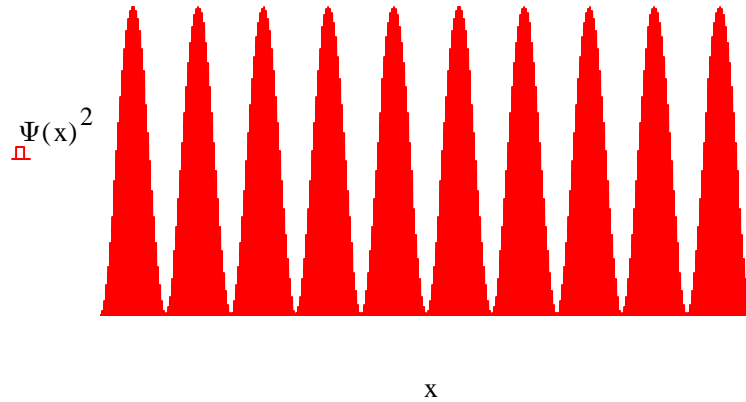# The Wigner Distribution for a Particle in a One-dimensional Box
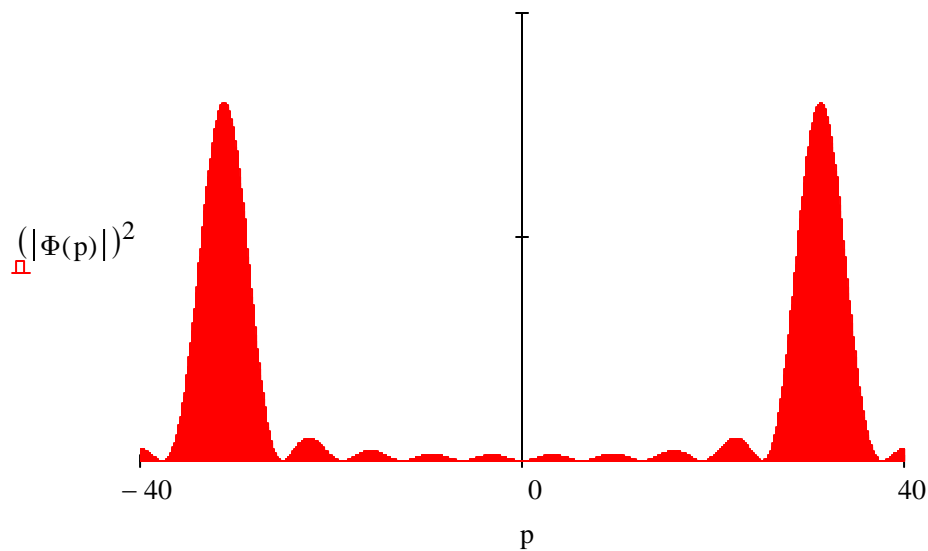
Frank Rioux

The following outlines the calculation of the Wigner distribution for a particle in a one-dimensional box for the n = 10 state. First the coordinate wave function is Fourier transformed into momentum space. Following that the Wigner function is calculated using the momentum space wave function.

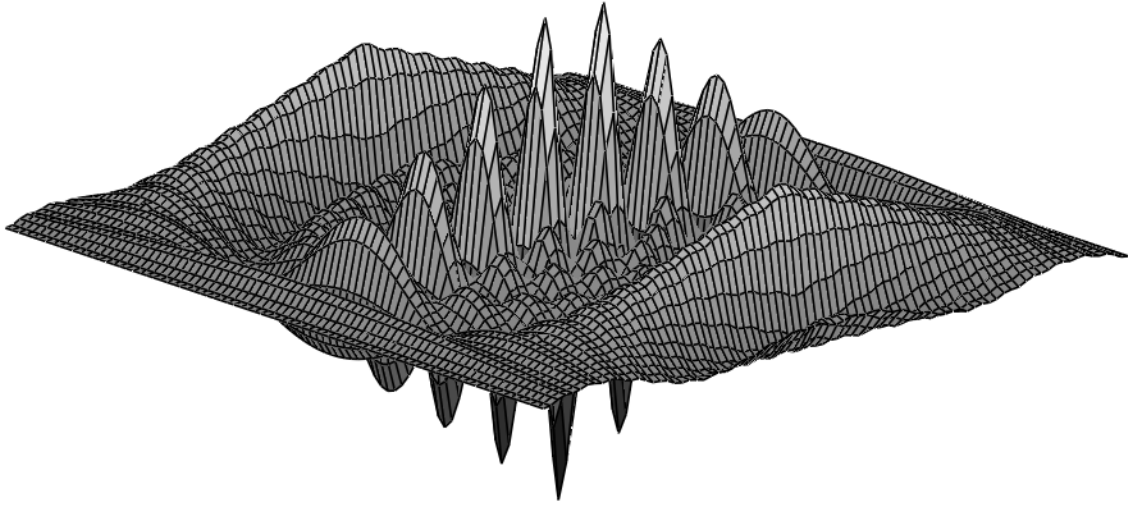$$\Psi(x) := \sqrt{2} \cdot \sin(10 \cdot \pi \cdot x)$$

$$\Phi(p) := \frac{1}{\sqrt{2 \cdot \pi}} \cdot \int_0^1 \exp(-i \cdot p \cdot x) \cdot \Psi(x) \, dx \text{ simplify} \rightarrow -\frac{10 \cdot \sqrt{\pi} \cdot \left(e^{-p \cdot i} - 1\right)}{100 \cdot \pi^2 - p^2}$$

$$W(x, p) := \frac{1}{2 \cdot \pi} \cdot \int_{-\infty}^{\infty} \overline{\Phi\left(p + \frac{s}{2}\right)} \cdot \exp(-i \cdot s \cdot x) \cdot \Phi\left(p - \frac{s}{2}\right) \, ds$$

$$N := 80 \quad i := 0..N \quad x_i := \frac{i}{N} \quad j := 0..N \quad p_j := -40 + \frac{80 \cdot j}{N} \quad \text{Wigner}_{i,j} := W(x_i, p_j)$$

Wigner