



FIVE-DAY WEBINAR - SERIES

ON

“Optical Forces on Atoms”

Transform the way you work. Make your career futuristic!

Speaker Details

Prof. Dr. Farhan Saif (SI, POP)

Department of Electronics, Quaid-i-Azam University, Islamabad

Course Outline:

The OIC Ministerial Standing Committee on Scientific and Technological Cooperation (COMSTECH) is pleased to announce a five-day scholarly webinar series based on the internationally recognized book “*Optical Forces on Atoms*”, authored by Prof. Dr. Farhan Saif (Quaid-I-Azam University, Islamabad) and Prof. Shinichi Watanabe (University of Electro-Communications, Tokyo), and published by IOP Publishers (UK).

This series aims to introduce participants to the fundamental and advanced concepts of **light-matter interaction**, **optical forces**, dynamical characteristics of atoms and macroscopic quantum systems, and experimental advancements. The sessions will guide participants from the **historical foundations** of quantum theory to the **latest developments** in quantum control, and quantum technologies.

Drawing upon the authors’ decades of research experience and pedagogical insight, the course combines conceptual depth with theoretical clarity to help participants develop a coherent understanding of this rapidly evolving field.

Learning Objectives:

By the end of this course, participants will be able to:

- Develop a systematic understanding of **optical fields and forces**, ultracold atoms, and the quantum characteristics of the atoms in electromagnetic radiation.
- Discuss **experimentally available optical models** relevant to ultra-cold atoms and light-matter coupling.
- Understand **quantum duality**, **coherence**, and **energy-band formation** in controlling matter waves.

- Explore **applications of quantum and atom optics**, complex dynamics, and their impact on emerging quantum technologies.
- Strengthen research capacity in **OIC member states** through exposure to cutting-edge trends in quantum optics and nano-photonics.

This course is open to:

- Graduate and postgraduate students in **Electronics, Physics, Chemistry, Atom Optics, Quantum Optics, Nanoscience and Quantum Technology**
- Researchers, faculty, and professionals from **academia, R&D laboratories, and high-tech industries**
- Research students and early-career scientists, and technologists
- Policy and program officers involved in promoting **advanced science and technology** within OIC member countries

Course Modules:

Day 1: Historical Foundations and Quantum Field States

- Evolution of quantum mechanics and quantum radiation
- Introduction to field quantization and state types
- Foundations of quantum radiation and field theory
- Interaction of atoms and electromagnetic waves

Day 2: Optical Forces and Atomic Cooling

- Mechanical action of light and optical trapping principles
- Entanglement, scattering and cooling of ultra-low atoms
- Atomic dynamics in optical gratings, and optical crystals
- Bose–Hubbard model, Wannier–Stark Ladder, Bloch Oscillation

Day 3: Cold Atoms in Lattices, Evanescent Fields, Higher Dimensions

- Atomic mirrors, gravitational cavity, waveguides, interferometer
- Surface traps, Quantum revivals of matter waves in nano traps
- Ultra-cold atoms and higher dimensional optical systems
- Quantum scars, Stability versus instability, Floquet analysis

Day 4: Complex Optical Systems and Quantum Dynamics

- Multi-dimensional optical systems and quantum recurrences.
- Dynamical localization, coherent acceleration, atomic bullets
- Radiation-pressure effects in macroscopic quantum systems
- Opto mechanical crystals, entanglement, chaos assisted tunneling

Day 5: Applications in Quantum Technologies

Expected Outcomes

By the end of this webinar series, participants will:

- Understand the **key theoretical frameworks** governing optical forces on atoms
- Gain familiarity with **experimental methods & applications** in quantum/atom optics
- Develop **conceptual clarity** on atom trapping, cooling, and coherence phenomena
- Identify **research and innovation opportunities** in nano and quantum technologies

Course Logistics

- **Dates:** 20–24 October 2025
- **Timing:** 02:30–03:30 PM (PST)
- **Format:** Hybrid (In-person & Online)
- **Venue:** COMSTECH Secretariat, 33-Constitution Avenue, G-5/2, Islamabad

Registration Link: [To be provided]

Contact:

 +92 51 9220681–3
 comstech@comstech.org

Poster of Certified Course: Attached