Please complete and sign the below application form and merge it with the other required documents into a single PDF (maximum file size: 25 MB) and upload this PDF according to the instructions provided at https://www.imprs-pks.mpg.de/application/application-procedure

The deadline of this application round is **April 30, 2025.**

1. Personal Data

First name	***Middle name***	***Last/Family name***

Date of birth *(dd/mm/yyyy) (optional)*	***Nationality*** *(optional)*

Please provide an address at which we will be able to contact you during the whole application process.

City	***Postal code***	***Country***

Street	***Number***

E-mail address	***Phone number*** *(optional)*

2. Academic Background

2.1 Qualifications

We are looking for talented students holding (or close to finishing) a **Master's Degree** (or an equivalent university degree, e.g., German "Diplom") in **physics, chemistry, mathematics or computer science**, with interests in studying atomic, molecular or condensed-matter phenomena or materials science.

	I already hold the following degree(s) *)	**Graduation Date** *(mm/yyyy)*	**I am <u>studying towards</u> the following degree(s)**	**Expected Graduation Date** *(mm/yyyy)*
Bachelor's Degree	☐		☐	
Master's Degree	☐		☐	
Combined Bachelor's/ Master's Degree	☐		☐	
Diploma	☐		☐	
Other *(please specify type)*	☐		☐	

**) Please include your graduation/grade certificate(s) in your application PDF.*

Please provide the details of the degree(s) you already hold or you are currently studying towards:

(1)

Type *(BSc, MSc, Diploma, …)*	***University/College***	***Scores*** *(Obtained/Max./Min.)*
Major subject	***Title of thesis*** *(if applicable)*	***(Expected) Graduation date*** *(mm/yyyy)*

(2)

Type *(BSc, MSc, Diploma, …)*	***University/College***	***Scores*** *(Obtained/Max./Min.)*
Major subject	***Title of thesis*** *(if applicable)*	***(Expected) Graduation date*** *(mm/yyyy)*

(3)

Type *(BSc, MSc, Diploma, …)*	***University/College***	***Scores*** *(Obtained/Max./Min.)*
Major subject	***Title of thesis*** *(if applicable)*	***(Expected) Graduation date*** *(mm/yyyy)*

2.2 Scholarships/Awards

If you received any scholarships or awards you feel are relevant to this application, list them here.

(1)

Type *(Scholarship, Award, …)*	***Awarded from***	***Date*** *(yyyy)*
Short description		

(2)

Type *(Scholarship, Award, …)*	***Awarded from***	***Date*** *(yyyy)*
Short description		

(3)

Type *(Scholarship, Award, …)*	***Awarded from***	***Date*** *(yyyy)*
Short description		

2.3 Publications

If you have any publications, you feel are relevant to this application, please list them here.

Title	**Reference**	**Publication Date** *(yyyy)*

2.4 Language Skills

The working language of the IMPRS-QDC program is English. *Please rate your English skills:*

☐ **Native** ☐ **Excellent** ☐ **Good** ☐ **Fair** ☐ **Poor**

If you took any English proficiency tests (e.g., TOEFL, IELTS, …), please list them here (please include your test certificate(s) in your application PDF):

(1)

Type *(TOEFL, IELTS, …)*	***Score***	***Date*** *(yyyy)*

(2)

Type *(TOEFL, IELTS, …)*	***Score***	***Date*** *(yyyy)*

3. Reference Letters

Each application needs to be supported by two referees. *Please provide the following link to your two referees to upload their reference letters by the end of the application deadline (please do not include any reference letters in your own application PDF):*

https://surveys.pks.mpg.de/471921?lang=en

NOTE: By providing the above link to your referees you agree that they share personal information about you with the IMPRS-QDC and its hosting institute, the Max Planck Institute for the Physics of Complex Systems (MPI-PKS).

4. PhD Project/Research Group Preferences

*Please check **at least one but not more than three preferences** for your PhD project/research group:*

Max Planck Institute for the Physics of Complex Systems (MPI-PKS), Dresden/Germany

MPI-PKS Dresden – Condensed Matter

- ☐ Non-equilibrium dynamics of many-particle systems (Prof. R Moessner)
- ☐ Experimental signatures of topological states of matter (Prof. R Moessner)
- ☐ Novel states of matter in magnetic quantum materials (Prof. R Moessner)
- ☐ The nature of spatio-temporal order in time crystals and related non-equilibrium phases (Prof. R Moessner)
- ☐ Transport, thermalization and disorder in driven quantum systems (Prof. R Moessner)
- ☐ Many-body physics on a noisy quantum computer (Prof. R Moessner)

MPI-PKS Dresden – Correlations and Topology

- ☐ Martingale topological phases of matter (Dr. AM Cook)
- ☐ Three-dimensional topological Skyrmion phases of matter (Dr. AM Cook)
- ☐ Generalized superexchange theory of anions with non-negligible spin-orbit coupling (Dr. AM Cook)

MPI-PKS Dresden – Finite Systems

- ☐ Non-adiabatic and topological effects of electron dynamics with ultrashort pulses (Prof. JM Rost/Prof. U Saalmann)
- ☐ Clusters and solid-state systems in strong laser fields (Prof. JM Rost/Prof. U Saalmann)
- ☐ Machine learning concepts for dynamics with noise (Prof. JM Rost/Prof. U Saalmann)
- ☐ Rydberg excitations in structured environments (Prof. JM Rost)
- ☐ Time and causality (Prof. JM Rost)

MPI-PKS Dresden – Correlations and Transport in Rydberg Matter

- ☐ Transport, localization, and correlation in interacting Rydberg atoms and molecules (Dr. M Eiles)
- ☐ Multichannel spectroscopy in Rydberg atom arrays (Dr. M Eiles)
- ☐ Localization, point defects, and interactions in Rydberg excitons in solid-state materials (Dr. M Eiles)
- ☐ External control and manipulation of Rydberg molecules (Dr. M Eiles)

MPI-PKS Dresden – Nonequilibrium Quantum Dynamics

- ☐ Tensor-networks-based reinforcement learning for quantum many-body systems (Dr. M Bukov)
- ☐ Reinforcement learning on near-term intermediate-scale quantum computing devices (Dr. M Bukov)
- ☐ Machine learning techniques in quantum many-body dynamics (Dr. M Bukov)
- ☐ Engineering effective Hamiltonians for quantum simulators using nonequilibrium drives (Dr. M Bukov)
- ☐ Equilibration and thermalization of nonequilibrium quantum systems (Dr. M Bukov)
- ☐ Control and manipulation of nonequilibrium quantum many-body states (Dr. M Bukov)
- ☐ Active matter with non-reciprocal interactions at the intersection of non-Hermitian classical and quantum many-body dynamics (Dr. M Bukov, Dr. R Alert)

MPI-PKS Dresden – Superconductivity and Magnetic Correlations

- ☐ New states of matter of correlated electrons in strong magnetic fields (Dr. A Wietek)
- ☐ Quantum oscillations in strongly correlated electrons (Dr. A Wietek)
- ☐ Physics of twisted moiré materials (Dr. A Wietek)
- ☐ Thermal transport in frustrated magnets and quantum spin liquids (Dr. A Wietek)
- ☐ Tensor networks methods for dynamics of 2D quantum lattice systems (Dr. A Wietek)

MPI-PKS Dresden – Dynamics of Quantum Information

- ☐ Entanglement dynamics in hybrid quantum circuits (Dr. P Claeys)
- ☐ Exactly solvable models of chaotic quantum many-body dynamics (Dr. P Claeys)
- ☐ Geometric probes of chaos and nonergodicity in quantum circuits (Dr. P Claeys)
- ☐ Quantum control algorithms for noisy quantum computers (Dr. P Claeys)

MPI-PKS Dresden – Functional Quantum Matter

- ☐ Spin group theory of unconventional quantum magnets (Dr. L Šmejkal)
- ☐ Electronic structure theory of topological magnets (Dr. L Šmejkal)
- ☐ Altermagnetic transport and spintronics (Dr. L Šmejkal)
- ☐ Theory of multiferroic materials (Dr. L Šmejkal)

Technische Universität Dresden (TUD), Dresden/Germany

TU Dresden – Institute for Theoretical Physics

- ☐ Classical and quantum dynamics in higher-dimensional systems (Prof. A Bäcker, Prof. R Ketzmerick)
- ☐ Fractal structure of resonance states in open systems (Prof. A Bäcker, Prof. R Ketzmerick)
- ☐ Quantum entanglement in interacting chaotic systems (Prof. A Bäcker, Prof. R Ketzmerick)
- ☐ Fully variational and semiclassical methods for Bose-Hubbard Hamiltonians (Prof. F Großmann)
- ☐ Semiclassical description of decoherence and dissipation in open quantum systems (Prof. F Großmann)
- ☐ Atoms, molecules and electrons in solids under the influence of extreme laser fields (Prof. F Großmann)
- ☐ Dynamics of open quantum systems (quantum stochastics, strong damping, light-matter systems) (Prof. W Strunz)
- ☐ Dynamics in strongly coupled cavity-QED (including continuous measurement) (Prof. W Strunz)
- ☐ Dynamics of quantum information and quantum thermodynamics, quantum foundations (Prof. W Strunz)
- ☐ Plasmon-molecule interaction (Dr. A Eisfeld)
- ☐ Organic molecules on dielectric surfaces (Dr. A Eisfeld)
- ☐ QM/MM (Quantum Mechanics/Molecular Mechanics) description of light harvesting systems (Dr. A Eisfeld)
- ☐ Non-linear spectroscopy (Dr. A Eisfeld)
- ☐ Near-field spectroscopy (Dr. A Eisfeld)

TU Dresden – Collective Dynamics

- ☐ Dynamics of Quantum Gases (Dr. M Haque)
- ☐ Thermalization of isolated quantum systems (Dr. M Haque)
- ☐ Open-system dynamics and non-hermitian spectra (Dr. M Haque)

TU Dresden – Quantum Many-Body Theory

- ☐ Topological phases in dissipative systems (Prof. JC Budich)
- ☐ Quench dynamics of correlated topological phases realized in ultracold atomic gases (Prof. JC Budich)
- ☐ New numerical approaches to correlated topological phases (Prof. JC Budich)

TU Dresden – Theoretical Chemistry

- ☐ Actinide-based metal-organic frameworks (Prof. T Heine)
- ☐ Development of correlated methods for solids incorporating heavy elements (Prof. T Heine)
- ☐ Topological properties in synthetic two-dimensional materials (Prof. T Heine)
- ☐ Quasi-particle chemistry (Prof. T Heine)

TU Dresden – Materials Science and Nanotechnology

- ☐ Advanced biomaterials modeling: development of physically inspired machine learning force fields (Prof. G Cuniberti)
- ☐ Generative models for the computational design of quantum materials (Prof. G Cuniberti)

TU Dresden / IFW – Experimental Solid-State Physics

- ☐ Electron spin resonance and magnetometry on correlated quantum magnets (Prof. B Büchner)
- ☐ Electronic structure of magnetic 2D materials by photoemission spectroscopy and microscopy (Prof. B Büchner)
- ☐ Bulk and surface magnetism and magnetodynamics of molecular magnet assemblies (Prof. B Büchner)
- ☐ Multiscale theoretical methods for surface deposition of functional molecules (Prof. B Büchner)
- ☐ Molecules on quantum materials studied by scanning tunneling microscopy (Prof. B Büchner)
- ☐ Quantum transport in topological materials (Prof. B Büchner)
- ☐ Quantum transport in low dimensional superconductors (Prof. B Büchner)
- ☐ Topology in electronic circuits (Prof. B Büchner)

Universität Leipzig (LU), Leipzig/Germany

Leipzig University – Fractionalization and Topology in Quantum Matter

- ☐ Non-perturbative approaches to strongly interacting gapless fermions in 2+1 dimensions and higher (Prof. I Sodemann)
- ☐ Novel probes and phenomena in quantum spin liquids and quantum Hall liquids (Prof. I Sodemann)
- ☐ Berry phase phenomena in charge and spin transport (Prof. I Sodemann)
- ☐ Far from equilibrium quantum states of matter (Prof. I Sodemann)
- ☐ Platforms for fractionalization beyond the quantum Hall regime and frustrated magnets (Prof. I Sodemann)

Czech Academy of Sciences (CAS), Prague, Czech Republic

CAS – Institute of Organic Chemistry and Biochemistry (IOCB)

- ☐ Molecular dynamics simulations of interactions of ions with hydrated proteins (Prof. P Jungwirth)
- ☐ Molecular simulations of hydrated phospholipid membranes (Prof. P Jungwirth)
- ☐ Development of force fields for molecular dynamics simulations (Prof. P Jungwirth)

University of Chemistry and Technology (UCT Prague), Prague, Czech Republic

UCT Prague – Theoretical Photodynamics

- ☐ X-ray photodynamics in the condensed phase (Prof. P Slavicek)
- ☐ Machine learning algorithms in spectroscopy and dynamics (Prof. P Slavicek)
- ☐ Computational X-ray spectroscopy (Prof. P Slavicek)
- ☐ Ab initio modelling of charge transfer reactions (Prof. P Slavicek)
- ☐ Probing and Transforming Matter by Electrons: From Molecules to Liquids (Prof. P Slavicek)
- ☐ Nuclear quantum effects in spectroscopy (Prof. P Slavicek)

Charles University, Prague, Czech Republic

Charles University – Mathematics and Physics Faculty

- ☐ Structure, dynamics and spectroscopy of proton defects in liquids (Prof. O Marsalek)
- ☐ Path integral molecular dynamics methodology and applications to hydrogen bonded systems (Prof. O Marsalek)
- ☐ Machine learning from molecular dynamics (Prof. O Marsalek)

Polish Academy of Sciences (PAS), Wroclaw, Poland

PAS – Institute of Low Temperature and Structure Research (ILTSR)

- ☐ Theoretical studies of strongly interacting bosons in the context of ultracold atoms in optical lattices (Prof. T Zaleski)
- ☐ Interplay of magnetism and superconductivity in heavy fermion systems - competition, coexistence, coupling (Prof. D Kaczorowski)
- ☐ Experimental studies of topological semimetals (Prof. D Kaczorowski)
- ☐ Superconductivity and condensation in Bose-Fermi mixtures in optical lattices (Prof. T Kopec)
- ☐ Fundamental and biomedical materials science of luminescent colloidal nanoparticles (Prof. A Bednarkiewicz)

University of Wroclaw, Wroclaw, Poland

University of Wroclaw – Institute of Theoretical Physics

- ☐ Superconductivity/superfluidity-Mott transition and BEC/BCS crossover (Prof. D Blaschke)
- ☐ Kinetic approach to the description of QED-like vacuum effects in graphene (Prof. D Blaschke)
- ☐ Crystalline color superconductor phases in compact star interiors (Prof. D Blaschke)
- ☐ Relativistic transport phenomena in many-body systems (Prof. A Sedrakian)
- ☐ Spectral functions for strongly coupled superfluids: From ultracold gases to dense quark matter (Prof. A Sedrakian)
- ☐ Relativistic superfluid hydrodynamics from projection operator formalism (Prof. A Sedrakian)
- ☐ Phi-derivable approach to the cluster virial expansion for strongly correlated many-particle systems (Prof. D Blaschke)

Wroclaw University of Science and Technology, Wroclaw, Poland

University of Wroclaw – Institute of Theoretical Physics

- ☐ Equilibrium and non-equilibrium dynamics of topological materials (Prof. P Surówka)
- ☐ Effective field theory description of fracton phases of matter (Prof. P Surówka)
- ☐ Hydrodynamics and elasticity of active matter (Prof. P Surówka)
- ☐ Machine Learning, Statistical Physics and Applications (Prof. P Surówka)

Do you have contact with one or more of the above IMPRS-QDC partner groups?

◯ **Yes** *Please specify:* _____

◯ **No**

5. Additional Information

5.1 About Your Motivation (max. 300 words)

Please describe briefly why you are interested in joining the IMPRS-QDC and why you prefer the PhD project(s)/research group(s) you checked in the list above.

5.2 About You (max. 300 words) - *optional*

Is there anything else you would like to tell us about yourself?

5.3 How did you learn about IMPRS-QDC?

- ☐ **DAAD**
- ☐ **EURAXESS**
- ☐ **academicpositions.com**
- ☐ **findaphd.com**
- ☐ **jobvector.de**
- ☐ **Social media** *(please specify)*

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- ☐ **Recommendation by supervisor or senior scientist**
- ☐ **Recommendation by former IMPRS student**
- ☐ **Other** *(please specify)*

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6. Acknowledgement

Please check the following boxes and sign the document:

☐ I confirm that all information provided in this application is complete and correct. The uploaded documents are true copies of my originals, without any changes. I am aware of the fact that false information will be considered a misdemeanor and will result in me being excluded from the application process or – if detected later – from the IMPRS-QDC.

☐ I consent to the storage of the data I provided for application and admission purposes. I agree that the information provided in this application will be shared with other persons involved in the application process of IMPRS-QDC.

☐ I acknowledge the data protection advice at https://www.pks.mpg.de/visitors-program/application/data-protection-advice-for-applicants/

Date** (dd/mm/yyyy)* ***Signature