

## Department of Physical Sciences (DPS)

### Minimum Eligibility criteria:

Applications are invited from candidates having Masters degree with at least 60% aggregate marks in any field of Physical Sciences for the Doctor of Philosophy (PhD) program. Final year post-graduate students who are yet to obtain their degree may also apply, however, they must complete the MSc/MS degree at the time of admission with the requisite 60% aggregate marks.

Selection of the candidates will be as per the GoI norms. Candidates belonging to the respective reserved category need to submit relevant certificates and documents.

### **Channel 1: Self Funded category**

For candidates in the self-funded category, apart from satisfying minimal eligibility criteria all candidates must have their own PhD fellowships, such as, UGC/CSIR-NET JRF, INSPIRE or any other equivalent fellowships. Please note that people who have INSPIRE FELLOWSHIP, should only apply if they have the "Provisional Offer of Research Studentship under INSPIRE Fellowship".

**Theoretical/Computational:** Following is the list of broad research areas [and some specific topics] in theoretical and/or computational physics where DPS is willing to take PhD students:

### Non-linear Dynamics - Biological Physics - Statistical Physics - Non-equilibrium Dynamics - Soft Condensed Matter Physics

- a. Polymer Physics, Physics of Biopolymers, Statistical Mechanics of Charged Polymers and Biocondensates
- b. Complex Systems, Evolutionary Game Theory and Statistical Learning
- c. To develop theoretical and computational models to understand the collective dynamics of active, out of equilibrium systems by using the tools from statistical physics, nonlinear dynamics, and soft condensed matter physics

### Gravitational Physics and Astrophysics

- a. Gravitation, Cosmology, Relativistic Astrophysics & Quantum Fields in Curved Spacetime.
- b. General relativistic fluid dynamics simulations

### Theoretical Condensed Matter - Statistical Mechanics

- a. Nonequilibrium quantum systems, Quantum Chaos, Ultracold quantum gases
- b. Dynamics of open quantum systems; Measurements in quantum mechanics; Nuclear magnetic resonance
- c. The interplay of inter-particle interaction, inhomogeneity from disorder and topological effects in the correlated quantum and classical matter.

- d. (i). theoretical aspects of quantum error correction and two dimensional surface codes
- d. (ii). theoretical aspects of quantum transport in topological states of matter
- e. Electronic, Optical, and Magnetic structure of 2D and 3D-strongly correlated systems by Density Functional Theory (DFT) approach.

**Experimental:** Following is the list of broad research areas [and some specific topics] in experimental physics where DPS is willing to take PhD students:

Optics/Spectroscopy

- a. (i) Dissociative electron attachment probed by Velocity Slice Imaging.
- a. (ii) Study of Ion-Pair Dissociation in electron collisions with molecules using Velocity Slice Imaging.
- a. (iii) Absolute dissociative electron attachment cross section in electron collisions with ground and excited state molecules using time-of-flight mass spectrometric technique.
  
- b.(i) Microbubble lithography: Generating novel mesoscopic architectures using Thermo-optical tweezers based directed self-assembly, and studying their science.
- b.(ii). Photophoretic trapping of absorbing particles in air: Developing 3d optical tweezers for trapping absorbing microparticles and uncovering the physics behind their phenomena.
  
- c.(i) Terahertz Spectroscopy and Pump Probe Spectroscopy of quantum materials and their heterostructures
- c.(ii). Using picosecond strain pulses and microscopic pump-probe techniques to investigate quantum materials

Experimental condensed matter physics

- a.(i) Quantum Information Processing using NV centres in diamond.
- a.(ii) Topological Insulators, Majorana Fermions and Weyl Semi-metals.
  
- b. Phase transitions, semiconductor optics, physics in high magnetic fields
  
- c. Quantum phases under extreme conditions of pressure.
  
- d.(i) Electronic and Magnetic structure by synchrotron based X-ray Photoemission spectroscopy (Both Angle-resolved and Angle-integrated).
- d.(ii) Electronic, Optical, Magnetic, and Transport properties of strongly correlated systems and novel nanomaterials.

## **Channel 2: Institute Funded category**

Institute funded positions are available in the following areas/topics:

### Soft Condensed Matter [Theoretical] [**Prof. Arindam Kundagrami** ]

Polymer Physics, Physics of Biopolymers, Statistical Mechanics of Charged Polymers and Biocondensates

### Astrophysics [Theoretical] [**Prof. Sudip Garain** ]

Numerical modelling of radiation from astrophysical plasma by Monte Carlo methods

### Theoretical Condensed Matter/Quantum Information [**Prof. Rangeet Bhattacharyya**]

Dynamics of open quantum systems; Measurements in quantum mechanics; Nuclear magnetic resonance.

### Theoretical Condensed Matter/Quantum Information [**Prof. Sourin Das**]

Theoretical aspects quantum information processing using topological qubits

### Optics/Spectroscopy [Experimental] [**Prof. Kamaraju Natarajan**]

Time resolved fundamental and higher (second, third ) Harmonic spectroscopy of 2D quantum materials.

### Non-linear Dynamics - Biological Physics - Statistical Physics - Non-equilibrium Dynamics - Soft Condensed Matter Physics [Theoretical] [**Prof. Rumi De**]

To develop theoretical and computational models to understand the collective dynamics of active, out of equilibrium systems by using the tools from statistical physics, nonlinear dynamics, and soft condensed matter physics

### Experimental Condensed Matter [**Prof. Chiranjib Mitra**]

Quantum Information Processing using NV centres in diamond.

## **DPS Autumn 2024 PhD Timeline :**

- PhD application portal opens: 1.3.2024
- Application portal closes: 30.4.2024
- Publication of shortlist for the Interview: 8.5.2024
- Selection Interview window : 24 - 31.5.2024
- Publication of PhD interview results by: 10.6.2024
- Pre-registration portal opens: 10.6.2024
- Pre-registration deadline: 15.7.2024
- PhD Registration (as per Academic Calendar):28.7.2024

**Orientation: 2 August 2024**