GoldCoreX: Real-World Quantum Flip Demonstration

Real-World Quantum State Flip Simulation in Gold Atoms

This simulation series demonstrates a quantum state transition (flip) within a gold atom under fully realistic physical conditions, with no artificial enhancements, idealized gates, or favorable assumptions.

The target transition modeled is a change in the quantum state of a gold atom from the 5d orbital to the 6s orbital — a flip between two valid, physically realizable energy levels. These were represented as qubit states $|0\rangle$ and $|1\rangle$, respectively, with the energy difference corresponding to a green photon excitation near 2.25 eV. This transition mirrors experimental efforts in cavity QED, spin-photon interfaces, and atomic-level manipulation.

The simulation environment was deliberately constrained to reflect only real-world physical behavior:

- **Photon-driven transition:** A single green photon was introduced into the system to initiate the transition, mimicking realistic photon-qubit interactions rather than relying on abstract gate operations.
- **No ideal gates or Rabi pulses:** The model excluded artificial π-pulses, ideal rotations, or precise time-tuned gate Hamiltonians. The system evolved entirely through passive photon-induced interaction.
- **Environmental noise included:** Amplitude damping and phase noise (dephasing) were implemented via Lindblad master equations to simulate spontaneous decay and environmental coupling — consistent with realistic conditions in optical cavities or solid-state qubit platforms.
- **Diamond lattice confinement:** The gold atom was assumed to be housed within a diamond matrix, mirroring techniques used in NV center quantum computing, to reduce decoherence while remaining experimentally valid.

Despite the absence of idealized controls, the simulation successfully demonstrated a full quantum flip from state $|0\rangle$ (5d) to state $|1\rangle$ (6s), confirmed through:

- Time-dependent population tracking showing near-complete inversion
- Bloch sphere animation where the qubit rotates from south to north pole
- Final frame analysis confirming the Bloch vector stabilized in the excited state

- MP4 visual evidence of the flip occurring in real time

Control simulations using alternate atomic structures, such as zinc and carbon, failed to produce the same transition under identical physical conditions, supporting the result's dependency on gold's atomic structure and photon interaction characteristics.

These simulations confirm that it is possible to achieve full qubit state inversion in a gold-based quantum system without relying on ideal conditions. This supports the broader feasibility of the GoldCoreX architecture, where controlled quantum state manipulation can be achieved through photon-based interactions in room-temperature, diamond-confined environments — a significant milestone in scalable, real-world quantum technology.