Polarization reviewed:

Horizontal scattering plane:
\[ P = \cos^2 \psi \]

Vertical scattering plane:
\[ P = 1 \]

Unpolarized beam:
\[ P = \frac{1 + \cos^2 \psi}{2} \]
Dumond Diagrams

Plot $\lambda (\theta) = 2dsin \theta$

Range of $\lambda$’s

$+n$, $-n$, all wavelengths get through 2nd crystal

Non-dispersive setting, $+n$, $-n$, all wavelengths get through 2nd crystal

Two Dumond curves of finite width overlap exactly:
Incident spread in $\lambda$ and $\theta$

Exit beam very narrow

$\lambda(\theta)$

$2d$

$K\alpha_1$

Crystal 1

Crystal 2

$\theta_B$

$2\theta_B$
Pendellösung Fringes

Interference from top and bottom of a thin film of thickness $t$.

\[ \Delta \theta = \frac{\lambda \sin(\theta + \psi)}{t \sin 2\theta} \]

in a plot of \( \frac{\sin^2 \varphi N}{\sin^2 \varphi} \) where $N$ is number of planes

$\psi$ is the angle of the planes with respect to the surface

Good first order estimate of thickness.
Derivation: assuming $\psi = 0$

Secondary minima occur at $n\pi/N$

$$2d \sin \theta = (m \pm \frac{1}{N}) \lambda$$

let $\theta = \theta_m + \Delta \theta$

$$\sin \theta = \sin(\theta_m + \Delta \theta)$$

$$= \sin \theta_m n \theta_m \cos \Delta \theta \pm \sin \Delta \theta \cos \theta_m$$

$$\sin \theta \approx \sin \theta_m + \Delta \theta \cos \theta_m \quad \text{(cos } \Delta \theta \approx 1, \ \sin \Delta \theta \approx \Delta \theta)$$

$$2d \sin \theta = 2d \sin \theta_m + 2d \Delta \theta \cos \theta_m = (m \pm \frac{1}{N}) \lambda$$

$$2d \Delta \theta \cos \theta_m = \frac{\lambda}{N}$$

$$\Delta \theta = \frac{\lambda}{2dN \cos \theta_m}$$

$$= \frac{\lambda}{2t \cos \theta_m} \quad \text{if } dN = t$$