Grupper til Challenge-Track-programmet E2016-F2018

Molekylefysik

Medlemmer:
Steen Brøndsted Nielsen

Nøgleord:
Energitransport- og omsætning; Molekylære reaktioner; Anslåede tilstandes fysik; Fotobiofysik; Eksotiske molekyler; Instrumentudvikling- og design.

Kompetencer:
Lasererfaring; Massespektrometri; Spektroskopi; Acceleratorfysik; Ion-lagring; Molekylære kvantefysikberegninger; Numerisk modellering; LabView programmering; God laboratoriepraksis; Litteratursøgning; Præsentation og formidling af videnskabeligt arbejde.

Evaluering:
Rapport (5 sider) og mundtlig præsentation (30 min) for hele gruppen.

X-ring group

Members

Henrik B. Pedersen

Keywords

Theme 1: Molecular VUV-photoabsorption, atmospheric physics, detachment and ionization, photodissociation, ion traps, ion storage rings, ASTRID2, synchrotron radiation
Theme 2: Classical non-linear dynamics, standing waves on a string

Competences

Labview programming, numerical simulations, experience with experimental work and data analysis, experience with non-linear problems, presentation skills

Evaluation

20-30 min. oral presentation for the group

Theoretical few-body physics

Members:
Nikolaj Zinner, Dimitri Fedorov, Aksel S. Jensen

Prerequisites:
Quantum mechanics, so the projects must be in the spring term 2017 or later.

Theoretical derivations and calculations, including:
Solutions of the Schrödinger equation - both analytical and numerical
Systems in one and two dimensions with short- or long-range interactions
Energies of particles in geometries with non-trivial curvature
Spin models and manipulation of transport properties
Quantum spin transistors in cold atoms and in superconducting circuits
The project will naturally be as close to the research topics of the group as possible.

Skills/competencies:
Analytical derivations
Programming of numerical implementations
Graphical presentation of results
Collaboration with researchers and older students toward common goals
Oral presentations and discussion at the group meetings

Evaluation:
Report

Surface Dynamics lab: Scanning Tunneling Microscopy studies of graphene

Members
Liv Hornekær m.fl.

Keywords
Functionalization, electronic properties and band gap engineering. Graphene, 2D materials, Scanning Tunneling Microscopy, Surface Science, Ultra High Vacuum, functionalization, band gap engineering.

Acquired skills

Experimental proficiency with scanning tunneling microscopy and ultrahigh vacuum techniques, experience with other surface science characterization techniques, insight into the very active and competitive field of 2D materials research, experience with collaboration in a research group (3 post docs, 4 PhD students), training in oral presentation of research results.

Final evaluation

Oral presentation of own research results and state-of-the-art within the field.

Materials science

Members:
Peter Balling, Brian Julsgaard, Sanjay Ram

Keywords:
Materials and light, Synthesis of new materials, laser-excited materials, light from silicon, efficient solar cells.

Competencies:
Micro- and nano-scale fabrication and analysis methods (e.g. under the theme ”Samples from cradle to grave”). Continuous and ultrafast laser/optical methods.
Hands-on research-lab training in optics, electronics and IT. Participation in an active research group with many different students and activities.

Evaluation:
A brief written report and/or a presentation at a group meeting.

Computer simulations of hard sphere gas, in and out of equilibrium

Members:
Alberto Imperato

keywords:
Ideal and interacting gas computer simulations thermodynamics. The project is in principle open to anybody, but I expect the more "theoretical oriented" students would prefer it. Requires knowledge of mechanics thermodynamics programming skills as acquired in Numerical Physics (1^{st} year course).

Evaluation:
Final report and presentation.

Ion trap group, Thermodynamics of coupled harmonic oscillators: From the classical to the quantum regime

Members

Alberto Imparato, Aurelien Dantan, and Michael Drewsen

Keywords

Classical/Quantum thermodynamics, harmonic oscillators, ion trapping, ion cooling, nano-optomechanics, fluorescence imaging, optical interference, power spectra analysis

Prerequisites:

Quantum mechanics, so the projects must be in the spring term 2017 or later.

Competencies:

A range of theoretical (T) and experimental (E) skills, including: Ion trapping (E/T), Handling of lasers (E), Ion cooling (E/T), Fluorescence imaging (E/T), Optical interference (E/T), Beat-frequency analysis – power spectra (E/T), Thermal motion of single oscillators – classical/quantum (T/E), Coupled motion of harmonic oscillators – classical/quantum (T/E), Energy flows between harm. osc.'s – energy fluctuations (T/E).
During the project you will become familiar with various computer programs for theoretical simulations, data acquisition and data analysis.

Examination:

A 30 min. oral presentation of results for the three researchers' group members.