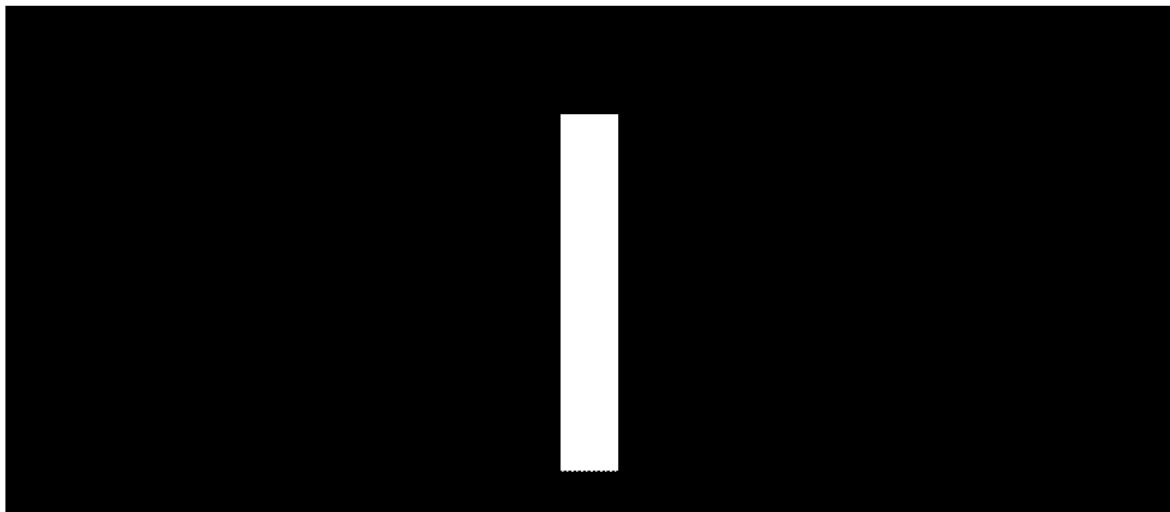


1.29: Single Slit Diffraction and the Fourier Transform

Slit width: $w := 1$

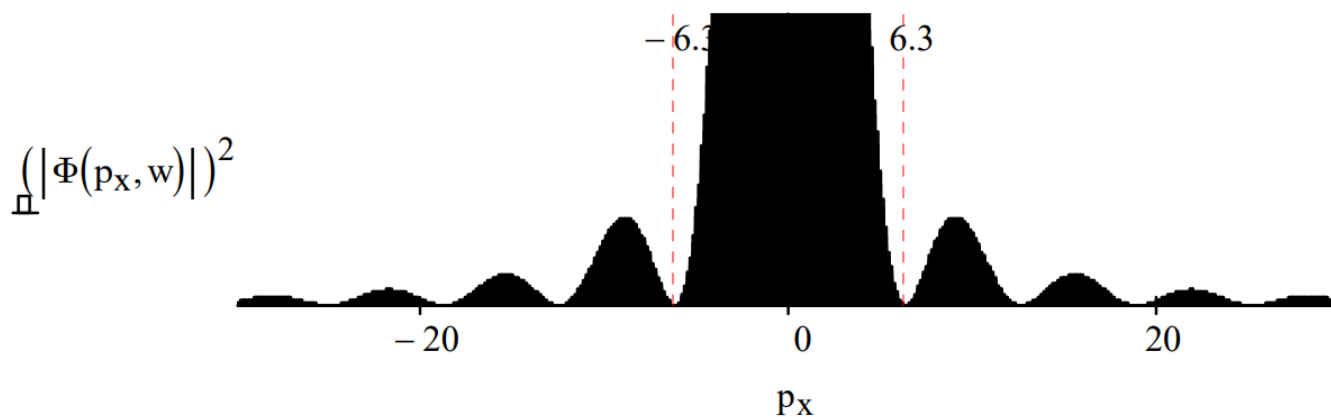
Coordinate-space wave function:
 $\Psi(x, w) := \text{if } [(x \geq -\frac{w}{2}) \cdot (x \leq \frac{w}{2}), 1, 0]$

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



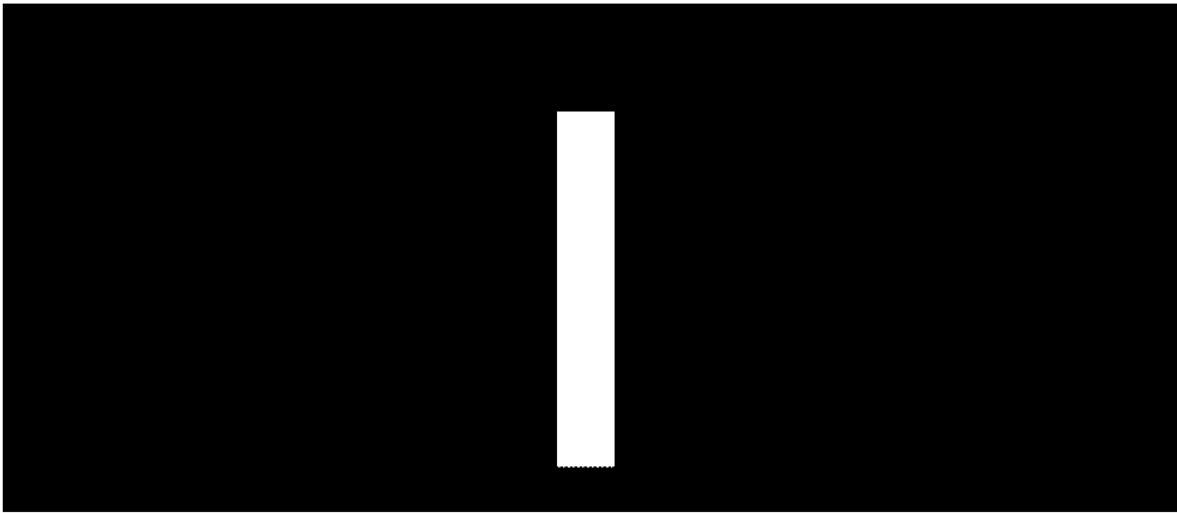
A Fourier transform of the coordinate-space wave function yields the momentum wave function and the momentum distribution function, which is the diffraction pattern.

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



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.

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



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