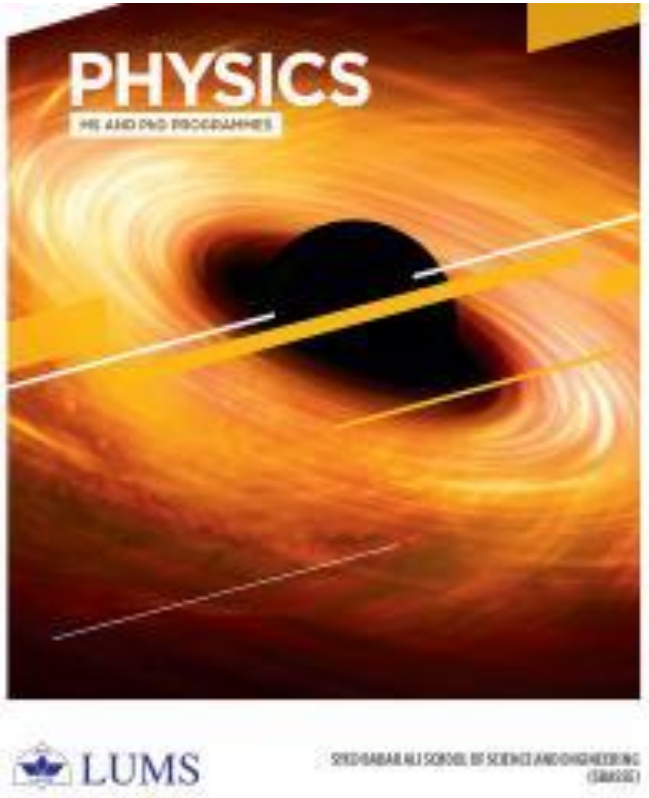


Department of Physics

Muhammad Faryad

Department Chair

Advisory Board Meeting, 25th January, 2021

Vision

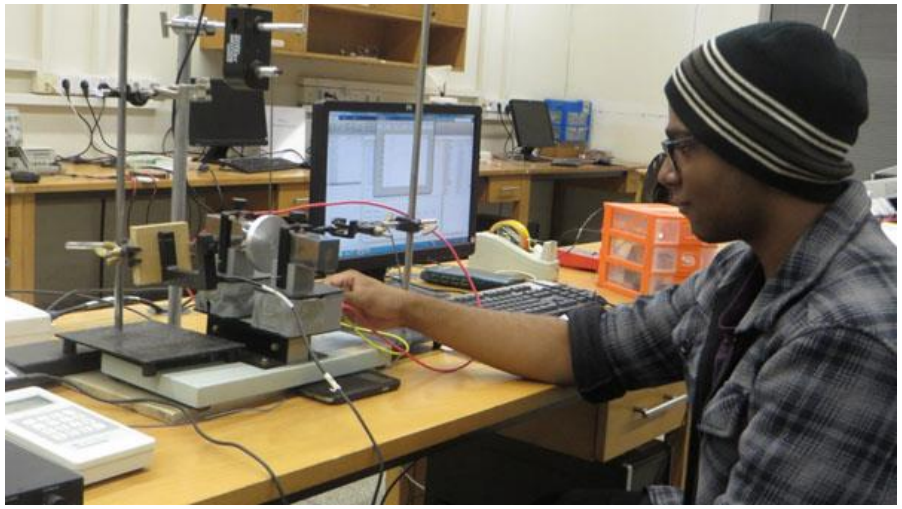
1. To provide strong academic training to students combining depth with breadth for future researchers, educators, and problem solvers

2. To provide quality training in diverse research areas relevant for modern world that complement expertise available in other Pakistani universities

3. To be the focal point of academic and research innovation in Pakistan for theoretical and experimental physics and helping lift the standards of education and research

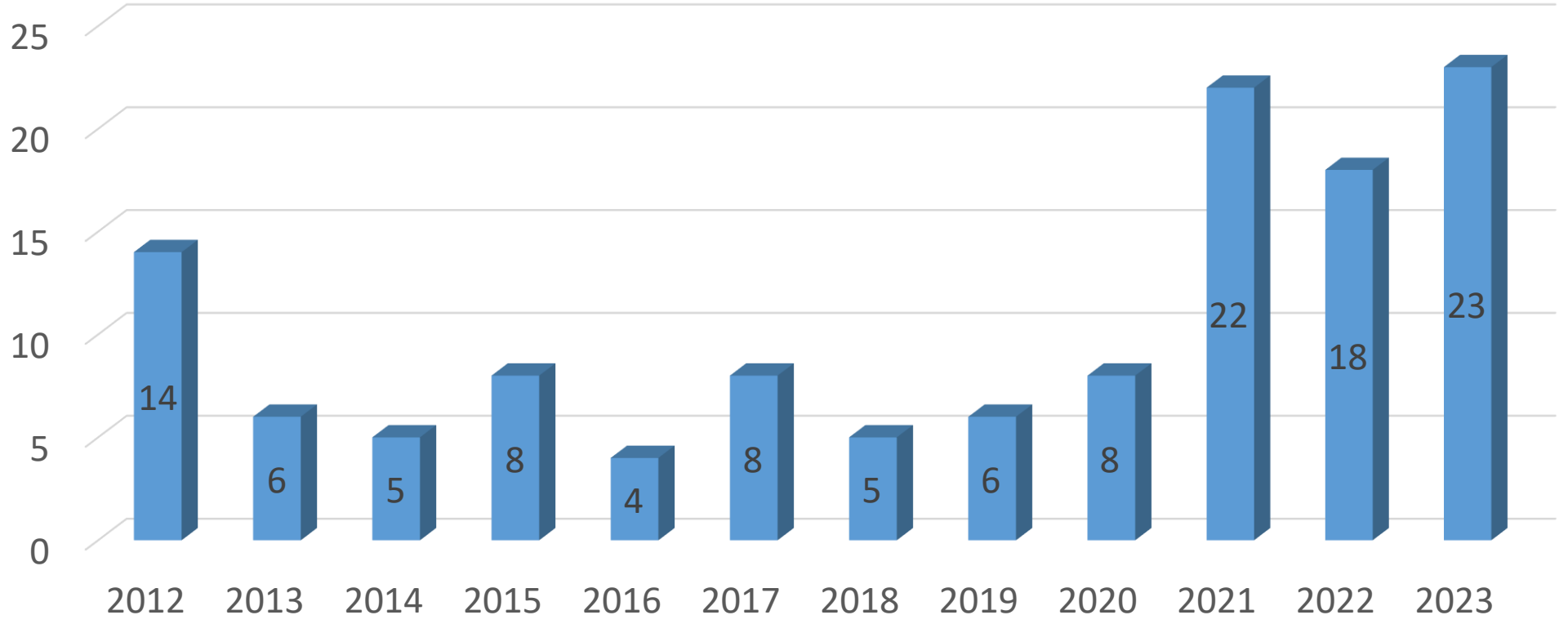
Overview

- Education
  - Students data
  - Students' achievements
  - Initiatives, adaptations during COVID19
- Research
  - Current research
  - Future plans
  - Challenges, requirements for growth



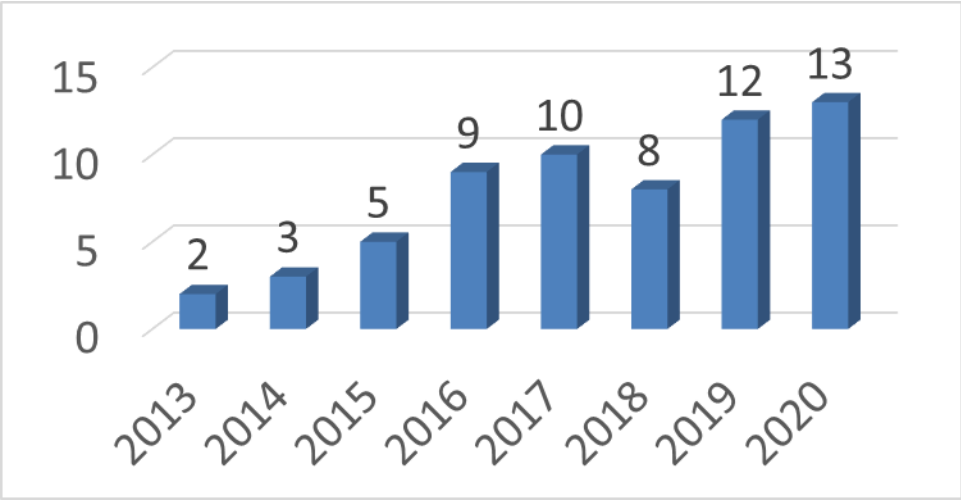
Education

Physics BS students are increasing

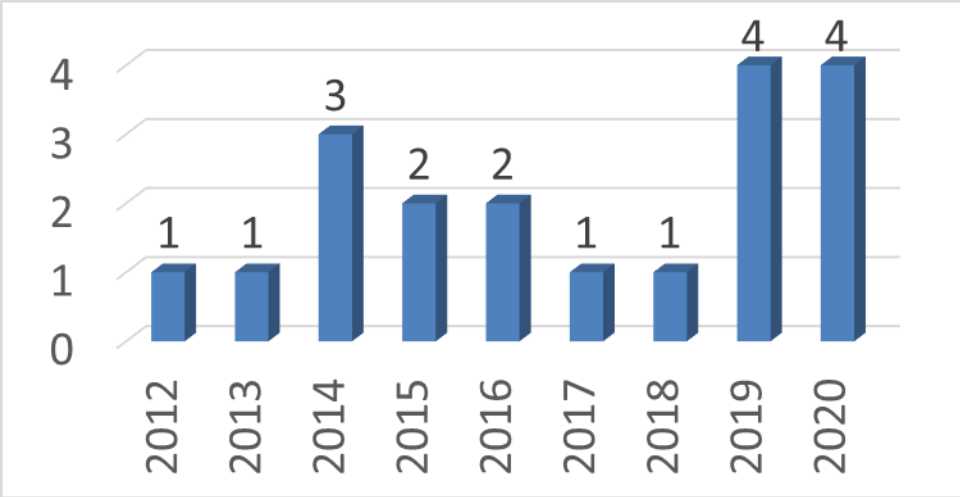


Attracting quality graduate students is a persistent challenge

MS Physics Students



PhD Physics Students



Two PhD students graduated (virtually) for the first time in 2020

Aamir Hayat, PhD Physics, 2020
Supervisor: Muhammad Faryad
Assistant Professor, University of Lahore, Sargodha campus, Sargodha

Ali Akbar, PhD Physics, 2020
Supervisor: Muhammad Sabieh Anwar
Lecturer, Govt Islamia College, Lahore

Both BS and MS students are finding good international placements

BS (2019-2020)

- Perimeter Institute
- Dartmouth College
- Northwestern University
- University of Maryland
- ICTP
- University of New Brunswick

MS (2019-2020)

- Harriot—Watt University
- Texas Tech
- University of Udine

Undergrad students are leading research on open quantum systems

PHYSICAL REVIEW A **101**, 022114 (2020)

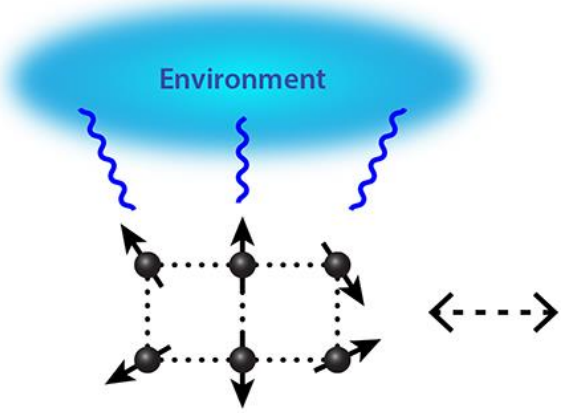
Geometric phase corrected by initial system-environment correlations

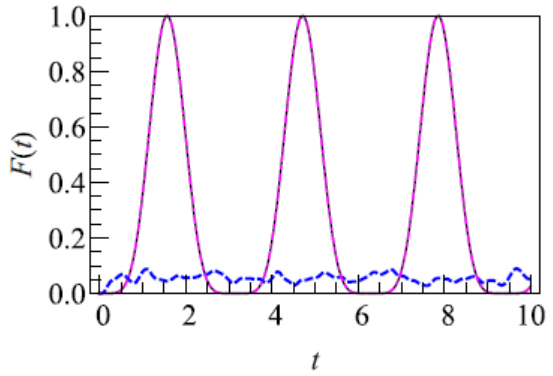
Sharoon Austin, Sheraz Zahid, and Adam Zaman Chaudhry*
School of Science & Engineering, Lahore University of Management Sciences (LUMS), Opposite Sector U, D.H.A, Lahore 54792, Pakistan

PHYSICAL REVIEW A **100**, 022102 (2019)

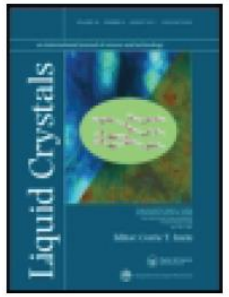
Continuous dynamical decoupling of spin chains: Modulating the spin-environment and spin-spin interactions

Sharoon Austin, Muhammad Qasim Khan, Maryam Mudassar, and Adam Zaman Chaudhry*
School of Science & Engineering, Lahore University of Management Sciences (LUMS), Opposite Sector U, D.H.A, Lahore 54792, Pakistan





Graduate students have started contributing to cutting-edge scholarship



Engineering fibre morphology in self-assembled physical gels of a prototypical discotic liquid crystal

Qurat Ul Ain[a*], Sehrish Iqbal[a*], Shahzad Akhtar Ali[a], Murtaza Saleem[a], Habib Ur Rehman[b], Ata ulHaq[a] and Ammar A. Khan[a]

[a]Department of Physics, Syed Babar Ali School of Science and Engineering (SBASSE, Lahore University of Management Sciences (LUMS), Lahore, Pakistan; [b]Department of Chemistry and Chemical Engineering, SBASSE, LUMS, Lahore, Pakistan

PHYSICAL REVIEW A **101**, 013832 (2020)

Radiation by a finite-length electric dipole in the hyperbolic media

Aamir Hayat and Muhammad Faryad*

Department of Physics, Lahore University of Management Sciences (LUMS), Lahore, Pakistan

Research Article Vol. 3, No. 4 / 15 April 2020 / *OSA Continuum* 878

OSA CONTINUUM

Magneto-optic modulation of lateral and angular shifts in spin-orbit coupled members of the graphene family

MUZAMIL SHAH AND MUHAMMAD SABIEH ANWAR*

Our UG and Grad students arranged webinars and outreach activities despite COVID-19

SPIE. STUDENT CHAPTER
LAHORE UNIVERSITY OF MANAGEMENT SCIENCES (LUMS)

New initiatives and opportunities due to COVID-19

- Physics Faculty started offering courses on computational physics, quantum engineering, and quantum information sciences
- Revived centuries old experiments like finding earth diameter, tracking stars etc. for laboratory courses to be done at home in Spring 2020
- Extensively used newly developed virtual classrooms for interactive teaching
- Online regime has offered us an opportunity to scale up number of students who can benefit in Pakistan
- We are planning for online public outreach

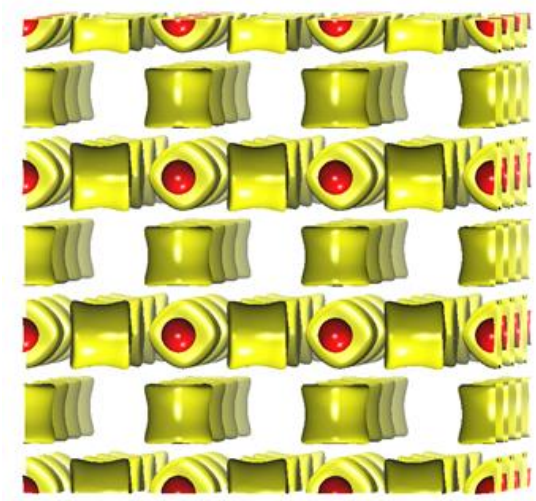
Inaugural 6-day math boot camp started for incoming SSE undergrads

- An intensive calculus boot camp was designed and interactively taught to incoming freshmen
- Similar boot camp is planned for next year for all SSE BS and for MS Physics students

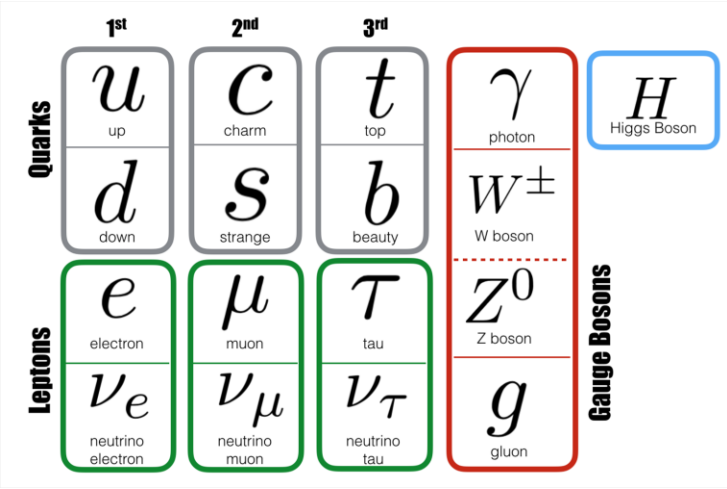
Research

Two new faculty members joined in Fall 2020 to boost our strength to 9

Rafi Ullah, PhD (Spain, 2018), Postdoc (Livermore Lab, CA)
Computational quantum and condensed matter physicist



Rizwan Khalid, Part III (Cambridge, 2006), PhD (Delaware, 2011)
Fundamental Theoretical Physicist



Existing expertise in the department

Theoretical and experimental

Classical and Quantum Optics

Materials fabrications, characterizations

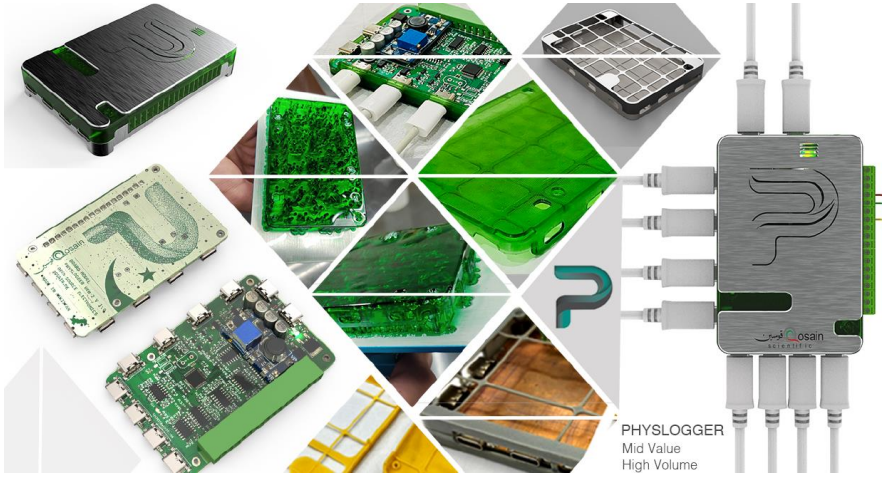
Cosmology, Quantum Gravity

Fundamental theoretical physics, high energy physics

Quantum theory and applications

Theoretical and computational

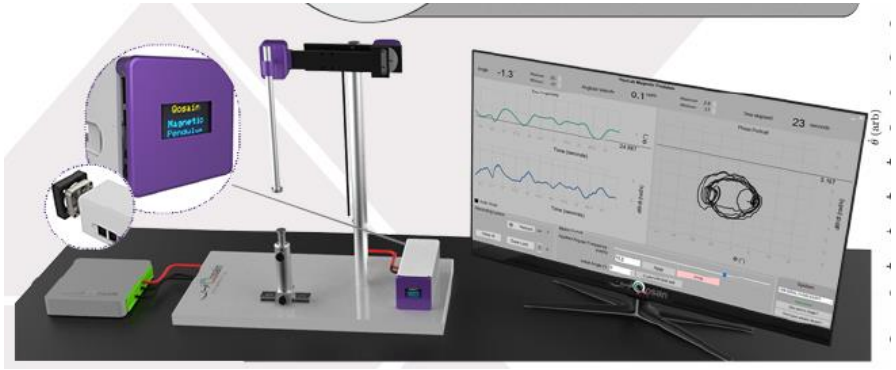
Innovative software and hardware development

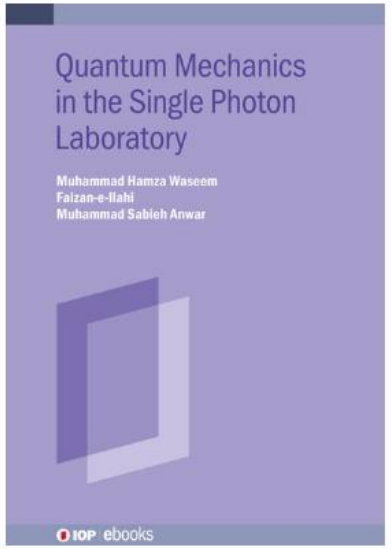


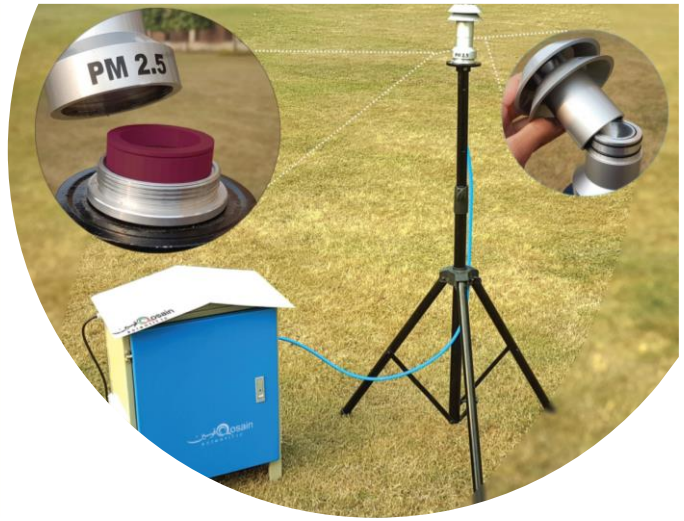
PhysSoft

PhysLogger

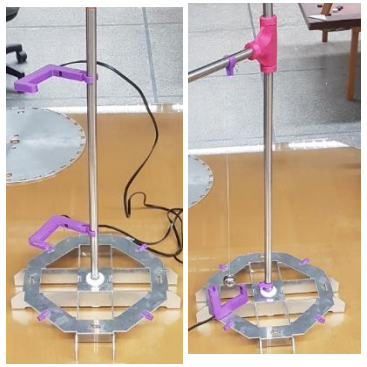
Advanced Lab Experiments



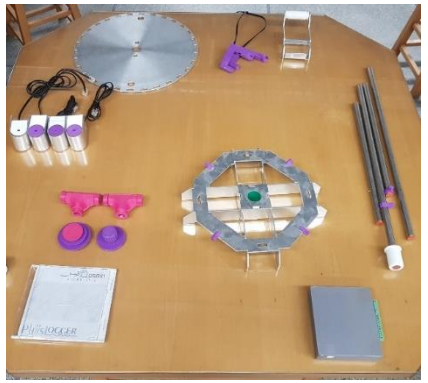




PhysFog: environmental sensing

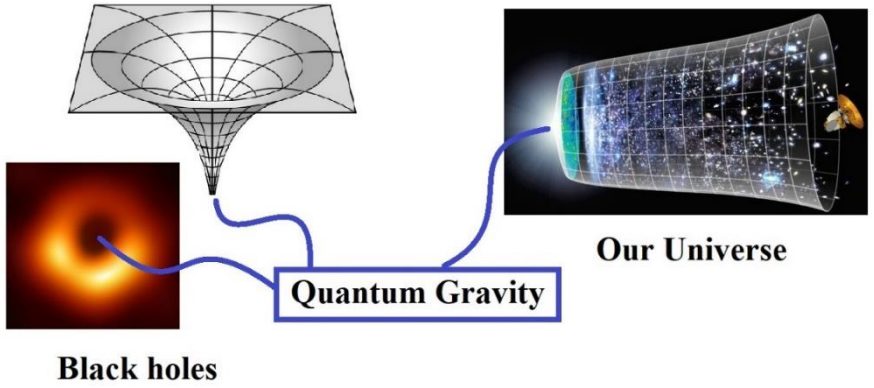


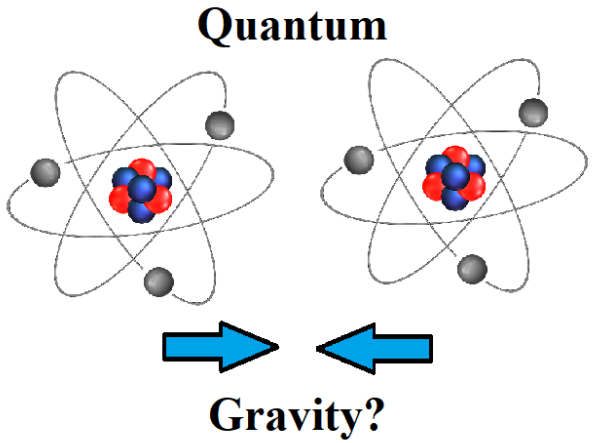
PhysInstruments



PhysBox (for homes)

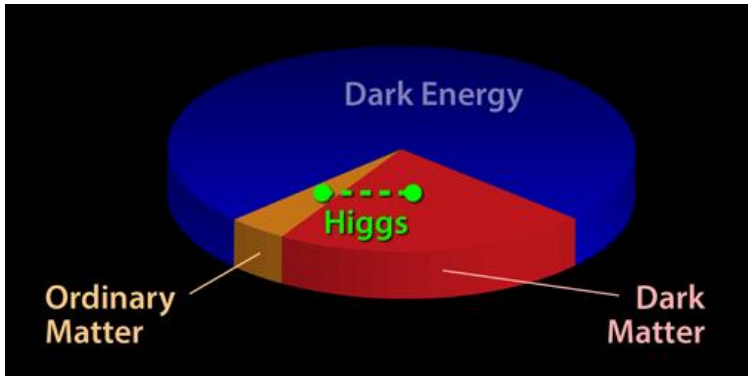
Work on quantum gravity and discovering physics beyond standard model began last year



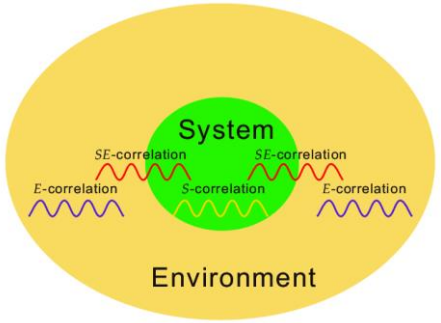


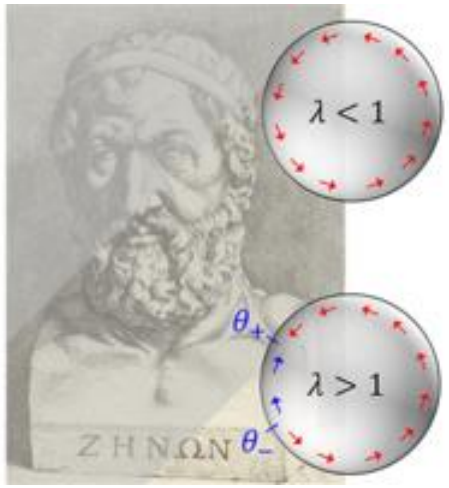
Quantization inspired by loop quantum gravity

Constraints on particle masses due to Higgs field

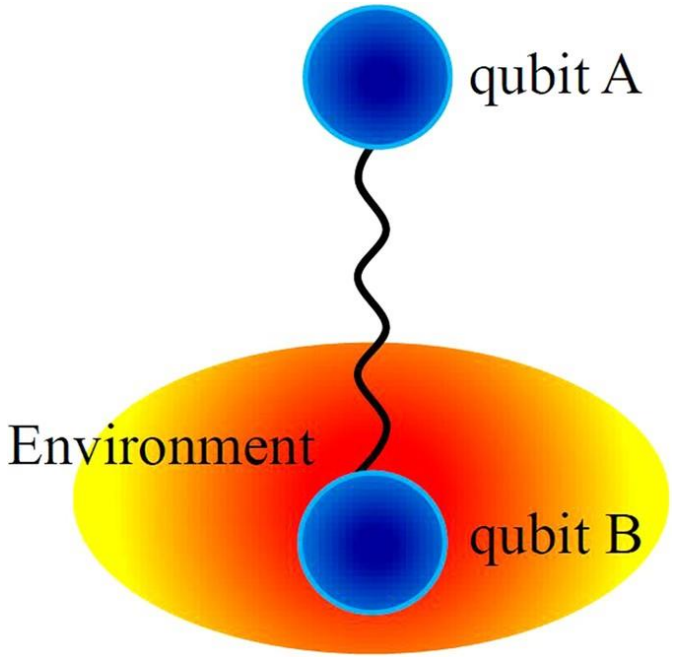


Open quantum systems underly quantum computers, quantum sensors and imagers



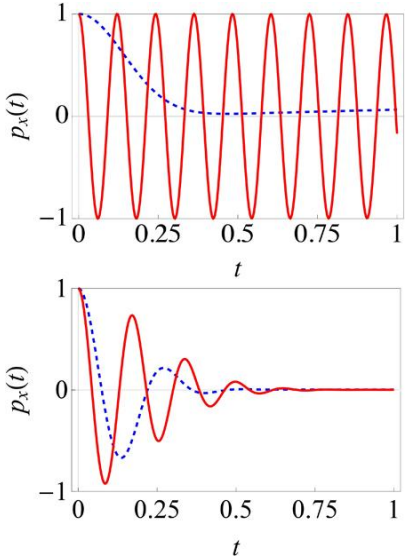


Quantum Zeno and Anti-Zeno effects

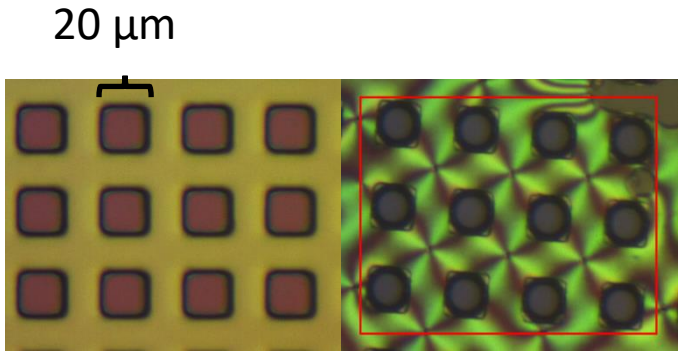


Qubit-qubit interaction is required for entanglement in quantum computing

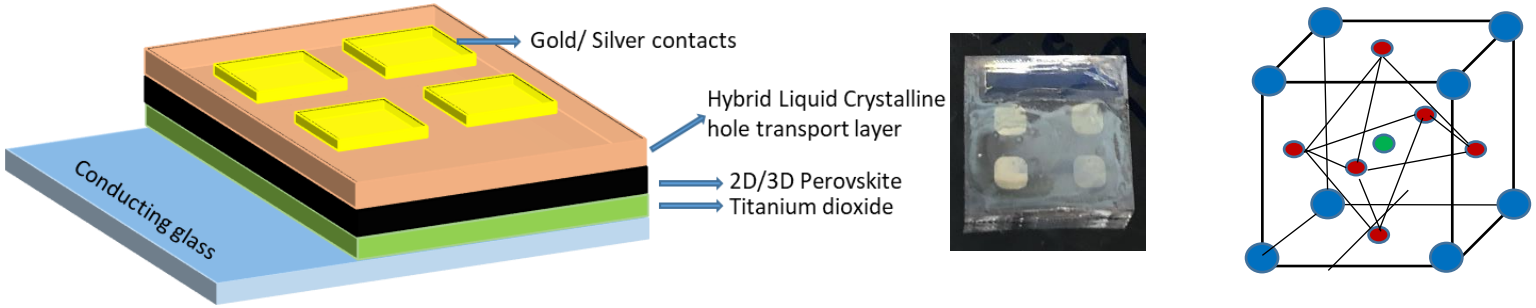
System-environment interactions control the lifetime of qubits



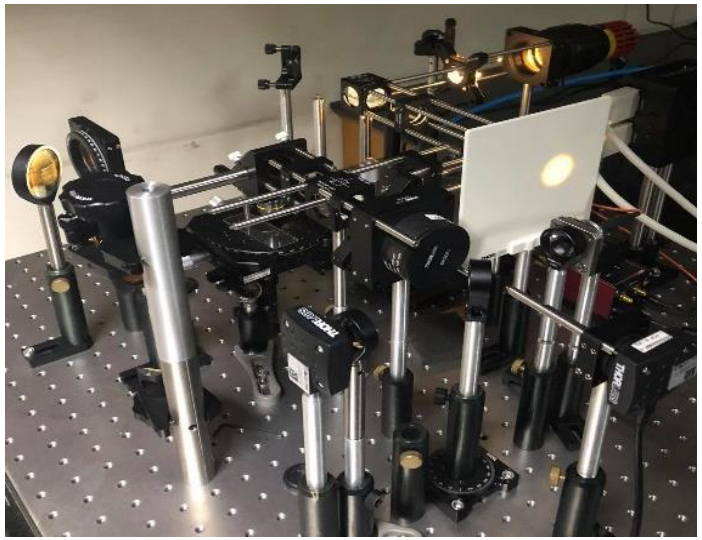
Research on self-assembled materials for optoelectronic devices



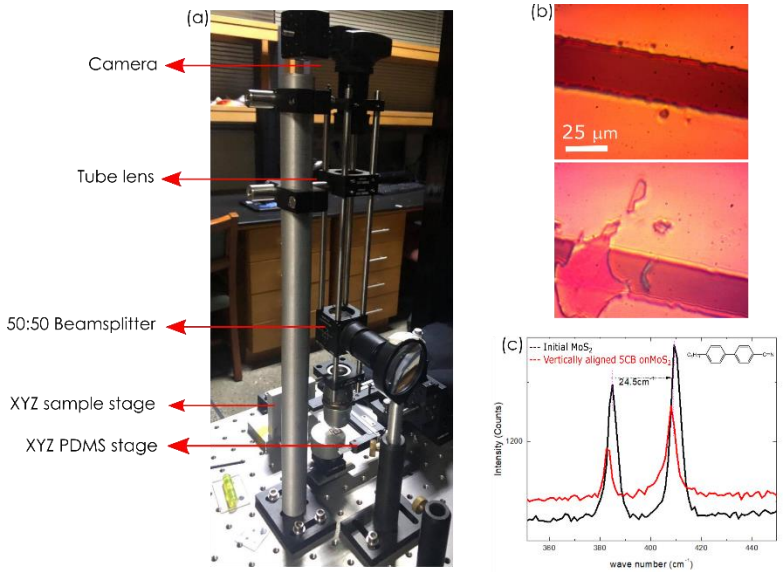
Deterministic topological defects in liquid crystals for bio-sensing applications



Towards stable and efficient perovskite solar cells



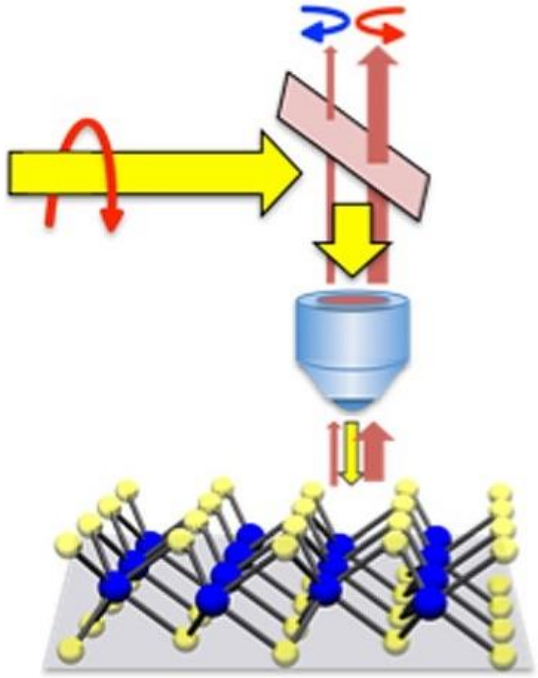
Versatile polarized microscopy and spectroscopy



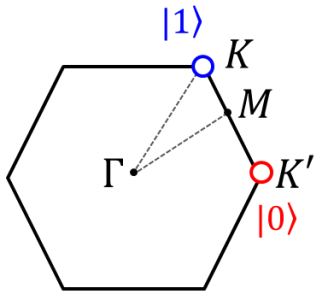
Deterministic 2-D materials transfer for quantum light devices

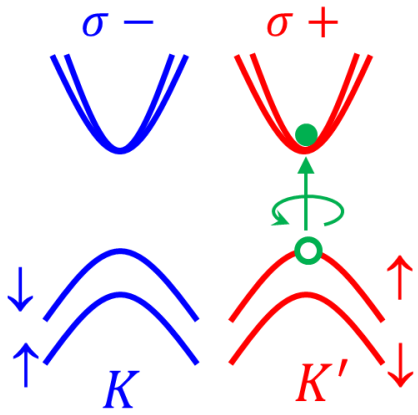
External quantum efficiency measurements of solar cells

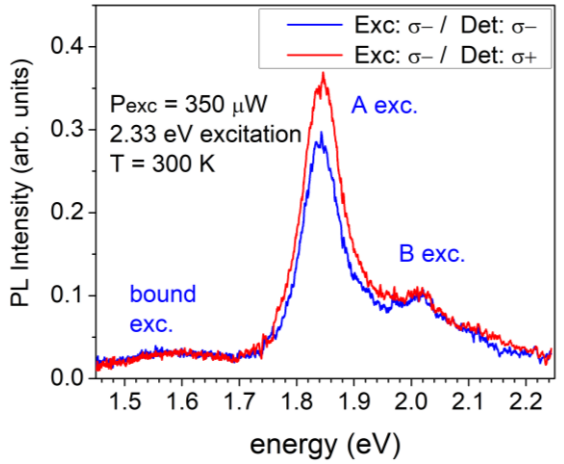
Research on qubit design using valley-spin physics for quantum computing



Two dimensional semiconductors



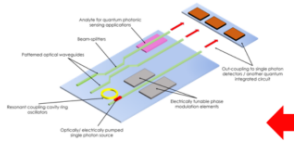




20% initialization qubit fidelity achieved at room temperature

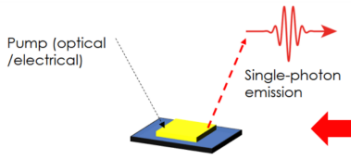
Watch another talk by Ata Ulhaq on Quantum Technologies

Quantum photonic circuit



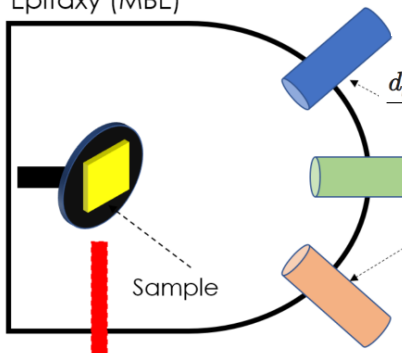
Quantum photonic integrated circuits

Quantum light

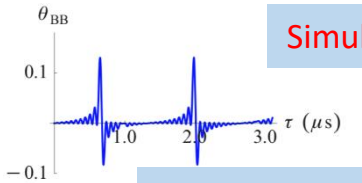


Single and entangled-photons light emitting diode devices

Device fabrication



Simulation



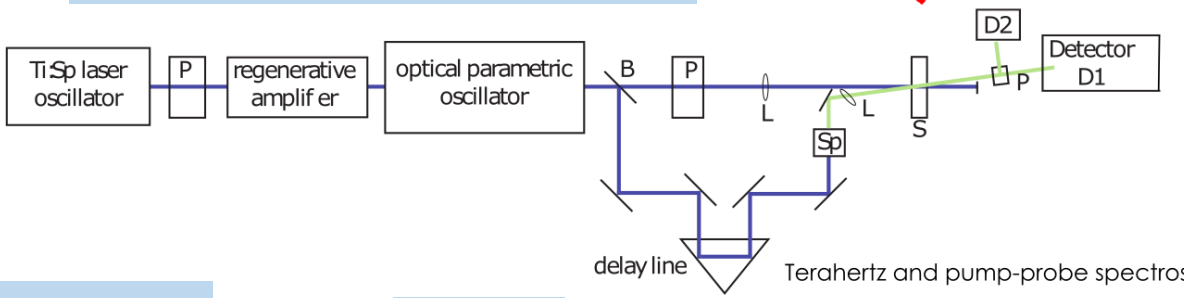
Theoretical Foundations

$$\frac{d\hat{\rho}_S(t)}{dt} = -\frac{i}{\hbar}\left[\hat{\mathrm{H}}_S(t), \hat{\rho}_S(t)\right] + \mathscr{L}_D(t)\,\hat{\rho}_S(t)$$

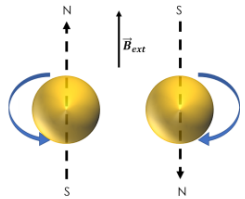
Magnonics

Spintronics

Ultrafast optical and THz spectroscopy



Terahertz and pump-probe spectroscopy



optical quantum sensor of spintronic effects

Scientific industry

Capacity

National capacity building for quantum physics research

Training

Teaching laboratories on Quantum phenomena

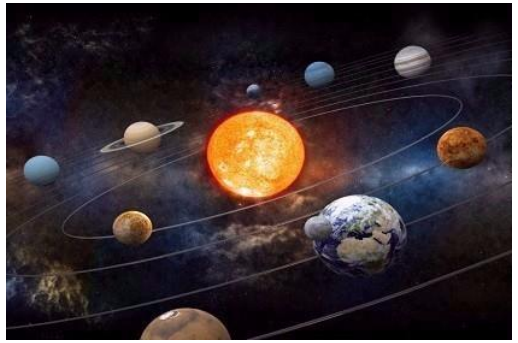
Teaching

Teacher training workshops on Quantum science and technologies

Our research is focused on gap areas in Pakistan

- Spectroscopy of atomic and nano-sized systems
- Qubits, open quantum systems' dynamics for quantum computing
- High energy physics focuses on physics beyond standard model and quantizing gravity
- Quantum computing and information
- Nanophotonics and nanao-optics
- Instruments, experiments, software development for research and academics

Target areas for future faculty hiring and courses

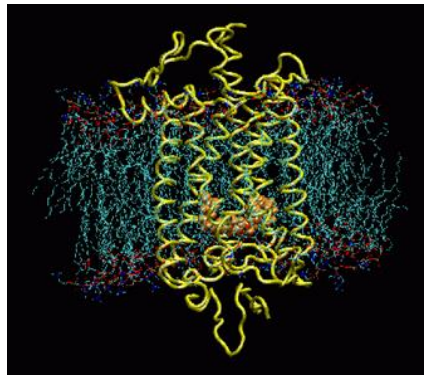


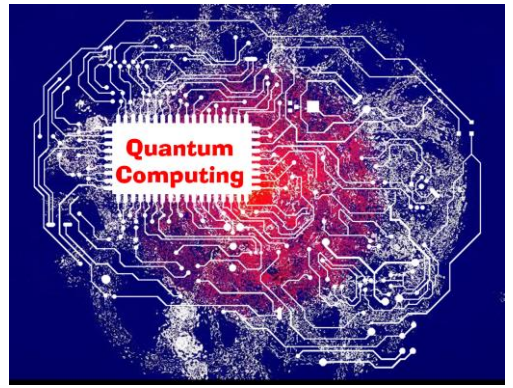
Earth and Planetary physics

Understanding the evolution and future of planet earth, and space-based technologies require expertise in this area

Physics of biomaterials is becoming more and more computational. The design of new drugs and understanding cellular mechanisms require computational physics

Computational Bio-Physics





Quantum information and computing

Future computing and secure communication will be based on quantum physics

Research excellence requires continuous investment in human resource and capital equipment

Availability of post docs will greatly enhance the quality of research and education

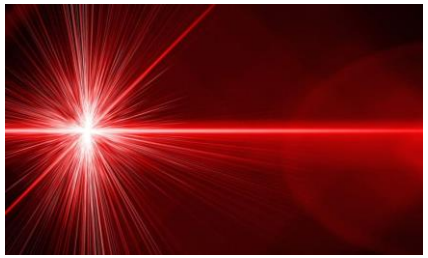
Many atomic and molecular phenomena have a time scale of femtoseconds. This requires an ultrafast laser

Post-doctoral Scholar

Cryogenics for low-temperature physics

Low-temperature capabilities will help us in building high fidelity quantum devices and explore controlled quantum systems

Ultrafast laser for time-resolved physics



Thanks