BOOK OF ABSTRACT

National Seminar on Recent Trends in Physics (NSRTP-2019)

January 19, 2019

Organised by, Department of Physics

Initiated by IQAC

Bidhan Chandra College, Asansol-4

About the Seminar

The objective of this seminar is to have a greater understanding of physics research and its applications to promote new industrial innovations. This proceeding highlights the latest results in the fields of condensed matter, nano-materials and materials science research. We sincerely hope that the seminar will help the students as well as the faculty members for a greater understanding of the world of physics research.

Dr. Subrata Das's focus is on the phosphor based white light emitting phosphor suitable for indoor and outdoor lighting. LED's have many advantages over incandecesent light sources, including low energy consumption, longer lifetime, smaller size and faster switching. LED's are used in applications in aviation lighting, automotive headlamps, advertising, traffic signals and many more. Recent developments have produced white light LED's suitable for room lighting. Phosphors were always the key component of high quality white LED light. Dr. Das's lecture would enable us to have the actual understanding of the phosphor based solid state lighting technology. In addition to that some potential phosphors for solid state lighting has been discussed.

Dr. Pradip Das's topic is conductance fluctuations and quantum oscillations in topological insulators. Topological insulators (TI's) are materials that behave as insulators in its interior and have conducting boundaries or edges. Topological order is protected by time reversal symmetry analogous to the quantum spin Hall effect. He has discussed the magneto transport study of nano device made from mechanically exfoliated flake of $PbBi_4Te_7$ topological insulator single crystal.

Dr. Gourav Bhattacharya's lecture focuses on the advanced energy materials for green energy storage. The global energy crisis is arising mainly because of the depletion of the non-renewable energy sources.

Our fourth speaker Prof. Samata Saha's lecture is about the advancement of the new generation Al-matrix composite. Metal matrix composite (MMC) materials have attracted considerable attention due to their ability to offer unusual combinations of stiffness, strength to weight ration, high temperature performance and hardness. Extensive research work in this area has led to the development of novel in situ processing techniques.

Apart from the invited talks, several poster presentations from different fields of physics are also extend our knowledge towards the world of new trends in research.

Dr. Sudipta Roy
Convener, NSRTP-2019

Organizing Committee:

Dr. Falguni Mukhopadhyay, Principal, Bidhan Chandra College, Asansol
Dr. Sudipta Roy, Convener, Department of Physics
Sri. Ajay Kumar Sharma, Treasurer, Department of Physics
Dr. Goutam Mukherjee, HOD, Department of Physics
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Dr. Sujit Kumar Bera, Bursur, Bidhan Chandra College, Asansol
Dr. Saumen Chakraborty, Member, Department of Physics

PROGRAM SCHEDULE

VENUE – SEMINAR HALL (Room No-307), BIDHAN CHANDRA COLLEGE ASANSOL

9.30 – 10.30 AM-Registration

10.30-11.00 AM- Inauguration

TECHNICAL SESSION-1 (11.00AM-12.00NOON)

Conductance Fluctuations and Quantum Oscillation in Topological Insulator

By Pradip Das

Department of Pure and Applied Physics, Guru Ghasidas Vishwavidyalaya, Koni Bilaspur-495009, C. G., India.

TECHNICAL SESSION-2 (12.00 NOON – 1.00 PM)

Structural and Electrochemical Properties of Carbonaceous Nanomaterials, Metal Oxides and Model Bio-membranes and Their Applications in Energy Storage Devices

By Gourav Bhattacharya

PhD. Research Scholar,
Department of Physics, School of Natural Sciences,
Shiv Nadar University, Delhi

1.00PM-2.00PM- Lunch Break

TECHNICAL SESSION-3 (2.00 PM-3.00PM)

Advancement in the new generation Al matrix composites—challenges and opportunities

By Smt. Samata Saha

Assistant Professor
School of Basic Science, Kazi Ranga University, Assam

TECHNICAL SESSION-4 (3.00 PM-4.00PM)

Phosphor based white light emitting systems suitable for indoor and outdoor lighting

By Subrata Das

Senior Scientist
Materials Science and Technology division, CSIR-National Institute for Interdisciplinary Science and Technology, Thiruvananthapuram-695019, India

TECHNICAL SESSION-5 (4.00 PM-5.00PM)

Poster Presentation- By the Participants

VALEDICTORY SESSION - (5.00PM –5.30 PM)

Vote of Thanks and Certificate Distribution

Table of Content

Conductance Fluctuations and Quantum Oscillation in Topological Insulator

Pradip Das
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Abstract: Topological insulators (TIs) are materials that behave as insulators in its interior and have conducting boundaries or edges. This unique characteristic of topological insulator was realized because of strong spin orbit coupling (SOC) of heavy elements. Topological order is protected by time reversal symmetry analogous to the quantum spin Hall effect. Here, we present the magneto-transport study of nano device [figure 1(a)] made from mechanically exfoliated flake of PbBi4Te7 topological insulator single crystal. Figure 1(b) have illustrated the temperature variation of Rxx, showing positive temperature coefficient of resistance above 15 K and bellow 15 K it shows saturating nature, reflecting the bulk metallic signature. We present the observations of weak anti-localization and Berry π Shubinikov-de-Haas (SdH) oscillations [figure 1(c-d)] accompanied by unique conductance fluctuations. phase confirmed from SdH oscillations indicate the Dirac nature of the carriers. Detail analysis of SdH oscillations corroborate the two calculated Fermi wave vectors correspond to the two surface Dirac cones (buried one inside other) and reveals that the oscillations show a beating nature corresponding to the presence of multiple frequencies related to different Fermi surfaces. Estimated root mean square amplitude in conductance fluctuations is higher than the usual universal conductance fluctuation. The fluctuations in conductance are decreasing with increasing field, exactly opposite to the observation we have for the SdH oscillations. Auto correlation functions [not shown] indicate observed fluctuation associated with the topological surface states.

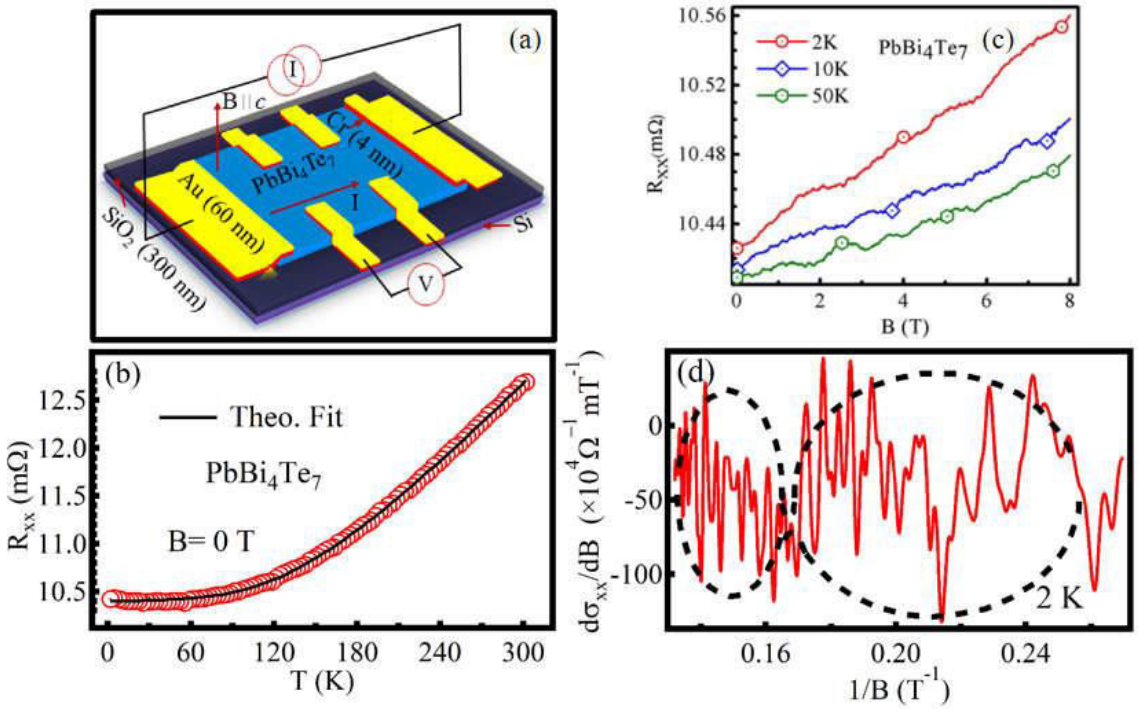

Figure: (a) Nano device of PbBi4Te7. (b) Temperature variation of longitudinal resistance for the nano device. (c) Variation of Rxx with magnetic field showing weak anti-localization. (d) SdH oscillations observed at 2 K, showing beating nature.

Structural and Electrochemical Properties of Carbonaceous Nanomaterials, Metal Oxides and Model Bio-membranes and Their Applications in Energy Storage Devices

Gourav Bhattacharya
PhD. Research Scholar,
Department of Physics, School of Natural Sciences,
Shiv Nadar University, Delhi.

Abstract: The global energy crisis, mainly due to the depletion of non-renewable energy resources, demands focused research on advanced energy materials for power generation and green energy storage. Supercapacitors are promising energy storage devices compared with traditional batteries; with elevated power density, high charge-discharge rates, improved cyclic stability and safer operation. However, the usage of supercapacitors is limited due to the relatively lower energy density. A device that could provide high energy and power density simultaneously can be utilized in multi-dimensional applications, such as portable electronics, electric vehicles etc. Therefore, the prime interest in this Ph.D. thesis is to enhance the energy density of supercapacitors, without affecting the power density and cyclic stability. To address this issue, two major strategies have been employed: i) synthesis and utilization of novel green nanomaterials and advanced engineered nanocomposites for high-performance stable supercapacitor electrode, ii) exploration of various combination of electrolytes to enhance the effective potential window of the device. To achieve the goal, different carbon-based nanomaterials, nanostructures, metal oxide nanoparticles and model bio-membranes, along with several aqueous, non-aqueous and polymer-based electrolytes have been utilized to design high performance supercapacitors. In-depth structural and electrochemical investigation have been carried out to understand the electrode-electrode and the electrode-electrolyte interactions and charge storage mechanism. Finally, fabrication and performance analysis of a lightweight, flexible, all-solid-state micro-supercapacitor is presented.

Phosphor based white light emitting systems suitable for indoor and outdoor lighting

Subrata Das
Senior Scientist
Materials Science and Technology division, CSIR-National Institute for Interdisciplinary Science and Technology, Thiruvananthapuram-695019, India
*Email: physubrata@gmail.com

Abstract: White light-emitting diodes (LEDs)are greatly used in producing displays and lighting sources due to their crucial advantages such as long lifetime, high luminescence productivity, extraordinary brightness, low power feeding, and eco-friendly nature.White light can be generated via the suitable phosphor coating on the blue or UV LED chips. This presentation will elaborate on the actual knowledge behind the phosphor based solid state lighting technology very briefly. In addition, some potential phosphors suitable for solid-state lighting will also be demonstrated.

Keywords: *Phosphors, photoluminescence, light emitting diodes.*

POSITRONIUM IMPACT IONIZATION OF ALKALI LIKE IONS

D. Ghosh*
Michael Madhusudan memorial College, Durgapur, Burdwan, India

Abstract: New experimental techniques and theoretical methods are enabling the understanding of basic atomic and molecular collision phenomena. Theoretical calculations complement experimental data and envisage to design future experiments. Relatively little theoretical work has been carried out though Positronium (Ps) turned out to be an interesting projectile. Such collisional processes also invoke knowledge on fundamental antiparticle-matter interactions. In this work a study of Ps impact ionization of Alkali like ions are performed in model potential approach. These collision processes find interest as alkaline ions have simple structure, where as the projectile being the simplest particle- antiparticle system.

From the theoretical perspective, single ionization process of Alkali like ions by Ps impact, is a bit difficult task as it becomes a four body problem. The complexity mainly arises due to the internal degrees of freedom of the projectile Ps which must be taken into account. However the direct Coulomb interaction between the Ps and the ionic target is very much smaller as compared to that arising from the electron exchange effect between them. The present calculations have been done with Distorted Eikonal Approximation [1] and in the frame work of model potential formalism [2,3].

The present target ionization (by Ps impact) is different from the pure single ionization of the target atom/ ion by positron or electron impact and as such the present Triple differential cross sections (TDCS) additionally carries the information about the influence of the Ps on the target electron distributions. Depending on the kinematics of the particular collision process and the model potential interesting behaviour of the TDCS have been found in the present work.

Key words:single ionization, Differential Cross sections, Positronium, Model potential, Eikonal approximation

References:

[1]. S. Roy et al 2005 J. Phys. B **38** 2145
[2]. A. Ghoshal and Y. K. Ho, Phys. Rev. A **95** 052502 (2017)
[3]. M K Pandey, Y-C Lin and Y K Ho J. Phys. B At. Mol. Opt. Phys. 49 (2016) 034007

Method of implementation of polarization encoded optical NOT gate based on polarization rotation in semiconductor optical amplifier

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Abstract: In this communication we are going to propose an optical NOT gate based on polarization rotation phenomenon in Semiconductor Optical Amplifier (SOA). The detection part is based on polarization encoding. It can solve the problem related to packet contention, wavelength contention, connectivity, scalability of the WDM networks. The SOA used for this purpose is tiny in shape (~ 800μm.) with less power requirement (≤ 0.5mW). As per our knowledge, most of the research works are based on intensity, phase and frequency encoding. Now intensity is loss dependent. Phase of a signal is very hard to handle in the long range communication. Frequency encoding needs high power laser sources and optical frequency detectors (OSA: Optical Spectrum Analyzer) are costly and power consuming. But polarization encoding deals with polarization of optical signals can be detected by simple polarizers. In this

communication we are going to deal with binary logic based optical switch for two different states of polarization of optical signals. We consider, 'horizontal polarization (●)' of optical signal as 'state 0', 'vertical polarization (↕)' as 'state 1'. Most of the optical devices used in this work, like polarization controller (PC), beam combiner (BC), polarization beam-splitter (PBS), polarizer (PZ) etc., are passive in nature. So, no extra power sources are needed. Some simulation work using MATLAB is used to analyze the performance of the proposed design (figure 1) working in ultra-high speed (~10GHz). Principle behind the operation of the switch is based on polarization induced gain of SOA in the counter propagating scheme. The non-linear polarization rotation of the probe beam due to high intense pump beam induced refractive index change is one of the important non linearity in SOA. Inside the SOA, the strong pump beam and the probe beam interact. This interaction causes change in the optical properties of the SOA which in turn modify the intensity and state of polarization of the probe beam. If linear light is injected into the SOA, after passing through it, the state of polarization (SOP) may be circular, elliptical or linear with rotated azimuth and the ellipticity angle of the probe beam changes with the propagation through the medium depending on the power level of the pump beam.

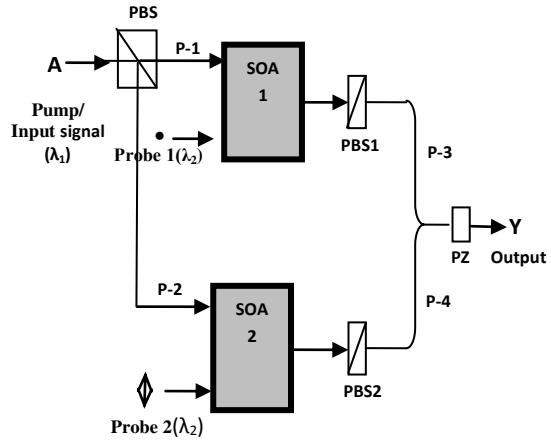

Figure 1

Case	Input (A)	Output(Y)
(I)	0(•)	1(↕)
(II)	1(↕)	0(•)

Horizontally polarized signal: state 0(•),
Vertically polarized signal: state 1(↕)

DETERMINATION OF DEBYE TEMPERATURE AND DEBYE-WALLER FACTOR OF $A^IB^{III}C_2^{VI}$ & $A^{II}B^{IV}C_2^{V}$ TYPE CHALCOPYRITE SEMI-CONDUCTORS

Ajay Kumar Sharma
Assistant Professor, B.C.College, Asansol, Research Scholar, JRU,Ranchi

Abstract: For more than 30 years, chalcopyrite semi-conductors with the forms $A^IB^{III}C_2^{VI}$ & $A^{II}B^{IV}C_2^{V}$ have attracted much attention due to their potential applications in non-linear optical devices, detectors, solar cells etc. Numerous researchers have proposed a numbers of models to study the mechanical, electronic, chemical and optical properties of these types of solids.In the present work a simple empirical model has been proposed to estimate the Debye temperature (Θ_D) of ternary chalcopyrite structure solids of $A^IB^{III}C_2^{VI}$ & $A^{II}B^{IV}C_2^{V}$ type from the electro-negativities of the constituent atoms and the principal quantum number of atoms of the compounds. The empirical relation is based on the chemical bond theory. The Debye-Waller factors for the ternary chalcopyrite semi-conductors are determined from the calculated values of Debye Temperature. The results obtained using the formula is found to be in excellent agreement with the available experimental data.

Analysis of soliton based 3-input NOR gate using Tera Hertz Optical Asymmetric Demultiplexer (TOAD)

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Abstract: As an alternative technique frequency encoding for representation of data has attracted a large number of researchers in optical computation and signal processing again. In last few years lots of frequency encoded logic processors have been proposed using varieties of switching mechanism like difference frequency generation, four wave mixing, non linear polarization rotation, cross gain modulation etc. The switch consists of a loop mirror with SOA (offset from the loop mid point by an amount Δ), control signal input points, a 2x2 coupler, and proper circulator, filters to introduce data signal and to extract output. The switch works in such a way that the output signals can be switched from port 1to port 2 by the application of control signal. The control signal and input data signal should have different frequencies. Input data signal splits into counter - clockwise (D_{ccw}) and clockwise (D_{cw}) components, which propagate around the loop and reach the SOA at slightly different times. If the control beam is absent then both these component experience same unsaturated SOA gain and recombine at the coupler. Since in this condition no phase difference is introduced between them, the data signal comes out of the reflected port i.e. output port P_2. No signal is present in this condition at port P_1. Now if the control signal is present, due to the gain saturation of the SOA and refractive index change, the two components will experience different phase shift. If the phase difference is π, then they recombine in the coupler and data signal will exit through output port P_1. In this condition there will be no signal at the port P_2.

In this paper, we have proposed and analyzed Tera Hertz Optical Asymmetric Demultiplexer (TOAD) based 3-input NOR gate using soliton pulse. Basically we used control signal and data signal as a soliton pulse train. The simulated output and pseudo eye-diagram of the NOR gate confirm that its feasibility in all optical and electrical communication system. The diagram of TOAD based 3-input NOR gate as shown in fig1.

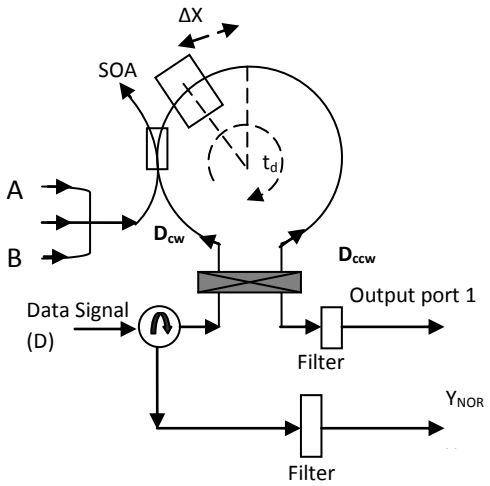

Fig1. TOAD based 3- input NOR gate

When any there is no signal in the inputs A,B and C, there is no gain saturation and phase change between counter propagating signal. So the second port transmits high light i.e. NOR output corresponding to A=B=C=0. Similarly, if there is at least one input is high, there is gain

saturation and phase change of π giving no output in the second port from where NOR output is taken. So, other conditions of NOR gate is also satisfied.

Nonlinear Kerr Lens Based All Optical Parity Generator

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Abstract: Optics has established itself as a promising candidate for future parallel computation and communication system. All optical switching has an important role for implementation of the optical computation and communication system components. There are several types of switching techniques based on different kind of optical phenomena and materials. Nonlinear material based switching is very important for the application in optical switching technology. The effectiveness of the switching depends on the amount of deviations produced by the nonlinearity of the devices (materials) and is better for prism shaped devices compared to slab structure and devices based on absorption are less susceptible to optical damage and has less speed of operation compared to refraction based devices which will be proposed in this communication. However, the deviation produced by a prism depends on the angle of incidence, and very small deviations can be produced for high intensity. Comparatively a lens can produce more deviation with same intensity and its focal length does not depend on the angle of incidence but is a constant quantity for a particular lens material and surroundings. It depends on the radii of curvature of the curved surfaces and can be adjusted to make the focal lengths as desired. In this communication a nonlinear lens utilizing Kerr effect in nonlinear materials. The variation of focal length, variation of Change of focal length, angular deviation corresponding to focal length with intensity of the incident light is analyzed. The refractive index of many optical materials depends on the intensity of the light, and is called Kerr effect, by analogy with the traditional Kerr electro optic effect. This effect can be explained by nonlinear polarization and the intensity dependent refractive index is given by

$$n = n_0 + n_2 I \ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Here 'I' represents the intensity of the incident light, n_0 represents the usual weak field refractive index, and n_2 is the nonlinear correction term. The nonlinear change may be produced by several mechanisms such as electronic polarization, molecular orientation change, thermal effects, photo-refraction etc. Electronic polarization produces n_2 with response time of femto-seconds and thus very fast. This refractive index change is utilized to change direction of propagation of a light beam of suitable intensity and optical switching can be achieved. This switching is utilized to design the Nonlinear Kerr Lens(NKL) and is utilized to design all optical parity generator. When there is no light shining in the NKL, the focal length is

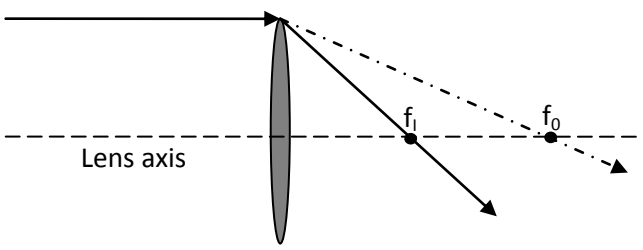

Figure 1. Nonlinear Kerr Lens(NKL)

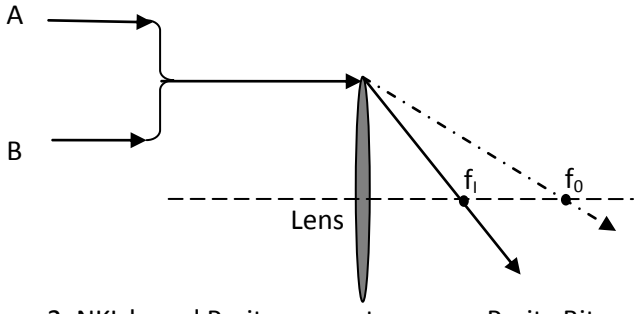

Figure 2. NKL based Parity generator Parity Bit

f_0, but when there is some light shining then the focal length changes to f_I, Using this lens in the figure 2 below a two bit parity generator is designed. When any one of the signals A and B is high, then the light follow the path through the focal point f_I, and when both the inputs A and B are high or Low, there is no light along this path. Thus this terminal behaves like an X-OR gate and hence produces Parity bit for the two bit number.

Effect of additional direct coupling on the hysteresis loop of mean field diffusively coupled oscillators

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Abstract: Death of oscillation is one of most emergent collective behavior of the coupled oscillators. The coupled oscillators under mean field diffusive coupling show an abrupt transition from oscillatory state to death state with hysteresis (explosive death) [1]. In this paper we modify the mean field diffusively coupled system by introducing an additional direct coupling. This modification is able to impose a control on the hysteresis occur in such system due to high nonlinearity. With the variation of the strength of direct coupling the area of hysteresis loop also varies. It is also possible to make it zero with proper choice of strength. The phenomenon of abrupt transition from oscillatory state to steady state is reduced under such condition, even if we observe the transition become continuous in case of limit cycle oscillator with zero hysteresis. To study the effect of such modification a numerical simulation has been carried over a mean field diffusively coupled limits cycle and also over a mean field diffusively coupled chaotic oscillators.

Key Words: Hysteresis, Explosive death, Control, Coupling

[1] U.K.Verma, A.Sharma, N.K.Kamal, J.Kurths and M.D.Shrimali, "Explosive death induced by mean field diffusion in identical oscillators", Scientific Report 7:7936, 2017. DOI:10.1038/s41598-017-07926-x