

International Workshop
*Mathematics and Physics of Complex
and Nonlinear Systems*

IIT Kanpur, March 14-26, 2004

Theme: *ChaNoXity: The Nonlinear Dynamics of Nature*

Organized by

Pons Varolii · Indian Institute of Technology Kanpur

in association with ····· Cerebellum

Medulla Oblongata · Indian Society of Nonlinear Analysts, Kolkata

Spinal Cord

The Workshop --- aimed at a focused debate and discussion on the mathematics and physics of *Chaos, Complexity, and the Nonlinear Dynamics of Nature* --- will seek to investigate the role of chaos, nonlinearity and complexity in the dynamical evolution of nature that is expected to induce a process of reeducation and reorientation to supplement the basically reductionist attitude of modern science. There will be approximately 45-50 hours of lectures by a core body of 10-12 speakers in the 2-week period of the Workshop. In keeping with its goal of providing an open platform for exposition and discourse on the thematic topic, each of the 5-6 lectures a day will be of 75 minutes duration to provide an adequate and meaningful interaction, formal and informal, between the speaker and his audience. The goals of the workshop will be to

- Create an awareness among the participants of the workshop, drawn from the research and educational institutions in India and abroad, of the role and significance of nonlinearity in its various manifestations and forms.
- Present an overview of the strong nonlinearity of chaos and complexity in natural systems from both the mathematical and as physical points of view. The relevant mathematics will be drawn from the following areas: topology, measure-theory, inverse and ill-posed problems, set-valued analysis, and nonlinear functional analysis.
- Explore the role of non-extensive thermodynamics and statistical mechanics in nonlinear systems.
- Motivate the teaching and research of nonlinear sciences in educational and research institutions.

★ **Why Nonlinearity?** ★

The reductionist approach of breaking down natural systems into its simple constituent units whose properties combine in a relatively simple manner to yield the complex laws of the whole has dominated the natural sciences over the last century with good reason: it has served to explain some of the most fascinating intellectual challenges of mankind. But shortfalls in reductionism are becoming increasingly apparent: whereas one of the most striking features of physical laws from those of Newton to Einstein is their inherent linear simplicity, the world outside the classroom is astonishingly complex and non-

linear. So then, why is the real world we live in so complex and challenging to the understanding of the fundamental nature of its dynamics if the governing laws are as simple as they are supposed to be?

The passionate believers of the new emergent science of nonlinearity believe that whereas twentieth-century theoretical physics came out of the relativistic and the quantum mechanical revolutions which was all about simplicity and continuity with its principal tool being calculus, twenty-first-century is slowly emerging out of the chaos revolution into complexity. Though its final expression remains to be found, thermodynamics, as a vital part of theoretical physics, is expected to partake in the transformation.

The Workshop, hopefully to be followed by similar ones in future, is expected to be a forum of inquiry into those aspects of nonlinearity that have made it the exciting field it promises to be, as also to contribute to the basic goal of the Indian Society of Nonlinear Analysts (ISNA) of providing a common platform for a meaningful and constructive interaction among the diverse fields of human scientific endeavour that are finding nonlinear techniques increasingly relevant and useful. Briefly, we expect to initiate discussions on the physics and mathematics of nonlinearity involving questions of why the linear reductionist world of today's classroom is so markedly different from the actuality of Nature, and to investigate the role of an integrative supplementary agenda in reductionism that seeks to explain those properties of the whole which emerge only when simple constituent parts are put together to interact and yield the resulting complex system. The uniquely distinguishing feature of this agenda that forms the theme of the meeting and is part of ISNA's objective, is that through a process of dialogue, debate and discussion on some of the open and most challenging questions of recent times, the Workshop will consciously seek to focus on the nonlinearity of Nature's evolutionary dynamics.

★ Duration of the Workshop ★

This intensive Workshop is for a period of two weeks March 14 to March 26, 2004

★ Conveners ★

Professor A Sengupta, Department of Mechanical Engineering, IIT Kanpur
Professor A Mookerjee, S N Bose National Centre for Basic Sciences Kolkata

★ Registration Fee ★

India: Rs 2500.00. *Bonafide Research Scholars:* Rs 1000.00; local hospitality not included. **Overseas:** USD 300.00.

Remit by A/C Payee Bank Draft in favour of "Nonlinear-Kanpur 2004" addressed to: Professor Brahma Deo, Department of Materials and Metallurgical Engineering, IIT Kanpur. You may also register at the registration desk, but please do send in the completed Registration Form.

★ Accommodation ★

All participants will be housed at Visitor's Hostel and Hall of Residence at IIT Kanpur. Contact: Professor Prabhat Munshi, Department of Mechanical Engineering, IIT Kanpur. E-Mail: pmunshi@iitk.ac.in

★ Proceedings ★

To be published after the Workshop. Details will be announced.

★ Programme Schedule ★

(All Lectures at Pioneer Batch Centre, IIT Kanpur Visitor's Hostel)

First Week, March 14-20

Sunday March 14, 2004

3:00-6:00 PM. Registration.

Monday March 15, 2004

9:00 AM. Inauguration of Workshop.

9:30 AM. Tea.

10:00 AM. S. Kesavan (Institute of Mathematical Sciences, Chennai) *Topological Degree and Bifurcation Theory*. Lecture 1.

11:15 AM. S. Abe (University of Tsubuka, Japan), *An Overview of Non-Extensive Statistical Mechanics*. Lecture 1.

12:30 PM: Lunch

3:00 PM. Karmeshu (Jawaharlal Nehru University, New Delhi) *Uncertainty, Entropy, and Maximum Entropy Principles*. Lecture 1.

4:15 PM. Kesavan, Lecture 2.

Tuesday March 16, 2004

9:00 AM. Karmeshu, Lecture 2.

10:15 AM. Abe, Lecture 2.

11:30 AM. Kesavan, Lecture 3.

12:45 PM. Lunch

3:00 PM. A. Robledo (Universidad Nacional Autonoma de Mexico, Mexico), *Ergodicity Failure and the Physical Realm of Non-Extensive Statistics*. Lecture 1.

4:15 PM. Karmeshu Lecture 3.

Wednesday March 17, 2004

9:00 PM. Masa-aki Sakagami (Kyoto University, Japan), *Thermodynamics of Self-Gravitating Systems*. Lecture 1. 9:00 AM. Kesavan. Lecture 5.

10:15 AM. Kesavan, Lecture 4.

11:30 AM. Karmeshu (Jawaharlal Nehru University, New Delhi), *Nonlinear Models of Social Systems*, Lecture 1.

12:45 PM. Lunch

3:00 PM. Robledo. Lecture 2.

4:15 PM. Kesavan. Lecture 5.

Thursday March 18, 2004

9:00 AM: Sakagami, Lecture 2.

10:15 AM. Robledo, Lecture 3.

11:30 AM. S. Abe (University of Tsubuka, Japan), *Equilibrium and Stationary*

Nonequilibrium states of Nonextensive Systems, Lecture 1.

12:45 PM. Lunch

3:00-6:00 PM. Open Forum I: Nonextensivity, Complexity and All That.

Coordinators: S. Abe and S. Kesavan.

Friday March 19, 2004

9:00-10:00 AM. Francisco Balibrea (University of Murcia, Spain) *Dynamical Systems of Low Dimension and Applications*. Lecture 1.

10:15-11:15 AM. Abe, Lecture 2.

11:30AM-12:30PM. A. G. Bashkirov, (Institute for Dynamics of Geophysics, Russian Academy of Sciences, Moscow). *Non-Boltzmannian Entropies and Maximum Entropy Principle*. Lecture 1.

12:45 PM. Lunch

3:00-4:00 PM. Balibrea, Lecture 2.

4:15-5:15 PM. Bashkirov, Lecture 2

Saturday March 20, 2004

9:00-10:00 AM. Balibrea Lecture 3.

10:15-11:15 AM. Bashkirov, Lecture 3.

Second Week, March 22-26

Monday March 22, 2004

9:00-10:00 AM. Balibrea, Lecture 4.

10:15-11:15 AM. Russ Marion (Clemson University, USA). *Complex Systems: Analyses of Leadership, Change and Disruption*. Lecture 1.

11:30AM-12:30PM. Bashkirov, Lecture 4.

12:45 PM. Lunch

3:00-4:00 PM. Balibrea, Lecture 5.

Tuesday March 23, 2004

9:00-10:00 AM. A. Mookerjee (S. N. Bose National Centre for Basic Sciences, Kolkata). *Scaling in Phase Transitions*.

10:15-11:15 M. Z. Nashed (University of Central Florida, USA), *Inverse ill-posed Problems and Nonlinear Analysis*. Lecture 1.

11:30AM-12:30 PM. Marion, Lecture 2.

12:45 PM. Lunch

3:00-4:00 PM. A. Mookerjee (S. N. Bose National Centre for Basic Sciences, Kolkata). *Nonlinear Stochastic Equations*.

4:30-5:30 PM. A. Sengupta (IIT Kanpur). *Chaos and Complexity: A Nonlinear Dynamics of Nature*. Lecture 1.

Wednesday March 24, 2004

9:00-10:00 AM. Nashed, Lecture 2.

10:15-11:15 AM. Marion, Lecture 3.

11:30AM-12:30PM. Karmeshu, Lecture 2.

12:45 PM. Lunch

3:00 PM-4:00. Bashkirov, Lecture 5.

4:30-5:30 PM. Sengupta, Lecture 2.

Thursday March 25, 2004

9:00-10:00 AM. Nashed, Lecture 3.

10:15-11:15 AM. A. Thakur (West Bengal University of Technology, Kolkata) *TBA*.

11:30AM-12-30PM. Karmeshu, Lecture 3.

12:45 PM. Lunch

3:00-6:00 PM. Open Forum II: Where to *ChaNoXity*?

Coordinators: M. Z. Nashed and A. G. Bashkirov.

Workshop Dinner. March 25, 8-10 PM

Sponsored by: Spinco Biotech, Delhi

Courtesy: Professor Pradip Sinha, BSBE

Friday March 26, 2004

9:00-10:00 AM Nashed, Lecture 4.

10:15-11:15 AM. Marion, Lecture 4.

11:30AM-12:30PM. Sengupta, Lecture 3.

12:45 PM. Lunch

3:00-4:00 PM. Marion, Lecture 5.

4:30-5:30 PM. Nashed, Lecture 5.

6:00-6:30PM Closing of Workshop.

ChaNoXity
Chaos–Nonlinearity–Complexity
The Nonlinear Dynamics of Nature