

# The Wigner Distribution Function for the Harmonic Oscillator

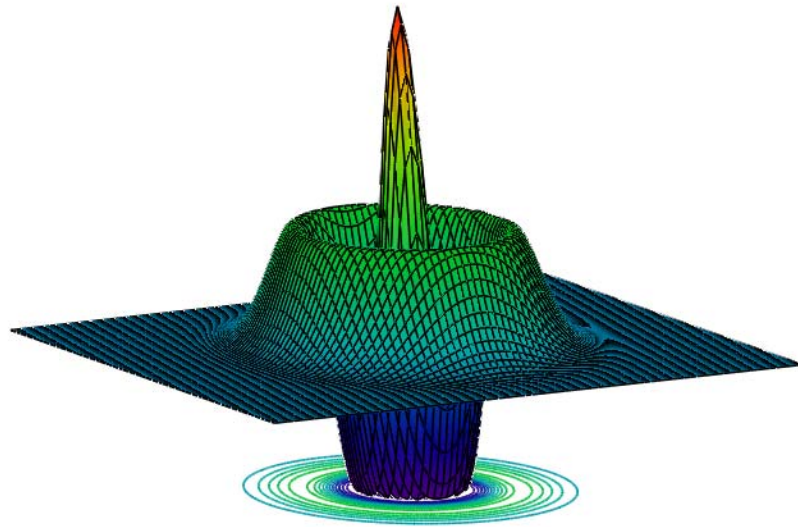
Given the quantum number this Mathcad file calculates the Wigner distribution function for the specified harmonic oscillator eigen state.

Quantum number:  $n := 2$       Harmonic oscillator eigenstate:  $\Psi(x) := \frac{1}{\sqrt{2^n \cdot n! \cdot \sqrt{\pi}}} \cdot \text{Her}(n, x) \cdot \exp\left(-\frac{x^2}{2}\right)$

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

Display the Wigner distribution:

$N := 80$      $i := 0..N$      $x_i := -4 + \frac{8 \cdot i}{N}$      $j := 0..N$      $p_j := -5 + \frac{10 \cdot j}{N}$      $Wigner_{i,j} := W(x_i, p_j)$



Wigner, Wigner