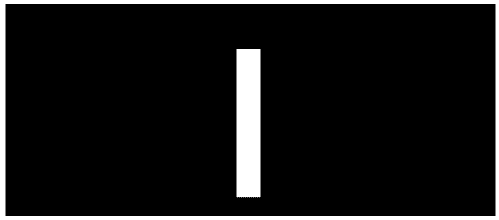
Single Slit Diffraction and the Fourier Transform

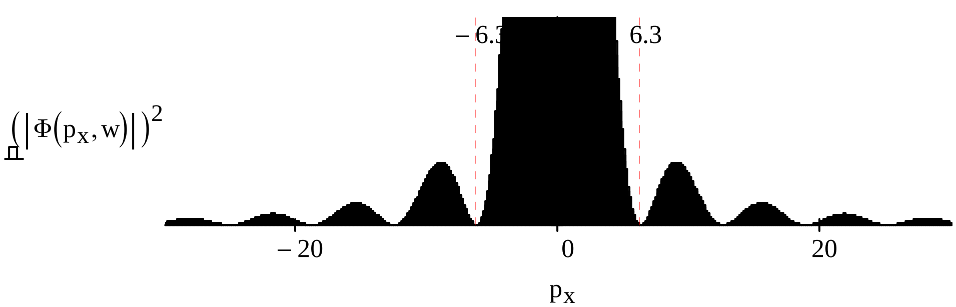
Slit width: $w := 1$ Coordinate-space wave function: $\Psi(x, w) := \mathrm{if}\left[\left(x \geq -\frac{w}{2}\right)\cdot\left(x \leq \frac{w}{2}\right), 1, 0\right]$

$$x := \frac{-w}{2}, \frac{-w}{2} + .005 .. \frac{w}{2}$$



A Fourier transform of the coordinate-space wave function yields the momentum wave function and the momentum distribution function, which is the diffraction pattern.

$$\Phi(p_x, w) := \frac{1}{\sqrt{2\cdot\pi\cdot w}}\cdot\int_{-\frac{w}{2}}^{\frac{w}{2}} \exp(-i\cdot p_x\cdot x)\, dx \text{ simplify } \rightarrow \frac{\sqrt{2}\cdot\sin\left(\frac{p_x\cdot w}{2}\right)}{\sqrt{\pi}\cdot p_x\cdot\sqrt{w}}$$



Now Fourier transform the momentum wave function back to coordinate space and display result. This is done numerically using large limits of integration for momentum.

$$\Psi(x, w) := \int_{-5000}^{5000} 2^{\frac{1}{2}}\cdot\frac{\sin\left(\frac{1}{2}\cdot w\cdot p_x\right)}{\pi^{\frac{1}{2}}\cdot w^{\frac{1}{2}}\cdot p_x}\cdot\frac{\exp(i\cdot p_x\cdot x)}{\sqrt{2\cdot\pi}}\, dp_x$$