## Robust emergent function in living systems

How the cell functions and which dynamics it chooses to go into, remain mysterious. We lack a clear understanding of the underlying mechanisms that give rise to outcomes given specific conditions such as the underlying genes or kinetic rates. Here, we use topological winding numbers to predict phase transitions between multistability and oscillations in a simple gene switch, providing simple analytical expressions for properties of the steady-state. More broadly, I will discuss fundamental differences with quantum topology, namely the need for non-reciprocity. Lastly, I provide examples in other biological and synthetic systems, showing how topology sheds light on emergent phenomena in non-equilibrium stochastic systems.

Gene switch:



Circadian rhythm:

