Title of the Lecture Workshop:  
Basic and Interdisciplinary Topics in Physics  
Midnapore College, Midnapore  
4-6 February 2013

Joint Conveners:  
Indrani Bose (Bose Institute, Kolkata);  
Bhupati Chakraborty (City College, Kolkata)  
Co-ordinator: M N Goswami (Midnapore College)

Total Number of Participants: 128 participants from different colleges.

Programme Schedule of Lecture workshop

**04.02.2013**

9-00 - 10-30: Registration  
10-30 -11.30: Inauguration  

11.30-12.30: Key Note Address: By Prof. P N Ghosh  
Former vice-Chancellor, Jadavpur University  

12.30 -1.30: Prof. A Ghosh  
Indian Association for the Cultivation of Science, Jadavpur  

1.30 – 2.30: Lunch  

2.30-3.30: Prof. S Banerjee  
Saha Institute of Nuclear Physics  

3.30-4.00: Tea Break  

4.00-5.00: IAPT-Midnapore College Centre for Science Culture Visit

**05.02.2013**

10.00-11.00: Prof. S Dey  
Indian Institute of Technology, Kharagpur  

11.00-11.30 : Tea break  

11.30-12.30: Prof. A K Raychaudhuri  
S N Bose National Centre for Basic Sciences  

12.30-1.30: Prof. B K Chakrabarti  
Saha Institute of Nuclear Physics  

1.30-2.30: Lunch  

2.30-3.30: Prof. D S Ray  
Indian Association for the Cultivation of Science, Jadavpur  

3.30-4.00: Tea Break  

4.00-5.00: IAPT-Midnapore College Centre for Science Culture
The joy of Small Things
A.K. Raychaudhuri
The progress of the human civilization depends on materials. The more advanced the civilization is it can make newer and cheaper materials for novel applications and use. The first part of the talk will discuss some of the important landmarks in modern day materials science and the challenges in front of it. I will point out areas where I believe the materials science in general and materials science in India in particular will play an important role.

In recent years considerable attention has been drawn to the field of nanomaterials –its synthesis, new science and phenomena and its applications. It is a rapidly expanding field. In this talk I will discuss, taking examples mostly from our own work the fabrication of different types of nanomaterials, the science that we do with it and of course the challenges of this fast expanding fields.

New Particle at the Large Hadron Collider
Prof. Sunanda Banerjee, F N A
On July 4, 2012 two experiments, working at the CERN Large Hadron Collider, jointly announced a strong evidence of observing a new particle state. The observed particle, approximately 135 times heavier than proton and with a very short life time, could be the elusive Higgs boson which the high energy physicists have been earnestly looking for during the past 25 years. This will close one of the puzzles of the Standard Model of particle physics. The search involved a consolidated effort from thousands of physicists from all over the world over two decades. The challenges in this search and Indian effort in this process will be discussed.

TURBULENT FLOW CHARACTERISTICS: GENERAL FEATURES
Subhasish Dey, FASc, FNASC, FNAE
Department of Civil Engineering
Abstract: In general, the fluid flow can be distinguished as laminar flow and turbulent flow. Laminar flow occurs at relatively low velocity and it is visualized as layered flow in which layers of fluid slide smoothly over each other with different flow velocities without microscopic mixing of fluid particles normal to the direction of flow. As the flow velocity exceeds a certain value, the flow loses its stability resulting into the sudden formation of eddies which spread throughout the flow region. Such highly irregular, random and fluctuating flow is called turbulent flow. The typical characteristic of turbulent flow is that the velocity and pressure at a fixed point in space do not remain constant at a time but fluctuate very irregularly with high frequency. Most flows in nature are turbulent. When turbulence is present, it dominates all other flow phenomena. The lecture is dedicated to present an overview on the turbulence characteristics in open channel flows.
Tipping Point Transitions in Complex Dynamical Systems
Indrani Bose, Department of Physics

Complex dynamical systems, ranging from ecosystems, the climate, financial markets to genetic networks and complex diseases undergo sudden shifts from one dynamical regime to another at critical conditions constituting the “tipping point” or more technically the “bifurcation point”. In ecology, the widely investigated cases include the collapse of vegetation under semi-arid conditions, the transition from a clear to a turbid lake, changes in the states of coral reefs, catastrophic shifts in fish or wildlife populations etc. Spontaneous systemic failures such as asthma attacks or epileptic seizures are also manifestations of sudden regime shifts. There are evidences to suggest that the progression of complex diseases may not be smooth but marked by an abrupt deterioration at a tipping point. Patterns of oceanic circulation and the climate are known to undergo sudden regime shifts. A recent analysis of known ecosystem shifts points to an approaching planetary-scale critical transition as a function of increased human activity. In cell biology, the most common example is that of a genetic circuit undergoing a transition from one stable gene expression state to another at a critical parameter value. Experimental observations of such transitions have been made in the cases of both natural and synthetic natural circuits. Financial markets are also known to undergo catastrophic shifts in the form of systemic crashes.

In this talk, two important issues related to abrupt regime shifts will be addressed. The first relates to whether a universal principle exists in unravelling the origins of tipping point transitions in a wide class of complex dynamical systems. We will discuss how bistability, an important concept in dynamical systems theory, provides the framework for a unifying mechanism. In addition, one has to take into account the probabilistic nature of the dynamics of complex systems giving rise to fluctuations (noise) around the average levels of key variables. The second issue relates to the existence of some early warning signals of abrupt regime shifts. We will discuss a few of these early signatures including critical slowing down, rising variance and lag-1 autocorrelation function and the skewness of the probability distribution as the tipping point is approached. A physical interpretation of these quantities will be given in an elementary manner. The aim of the talk will be to highlight how physics-based concepts and techniques provide important insight on the tipping point transitions exhibited by diverse dynamical systems.

Econophysics of Income & Wealth Distributions in Societies
Bikas K. Chakrabarti
Saha Institute of Nuclear Physics, Kolkata

Abstract:
Increasingly, a huge amount of statistics have been gathered which clearly indicates that income and wealth distributions in various countries or societies follow a robust pattern, close to the Gibbs distribution of energy in an ideal gas in equilibrium. However, it also deviates in the low income and more significantly for the high income ranges. Application of physics models provides illuminating ideas and understanding, complementing the observations. We intend to discuss these recent developments.
A nonlinear dynamical system can self-organize itself to exhibit a variety of phenomena, such as, propagation of waves, formation of patterns, temporal oscillations of chemical reactions and so on. The examples range from physics and chemistry to biology and ecology. We intend to discuss some of these issues qualitatively from some basic standpoint.