Horizontal focusing conditions for crystal monochromator

Define 2θ as the scatteing angle of the central part of the beam and ϕ as the angle between the incident beam and the monochromator as shown on the sketch below. ρ denotes the displacement from the center of the monochromator in the direction indicated. Denote by ψ(ρ) the rotation with respect to the monochromator frame of the MCU at position ρ. The positive sense of rotation for individual MCUS (ψ(ρ)) coincides with the positive sense of rotation for the entire device (ϕ).

Monochromatic focusing at specified 2q is achieved for

$$f = A\tan\left(\frac{\sin 2q}{\cos 2q + L_1/L_0}\right) \quad \text{for} \quad \cos 2q + L_1/L_0 \geq 0$$

$$f = A\tan\left(\frac{\sin 2q}{\cos 2q + L_1/L_0}\right) + p \quad \text{for} \quad \cos 2q + L_1/L_0 < 0$$

and

$$y(r) = A\tan\left(\frac{\sin 2q}{\cos 2q + L_1/L_0 - (r/L_0)\sqrt{1+(L_1/L_0)^2 + 2(L_1/L_0)\cos 2q}}\right) - q$$

Point to point focusing at specified 2q **and** f is achieved for

$$y(r) = q - f - \frac{1}{2}\left(A\tan\left(\frac{r\sin f}{L_0 - r\cos f}\right) + A\tan\left(\frac{r\sin(2q - f)}{L_1 + r\cos(2q - f)}\right)\right)$$

This formula does not yield the same result as the one above when ϕ is chosen to achieve monochromatic point to point focusing. This is because we have optimized for monochromaticity in the former case and for spot size in the latter case.