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07/07/23

DCI in XICSRT update: How does changing the rocking curve and crystal depth affect the spatial resolution of detector image?

Summary

Rocking Curve

- Larger rocking curves are more efficient than lower rocking curves. This makes sense because higher rocking curves means a higher chance that photons are deflected off the crystal at a certain Bragg angle.

Crystal Depth

- Larger crystal depths seem to increase efficiency. This can intuitively be proven since greater crystal depths mean more layers within the crystal structure in which more photons can be reflected.

Method

To test for multiple parameters, I put the XICSRT program in a for loop running for the number of parameters there were to test. This was done for every variable (rocking curve and crystal depth for both concave and convex crystal). The code is very messy, as I put the 3 plots into one figure and redirected the print statements to write into a txt file for each run.

Plots

(I will include all of the .png files in separate folders within the zip file to maintain the image quality)

Concave Si-533 Crystal

Rocking curve:

Intensity = 1e7 for 5 iterations (5e7 photons)

Values = [48.070e-5, 48.070e-4, 48.070e-3, 48.070e-2] (radians)

There is a significant efficiency increase between the 48.070e-4 and 48.070e-3 rocking curves. In terms of detector image quality, more photons are spreading out horizontally.

Crystal Depth:

Intensity = 5e7 for 5 iterations (25e7 photons)

Values = [0.002, 0.004, 0.006, 0.008, 0.01] (meters)

There is an increase of efficiency as we increase the crystal depth, but the change is decreasing as well. Increasing the crystal depth seems to decrease the width of where the photons hit the detectors (more intense in the middle).

I also used larger crystal depths from 2mm to 10mm because using 2μm outputted errors in the gaussfit function for the bottom plot. Nonetheless, the important factor was the change in the crystal depth.

Convex Si-422 Crystal

Rocking curve:

Intensity = 1e7 for 5 iterations (5e7 photons)

Values = [~~48.070e-5~~, 48.070e-4, 48.070e-3, 48.070e-2] (radians)

There is a significant efficiency increase the higher the rocking curve and gets as high as 58% (seems very unrealistic, maybe an error on my part). The fact that the convex crystal reflects directly to the detector may be an explanation for this. Similar to the effects of increasing the rocking curve of the concave crystal, more photons are spreading out horizontally on the detector. The 48.070e-5 rad rocking curve run did not run properly.

Crystal Depth:

Intensity = 5e7 for 5 iterations (25e7 photons)

Values = [0.002, 0.004, 0.006, 0.008, 0.01] (meters)

Between 2mm and 4mm is a slight efficiency increase, as well as a decrease in the width where the photons hit the detector. However, from 4mm to 10mm the efficiency seems to revolve about 27.36%, going above and below that value. The detector also seems to remain almost exactly the same.