

A short course on Superoscillations and Weak Measurement

5 – 12 December 2016

OVERVIEW

This concerns a substantial and fast-developing new area, linking a number of what were thought to be separate subjects: quantum physics, optical singularities, mathematical function theory, and superresolution microscopy. These are subjects that do not form part of the usual student or Ph.D courses, but can be explained without too much high-power theory. It provides a wonderful illustration of the unity of different areas of mathematics and physics. ‘Weak Measurement’ has been experimentally realized and has been used for accurate parameter estimation. This subject has found applications in variety of areas starting from Quantum Parameter Estimation, Spin Hall Effect etc. The theoretical underpinning of this is the subtle phenomenon of Super oscillations.

Objectives and course details:

The primary aim of the proposed course is to introduce students to the basic concepts of superoscillations. The course will cover the following topics:

- Parameter estimation and weak value amplification in quantum physics, e.g., electron spin.
- Optical singularities and amplification of effects like Goos–Hänchen and Imbert–Fedorov shifts in optical wave packet dynamics.
- Mathematical function theory: The mathematical underpinning behind weak measurement needs to be carefully understood in the context of function theory.
- Superresolution microscopy: Weak measurement and Superoscillations are finding application in Superresolution microscopy. This has tremendous scientific and technological importance

Every morning there will be a one-hour lecture on the topics outlined above. This will be followed by tutorial and discussions. Tutorials will be based on concepts developed in the lecture and will be designed by the external expert. The local coordinator, together with PhD students, will conduct the tutorials. There will be ample opportunities for participants to interact with the expert throughout the duration of the course.

COURSE VENUE

Lecture Hall Complex
Indian Institute of Science Education and Research Kolkata
Mohanpur – 741 246, West Bengal, India

TARGET AUDIENCE

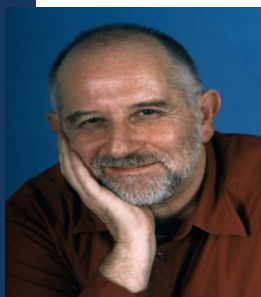
- The proposed course is aimed at 4th and 5th year BS-MS, Integrated PhD and PhD students of IISER Kolkata.
- Teachers and researchers from colleges and universities.

COURSE FEES

- Student participants: ₹2,000/- (refundable caution money)
- Academics, Researchers and Teachers: ₹5,000/-
- Industry participants: ₹10,000/-
- Participants from abroad: \$200/-

The above fee includes all instruction material, computer use for tutorials and assignments, laboratory equipment usage charges, free internet facility.

THE FACULTY



Sir Michael Victor Berry (FRS) is a mathematical physicist at the University of Bristol, England. He was elected a fellow of the Royal Society of London in 1982 and knighted in 1996. From 2006 he has been editor of the journal, *Proceedings of the Royal Society*. He is famous for the Berry phase, a phenomenon observed e.g. in quantum mechanics and optics. He specialises in semi classical physics (asymptotic physics, quantum chaos), applied to wave phenomena in quantum mechanics and other areas such as optics. He is also currently affiliated with the Institute for Quantum Studies at Chapman University in California. Career The son of a London taxi driver,[4] Berry has a B.Sc. in physics from the University of Exeter and a PhD from the University of St. Andrews. [5] Since then, he has spent his whole career at the University of Bristol: research fellow, 1965–67; lecturer, 1967–74; reader, 1974–78; Professor of Physics, 1978–88; Royal Society Research Professor since 1988.

Professor Berry is the recipient of many distinguished awards: • Maxwell Medal and Prize, Institute of Physics, 1978 • Elected Fellow of the Royal Society of London, 1982 • Elected Fellow of the Royal Society of Arts, 1983 • Elected Fellow of the Royal Institution, 1983 • Elected Member of the Royal Society of Sciences in Uppsala, Sweden, 1986 • Bakerian Lecturer, Royal Society, 1987 • Elected member of the European Academy, 1989 • Dirac Medal and Prize, Institute of Physics, 1990 • Lilienfeld Prize, American Physical Society, 1990 • Royal Medal, Royal Society, 1990 • Naylor Prize and Lectureship in Applied Mathematics, London Mathematical Society, 1992 • Foreign Member: US National Academy of Science, 1995 • Dirac Medal, International Centre for Theoretical Physics, 1996

• Kapitza Medal, Russian Academy of Sciences, 1997 • Wolf Prize for Physics, Wolf Foundation, Israel, 1998 • Honorary Fellow of the Institute of Physics, 1999 • Foreign Member: Royal Netherlands Academy of Arts and Sciences, 2000[7] • Ig Nobel Prize for Physics, 2000 (shared with Andre Geim for "The Physics of Flying Frogs") • Onsager Medal, Norwegian Technical University, 2001 • Gibbs Lecturer, American Mathematical Society, 2002 • 1st and 3rd prizes, Visions of Science, Novartis/Daily Telegraph, 2002 • Elected to Royal Society of Edinburgh 2005 • Pólya Prize, London Mathematical Society 2005 • Doctor of Science, honoris causa, University of Glasgow 2007 • Doctor of Science, honoris causa, Russian-Armenian (Slavonic) University in Yerevan 2012 • Lorentz Medal (2014)



Prasanta K Panigrahi is Professor of Physical Sciences at Indian Institute of Science Education and Research Kolkata and is currently the Dean of Faculty Affairs. His research focuses on Bose-Einstein Condensates, Cold fermions, Nonlinear Dynamics, Quantum Computation and Quantum Information, Field Theory and applications of Wavelet Transform.

COURSE CO-ORDINATOR

Prof. Prasanta K. Panigrahi

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IMPORTANT INFORMATIONS

- For course registration please visit: <http://www.gian.iitkgp.ac.in/GREGN/index>
- Registration Deadline: **30 October 2016**
- Fess to be paid by NEFT:
 - Name of the Beneficiary: IISER Kolkata Project A/c
 - Name of Bank and Branch: Indian Overseas Bank, Mohanpur
 - Beneficiary Account No.: 325001000000002
 - Bank MICR Code: 700020092
 - Bank IFS Code: IOBA0003250
- Accommodation based on nominal charges (per day) will be available to all participants. Participants need to bear their own accommodation and food expenses.

- After successful completion of the course, all participants will get participation certificates.
- No TA, DA will be provided to the participants.
- How to reach: <http://www.iiserkol.ac.in/contactus/how-to-reach>

ABOUT IISER KOLKATA

The Indian Institute of Science Education and Research (IISER) Kolkata was established in 2006 by the Ministry of Human Resource Development (MHRD), Government of India. This initiative was a part of the Government's effort to set up a number of new academic institutions of international standard that would train specialised manpower in basic sciences and allied technologies. Our central theme is to provide quality science education and to carry out research in basic and frontier areas of science involving both undergraduate and postgraduate students, in an intellectually vibrant atmosphere. Through borderless and flexible education programmes involving multi-disciplinary as well as inter-disciplinary curriculum, IISER Kolkata provides an unparalleled opportunity for young students to experience the excitements of research in basic sciences. In essence, IISERs are devoted to both teaching and research in an integrated manner – thus nurturing both curiosity and creativity. For more details please visit the link <http://www.iiserkol.ac.in>, and to reach **IISER Kolkata**, please see the link <http://www.iiserkol.ac.in/contactus/how-to-reach>.