



**IMAGINE  
YOUR  
FUTURE**

**MS & PhD  
PHYSICS**

Syed Babar Ali School of Science and Engineering

# CREATING IMPACT THROUGH RESEARCH



The Syed Babar Ali School of Science and Engineering (SBASSE) at LUMS is making significant strides in the experimentation of teaching and learning, while celebrating the novelty of research. SBASSE, through innovative and impactful contributions to science and technology, is nurturing future leaders with the potential to impact society.

SBASSE offers undergraduate, graduate and doctoral degrees in a wide range of disciplines. The MS programmes at SBASSE are rigorous and designed to impart specialised professional and research-oriented training to students. To graduate, students must accumulate a total of 30 credit hours either entirely from coursework, or by completing 24 credit hours from coursework and 6 from research work/thesis. Thus all SBASSE departments offer two options to choose from: MS-by-Coursework or MS-by-Thesis.

The SBASSE PhD programmes prepare students to think scientifically and conduct high-quality research independently. Major milestones that must be achieved for the successful completion of the PhD degree include the Coursework, Comprehensive (Qualifying) Examination, Thesis Proposal Defense, at least one peer-reviewed journal article and PhD Thesis Defense.

During the course of study, student learning takes place through lectures, tutorials, laboratories, problem-solving exercises, research projects and frequent interaction with experienced, world-class faculty members.

## WHY CHOOSE SBASSE

### QS World University Rankings by Subject

#301-350 Computer Science and Information Systems

#351-400 Engineering – Electrical and Electronics

#401-450 Engineering and Technology

#501-550 Physics and Astronomy

### KEY INITIATIVES

#### THE ONLY 600 MHZ NMR SPECTROMETER IN THE REGION

SBASSE's 600 MHz nuclear magnetic resonance (NMR) spectrometer can be accessed for molecular analysis. Researchers can send their samples and obtain high resolution spectra, both in one and two dimensions.

#### WEB PORTAL TO ACCESS ONLINE COURSES

The School's website hosts a portal that provides access to diverse online courses produced by its faculty. The offered courses range from introductory to advanced levels.

#### MATLAB ACCESS FOR EVERYONE

A MATLAB license for everyone working at the School including faculty, staff, researchers and students provides complete access to all of its toolboxes.

#### HIGH VOLTAGE ENGINEERING LABORATORY

This lab has been established to become a nursery for important work in the field of high voltage and power systems.

#### CLOUD CLASSROOMS

SBASSE is combining virtual classrooms with real learning by introducing a blended learning solution. Roving cameras, instructor-controlled zoom,

full wall projection of participants for maximum immersiveness, ability to record and display multiple views are some of the technical capabilities.

#### CENTRAL LAB

The Lab aims at becoming the go-to place for high-end characterisation and analysis for academia and industry within the country. Student apprenticeships, restructuring of the Central Lab committee, efforts to add new equipment and a brochure to disseminate information about the Lab, all speak to this.

#### PLACEMENTS

SBASSE has top academic placements (Massachusetts Institute of Technology, Harvard University, University of Warwick, University of Oxford, University of Cambridge). Its graduates are hired by top local and international organisations (Engro Corporation, Nestle Pakistan, Systems Ltd., Microsoft, Google, Facebook).

### LEARNING WITHOUT BORDERS

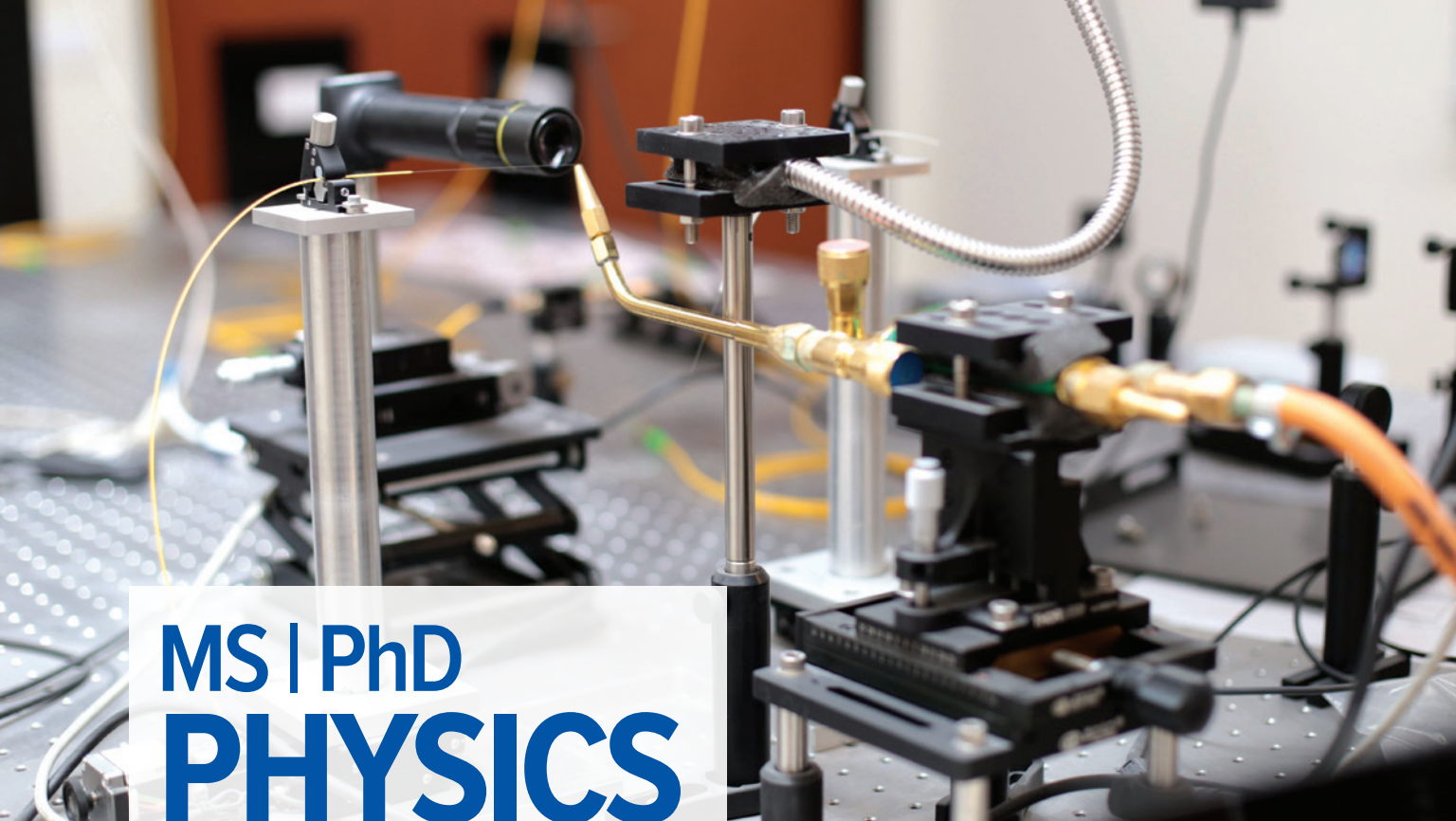
Research and teaching at LUMS truly offers its community 'Learning Without Borders' by breaking academic, geographic and socio-economic barriers to make education accessible to all. The University continues to be an intellectual hub, rich with varying perspectives and transformative ideas. With an environment brimming with inclusion, unity, and boundless knowledge, learning continues in and beyond the campus walls with the aim to develop innovators, leaders and change-makers who can contribute to the community and build strong borderless networks.

### TOP QUALITY PUBLICATIONS

SBASSE faculty have produced around 300 articles, all published in international venues of prestigious ranking.

### RECOGNITION OF TOP RESEARCH THROUGH SYED BABAR ALI RESEARCH AWARDS (SBARA)

These Awards recognise PhD students. The winners, called the Syed Babar Ali Fellows, are selected for the novelty of their research work, and the potential for lasting impact to their disciplines and the society.



# MS | PhD PHYSICS

## How will you launch your new world?

The Department of Physics focuses on probing fundamental physical aspects of the universe and the underlying mathematics, as well as novel applications in diverse areas.

An important characteristic of the Department is embodied in encouraging students to get involved in research questions and exploratory experiments outside the formal classroom or laboratory coursework. Regular seminars and colloquia are led by faculty, students, as well as distinguished speakers from outside LUMS, and provide a chance to keep abreast of cutting edge and high impact research.

## What will your new world invent?

The Physics faculty is actively engaged in research in the areas of Basic and Applied Physics. Both theoretical and experimental research is being conducted in the Department with active involvement of graduate students. Faculty members and their research areas are listed below:

### SPIN AND PHOTON PHYSICS

Dr. Muhammad Sabieh Anwar

### QUANTUM DYNAMICS

Dr. Adam Zaman Chaudhry

### PLASMONICS AND NANOENGINEERED MATERIALS

Dr. Muhammad Faryad

### SOLAR CELLS AND OPTOELECTRONICS

Dr. Ammar Ahmed Khan

### QUANTUM OPTICS

Dr. Ata Ulhaq

### QUANTUM FIELD THEORY

Dr. Tajdar Mufti

### COSMOLOGY AND GENERAL RELATIVITY

Dr. Syed Moez Hassan

### HIGH ENERGY PHENOMENOLOGY

Dr. Rizwan Khalid

### CONDENSED MATTER THEORY

Dr. Rafi Ullah

### LASER ENGINEERING AND TECHNOLOGY

Dr. Tayyab Imran

## How will Physics help you realise your ambition?

The Department of Physics houses:

- Laboratories in Solid State Physics, Nanoscience, Optics and Photonics, Radiation Physics, and Measurement and Instrumentation
- Homegrown facilities in diverse areas of Physics, including synthesis of new materials, cryogenic and high temperature transport, electrical, thermal and magnetic property measurements, homebuilt atomic force microscopy and magnetic resonance devices
- A wide range of experimental facilities in optics like optical spectroscopy, optical and Kerr microscopy, sensitive imaging, light modulation, radiation detection, X-ray fluorescence, quantum optics, single photon detection, electrodeposition, electrospinning, sputter coating, and high speed electronic test and measurement equipment
- Research groups headed by various faculty members aiming to explore various fields

## Embrace the Physics experience

- Dr. Ata Ulhaq, has co-authored a paper with his PhD student, Shahzad Akhtar Ali on Helicity-selective Raman scattering from in-plane anisotropic  $\alpha$ -MoO<sub>3</sub>. This paper has been published in *Applied Physics Letters*.
- Dr. Muhammad Sabieh Anwar, along with student, Abdullah Irfan (BS Physics 2021) helped develop an experiment where a drop of liquid oxygen and its tail of gaseous oxygen, is seen orbiting a magnet. The data from this experiment was recorded and analysed by students at the PhysLab.
- HEC, Pakistan's six-month research fellowship, the International Research Support Initiative Programme (IRSIP), is for students enrolled in full-time PhD programmes in Pakistan. LUMS PhD Physics students, Ali Raza Mirza and Qurat ul Ain received IRSIP funding. Through this funding, Mirza visited the Department of Physics and Astronomy at the University of Manchester, UK in Spring 2022 for research work on 'Open quantum system dynamics and correlations' and Ms. Qurat ul Ain visited the Ecole Polytechnique Fédérale de Lausanne, Switzerland for research work on 'Emerging photovoltaic devices'.
- Drs. Ata Ulhaq, Ammar Khan, Adam Zaman and Muhammad Sabieh Anwar, lead the quantum revolution team, who have designed and built optical systems that integrate lasers, optics, microscopy and spectroscopy into a highly specialised optical setup. Some of these experiments use laser light to initialise and control qubits; a fundamental unit of quantum computing, with the promise of completely revolutionising computer technology by providing unbreakable encryption protocols for security applications and incredible computing speeds.
- The PhysLab team published *Quantum Mechanics in the Single Photon Laboratory*. In this book, Dr. Muhammad Sabieh Anwar and students from the University of Engineering and Technology, Lahore, describe their innovative experiments at the heart of quantum information processing.
- The International Commission for Optics and the Abdus Salam International Centre for Theoretical Physics declared Dr. Muhammad Faryad, as winner of the 2019 Gallieno Denardo Award, for his contributions to Optics research and education.
- Graduates of the MS Physics programme have secured PhD admissions to prestigious universities in the USA. Bilal Ahmed was admitted to the University of South Florida (USF); Hassan Bukhari secured admission at the University of Iowa (UIOWA); Muhammad Shiraz got into the University of Alabama at Birmingham and Haseeb Ahmed got into the University of California Merced (UC Merced).
- Dr. Ali Akbar, PhD Physics alumnus, received a Post Doc offer at the University of Nottingham, UK, School of Physics and Astronomy for the period of two years starting from Fall 2022. His research work is on quantum sensing an optical magnetometry.
- Dr. Amina Farooq, PhD Physics alumna, secured a Post Doc position at Oklahoma State University, USA for 3 years starting from Fall 2022.
- PhD Physics student, Aamir Hayat published his research on radiation in hyperbolic media in the prestigious journal, *Physical Review A*.



### DR. MUHAMMAD SABIEH ANWAR

Ahmad Dawood Chair, Dean and Professor, Syed Babar Ali School of Science and Engineering

"The graduate programmes in science and engineering at SBASSE are poised to make an impact. Our deepest impact as an institution would truly be made by the research that emanates from our graduate education and the research that it propels. We are committed to providing a collegial, rigorous and progressive research milieu that triggers the thirst for knowing and seeking the truth, and in the process, creating tools, gadgets, machines and ideas that address the human condition and global issues. We promise that our graduate programmes will make you ride through the two extremes of the microcosm and the macrocosm, the ideal and the practical, the abstract and the tangible. Welcome to the Syed Babar Ali School of Science and Engineering!"



## YOUR JOURNEY BEGINS HERE!

### Admission Criteria for Local and International Students

Admission is purely merit-based and rests on the following criteria:

#### MS Programme

- Academic Record
- Performance in Admission Tests
- Application Review
- Submission of complete online application, application processing fee and supporting documents by the stipulated deadline
- Interview Performance (if needed)
- Letter of Recommendation

Scan for more information



#### PhD Programme

- Academic Record
- Performance in Admission Tests
- Application Review
- Research Statement
- Submission of complete online application, application processing fee and supporting documents by the stipulated deadline
- Letters of Recommendation
- Interview Performance (if shortlisted)

**Note:** This is the minimum criteria that applicants need to fulfil in order to be eligible to apply. Fulfilment of this criteria does not guarantee admission to LUMS.

Scan for more information



### Admission Criteria for PhD Programme for Foreign Nationals

SBASSE's PhD application for foreign nationals caters to applicants who currently reside outside Pakistan and have a foreign nationality.

All other applicants (i.e. those who have dual nationality, are Pakistani nationals, or are overseas Pakistanis) are required to apply through the regular admission application.

Admission is purely merit-based and rests on the following criteria:

- Academic Background
- Research Background
- Online Test and Interview (if shortlisted)

In order to study at LUMS, foreign nationals must obtain a 'Study Visa' from the Pakistani Embassy/Consulate working in their country. The Pakistani Embassy/Consulate will only issue a Study Visa for students' stay at LUMS upon receipt of Higher Education Commission (HEC), Pakistan's 'No Objection Certificate' and clearance from the Ministry of Interior, Pakistan.

For the issuance of Visa, students must submit relevant documents to the LUMS Admissions Office through postal mail/courier service by the stipulated deadline.

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## FINANCIAL SUPPORT FOR LOCAL AND INTERNATIONAL STUDENTS

Admission to all LUMS programmes is purely on merit and independent of students' ability to pay the related tuition fees. Once a student has been admitted to a programme, there are several mechanisms in place to provide financial support based on need and merit. All awards are reassessed each academic year based on performance, need, available resources and prevailing University policies. LUMS is committed to providing as much financial assistance as possible within the limits of its available resources. Nevertheless, the University may not be able to meet all requests for financial assistance, and it is strongly recommended that applicants secure as much of their own funding as possible. Several funding opportunities are available to deserving MS and PhD students. These include:

- Merit Scholarships
- Partial tuition fee waivers for MS Basic Sciences students
- LUMS Interest-free Loan that covers partial to full tuition fee expense (only for local applicants)
- External Scholarships (support and eligibility for these scholarships vary depending on the donor)
- Options to work as Research or Teaching Assistants (subject to availability)
- Full funding of the PhD, which covers tuition, registration, admission fee and a monthly stipend for 4 years

Scan for more information



#### DR. ADAM ZAMAN

Chair and Associate Professor, Department of Physics

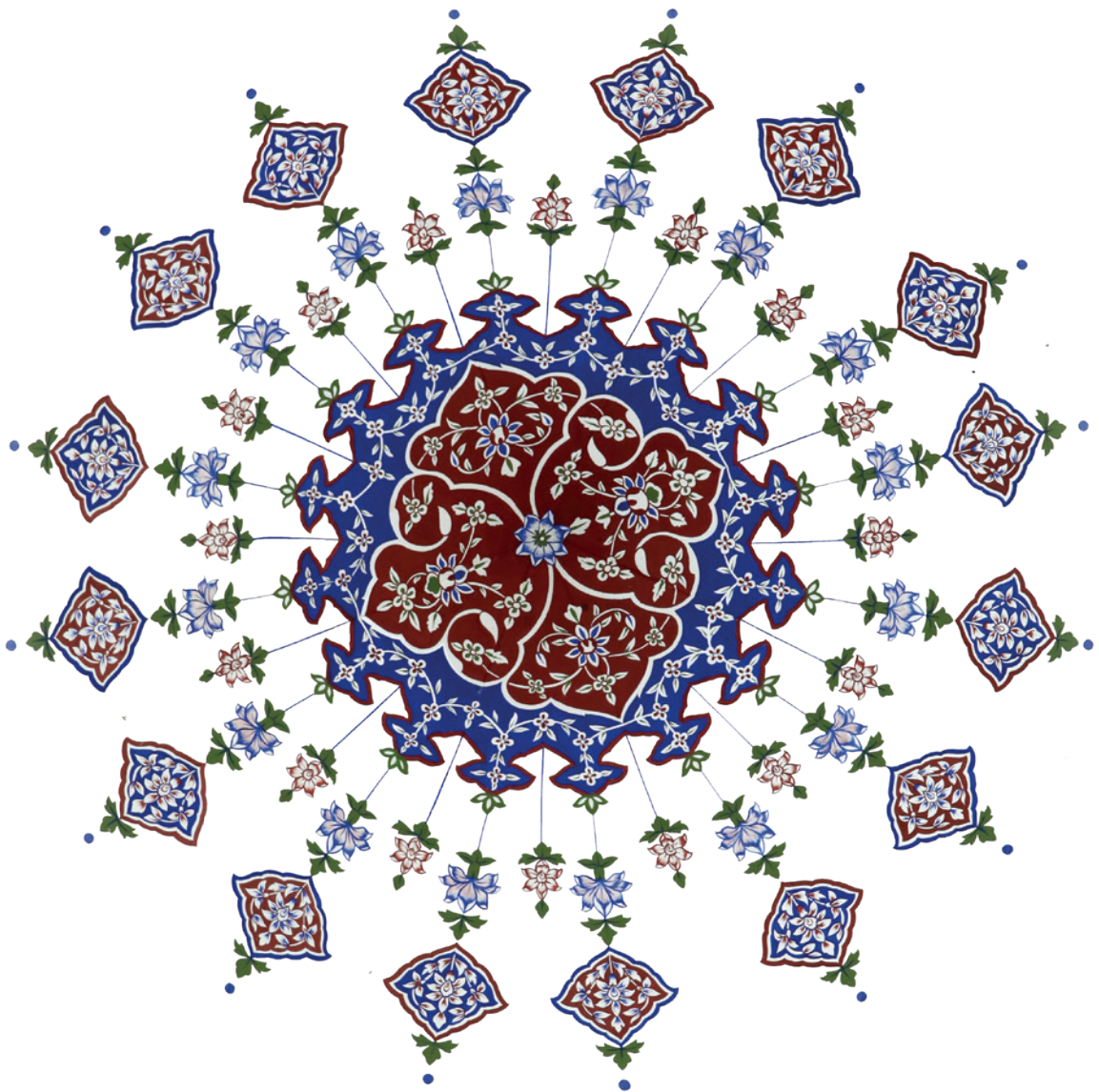
"The intellectual environment and academic freedom offered by the department are unmatched in the country. The faculty is composed of a group of extremely talented active scientists working on a variety of areas. As a graduate student, you will not just be working as an apprentice under these scientists; rather, you will be treated as a scholar, out to make discoveries and uncover mysteries. It will be up to you to prove that you deserve this designation."



#### SHAYAN NADEEM

MS Physics 2021

"Coming to LUMS to pursue this programme was undoubtedly the best decision I could have made. The Department of Physics at LUMS has an atmosphere conducive to learning, the faculty is very accommodating, and the student body is really helpful. I am incredibly grateful to all my professors, especially Dr. Tajdar Mufti, for their guidance and support. Under their guidance, I secured a PhD position at Baylor University, where I now hope to pursue my passion."



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**#LearningWithoutBorders**