Level of education: **Master**
Field of study: **16.04.01 Technical Physics**

Advanced Quantum and Nanophotonic Systems

OPTOMECHANICS

Credits: 6 ECTS		
Semester		**Assessment**
2nd semester	6 ECTS	Exam

Course developers: **Mihail Petrov**

The course is aimed to give an introduction to the concept of how it is possible to manipulate the matter with light. We will cover optical tweezers (2018 Nobel prize in Physics), go deeper into fundamentals of optical forces and torque from classical and quantum perspective (e.g. lecture about LIGO project). Lastly, we will go through the cavity optomechanics and see how it is possible to realize an interplay between phonons and photons. Each topic is supported by unique, interesting problems. After this course each student will gain a nice perspective of physics behind each effect, and will be able to read and analyze related papers about novel discoveries in the field.

Requirements

Course prerequisites: Quantum optics.

Course structure

1. NANOPARTICLE OPTOMECHANICS
    1.1. Forces on particles. Optical tweezers.
    1.2. Sophisticated effects: optical binding, optical pulling, optical torques.
    1.3. Plasmonic and metamaterials for optomechanics.

2. CAVITY OPTOMECHANICS
    2.1. Types of optomechanics interaction for cavities.
    2.2. Resonant and non-resonant Mandelstam-Brillouin scattering.
    2.3. Optomechanical nonlinearity (classical consideration): bistability, heating and cooling.
    2.4. Mandelstam-Brillouin Scattering in the bulk.

3. QUANTUM OPTOMECHANICS

3.1. Optomechanical interferometry.

3.2. Quantum-fluctuation interactions (Casimir force, Casimir-Polder potential).

3.3. Dynamical Casimir effect (optional).

3.4. Atomic optomechanics and atomic cooling (Doppler cooling, optical viscosity, magneto-optical trap, Sisyphean cooling).

Assessment

During the semester students solve problems. To obtain an "excellent" it is necessary to solve at least 6 problems.

Faculty: **Faculty of Physics**

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Tags: **Optomechanics; Optical tweezers; optical forces; Mandelstam-Brillouin scattering; Casimir force; Dynamical Casimir effect**