

2026 HBCU CHIPS Network Conference

Contribution ID: 11

Type: ORAL

Implementation of Finite state logic machines via the dynamics of atomic systems

Wednesday, April 1, 2026 1:30 PM (20 minutes)

Following the success of Moore's predictions, we are approaching a limit in the miniaturization of semiconductors for computing materials. This has led to the exploration of various research paths in search of alternative computing paradigms, such as quantum computing, 3D transistors, molecular logic, and continuous logic. In this context, we propose a novel approach in which the dynamics of a two-level atom is used to execute classical Boolean logic operations. Unlike traditional combinational logic circuits, where the output depends solely on the input, we suggest a finite-state machine-like computing model, where the output is influenced by both the input and the system's initial state. The proposed mechanism leverages the dynamics of a two-level quantum state, with information encoded in observable quantities. These observables, the density matrix's population (diagonal) and coherence (off-diagonal) elements, were analyzed using the Liouville equation. The selection of observables within the Liouville space allows us to encode more variables. Although environmental noise may cause some loss of encoded information, fast computations can still be performed before it dissipates. In addition, logic operations can be read in parallel, enabling complex computations. This system can also be scaled to an N-level configuration.

Academic or Professional Status

Faculty

Author: Dr HAILU, Dawit (Bowie State University)

Presenter: Dr HAILU, Dawit (Bowie State University)

Session Classification: Technical Session 1

Track Classification: Quantum Technology