Yale Hackathon 2025: Alice & Bob

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Overview

01
Wigner Functions

Understanding and generation of Wigner Functions for Fock States, Coherent States, and Cat States.

02
Density Matrix

Reconstruction of the density matrix from the Wigner Function.

03
Shaping the Fit

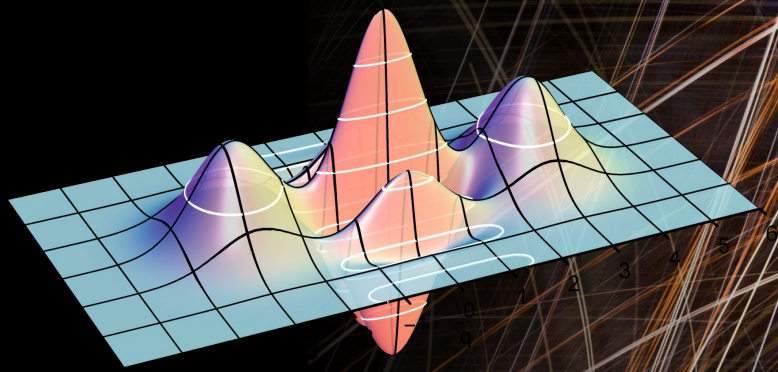
Simulation of noisy data with Gaussian Noise.

04
Denoising

Corrections of background noise.

The Wigner Function

We know the distinction between Classical Mechanics and Quantum Mechanics is the quantization of energy. Heisenberg's Uncertainty Principle also tells us that one cannot know both the position and momentum of a particle with complete precision. The Wigner Function allows us to visualize quantum states in phase space, allowing for negative probability values that reflect non-classical behavior.



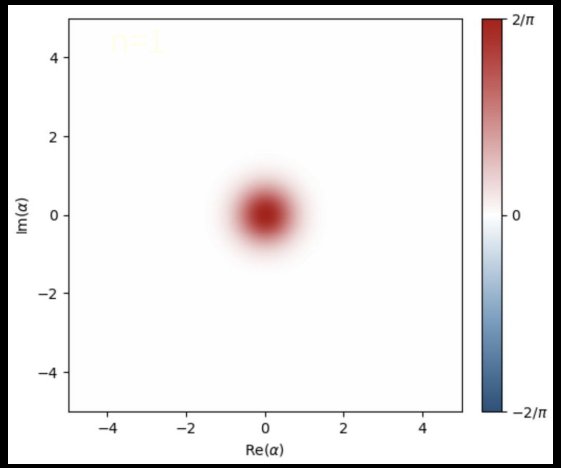
01

Wigner Functions

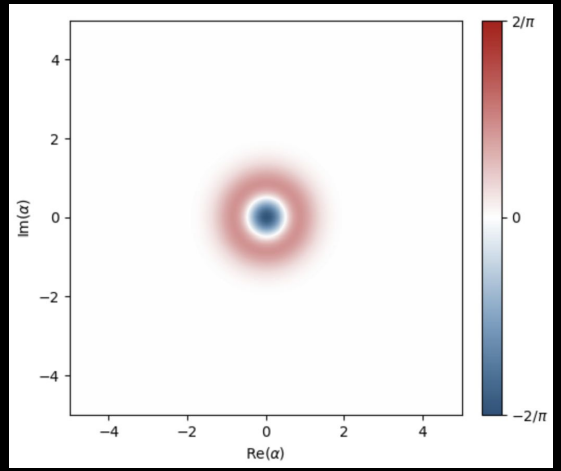
Computation and Visualizations

Fock States

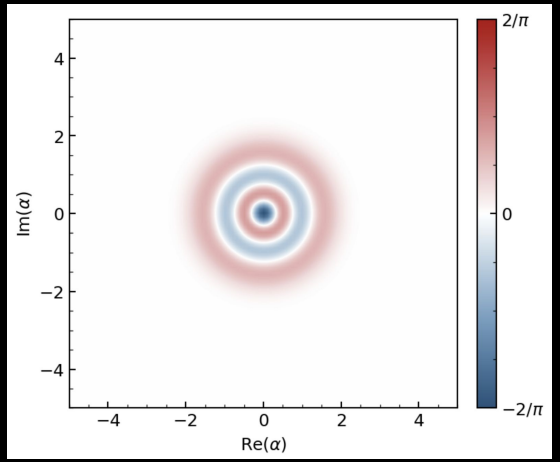
n=0



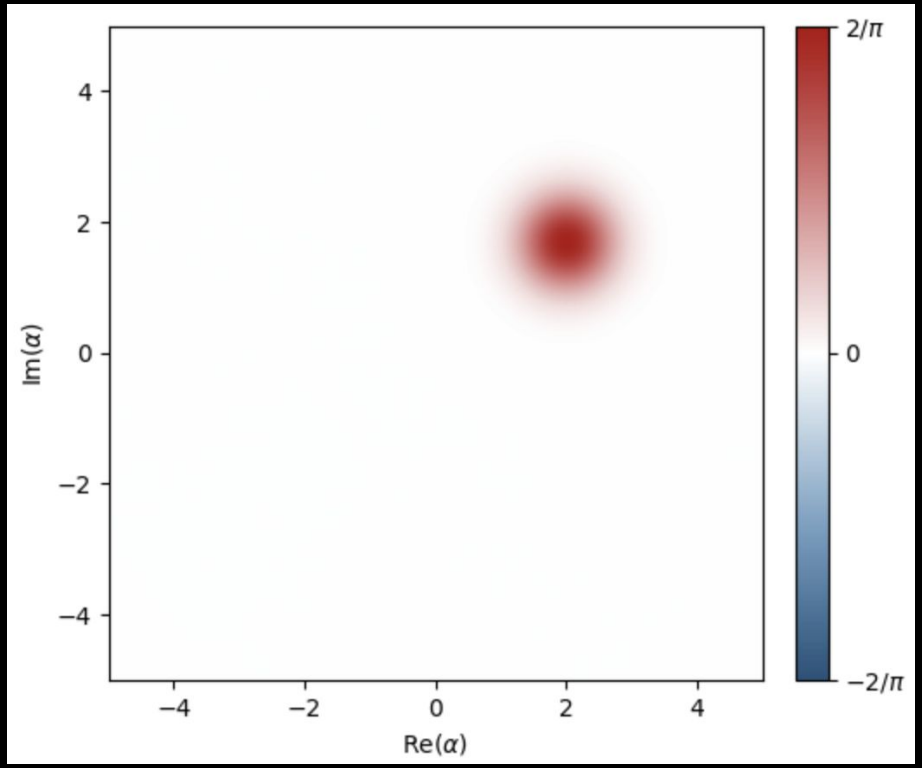
n=1



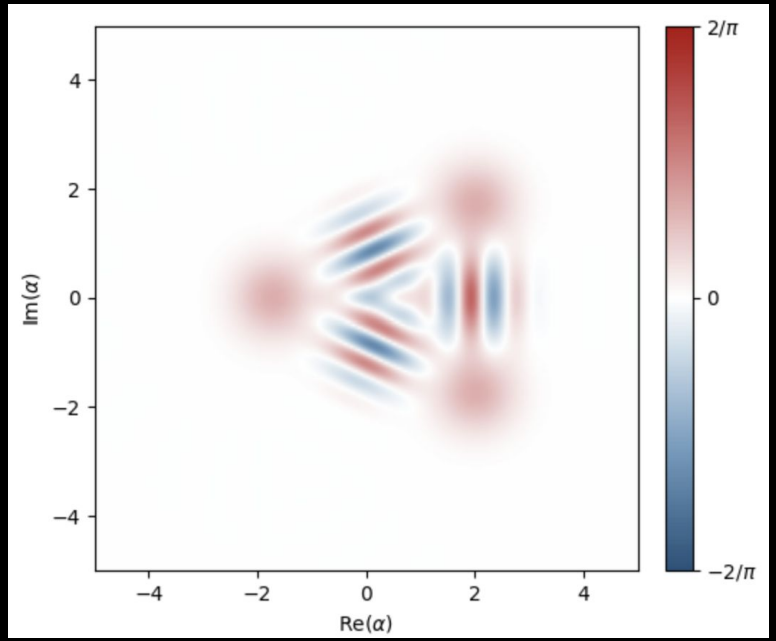
n=3

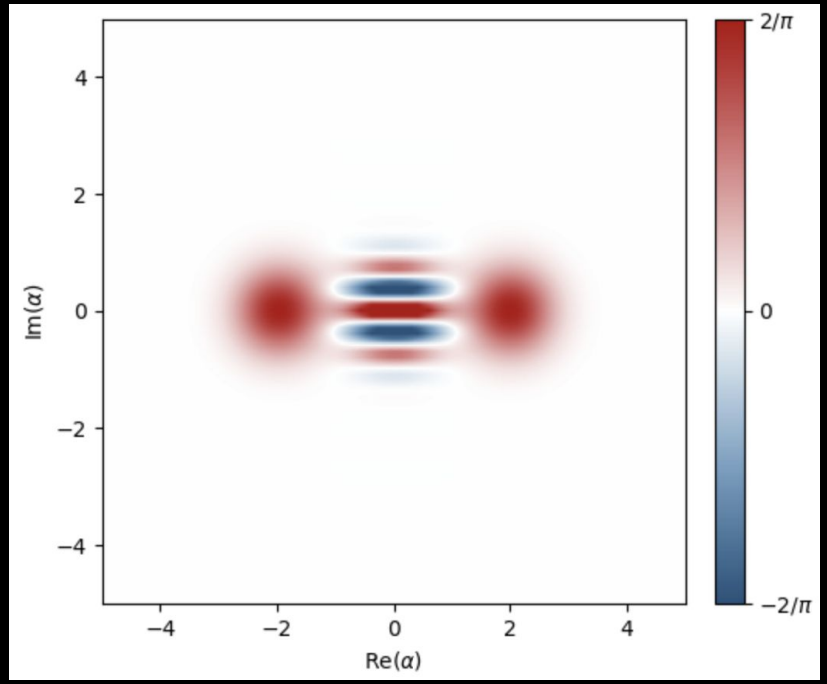


Coherent States

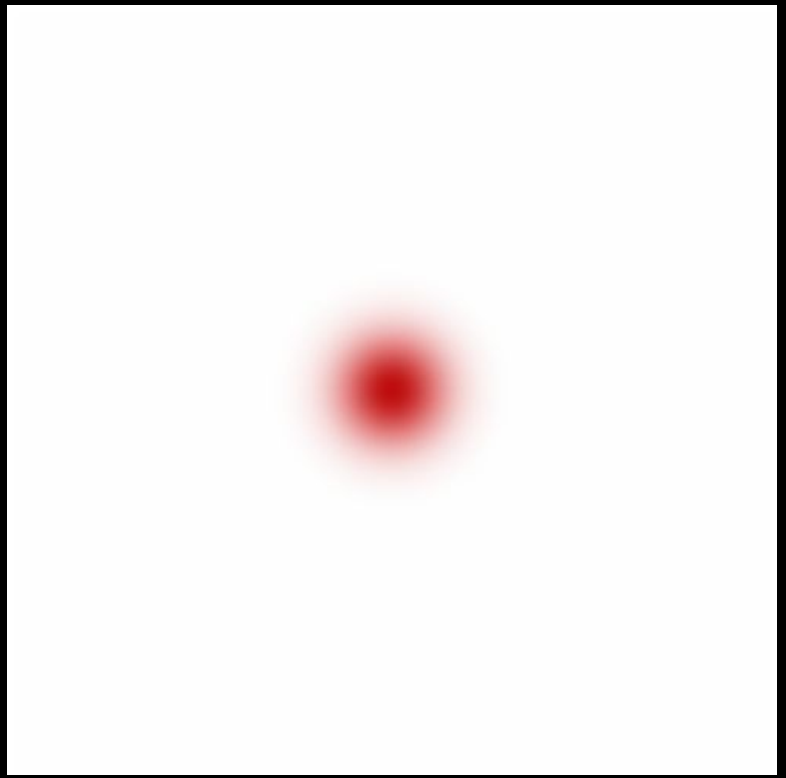


Cat States

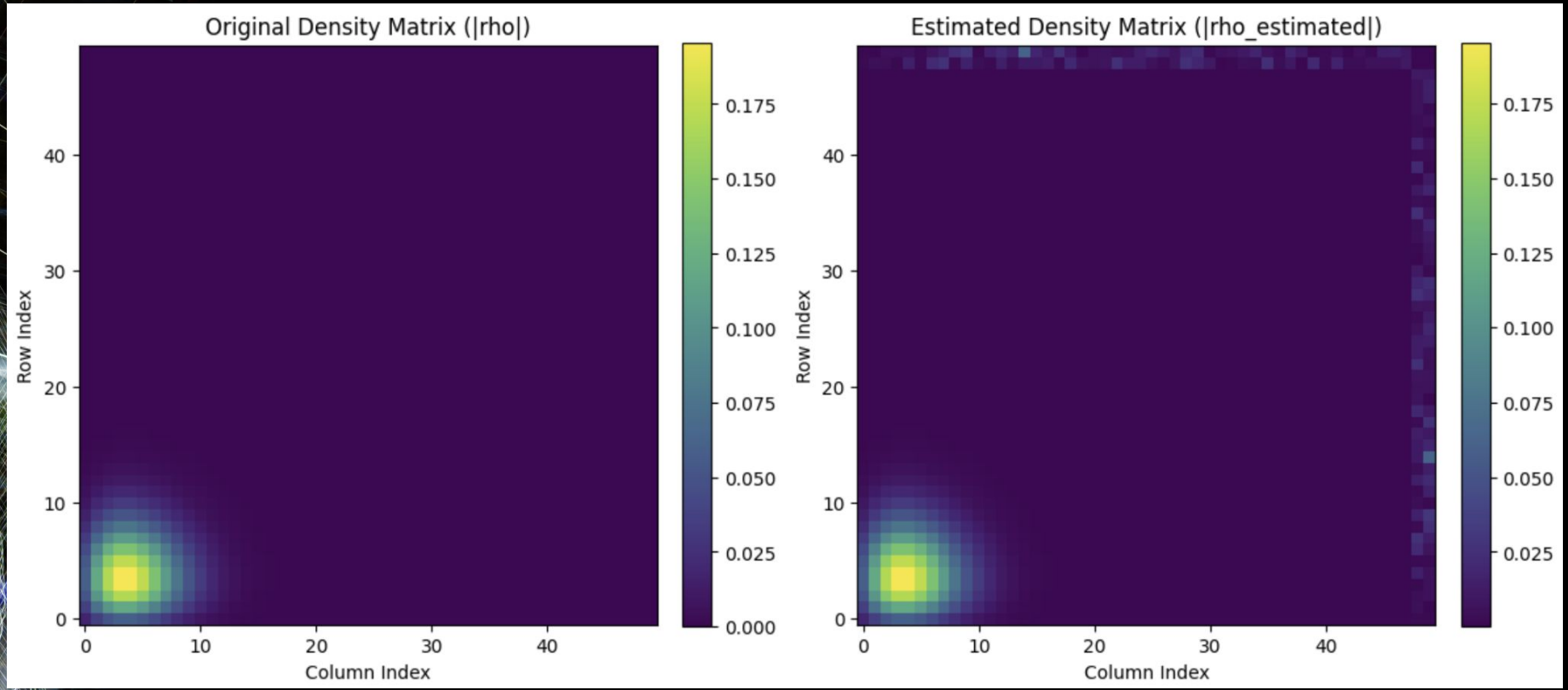




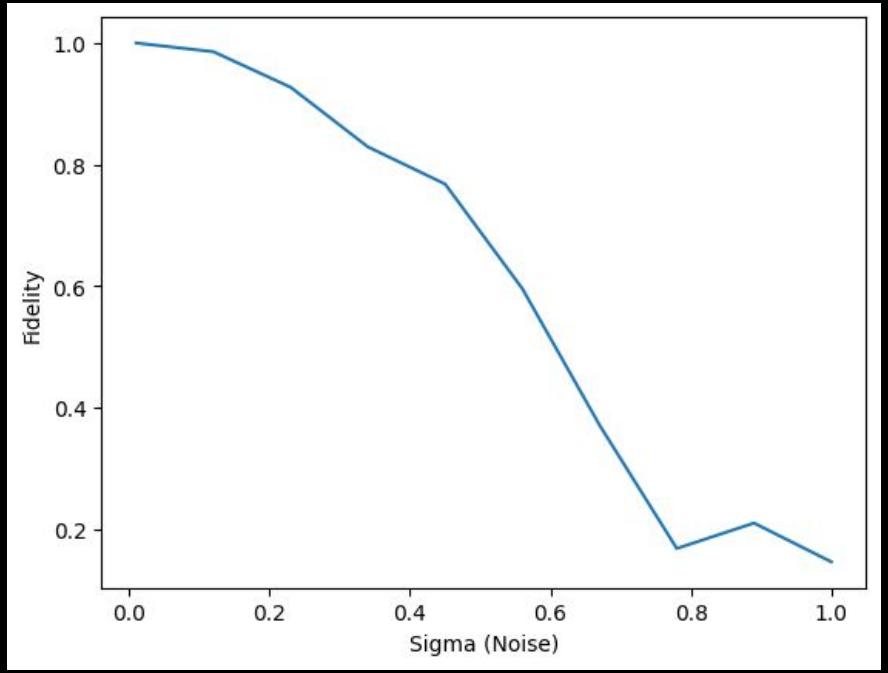
Dissipative Cat State



Reconstruction from Wigner Data



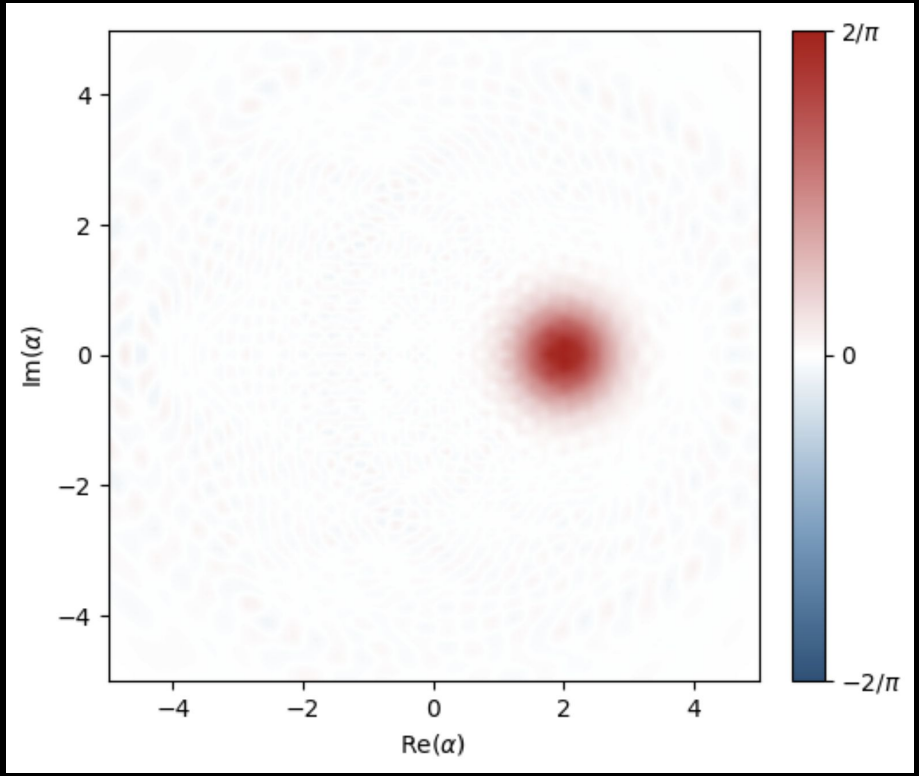
Fidelity Versus Sigma



02

Density Matrix

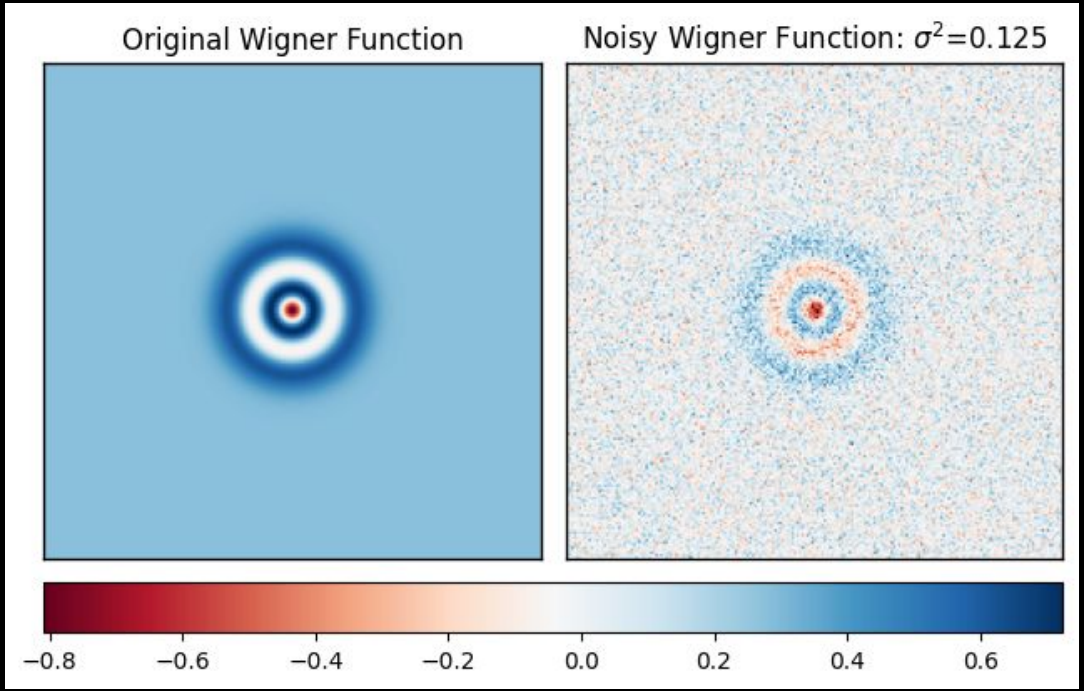
Wigner estimated from ρ



03

Shaping The Fit

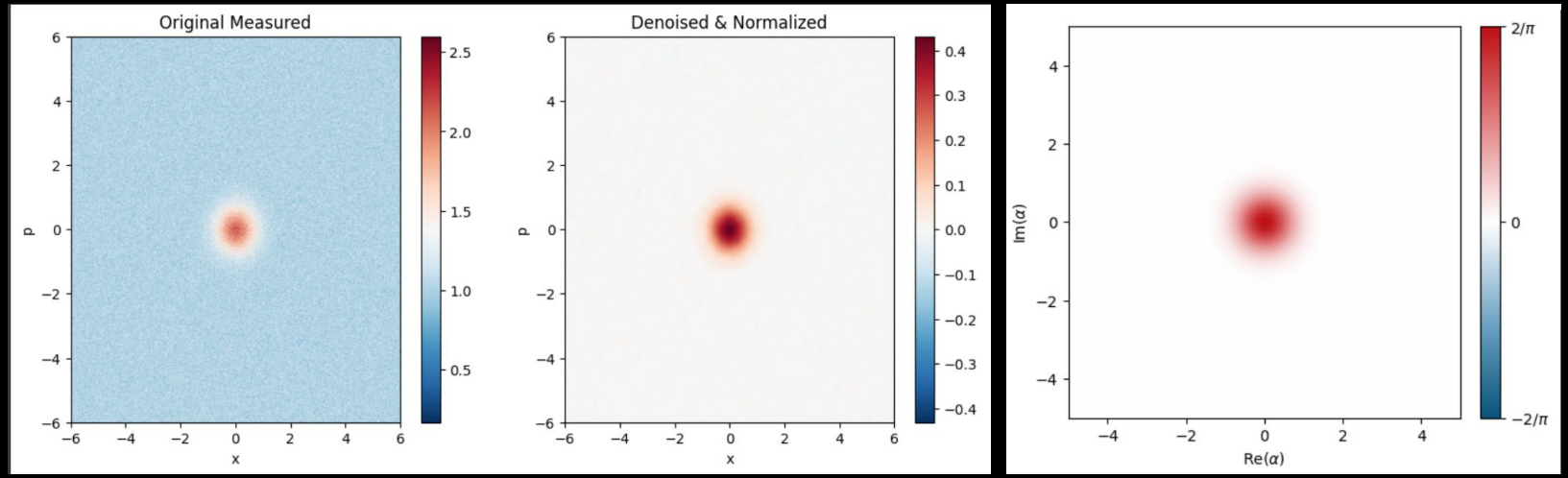
Gaussian Noise on Fock State



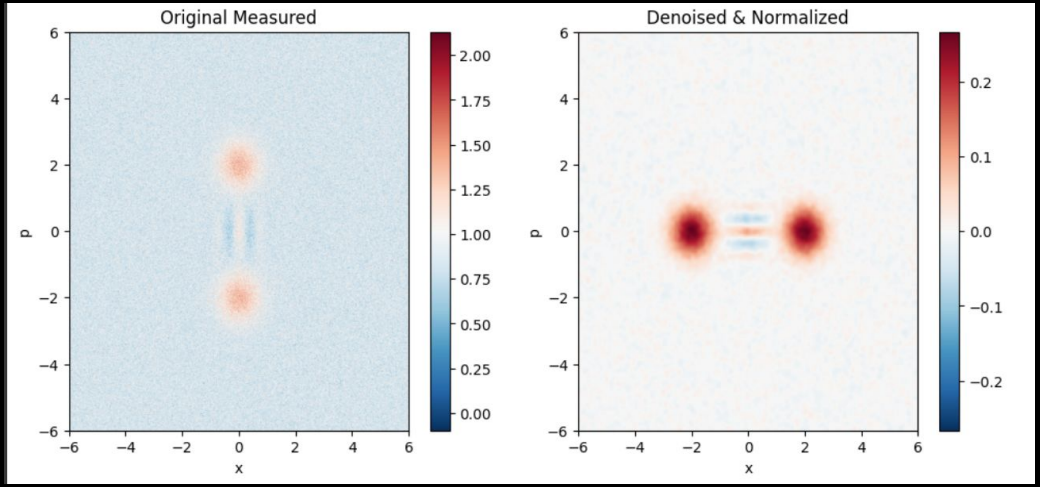
04

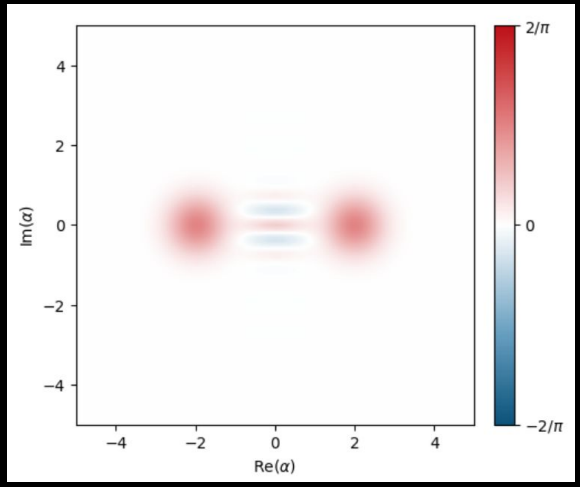
Denoising

Denoising and Normalizing Vacuum State

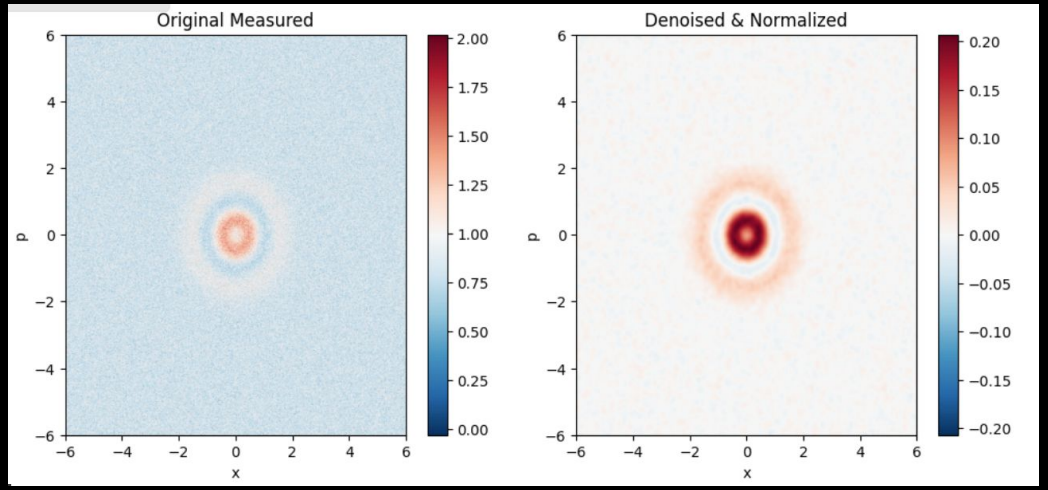


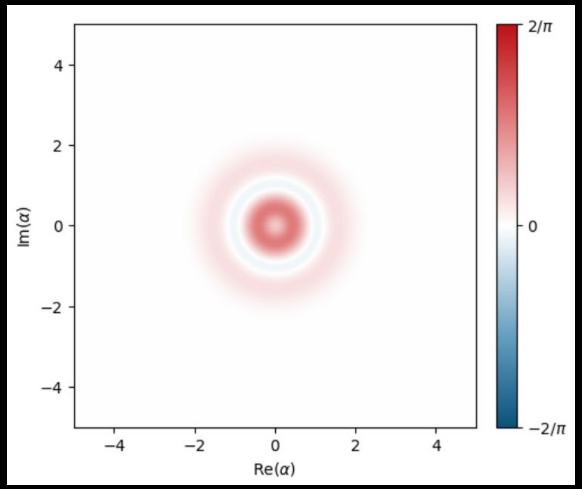
Denoising and Normalizing Cat State





Denoising and Normalizing Fock State





Thank you!