# Research Sketch: Uncertainty Principle, Entropy, and Quantum Path Selection

This note combines a raw conceptual sketch with an extended research-style framing. It reflects exploratory ideas by Christian Dzidula Dotsey on the possible role of the uncertainty principle as a stabilizing mechanism, its relation to entropy conditions, and potential connections with quantum path representations.

## Raw Statement

The element of uncertainty principle in nature is to prevent the energy particle from bonding with a structure that does not lead to the equilibrium or the element's true conservation. The uncertainty principle made sure that the bond or structure formed with another particle leading to the entire conservation of the particle energy in the state it finds itself.

## Extended Interpretation

In thermodynamics, the condition $dS = 0$ characterizes equilibrium, a state of no net entropy production. The raw sketch above interprets the uncertainty principle as a constraint ensuring that only equilibrium-consistent structures are realized. This raises the question of whether the uncertainty principle can be understood as a microscopic mechanism that underlies the macroscopic condition $dS = 0$.

Furthermore, in recent work on quantum paths (e.g. Krenn et al.), complex quantum states are represented as superpositions of many possible trajectories, with only some contributing constructively to observable outcomes. This suggests a possible link: uncertainty relations may act to eliminate unstable or forbidden configurations at the microscopic level, while entropy conservation ($dS = 0$) describes the macroscopic manifestation of this selection process.

## Research Questions

1. Can the uncertainty principle be formally connected to the thermodynamic condition $dS = 0$, beyond its established role in quantum statistical mechanics?

2. Is there a microscopic link between uncertainty constraints and entropy conservation laws?

3. In quantum path frameworks, does uncertainty determine which paths are stable/realizable, while entropy conditions describe the macroscopic consequence?

4. Could such a unifying interpretation yield new insights into stability, equilibrium, or state selection in quantum systems?