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The solid angle correction, as specified on pages 14-16 of the SANS data reduction document, says that the correction for solid angle is to divide the counts in a pixel by the solid angle subtended by the pixel as seen from the sample position.

Assume that the instrument components have already been set in the coordinate system, as specified in the document. Then, the sample is at the origin and we have a pixel at $\vec{r}$

$$\vec{r} = \langle x, y, z \rangle$$

The pixel has a width p_x and a height p_y. The solid angle of a pixel for the 2PSD arrays in use on the SANS at ORNL is

$$d\Omega = \frac{p_x p_y \cos^2(2\theta)\cos\alpha}{D^2}$$

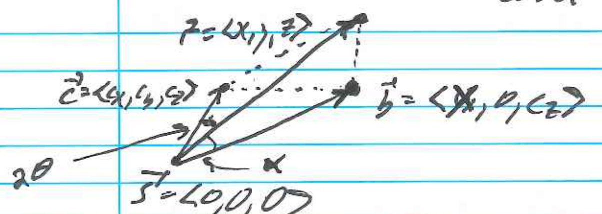
$D^2 = \|\vec{r}\|^2 = x^2+y^2+z^2$. 2θ is the scattering angle and α is the angle along the length of the tube from the horizontal

Let the beam center $\vec{c} = \langle c_x, c_y, c_z \rangle$

$\cos 2\theta = \vec{r}\cdot\vec{c} / \|\vec{r}\|^2$ NOPE $= \vec{r}\cdot\vec{c} / \|\vec{r}\|\|\vec{c}\|$!

The vector to the tube of the pixel is $\vec{b} = \langle x, 0, c_z \rangle$ (see the figure).

$\cos\alpha = \vec{r}\cdot\vec{b} / \|\vec{r}\|^2$ NOPE $= \vec{r}\cdot\vec{b} / \|\vec{r}\|\|\vec{b}\|$



All distances are in mm.

case for testing

$$\vec{c} = \langle 0, 0, 5000 \rangle$$

$$\vec{r} = \langle 320, -160, 5000 \rangle$$

$$p_x = \cancel{0.425}\ 4.25,\quad p_y = \cancel{0.550}\ 5.50$$

$\Rightarrow \vec{b} = \langle 320, 0, 5000 \rangle$ OK

$= D^2 = \|\vec{r}\|^2 = (320)^2 + (-160)^2 + (5000)^2$ OK

$D^2 = 25,128,000 \text{ mm}^2$ OK

$\Rightarrow \vec{r}\cdot\vec{c} = 320\cdot 0 - 160\cdot 0 + 5000^2 = 25,000,000 \text{ mm}^2$ OK

$\Rightarrow \vec{r}\cdot\vec{b} = 320\cdot 320 - 160\cdot 0 + 5000^2 = 25,102,400 \text{ mm}^2$ OK

$\Rightarrow \cos 2\theta = \frac{25,000,000}{25,128,000} = 0.9949060809$ wrong

$\Rightarrow \cos\alpha = \frac{25,102,400}{25,128,000} = 0.9989812162$ wrong

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$P_x P_y = 23.375 \text{ mm}^2$

Lets try this again....

$D^2 = 25,128,000 \text{ mm}^2 \Rightarrow \|\vec{F}\| = D = 5,012.7836578093 \text{ mm}$

$\|\vec{C}\| = 5,000 \text{ mm}$

$\|\vec{S}\| = [320^2 + 0^2 + 5000^2]^{1/2} = 5,010.2295356600 \text{ mm}$

$\cos 2\Theta = 25,000,000 / (5,000)(5,012.7836578093) = 0.9974497886$

$\cos \alpha = 25,102,400 / (\overset{\|\vec{F}\|}{\cancel{5,000}})(5,010.2295356600) = 25,102,400 / (5,012.7836578093) \times (5,010.2295356600)$

$= 0.9994904782$

Then $d\Omega = \dfrac{(23.375)(0.9974497886)(0.9994904782)}{(5,012.7836578093)^2}$

$d\Omega = 9.2739211675 \times 10^{-7}$

If the counts in the pixel are $I = 156$, then $dI = 12.4899959968$

from Equation 3.8 on page 15 of the SANS data reduction document

$I_{corr} = I / d\Omega = 156 / 9.2739211675 \times 10^{-7}$

$I_{corr} = 1.6821363605 \times 10^{8}$

and $dI_{corr} = dI / d\Omega = 12.4899959968 / 9.2739211675 \times 10^{-7}$

$dI_{corr} = 1.3467869493 \times 10^{7}$

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