

Department of Physical Sciences (DPS)

Minimum Eligibility criteria:

Applications are invited for the Doctor of Philosophy (PhD) program in Physics from candidates having either

(i) Masters degree with at least 60% (55% for reserved category) aggregate marks in any field of Physical Sciences .

or (ii) 4-year BS with 75% (70% for reserved category) aggregate marks with Physics as one of the subjects.

Final year MS / BS who are yet to obtain their degree may also apply, however, they must complete the MSc/MS/BS degree at the time of admission with the requisite 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. Theoretical polymer physics
- b.1. Nonequilibrium Phases Transitions
- b.2. Hyperuniform states of matter

Gravitational Physics and Astrophysics

- a.1. Numerical modelling of radiation from astrophysical plasma
- a.2. General relativistic fluid dynamics simulations around compact objects
- b. Early Universe Cosmology
- c. Quantum fields in curved spacetime and relativistic astrophysics of compact stars

High Energy Physics

Theoretical Condensed Matter physics

- a. Electronic, Optical, and Magnetic structure of 2D and 3D-strongly correlated systems by Density Functional Theory (DFT) approach.
- b. Dynamics of open quantum systems; Measurements in quantum mechanics; Nuclear magnetic resonance.
- c.1. Quantum computation: Holographic codes and quantum error correction
- c.2. Quantum materials: spintronics via spin polarized supercurrents in altermagnet-superconductor hybrid structure
- d. Non-equilibrium dynamics of ultracold quantum gas, Dissipative dynamics and chaos in open quantum systems
- e.1. Study of static and dynamic correlations across melting in two dimensional systems with long-range interacting particles, both in the presence and absence of impurities
- e.2. Disordered quantum systems and non-equilibrium dynamics in them

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

Experimental condensed matter physics

- a. Spintronics experiment
- b.1. Quantum Information Processing using NV centres in diamond
- b.2. Topological Insulators, Majorana Fermions and Weyl Semi-metals
- c.1. Electronic and Magnetic structure by synchrotron based X-ray Photoemission spectroscopy (Both Angle-resolved and Angle-integrated)
- c.2. Electronic, Optical, Magnetic, and Transport properties of strongly correlated systems and novel nanomaterials
- d. Investigations of strongly correlated systems and quantum materials at extreme conditions of pressure and temperatures
- e.1. microscopy of phase transitions in correlated electron systems
- e.2. spectroscopy and transport studies in very high magnetic fields

Optics/Spectroscopy

- a. Terahertz Spectroscopy and Pump Probe Spectroscopy of Quantum materials and their heterostructures

- b.1. Photophoretic trapping of absorbing particles in air: Developing 3d optical tweezers for trapping absorbing microparticles and uncovering the physics behind their phenomena
 - b.2. Microbubble lithography: Generating novel mesoscopic architectures using Thermo-optical tweezers based directed self-assembly, and studying their science
 - b.3. Non-equilibrium statistical mechanics using optically trapped colloidal particles: Development of Brownian heat engines in complex fluids, statistical mechanics of active matter, etc
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- c.1. Study of Dissociative Electron Attachment to ground and excited state molecules
 - c.2. Study of Ion Pair Dissociation Dynamics to ground and excited state molecules
 - c.3. Dissociative electron attachment to molecular clusters

Channel 2: Institute Funded category

For candidates with valid rank in one of the national level exams: GATE/JAM/JEST/NET-LS.

Institute funded positions are available in the following areas/topics and only with the faculty members mentioned below:

Gravitational Physics and astrophysics [Theoretical] [**Dr. Koushik Dutta**]

- a. Early Universe Cosmology

Gravitational Physics and astrophysics [Theoretical] [**Dr. Golam M Hossain**]

- a. Quantum fields in curved spacetime and relativistic astrophysics of compact stars

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

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

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

- a.1. Quantum computation: Holographic codes and quantum error correction
- a.2. Quantum materials: spintronics via spin polarized supercurrents in altermagnet-superconductor hybrid structure

Condensed Matter [Theoretical] [**Prof. Satyabrata Raj**]

- a. Electronic, Optical, and Magnetic structure of 2D and 3D-strongly correlated systems by Density Functional Theory (DFT) approach

Soft Condensed Matter - Statistical physics [Theoretical] [**Dr. Arindam Kundagrami**]

a. Soft condensed matter physics, physics of biopolymers and intrinsically disordered proteins - application of analytical and numerical methods in statistical mechanics to solve problems

Condensed Matter [Experimental] [**Dr. Partha Mitra**]

a. Spintronics experiment

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

a. Quantum Information Processing using NV centres in diamond

Optics/Spectroscopy [Experimental] [**Prof. Dhananjay Nandi**]

a. Molecular fragmentation dynamics in the electron collisions with gas phase molecules

DPS Spring 2025 PhD Timeline :

- PhD application portal opens: 26.09.2024
- Application portal closes: 20.10.2024
- Publication of shortlist for the Interview: 30.10.2024
- Selection Interview window: November 11 - 18 2024
- Publication of PhD interview results by: 9.12.2024
- Pre-registration portal opens: 10.12.2024
- Pre-registration deadline: 24.12.2024
- Orientation: 2 January 2025