ICTP Prize 2020

15 September 2021, 16:00

http://indico.ictp.it/event/9686/

PROGRAMME

The Abdus Salam
International Centre
for Theoretical Physics

United Nations Educational, Scientific and Cultural Organization

IAEA
International Atomic Energy Agency

THE 2020 ICTP PRIZE

The ICTP Prize was created in 1982 by the ICTP Scientific Council to recognize outstanding and original contributions in physics by young scientists from, and working in, developing countries. The ICTP Prize includes a sculpture, certificate and a cash award.

ICTP has awarded its 2020 ICTP Prize to

Dibyendu Roy
Raman Research Institute, Bangalore, India

Mehdi Kargarian
Sharif University of Technology, Tehran, Iran

Dibyendu Roy's contributions in the field of non-equilibrium properties of mesoscopic systems have led to a deeper understanding of particle, heat and energy transport in open quantum systems. Of particular importance are his seminal works on topological superconductors as well as the interaction of light with matter, including strong photon-photon interactions in waveguide quantum electrodynamic systems. His theoretical predictions have since been verified in spin noise spectroscopy experiments.

Topological phases and strongly correlated electrons are at the core of Mehdi Kargarian's research. He has discovered two of the first examples of fractionalized topological phases where both electron-electron interactions and spin-orbit coupling are important. He also predicted new phases of matter which are known as "weak topological Mott insulator" and the "topological crystalline Mott insulator". Within Iran, Mehdi has served as mentor to a new generation of scientist and provides a key bridge to global scientific developments in the theory of interacting topological phases of matter.

Each year, the ICTP Prize is given in honor of a scientist who has made outstanding contributions to the field in which the prize is given. The 2020 ICTP Prize is dedicated to the memory of David J. Thouless, the main discoverer of topological phases of matter. His fundamental contributions, for which he was also awarded the 1990 Wolf Prize and the 2016 physics Nobel Prize, first explained the coexistence of fluctuations and rigidity in two dimensional systems, then posed the bases of our current understanding of the quantum Hall effect.

2020 ICTP PRIZE CEREMONY PROGRAMME

Welcome remarks, Atish Dabholkar, Director, ICTP

Introductory remarks, Prof. Roderich Moessner, Director and Scientific Member at the Max Planck Institute for the Physics of Complex Systems, Dresden, Germany

Exploring nonequilibrium many-body dynamics of photons using waveguide quantum electrodynamics systems

Dibyendu Roy, Raman Research Institute, Bangalore, India

Abstract:
Photon-photon scattering in vacuum is extremely weak. However, strong effective interactions between single photons can be realized by employing strong light-matter coupling. These interactions are a fundamental building block for quantum optics, bringing many-body physics to the photonic world and providing essential resources for quantum photonic devices and optical metrology. Waveguide quantum electrodynamics (QED) systems have been recently explored to realize strongly interacting photons in one-dimensional systems with no optical confinement along the propagation direction. The absence of optical confinement, which has particular advantages in building quantum networks, makes the waveguide QED systems different from their well-known predecessors, cavity QED and circuit QED systems. These cavity-free systems feature intrinsically nonequilibrium, quantum many-body dynamics. The input field is driven by either a laser or microwave generator, imposing a nonequilibrium boundary condition on the propagating photons. I shall describe our research to theoretically study photon-photon correlation mediated by local light-matter coupling in waveguide QED systems in the strongly interacting and nonequilibrium regimes. I shall further discuss the physical mechanisms behind various applications of these systems in recent years and current trends and future possibilities in this rapidly developing discipline.

Introductory remarks, Prof. Allan MacDonald, Department of Physics, College of Natural Sciences, The University of Texas at Austin, USA

Topological Materials: Correlations and Symmetry

Mehdi Kargarian, Sharif University of Technology, Tehran, Iran

Abstract:
Topological phases of matter have received a surge of interest in recent years, promising a new venue for applications in spintronics and building quantum computers. Topological concepts developed primarily in mathematics have underlined the discovery of topological materials such as topological insulators, superconductors, metals, and quantum magnets. From the physics point of view the electron correlations, nonspatial and crystalline symmetries, spin-orbit coupling, and their interplay play important roles in realizing quantum materials with topological electronic structure in both bulk and surfaces. Electron correlations could lead to electron fractionalizations and emerging exotic quasiparticles with nontrivial statistics being potentially investigated for topological quantum computations. Hence understanding the microscopic origin of quantum topology of underlying electronic structures pave the way for discovering new states of matter in the bulk and heterostructures with ambitious functionalities and applications.In this talk, I briefly discuss the effects of electron correlations and symmetry in topological insulators and introduce new types of Dirac semimetals using symmetry classification.