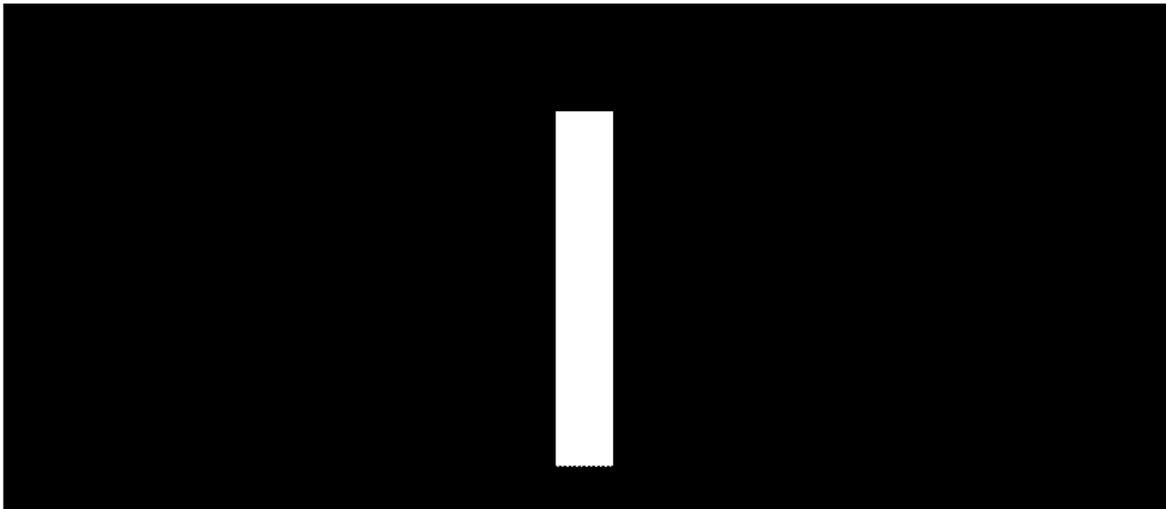


1.29: Single Slit Diffraction and the Fourier Transform

Slit width: $w := 1$

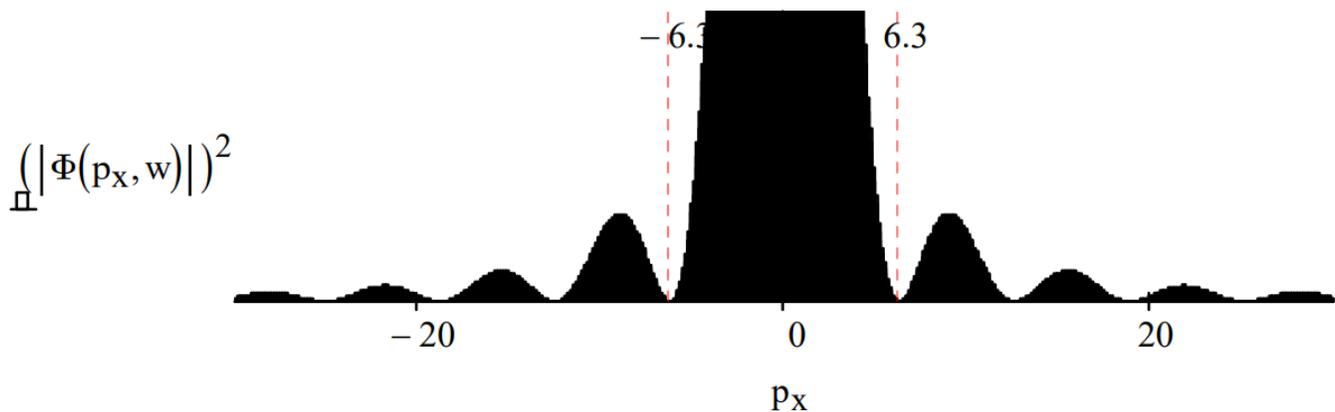
Coordinate-space wave function:
 $\Psi(x, w) := \text{if} \left[\left(x \geq -\frac{w}{2}\right) \cdot \left(x \leq \frac{w}{2}\right), 1, 0 \right]$

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



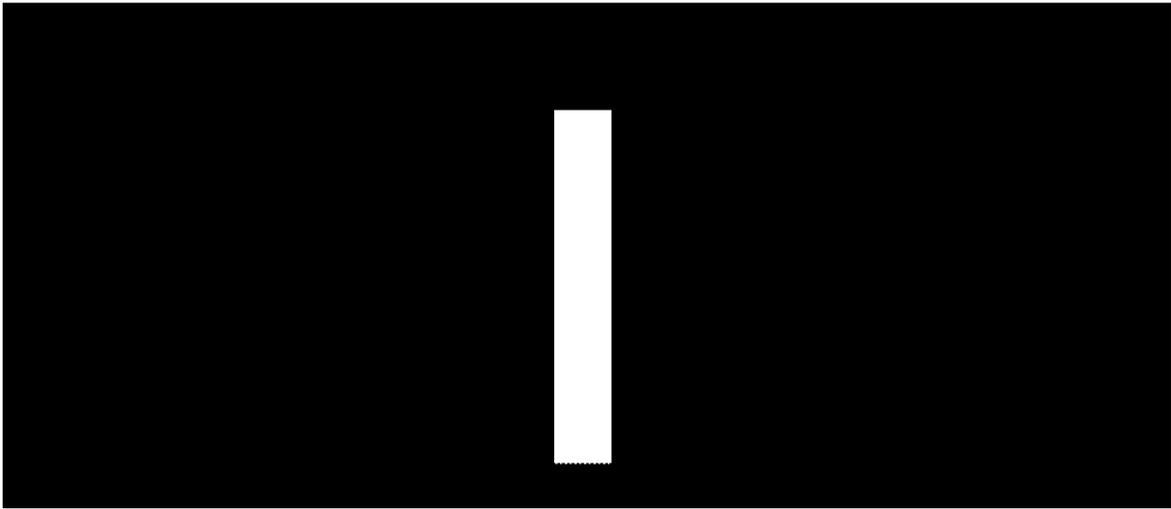
A Fourier transform of the coordinate-space wave function yields the momentum wave function and the momentum distribution function, which is the diffraction pattern.

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



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.

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



This page titled [1.29: Single Slit Diffraction and the Fourier Transform](#) is shared under a [CC BY 4.0](#) license and was authored, remixed, and/or curated by [Frank Rioux](#) via [source content](#) that was edited to the style and standards of the LibreTexts platform.