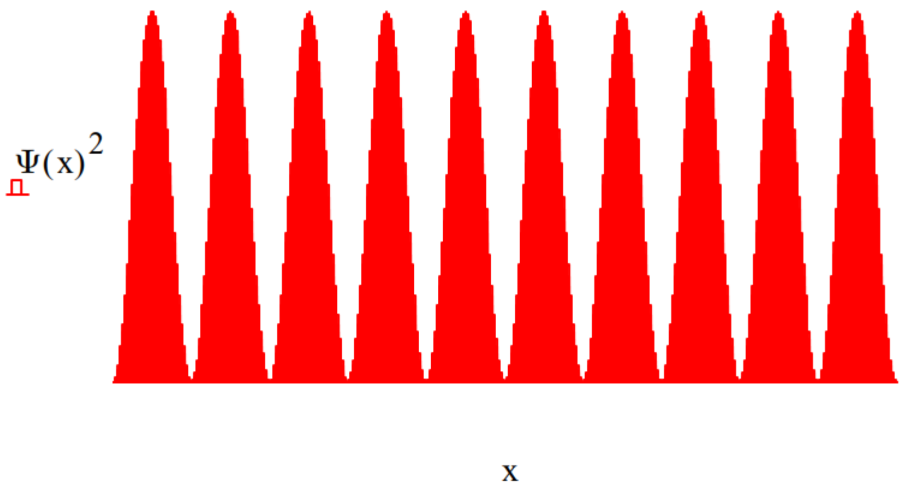
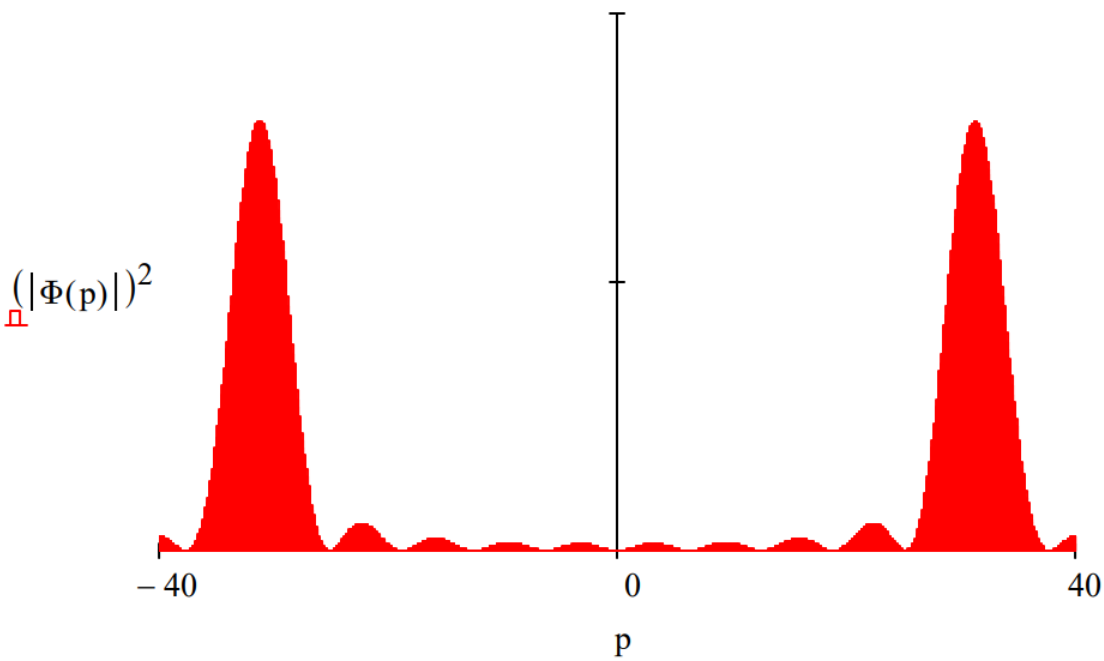
# 1.71: The Wigner Distribution for a Particle in a One-dimensional Box

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.

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



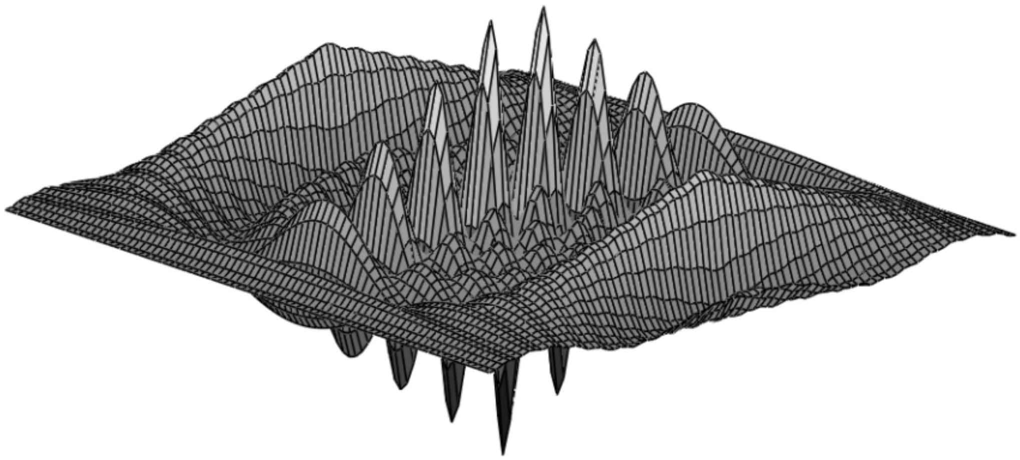

$$\Phi(\mathrm{p}) := \frac{1}{\sqrt{2\cdot\pi}}\cdot\int_0^1 \exp(-\mathrm{i}\cdot\mathrm{p}\cdot\mathrm{r})\cdot\Psi(\mathrm{x})\mathrm{dx} \text{ simplify } \rightarrow -\frac{10\cdot\sqrt{\pi}\cdot\left(\mathrm{e}^{-\mathrm{p}\cdot\mathrm{i}}-1\right)}{100\cdot\pi^2-\mathrm{p}^2}$$




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

$$\mathrm{N} := 80 \qquad \mathrm{i} := 0\ldots\mathrm{N} \qquad \mathrm{x_i} := \frac{\mathrm{i}}{\mathrm{N}}$$

$$\mathrm{j} := 0\ldots\mathrm{N} \qquad \mathrm{p_j} := -40+\frac{80\cdot\mathrm{j}}{\mathrm{N}} \qquad \mathrm{Wigner}_{i,j} := W\left(x_i, p_j\right)$$



Wigner

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