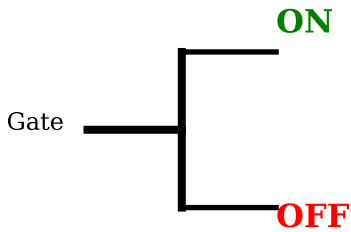
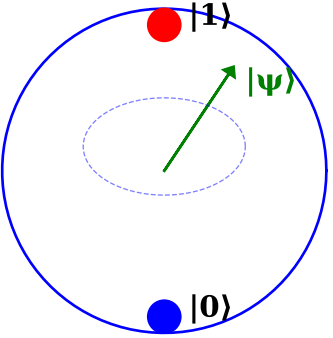


# Hardware Validation 2: Categorical States are Physical Digital States

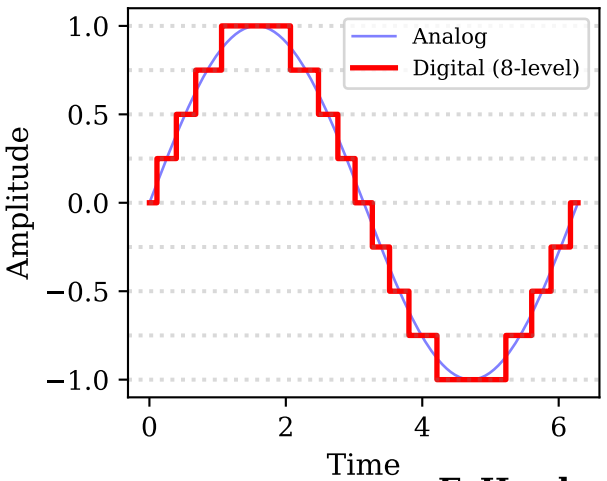
**A. Transistor  
(Binary Categorical)**



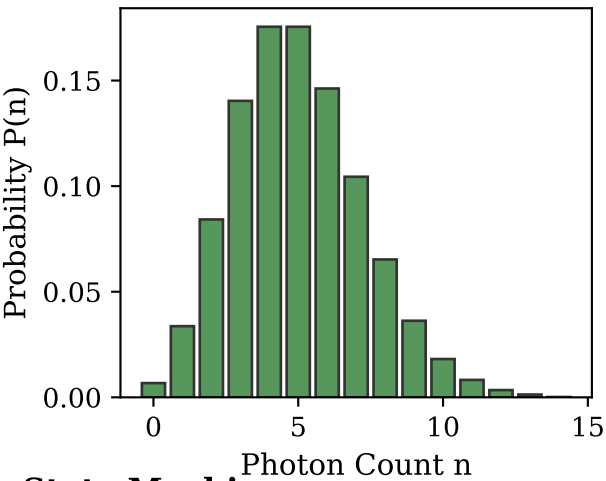
**B. Qubit  
(Quantum Categorical)**



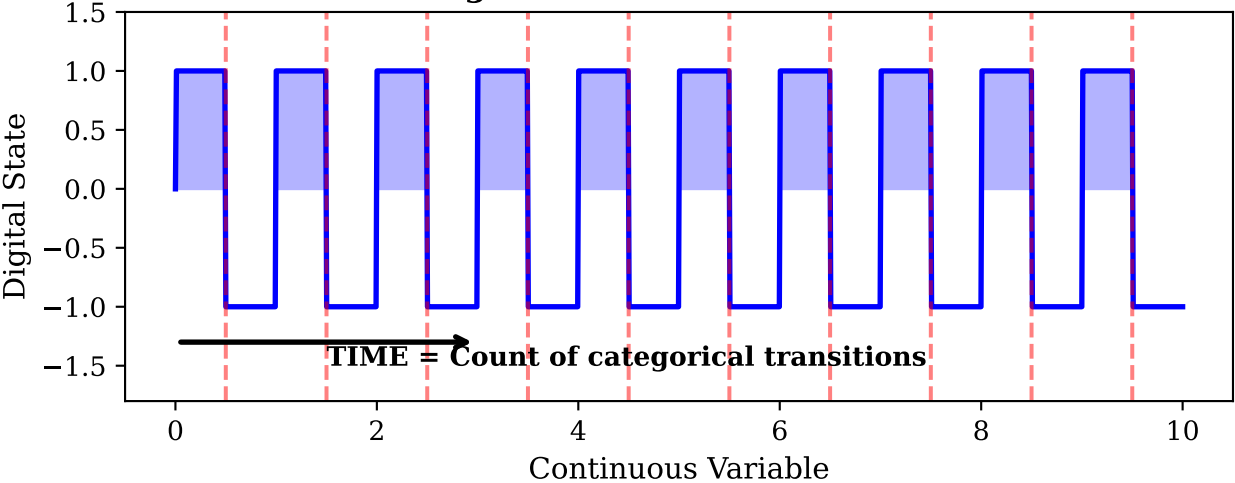
**C. ADC  
(Continuous  $\rightarrow$  Categorical)**



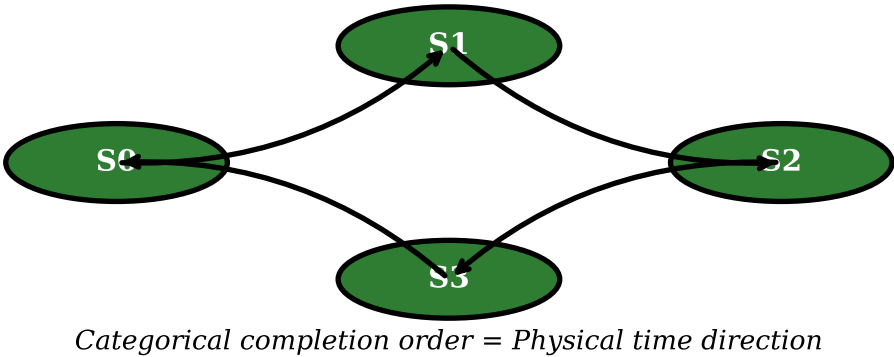
**D. Photon Counter  
(Discrete Quanta)**



**E. Time Emergence: Clock Transitions Define Time**



**F. Hardware State Machine  
(Categorical Transitions)**



**G. Hardware Examples**

- Digital Electronics:
- Transistors: ON/OFF (2 states)
  - RAM cells: 0/1 per bit
  - CPUs:  $10^9$  categorical transitions/sec
- Quantum Hardware:
- Superconducting qubits:  $|0\rangle$ ,  $|1\rangle$
  - Trapped ions:  $|\uparrow\rangle$ ,  $|\downarrow\rangle$
  - Photon polarization:  $|H\rangle$ ,  $|V\rangle$

Every computer clock tick is a categorical completion event that advances 'time'.

**H. Measurable Predictions**

1. **Categorical Irreversibility:**  
Once a bit flips 0 $\rightarrow$ 1, it STAYS 1 until actively reset
2. **Completion Order = Time:**  
CPU instruction counter = elapsed time (measured in clock cycles)
3. **Discreteness:**  
No 'half-photon' ever detected  
No 'partial bit' in any memory

Categorical states are REAL hardware states.