PROPERTIES OF MESOSCOPIC SYSTEMS

Moscow Institute of Physics and Technology (National Research University)

Degree or qualification is awarded: **PhD (Candidate of Science)**

Language of study: **English**
Mode of study: **full-time**
Duration: **4 years**
Availability of free education: **yes**
Price: **375 000 RUB**

Programme webpage at the university website: https://eng.mipt.ru/programs/properties-of-mesoscopic-systems/

Programme curator: **Denis Ustyuzhaninov**
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Entry requirements:

- Master's degree / equivalent in a related field
- B2 level of English
- Good track record of publications related to the topic of the intended research
- Strong research proposal 1,500 - 3,500 words

Research supervisor:
Rashid Nazmitdinov
PhD, DSc

Supervisor's research interests:
My research activity is devoted to a few directions:

- Transport phenomena in mesoscopic systems.
- Regular and chaotic features of finite quantum systems.
- Effect of various semiconductors on efficiency of solar cells.

The main focus in the first research line is the investigation of spin-orbital interaction on the spin current in graphene, quantum dots and twodimensional nanostructures. This study is useful for construction of various nanodevices that can be used as building blocks for nanoelectronics. It will also help to understand fundamental features of spintronics. In the mesoscopic systems there is a strong interplay between classical (macroscopic) and quantum (microscopic) degrees of freedom. Very often we have to deal with nonintegrable systems. However, many properties of such systems can be analyzed in terms of classical periodic orbits. The second research line is devoted to analysis of the conditions that allow to illuminate hidden symmetries in the classical analogues of corresponding quantum systems. As a result, these symmetries manifest themselves in the corresponding quantum spectra as specific integrals of motion, that could elucidate their quantum properties. One of the main challenge of the modern photovoltaics is a construction of efficient thinfilm technology. My third research line is devoted to analysis of various physical conditions that would allow to increase power conversion efficiency of thinfilm solar cells based on perovskite semiconductors.

Research highlights:
The main goal of my research is to find fundamental laws that would be useful for creation of various nano systems for technological applications.

Supervisor's specific requirements:
Good physical and mathematical background, knowledge of programming languages such as Mathematica, Maple, CI, Fortran.

Main publications:

- J.L. Birman, R.G. Nazmitdinov, V.I. Yukalov, “Effects of symmetry breaking in finite quantum systems” Physics Reports 526 (2013) pp.1-91.
- R.G. Nazmitdinov, A. Puente, M. Cerkaski, and M. Pons, “Self-organization of charged particles in circular geometry” Phys.Rev.E95(2017)026602.
- F. Bonin-Ripoll, Ya. B. Martynov, G. Cardona, R.G. Nazmitdinov, R. Pujol-Nadal “Synergy of the ray tracing+carrier transport approach: On efficiency of perovskite solar cells with a black reflector” Solar Energy Materials and Solar Cells 200 (2019)110050. M. Pudlak, R.G. Nazmitdinov “ Klein collimation by rippled graphene superlattice” J. Phys.: Condens. Matter 31 (2019)495301.
- R.G. Nazmitdinov, “From Chaos to Order in Mesoscopic Systems” Phys.Part.Nucl.Lett.16(2019)159.

Specializations within this programme