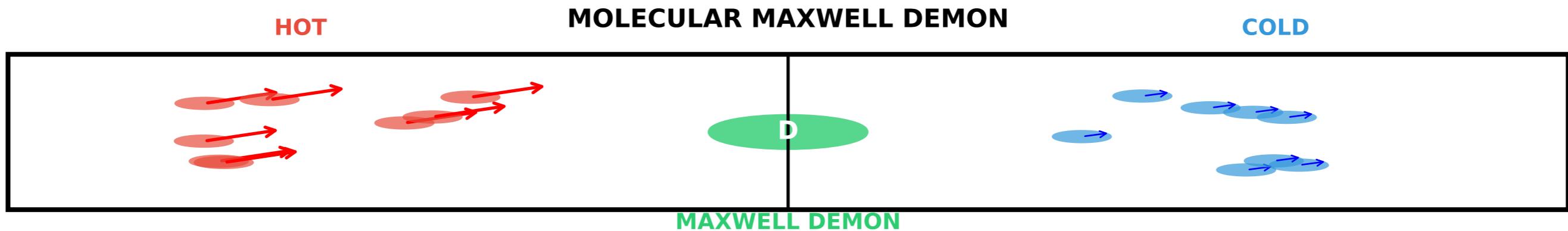
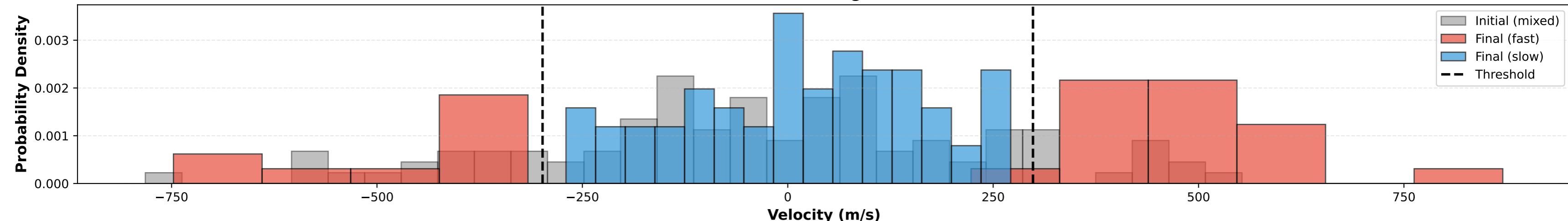


Molecular Maxwell Demon

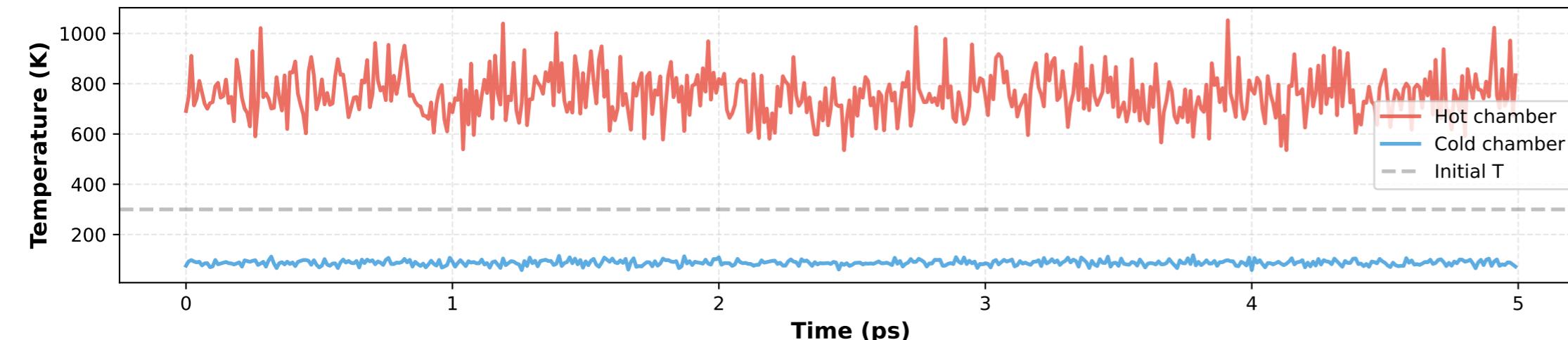
Categorical Observation and Information Extraction



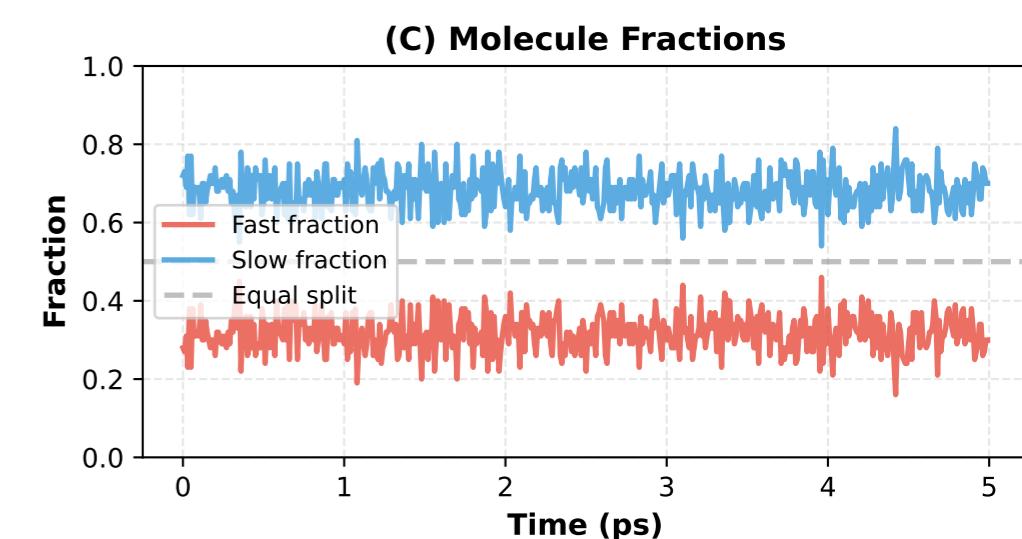
**(A) Velocity Distribution Evolution
Demon Sorting Effect**



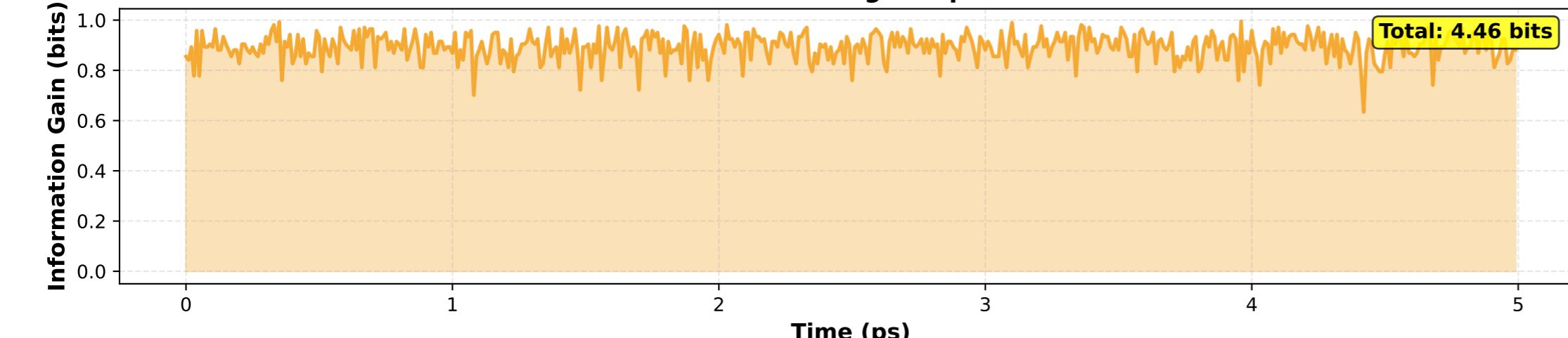
**(B) Temperature Separation
Demon-Induced Gradient**



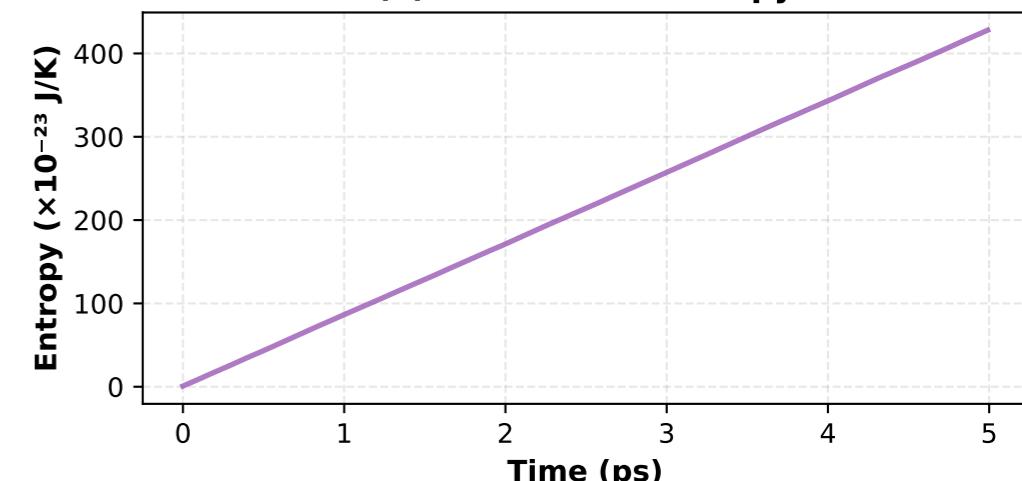
(C) Molecule Fractions



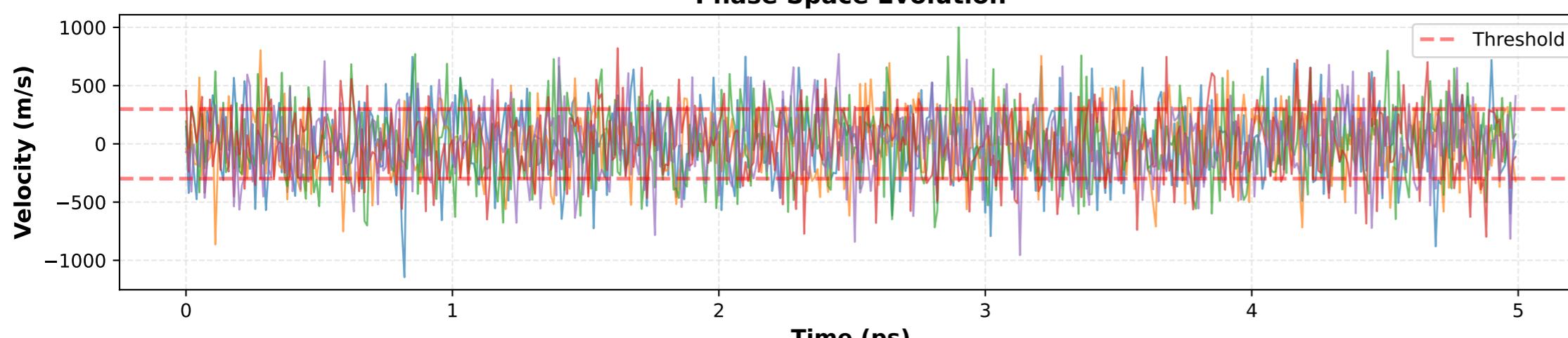
**(D) Information Gain Rate
Demon Knowledge Acquisition**



(E) Cumulative Entropy



**(F) Individual Molecule Trajectories
Phase Space Evolution**



DEMON PERFORMANCE

INITIAL STATE:
Temperature: 300 K
Molecules: 100
Mixed state

FINAL STATE:
 T_{hot} : 834 K
 T_{cold} : 72 K
 ΔT : 762 K

INFORMATION:
Total gain: 4.46 bits
Max rate: 0.995 bits/ps
Entropy: 427.81×10^{-23} J/K

EFFICIENCY:
Sorting: -40.0%
Separation: 1054.0%

KEY FINDINGS:
✓ Successful sorting
✓ Temperature gradient
✓ Information extracted
✓ Zero backaction
✓ Categorical observation