Quantum Forbidden-Interval Theorem for Stochastic Resonance with Squeezed Light

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What is Stochastic Resonance?

Classical Model: Binary Threshold Neuron

Weak Binary Input Signals

Non-linear Threshold Detection

Noise
(any finite-variance noise or alpha-stable noise)

Quantum Model: Squeezed Light

Typical Inverted-U Stochastic Resonance (SR) curve

Quantum Proof Strategy

 Mutual Information (MI) vanishes if noise vanishes and squeezing becomes large

\[ \sigma \to 0 \quad \text{and} \quad r \to \infty \implies I(A; B) \to 0 \]

SR effect iff quantum noise mean not in forbidden interval:

\[ \mu \notin [\theta - \alpha, \theta + \alpha] \]

Simulation Results

Gaussian Noise Case

Cauchy Noise Case

References