**大数据与复杂性科学**

**内容简介**

1. **贾韬教授：The statistical mechanics of how physicists shift their research focus**

Changing and shifting research interest is an integral part of a scientific career. Despite extensive investigations on various factors that influence a scientist's choice of research topics, we lack a quantitative assessment of the statistical mechanism that gives rise to macroscopic patterns characterizing research interest evolution undertaken by an ensemble of scientists. Here using publication records of over 14,000 authors in physics, we find that the extent of research interest change within population follows an exponential distribution, helping us to uncover three fundamental features characterizing this dynamical process. Inspired by Isaac Newton's retrospection that doing science he was like ``... a boy playing on the sea-shore ... finding a smoother pebble or a prettier shell than ordinary", we develop a random walk based model for research interest evolution, which captures patterns observed empirically. By analyzing the correlation between an individual's interest change and performance change, we find that changing research interest on average does not hurt productivity and those who change are more likely to increase the impact of the work. The results uncover previously unknown regularities underlying individual careers, providing a new basis for future studies of research interest evolution.

1. **吕欣副教授：Big Data in Response to Climate Disasters**

Climate change is likely to drive migration from environmentally stressed areas. However quantifying short and long-term movements across large areas is challenging due to difficulties in the collection of highly spatially and temporally resolved human mobility data. This talk will illustrate how large-scale mobility data could be used to overcome such difficulties. Using data collected during Cyclone Mahasen, which struck Bangladesh in May 2013, we characterize spatiotemporal patterns and anomalies in calling frequency, mobile recharges, and population movements before, during and after the cyclone. We then demonstrate how mobile data for the first time allow us to study the relationship between fundamental parameters of migration patterns on a national scale. The methodological framework described here provides an important addition to current methods in studies of human migration and climate change.

1. **严钢博士：Network control and its application to nervous systems**

Recent advances in network control have offered a powerful mathematical framework to explore the structure-function relationship in complex biological, social, and technological networks. Yet, we continue to lack experimental confirmation of the relevance of the underlying control principles to real-world systems. In this talk we will show that the responsive behaviors of a worm can be mapped into a network control problem, through which we predict the previously unknown role of several neurons in the locomotion of worms. We validate these novel predictions through neuroscience experiments. We also show that our predictions are robust to missing and rewired connections in the existing data, indicating the applicability of these techniques to larger and less well-characterized nervous systems. Our results offer the first direct experimental confirmation of the predictive power of network control principles in living systems.

1. **吴枝喜教授：网络上SIS疾病传播模型的动力学关联问题研究**

对于网络上的疾病传播，当底层网络基底结构的演变时间尺度远远大于疾病传播时间尺度时，会出现相应的动力学关联：与多个染病者为邻的易感者更容易被感染。结合“异质的平均场近似理论”与“近似主方程方法”，探讨了网络上SIS疾病传播模型的动力学关联问题。通过“最大熵原理”的思想进行适当的关联近似，得到了(与现有理论方法相比)更为精确的疾病传播规模和传播阈值。