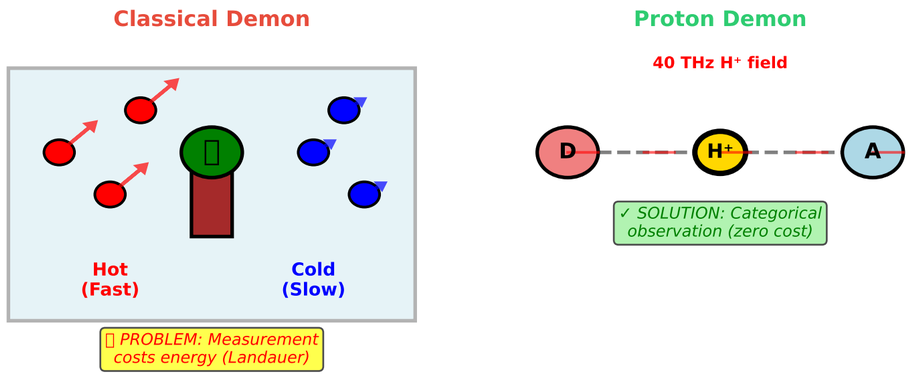
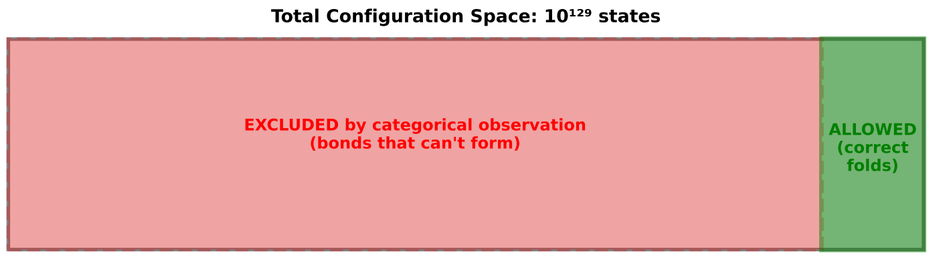
Proton Maxwell Demon: Categorical Observation Mechanism
Zero-Energy Information Processing in Protein Folding

(A) Classical Maxwell Demon vs Proton Demon

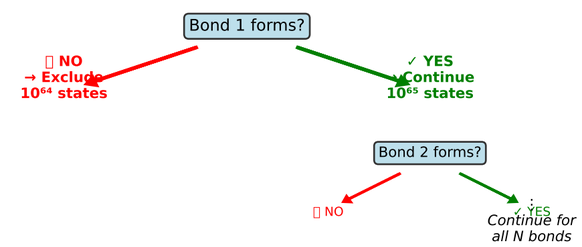


KEY DIFFERENCE:
• Classical: Demon measures molecule speeds → costs energy
• Proton: Demon observes categorical states → zero energy cost
• Categorical = "bond exists" or "bond doesn't exist" (discrete)
• No continuous measurement needed!

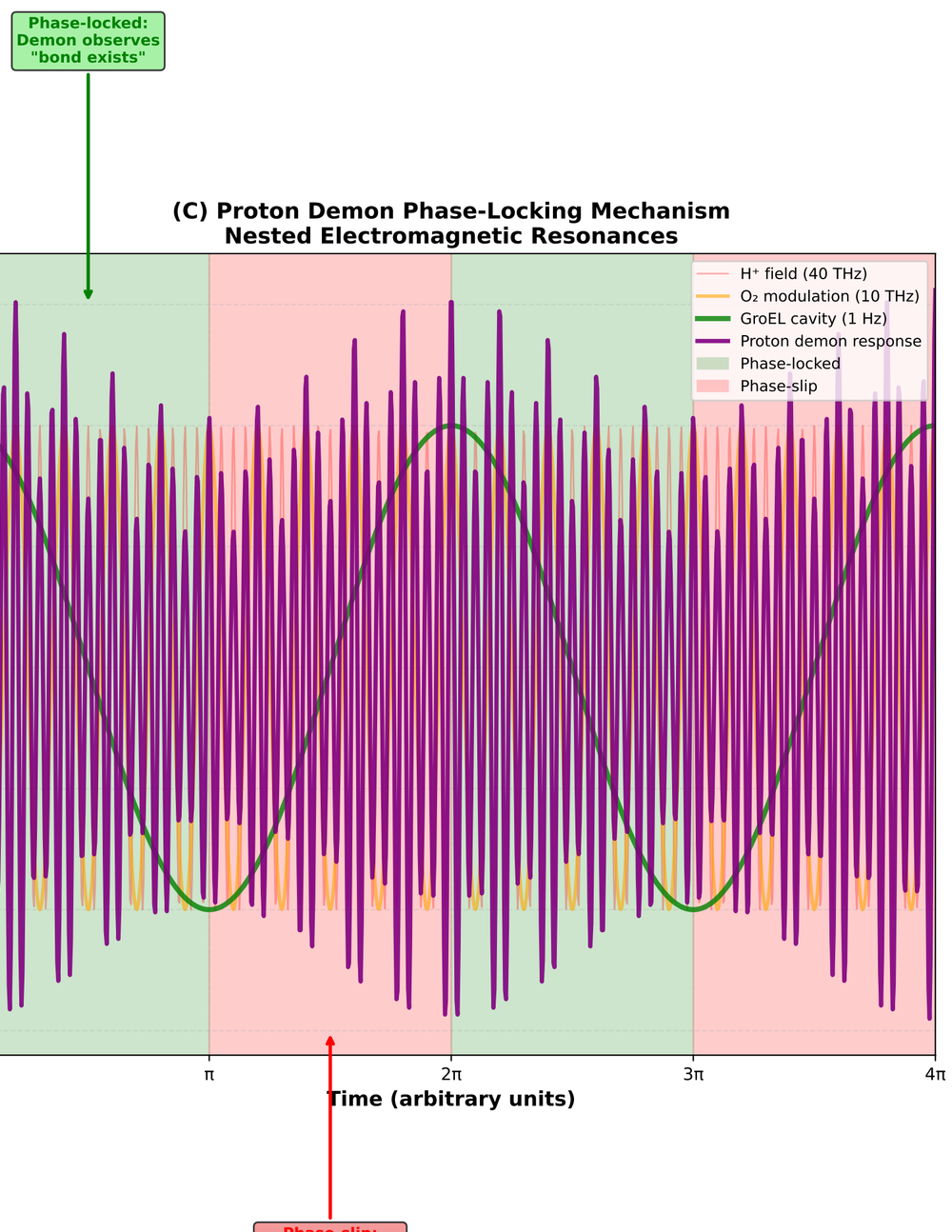
(B) Categorical State Space Exclusion



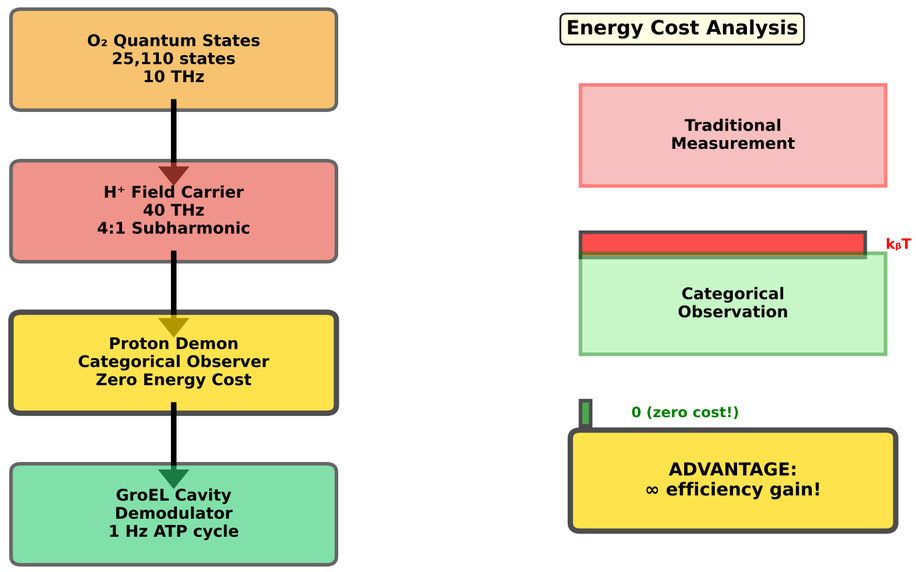
Categorical Decision Process:



EXPONENTIAL EXCLUSION:
• Each bond decision excludes ~half of remaining states
• After N bonds: only 1 pathway remains!
• Information cost: 0 (categorical observation)
• Time cost: O(N) not O(10¹²⁹)



(D) Information Flow & Energy Cost



KEY INSIGHTS:
1. Proton demon observes discrete states (bond/no-bond)
2. Categorical observation costs ZERO energy (Landauer limit avoided)
3. Information flows: O₂ → H⁺ → Proton → GroEL
4. Each observation excludes wrong configurations exponentially
5. Result: Protein folding solved in polynomial time!