Equatorial Aberration for Powder Diffraction Data Collected by Continuous Scan of a Silicon Strip X-ray Detector

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Current data acquisition system of a laboratory powder X-ray diffractometer with a silicon strip X-ray detector (SSXD) usually support a continuous scan integration method, where output counts from each of detector strips are added to the total counts for appropriate 2Θ-bin of the output data storage.

An explicit approximate formula of the equatorial aberration function for the apparent diffraction angle of 2Θ, equatorial divergence Φ, and the view angle of the detector face 2Ψ is given by

$$\omega(\Delta 2\Theta;\, \Theta, \Phi, \Psi) = \begin{cases} \dfrac{2\tan\Theta}{\Phi\Psi} \ln\dfrac{\phi_U}{\phi_L} & \left[\Delta 2\Theta_L < \Delta 2\Theta < \Delta 2\Theta_U\right] \\ 0 & \left[\text{otherwise}\right] \end{cases},$$

$$\Delta 2\Theta_L = -\frac{\Phi^2 + \Phi\Psi}{2\tan\Theta},\ \Delta 2\Theta_U = \begin{cases} \dfrac{\Psi^2}{8\tan\Theta} & \left[\Psi \le 2\Phi\right] \\ \dfrac{-\Phi^2 + \Phi\Psi}{2\tan\Theta} & \left[2\Phi < \Psi\right] \end{cases},$$

$$\phi_L = \max\left\{-\frac{\Psi}{4} + \sqrt{D}, \frac{\Psi}{4} - \sqrt{D}\right\},\ \phi_U = \min\left\{\frac{\Phi}{2}, \frac{\Psi}{4} + \sqrt{D}\right\},$$

$$D = \frac{\Psi^2}{16} - \frac{\Delta 2\Theta\tan\Theta}{2}$$

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The profiles of the aberration function calculated for $2\Theta = 30^\circ$, $\Phi = 1.25^\circ$, and $2\Psi = 4.89^\circ$ and 0.001° are shown in Fig. 1.

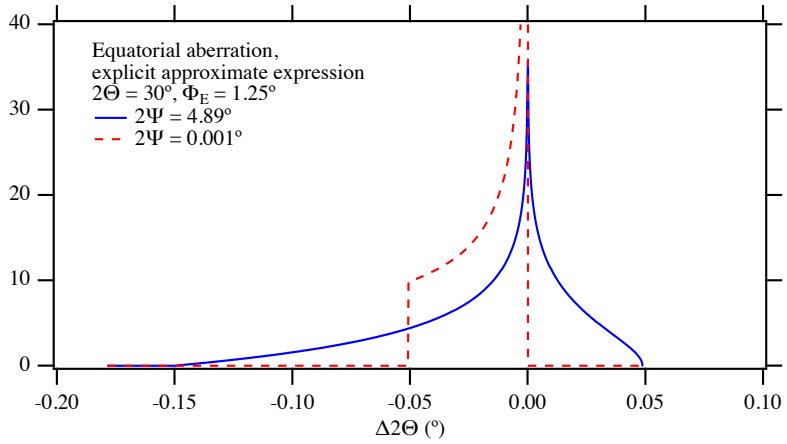

Fig. 1 Equatorial aberration function for continuous-scan SSXD data.