**Tata Institute of Fundamental Research**
Survey No. 36/P, Gopanpally Village, Serilingampally, Ranga Reddy Dist., Hyderabad – 500 046

# Colloquium

## Emergent states in complex systems with multiple time scales

## G Ambika

### IISER, Thiruvananthapuram

Many real-world systems are complex systems having interacting subsystems that differ in their intrinsic dynamical time scales. Then their nonlinearity, heterogeneity in time scales and nature of interactions can lead to many interesting and complex emergent states. The systems may self-organise leading to suppression and recovery of oscillations, frequency synchronisation, locking or suppression and chimera states etc.

In this talk I will introduce such phenomena that occur in systems coupled on networks, including the transitions in their dynamical states and related cross over phenomena. The spatial and temporal order in a community structured network of neurons will be presented as an illustration. I will also present a new type of chimera state, called frequency chimera, where the coherence and incoherence among the systems are defined with respect to the frequency of their oscillations. The systems, starting with random initial conditions, self-organise to form structured patterns with spatial domains of coherence coexisting with domains that are incoherent in frequencies. Our study has relevance in understanding such spatio-temporal patterns observed in real-world systems where mismatch in timescales is natural and prevalent, like neuronal systems, power grids, and social networks.

**References:**

• Role of time scales and topology on the dynamics of complex networks- Kajari Gupta and G. Ambika- Chaos 29, 033119 (2019)
• Frequency locking and travelling burst sequences in community structured network of inhibitory neurons with differing time-scales- Kunal Mozumdar and G Ambika- Commun Nonlinear Sci Numer Simulat 69 320–328, (2019)
• Frequency chimera state induced by differing dynamical timescales, Sneha Kachhara and G. Ambika, Phys Rev E 104, 064214 (2021)

***Monday, Sep 4th 2023***

***4:00 PM (Tea / Coffee 03.45 PM)***

***Auditorium, TIFR-H***