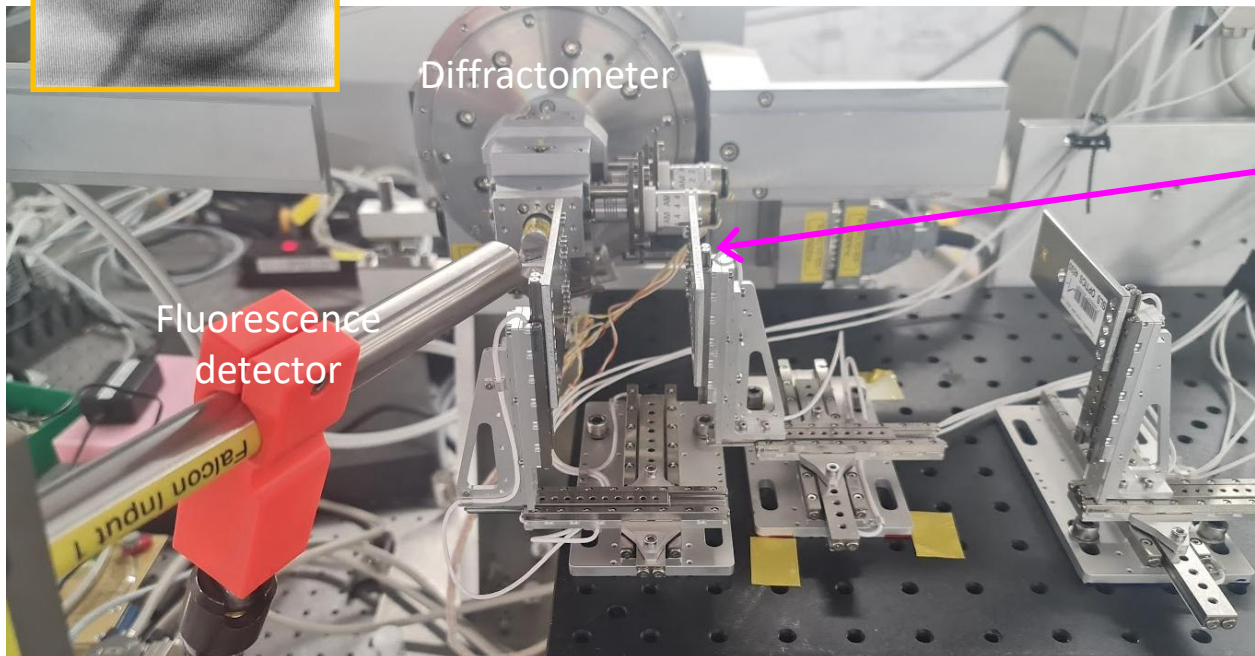
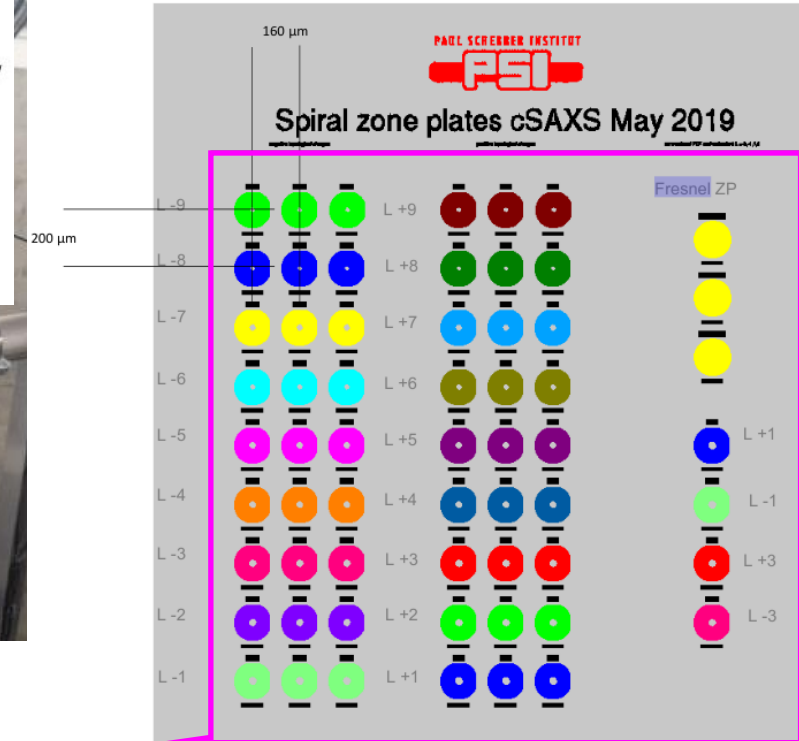
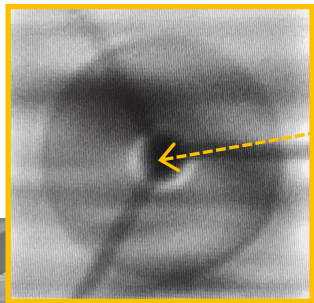
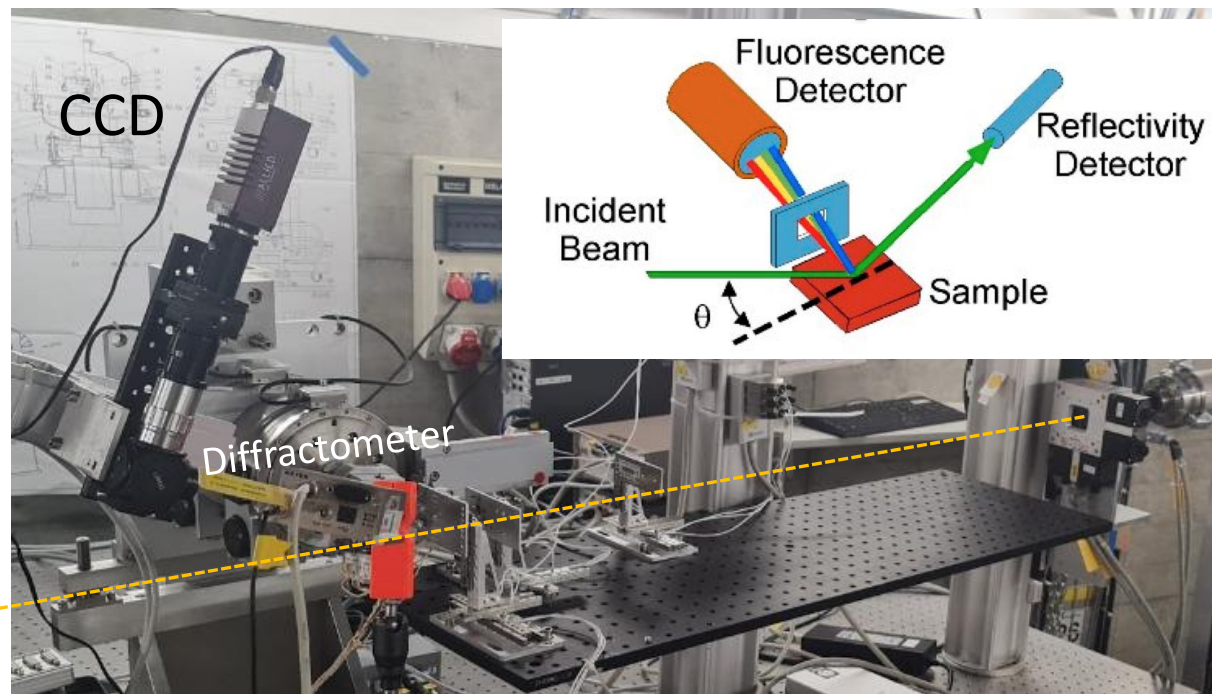
Sample Slit			✖
8871	0	8871	
0.177%	0%	0.177%	+
10	-	-	
0.999	0.000	-0.001	

CCD Aperture			✖
8871	0	8871	
0.177%	0%	0.177%	+
500	-	-	
0.999	0.000	-0.001	

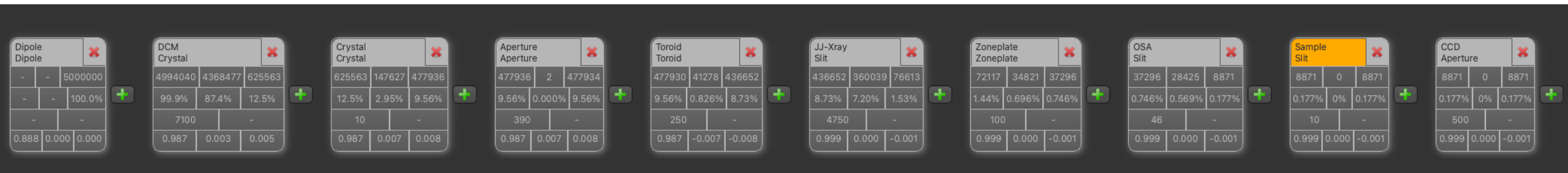
BENDING MAGNET



X05DA Optics beamline



Part 1: LET THERE BE LIGHT



Dipole Dipole **DCM Crystal** **Crystal Crystal** **Aperture Aperture**

Parameters: Dipole [Dipole]

Number of RAYS 5000000

Source Width (x) 0.056 mm

Source Height (y) 0.011 mm

Vertical E-Beam Divergence 0.83 μ rad

Horizontal Divergence 0.1 mrad

in degrees: 0.00572958 $^{\circ}$

in seconds: 20.6265 sec

Electron Energy 2.4 GeV

Ring Orientation clockwise

Bending Radius 5.7 m

Magnetic Field Strength 1.40421 T

Critical Energy 5.37923 keV

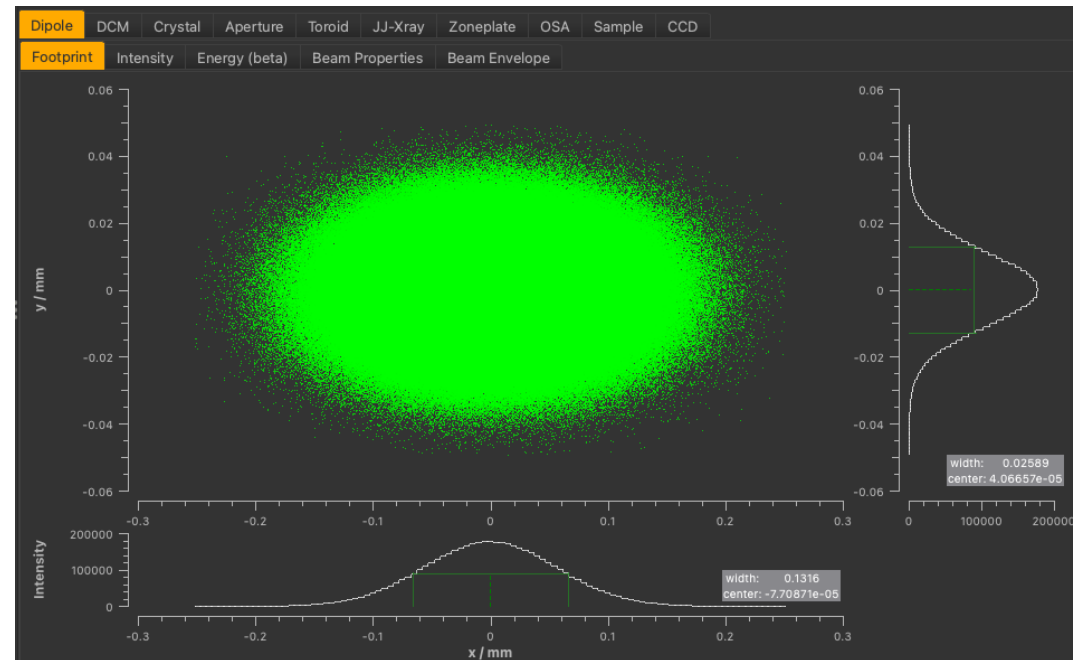
Total Power 0.840531 W/0.1A

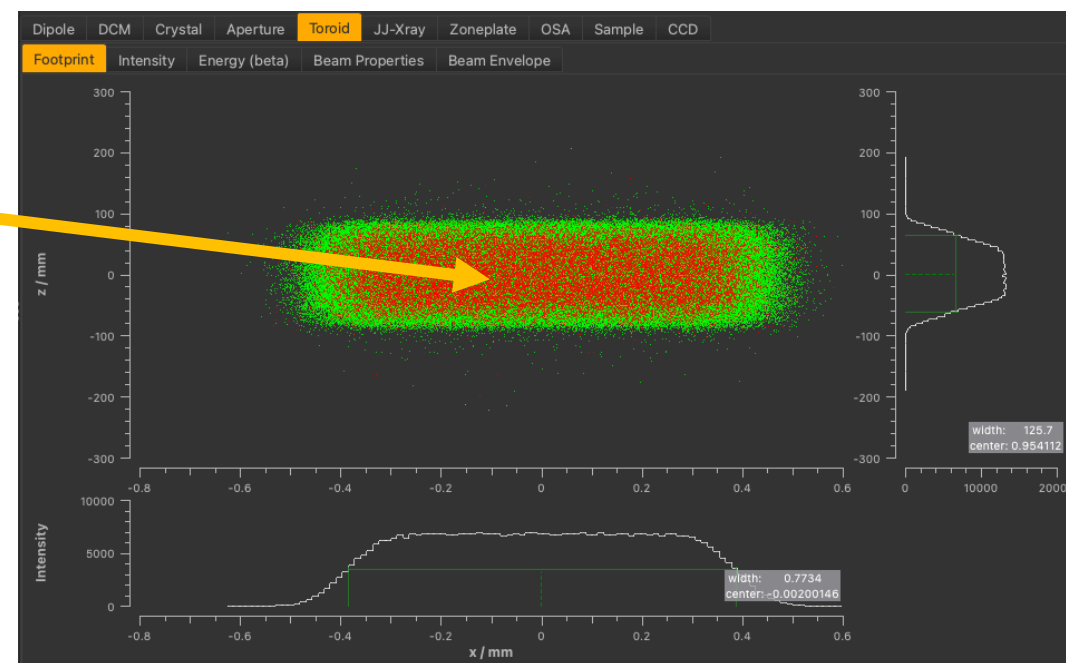
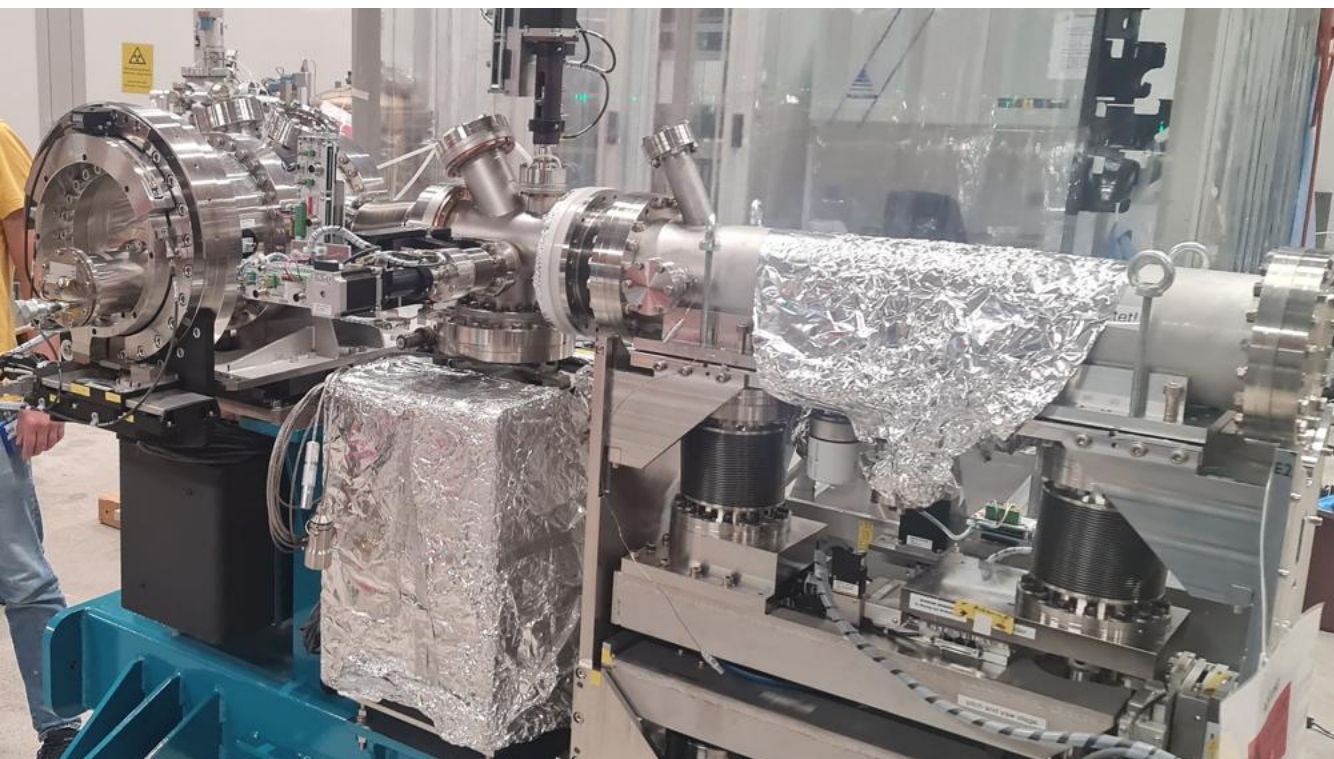
Alignment Error No

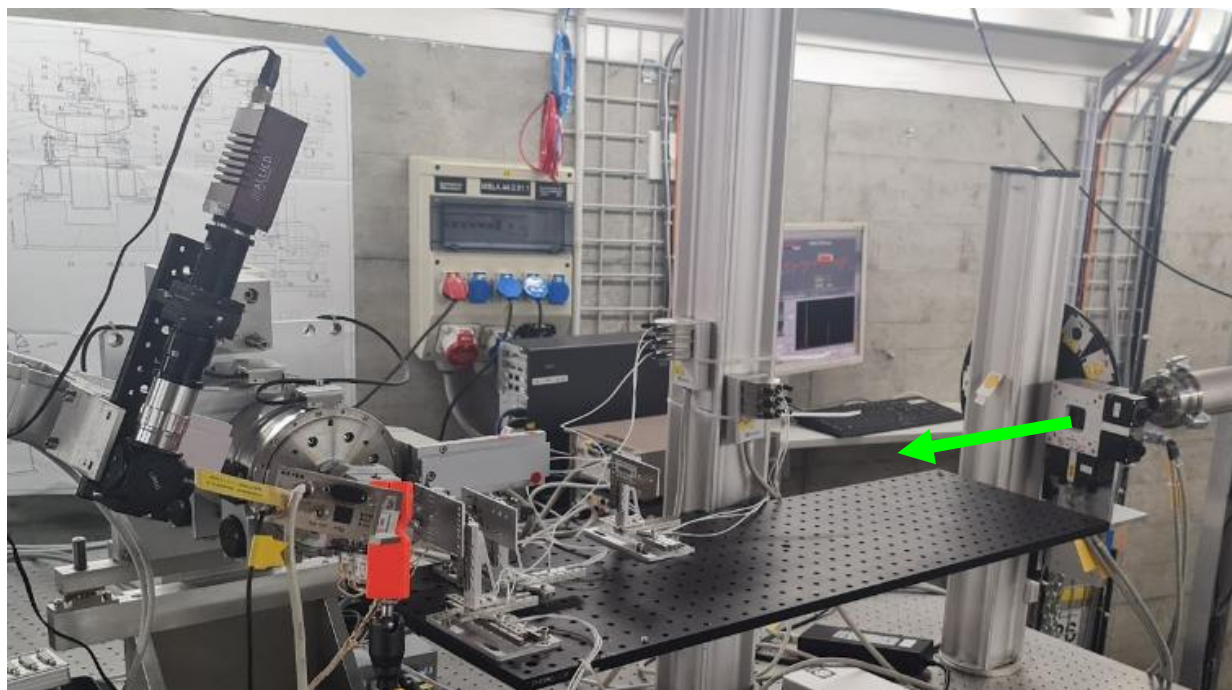
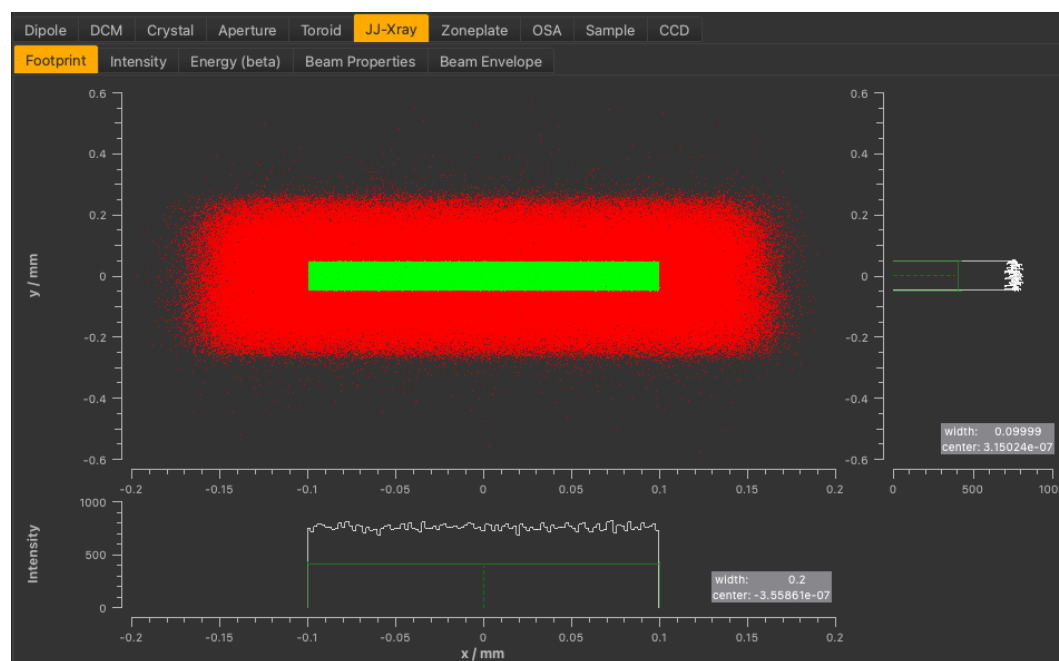
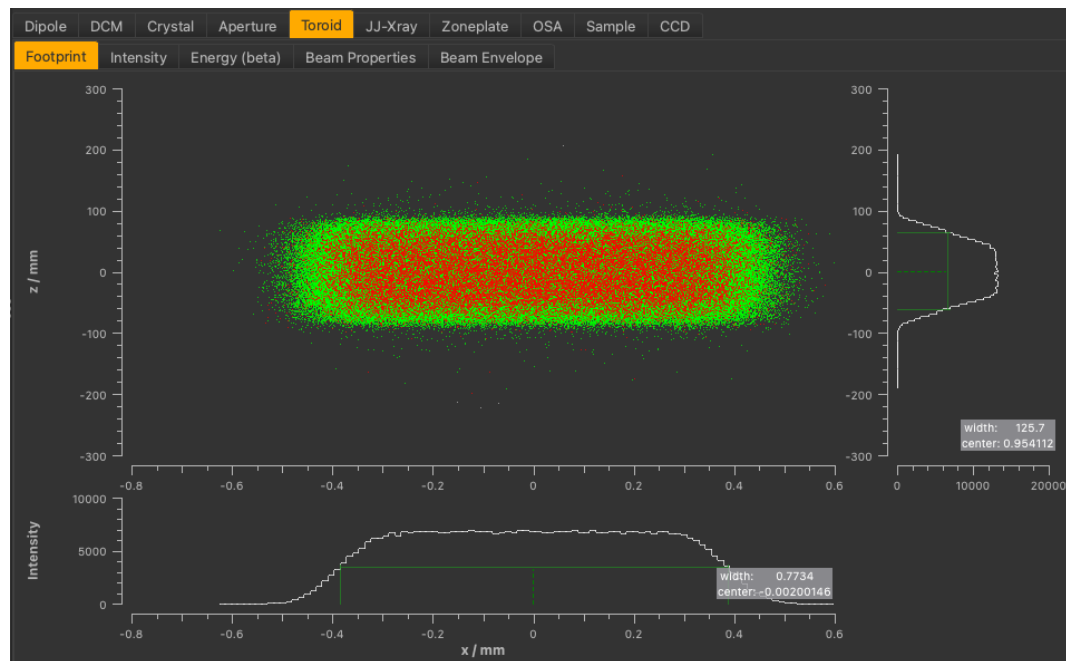
Translation Tx 0 mm

Translation Ty 0 mm

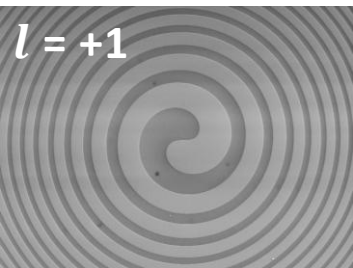
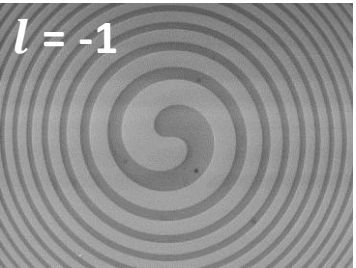
Lets trace 5 000 000 rays through the beamline



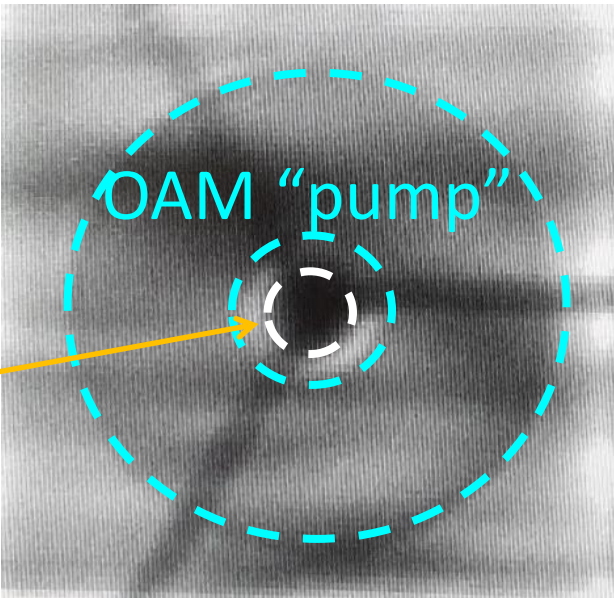




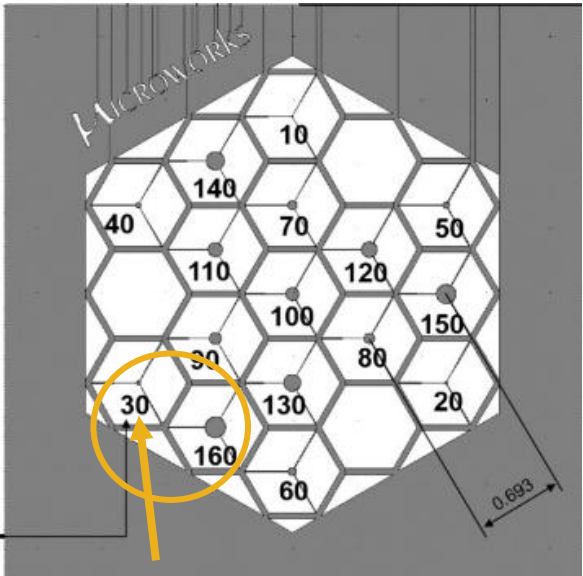
GeTe OAM setup



direct beam “probe”

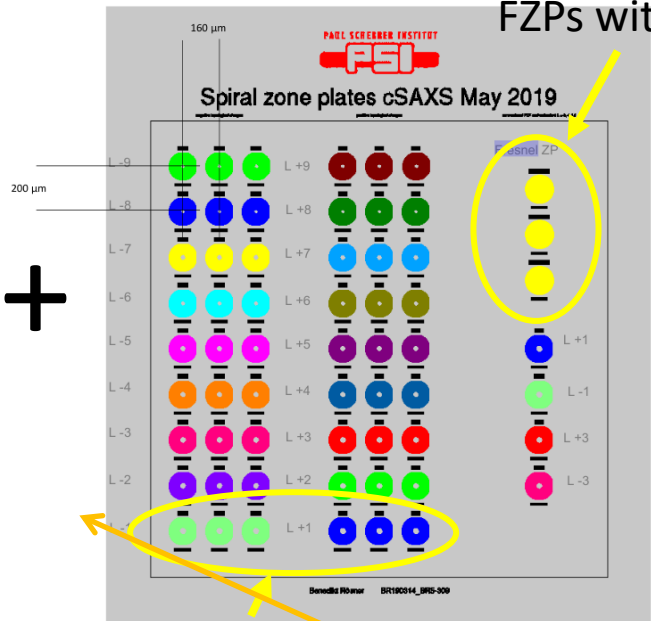


Stopper

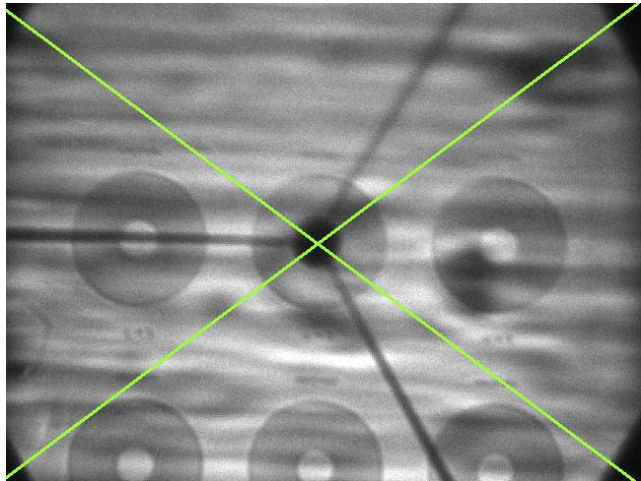


30 μm stopper

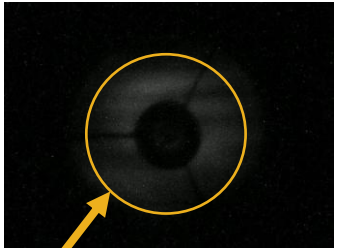
Zone Plates



FZPs without OAM

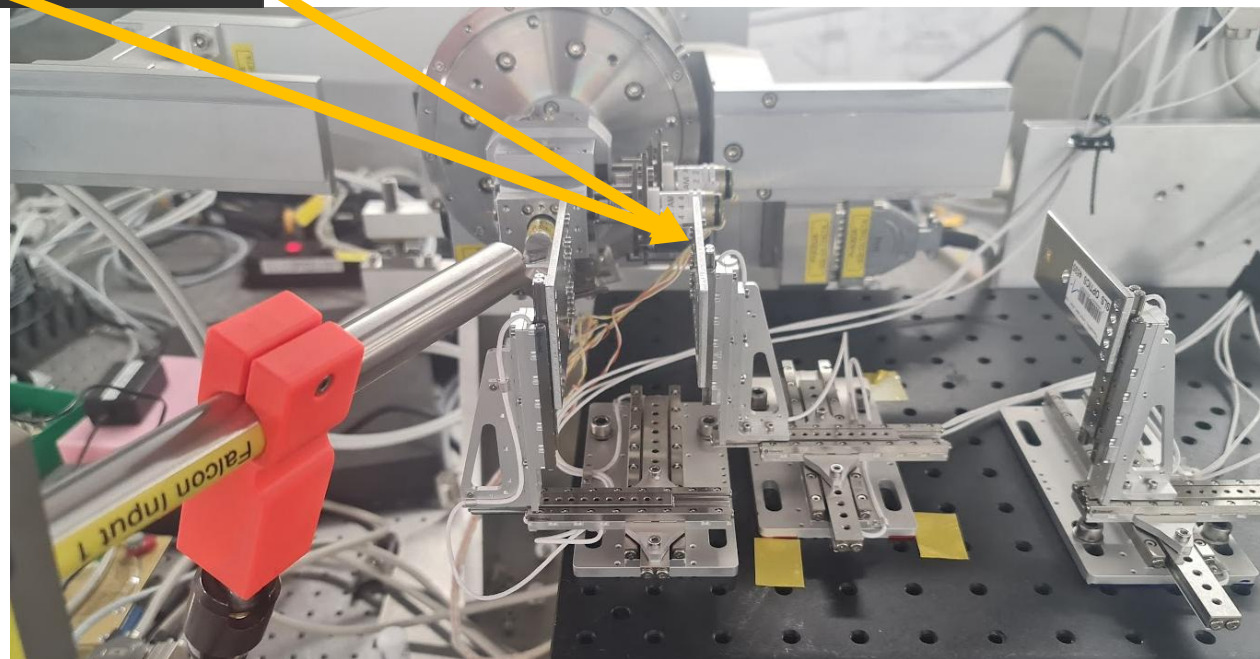
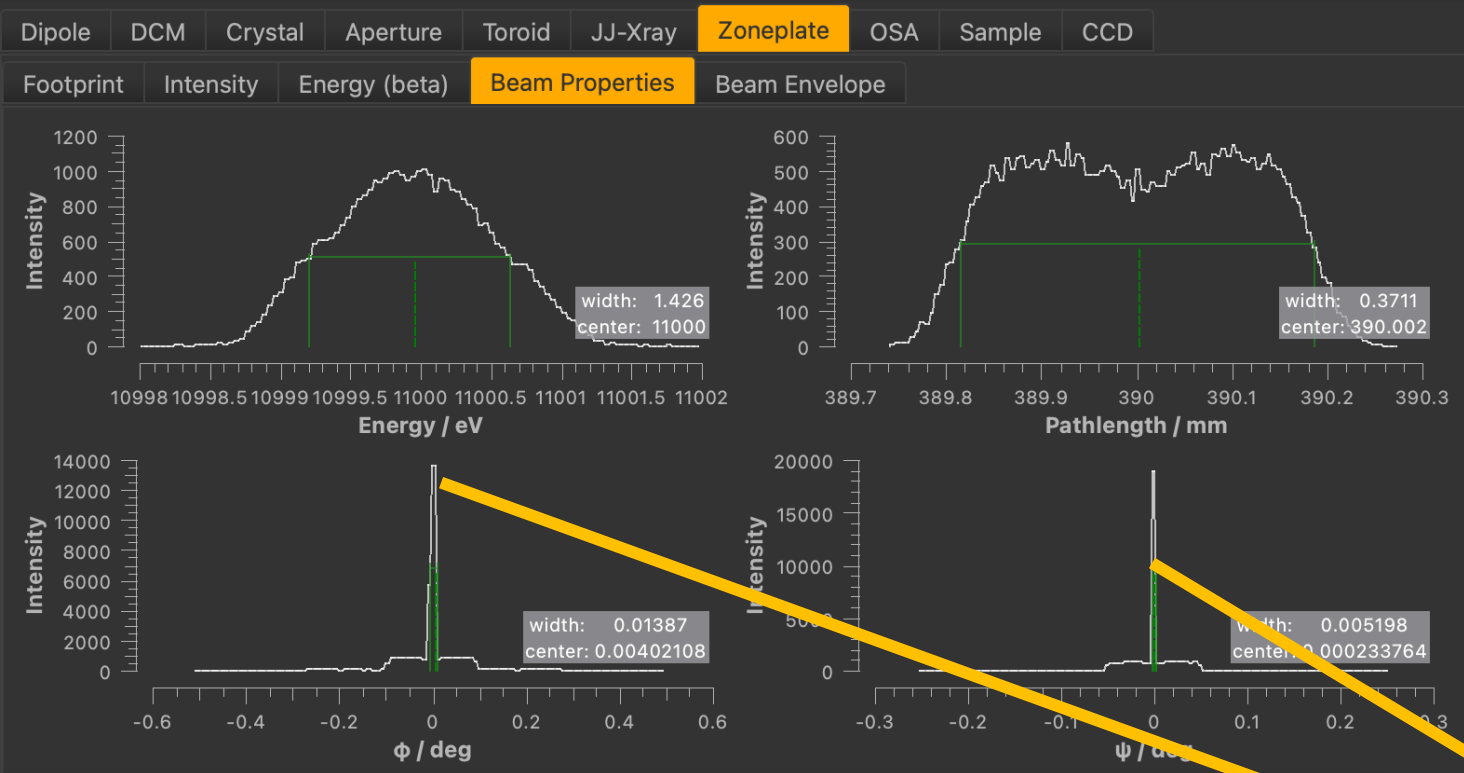


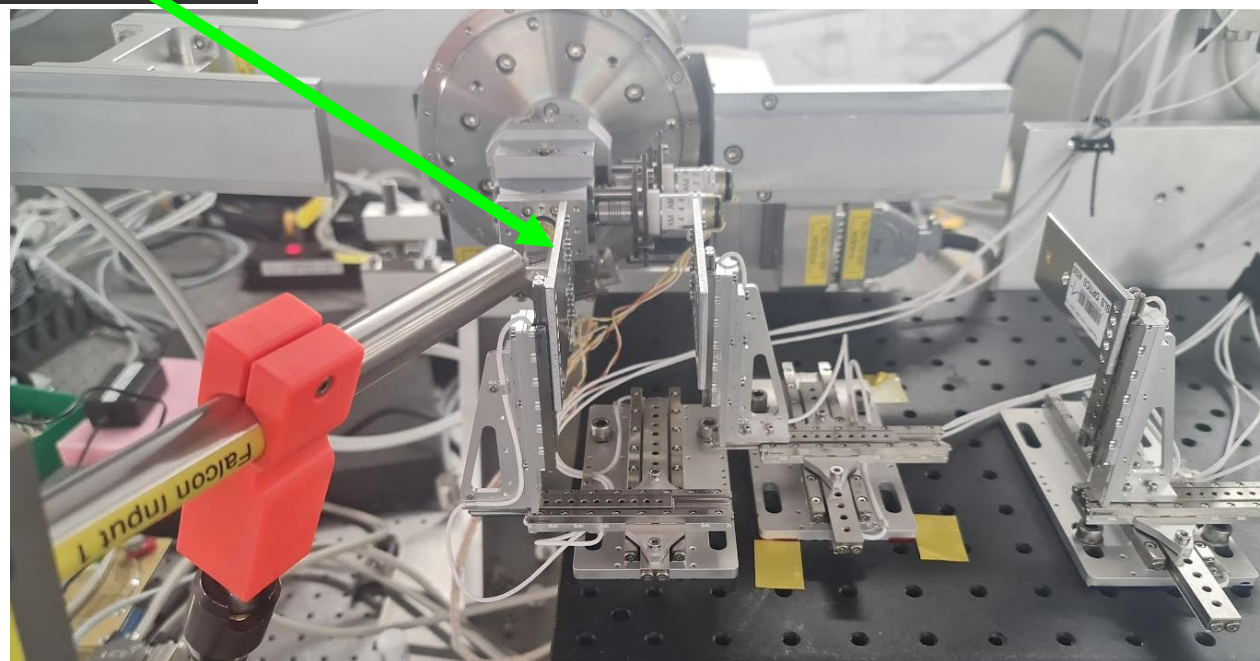
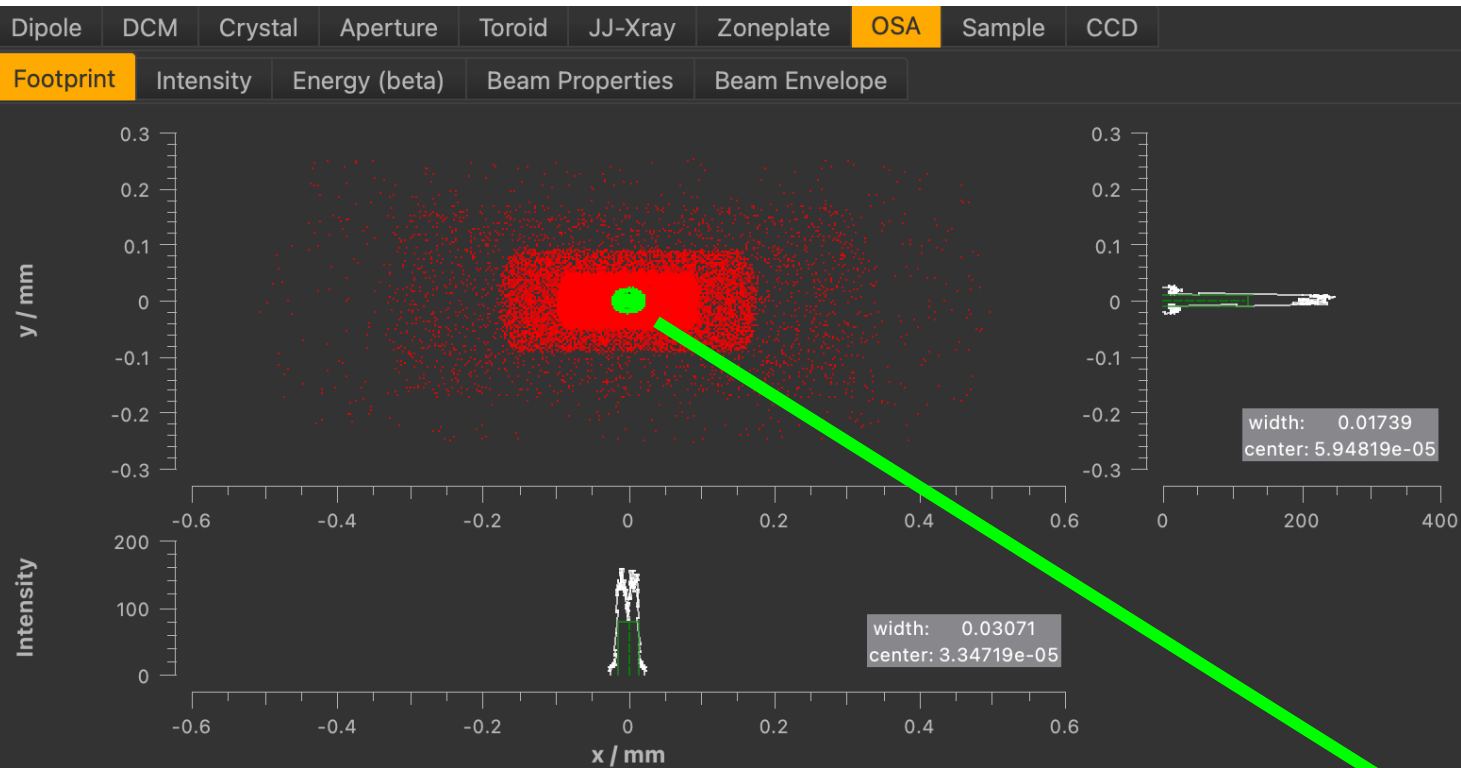
pinhole



30 μm pinhole

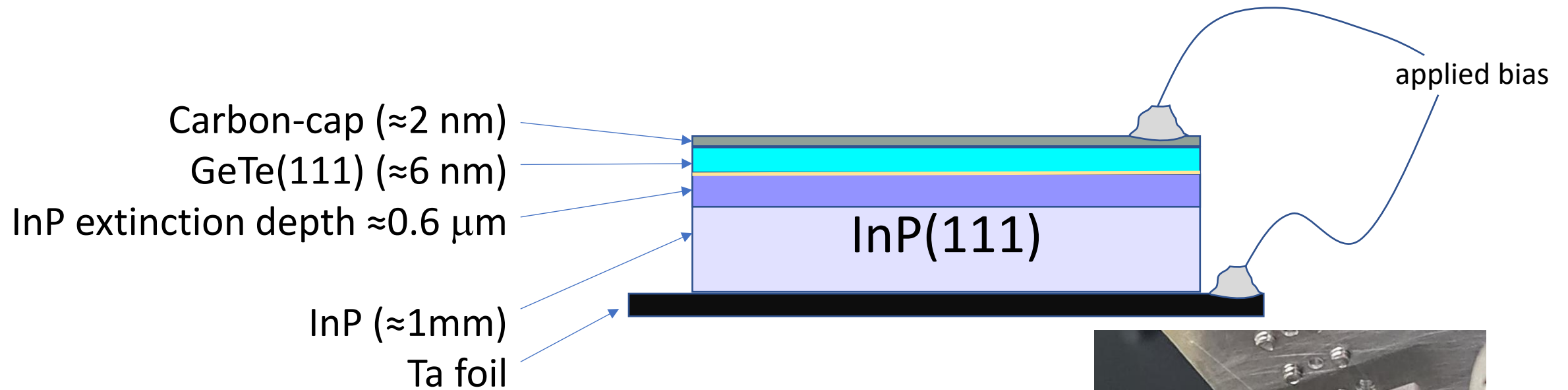
ZPs with OAM

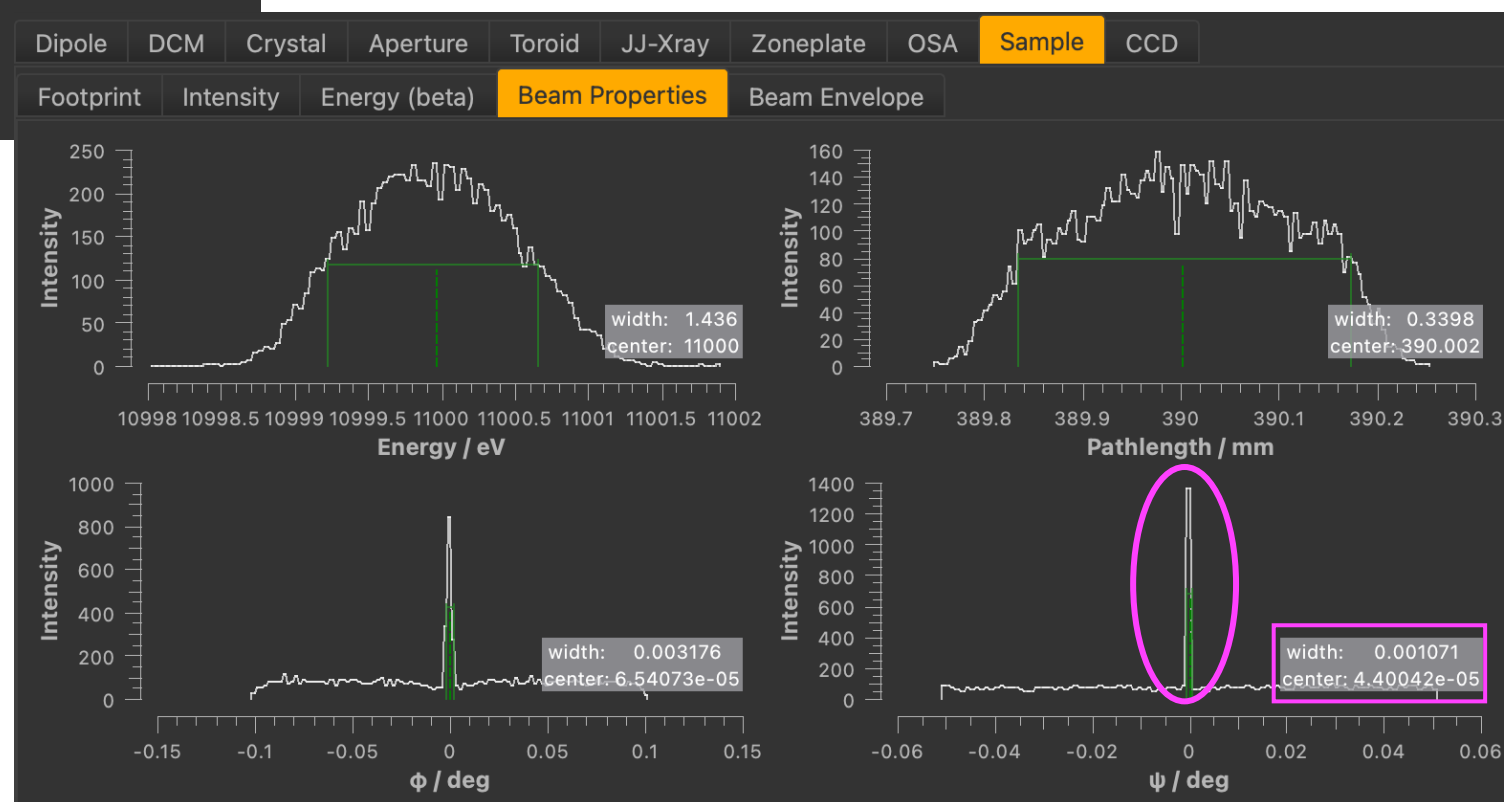
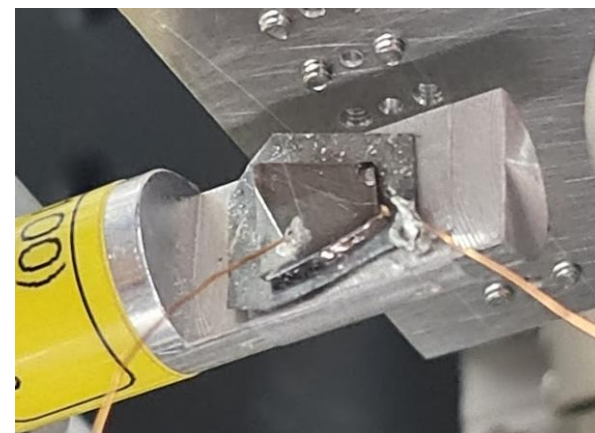
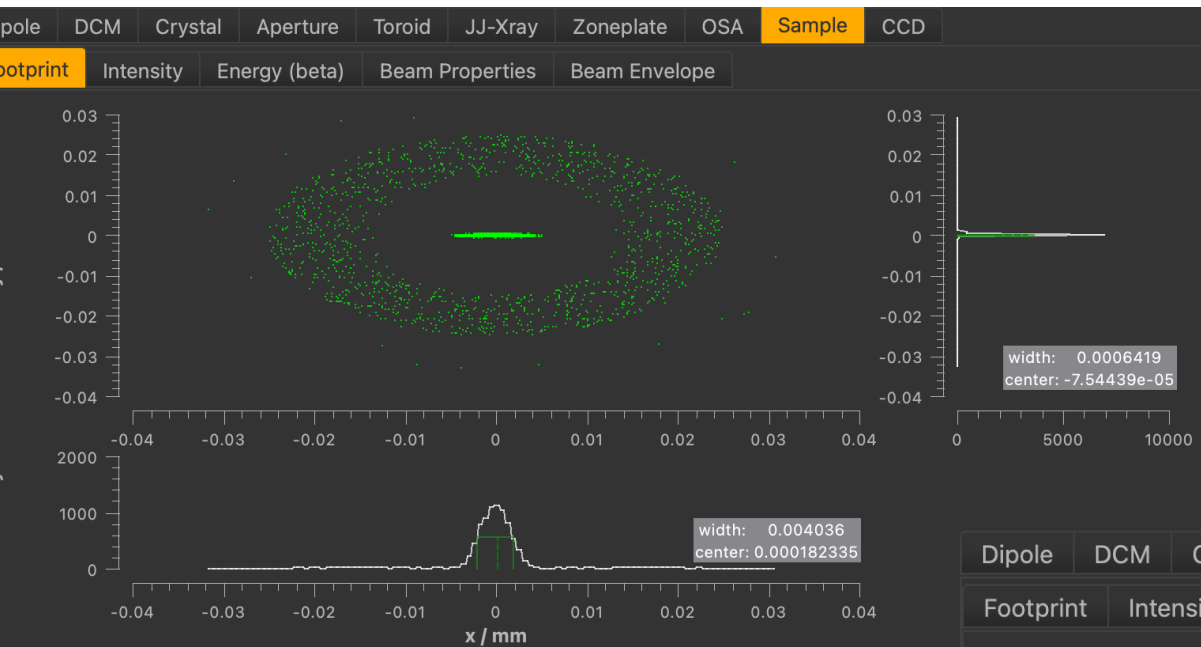




Sample

GeTe(111) “device”



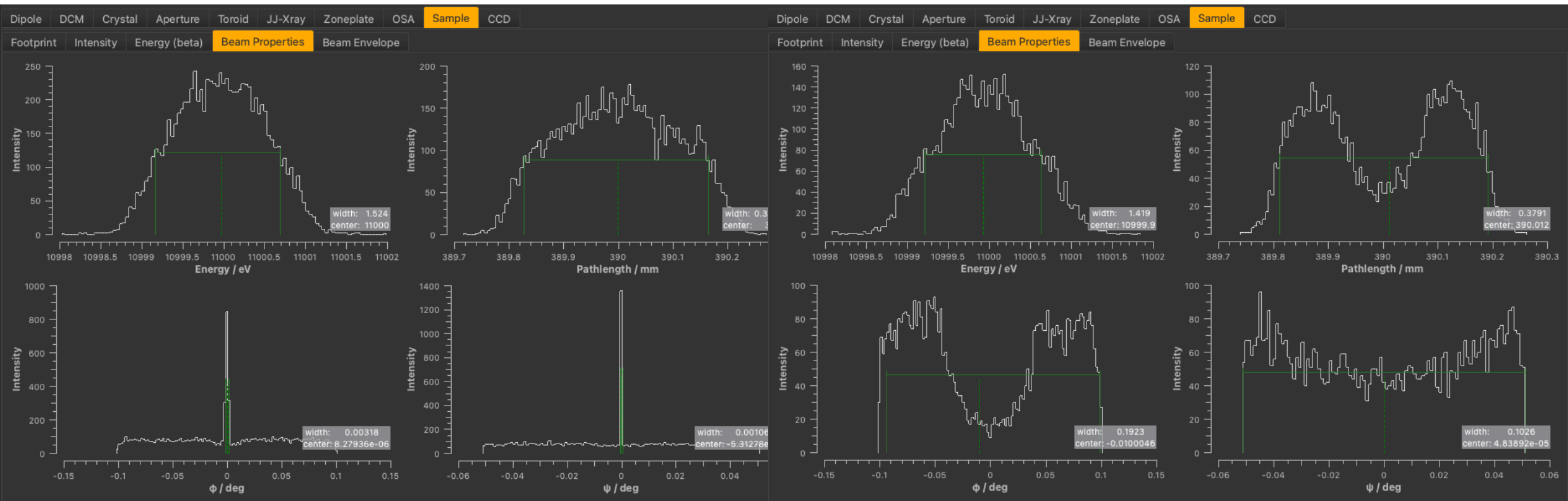


ZP stopper 0.03x0.03

Dipole Dipole - - 5000000 - - 100.0% 0.888 0.000 0.000	+	DCM Crystal 4994040 4368477 625563 99.9% 87.4% 12.5% 7100 - 0.987 0.003 0.005	+	Crystal Crystal 625563 147627 477936 12.5% 2.95% 9.56% 10 - 0.987 0.007 0.008	+	Aperture Aperture 477936 2 477934 9.56% 0.000% 9.56% 390 - 0.987 0.007 0.008	+	Toroid Toroid 477930 41278 436652 9.56% 0.826% 8.73% 250 - 0.987 -0.007 -0.008	+	JJ-Xray Slit 436652 360039 76613 8.73% 7.20% 1.53% 4750 - 0.999 0.000 -0.001	+	Zoneplate Zoneplate 72117 34821 37296 1.44% 0.696% 0.746% 100 - 0.999 0.000 -0.001	+	OSA Slit 37296 28425 8871 0.746% 0.569% 0.177% 46 - 0.999 0.000 -0.001	+	Sample Slit 8871 0 8871 0.177% 0% 0.177% 10 - 0.999 0.000 -0.001	+	CCD Aperture 8871 0 8871 0.177% 0% 0.177% 500 - 0.999 0.000 -0.001
--	---	--	---	--	---	---	---	---	---	---	---	---	---	---	---	---	---	---

ZP stopper 0.03x0.03

ZP stopper 0.05x0.05



Part 2: Diffraction Experiment

Load measured diffraction data under OAM and bias “trained” GeTe sample

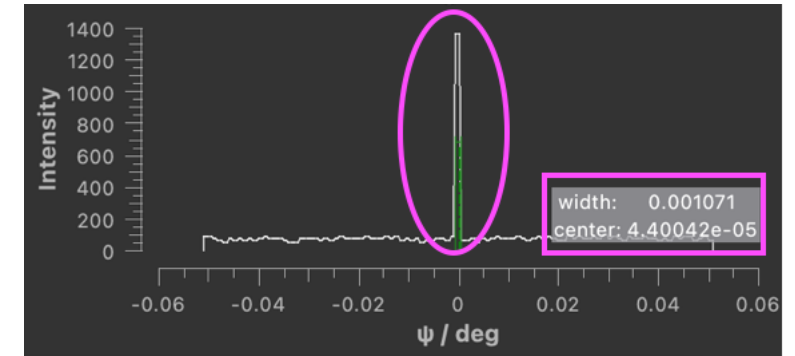
```
M = readmatrix('/xxx/Dropbox/SFEL2026/RAY-UI/bias_data.csv');  
eta_3=M(:,1);diff_3=M(:,2);  
M = readmatrix('/xxx/Dropbox/SFEL2026/RAY-UI/oam_data.csv');  
eta_4=M(:,1);diff_4=M(:,2);
```

Load intrinsic theoretical diffraction data:

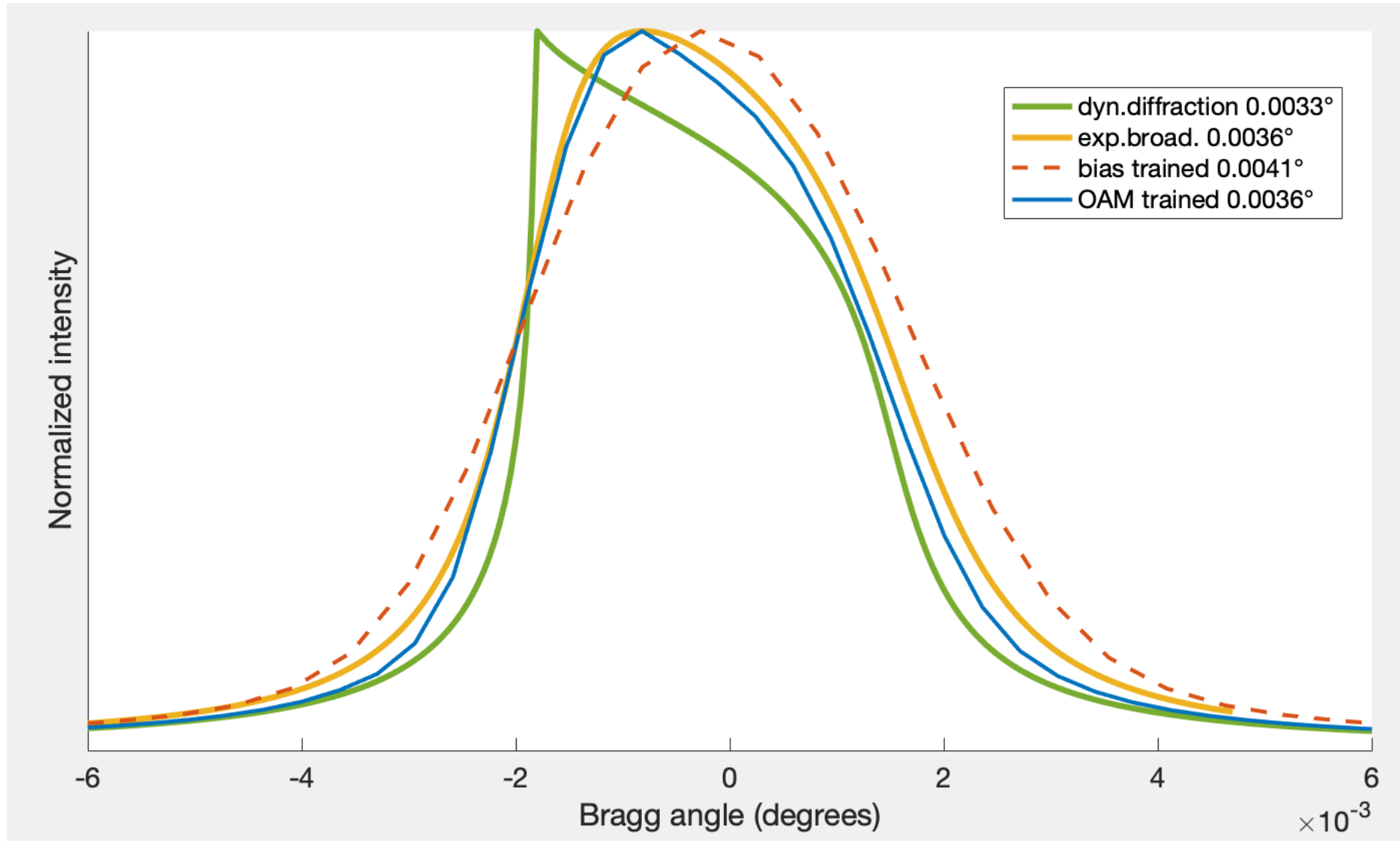
```
M = readmatrix('/xxx/Dropbox/SFEL2026/RAY-UI/intrinsic_data.csv');  
eta_1=M(:,1);diff_1=M(:,2);
```

Convolute the theoretical data with PearsonVII distribution with beam divergence from the RAY_UI output (instrumental broadening); and compare the result with measured OAM and BIAS diffraction data in both shape and FWHM

```
M = readmatrix('/xxx/Dropbox/SFEL2026/RAY-UI/exp_broadened.csv');  
eta_2=M(:,1);diff_2=M(:,2);
```



Part 2: Diffraction Experiment



Backup slides

