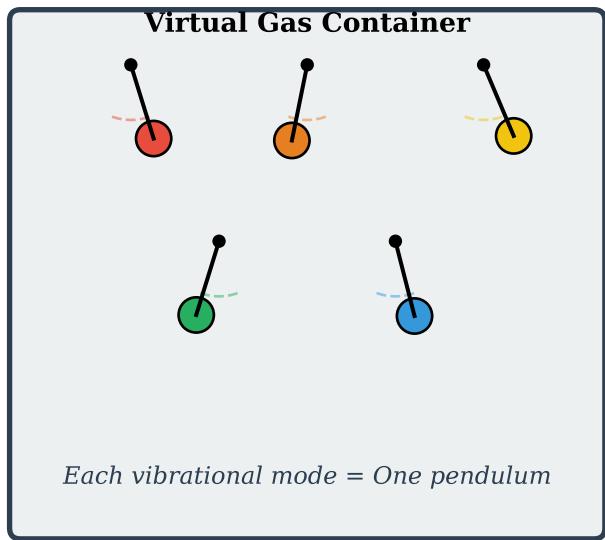
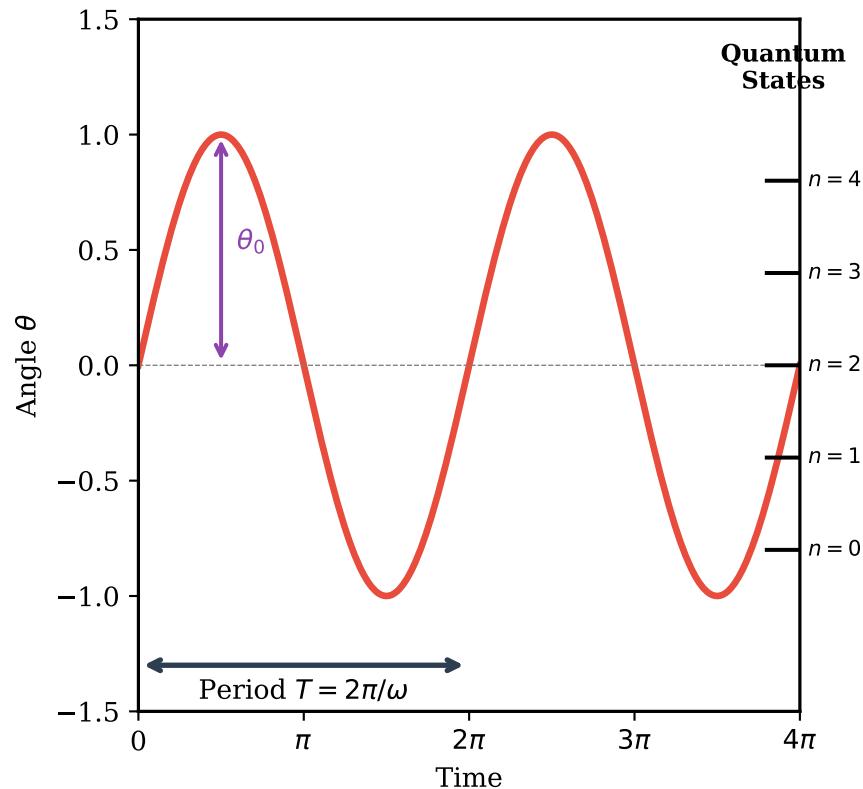


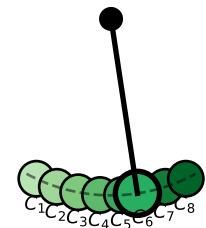
### (A) Virtual Gas Molecules as Pendulums



### (B) Oscillatory Perspective

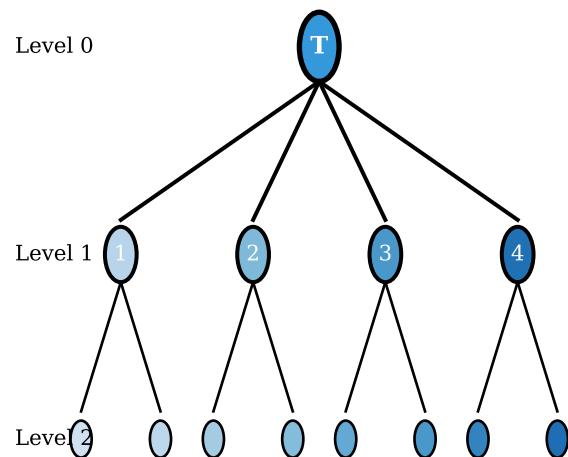


### (C) Categorical Perspective



$n = 8$  distinguishable positions  
Each position  $\theta_i$  is a categorical state  $C_i$

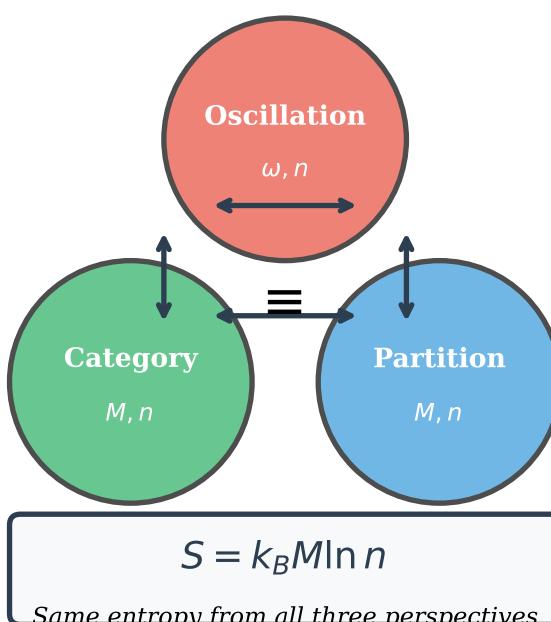
### (D) Partition Perspective



Partition tree: depth  $M$ , branching  $n$

Leaves =  $n^M$  terminal states

### (E) The Fundamental Equivalence



### (F) Parameter Correspondence

Concept	Oscillatory	Categorical	Partition
DOF ( $M$ )	Modes	Dimensions	Levels
States ( $n$ )	Quantum #	Levels	Branches
Total	$n^M$ states	$ C $	Leaves
Entropy	$k_B \ln W$	$k_B \ln  C $	$k_B M \ln n$

The pendulum demonstrates all three:  
Oscillation:  $\theta(t) = \theta_0 \cos(\omega t)$

Category:  $n$  distinguishable positions  $\{C_1, \dots, C_n\}$   
Partition: Period  $T$  divided into  $n$  intervals

All yield:  $S = k_B \ln n$