UNIVERSITÉ DE FRIBOURG
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DÉPARTEMENT DE PHYSIQUE
FACULTÉ DES SCIENCES ET DE MÉDECINE

Travaux d'initiation à la recherche
27 mai 2026, 13h15 – 16h30 salle 1.50

Speaker: David BERSET
Supervisor: Dr. PD Joanna Hoszowska

Title: **L-shell shake processes and KαL satellites resulting from 1s photoionization in 3d transition metals**

Abstract:

This work focuses on the experimental study of X-ray emission spectra from 3d transition metals using a curved-crystal von Hamos wavelength-dispersive X-ray spectrometer. The samples were excited by the bremsstrahlung radiation produced by an X-ray tube, allowing the observation of the main Kα diagram lines as well as KαL satellite structures. The analysis was mainly focused on the Kα transitions and their KαL satellites, whose relative intensities provide information about double ionization and shake processes involving the L shell. The measured X-ray spectra were fitted using a least-squares procedure to separate the contributions of the main diagram lines and the satellite components. From these fits, the spectral profiles, transition energies, and integrated intensities were extracted. The ratio I KαL /I Kα was then determined to quantify the contribution of the satellite emission relative to the total Kα intensity. This ratio provides an estimate of the probability of shake processes involving the L shell.

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Speaker: Anaïs BUCHER
Supervisor: Dr. Premysl Marsik, Group Bernhard
Title: **Ellipsometric Investigation of Thin Films**

Abstract:

This project focused on the characterization of thin films using ellipsometric techniques, based on probing a sample with polarized light and measuring the change in polarization state (characterized by Ψ and Δ) upon reflection. The aim of this study is to compare two different types of ellipsometers. The first one is a variable angle spectroscopic ellipsometer, measuring Ψ and Δ spectra in the visible range extending slightly into the UV and NIR range, thus allowing precise determination of the dielectric function of the film through regression analysis. The second one is a 2D imaging ellipsometer, capable of capturing high-contrast microscopic images of a sample's surface, and of performing local ellipsometric measurement for precisely predefined regions of the film. This work provides insight into how these two ellipsometers complement each other. Three types of samples, consisting of a thin film deposited on a substrate, were investigated, namely SiO2 on Silicon, NbSe2 on YAlO3 and spin-coated films.

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Speaker: Flavie-Morgane BRODARD
Supervisor: Dr. Milagros Montemurro, Group Acuna
Title: **Plasmonic antennas for DNA sensing**
Abstract:

The single-detection of fluorophores can be used as a tool to quantify the concentration of miRNAs, that are present in body fluids. These concentrations are used to monitor a disease during the treatment. However, the detection of fluorophores in a body fluid is limited because of the complex background. A way to handle this limitation is the use of plasmonic nanoantennas as they enhance and confine the electromagnetic field of the incident light, leading to an increased brightness for a fluorophore placed in the hot-spot of the nanoparticles.
This work aims to quantify the plasmon-enhanced fluorescence in a buffer and in a complex background, namely the human serum. To this end, the photons count for samples without or with nanoantennas are measured with a wide-field microscope. These results were then used to determine whether the use of plasmonic nanoantennas provide an advantage for the detection of miRNAs in a complex background.

Speaker: Lorian THALMANN
Supervisor: Dr. Karol Kolataj, Group Acuna
Title: **High Refractive Index Dielectric Nanoantennas**
Abstract:

DNA-based nanoantennas provide a reliable structure for fluorescence detection and precise measurements. This project investigated fluorescence enhancement in gold and silicon nanoparticle dimers assembled on DNA origami scaffolds. Fluorophores were incorporated into the structures and characterized using widefield fluorescence microscopy. Gold nanoparticle assemblies exhibited significant fluorescence enhancement compared to DNA origami controls, while silicon-based systems, under the experimental conditions used, did not show the expected enhancement. These results demonstrate the potential of DNA origami-based plasmonic nanoantennas for nanoscale light manipulation and fluorescence enhancement applications.

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Speaker: Esteban YANEZ VOGEL
Supervisor: Dr. Véronique Trappe
Title: **Cracking the Perfect "Œuf Mollet"**
Abstract:

Nowadays eggs have a great importance in the food industry because of their *high protein* composition and accessibility. In this talk I will briefly explain how heat denaturation of proteins in Egg White and Yolk will induce aggregation and the formation of a 3D network, which dramatically changes the mechanical properties of the egg. These properties were probed by imposing an oscillatory deformation, which permitted for a quantitative study of egg white and yolk gelation submitted to different heating ramps. Interestingly we found that egg white gels present distinct final moduli depending on the target temperature while the moduli of the egg yolk gel do not. Moreover, our study exposes different gelation kinetics between a slow egg yolk and a fast egg white gelation, which encodes all the information needed for achieving the perfect Oeuf mollet.

Speaker: Marwen OUERGHEMMI
Supervisor: Dr. Chi Zhang, Group Scheffold
Title: **Three-Body Optical Binding**
Abstract:

This thesis investigates whether light-induced interactions between colloidal particles are purely pairwise or include many-body contributions. Micrometer-sized spherical colloidal particles are confined using holographic optical tweezers, where the incident light induces optical binding forces. Particle positions are measured with nanometric precision using high-resolution microscopy and an adaptive image reconstruction algorithm. From the recorded trajectories, spatial probability distributions are reconstructed and converted into effective interaction potentials using the Boltzmann relation. The interaction potential is first measured for two particles to determine the pairwise optical binding potential. Measurements are then extended to three-particle configurations to identify possible three-body contributions. Preliminary results show clear deviations from pairwise additivity in the three-particle potentials. We find a non-zero three-body contribution to the interaction potential, demonstrating the presence of many-body optical binding forces.

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Speaker: Leonardo NICCHIOTTI

Supervisor: Prof. Yi-Cheng Zhang, Group Zhang

Title: **Stable marriage problem under information constraints**

Abstract:

The Stable Marriage Problem, introduced by Gale and Shapley in 1962, provides the canonical solution to two-sided matching, guaranteeing stable outcomes under one critical assumption: that all agents know each other's preferences perfectly. In real markets (school choice, residency matching, kidney exchange) this assumption is rarely satisfied. Students do not know how to rank thousands of universities; applicants do not see CEO's lists. This presentation explores what happens to matching outcomes when agents have only partial information and rationally truncate their acceptable lists.

We introduce a parametric model where social information is captured by a parameter α that goes from complete ignorance to perfect knowledge, and where agents include candidates in their acceptable list only when their estimated rank falls below a threshold T. Through Monte Carlo simulation, we investigate how the joint configuration (α, T) reshapes matching quality, equity between sides, and the singleness rate. We will discuss about what these results reveal on the role of social information in two-sided markets.

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Speaker: Léa DUPONT
Supervisor: Dr. Frédéric Chassot, Group Monney
Title: **Photoemission study of Au(111) and In2Se3**

Abstract:

This work is an introductory experimental research project that presents an analysis of Au(111) and In2Se3 2H and 3R polytypes using angle-resolved photoemission spectroscopy (ARPES) and X-ray photoelectron spectroscopy (XPS). The energy splitting visible on the band structure due to the Rashba effect for Au(111) is studied and the effective mass can be extracted. The chemical composition of the In2Se3polytypes is confirmed by XPS and the band gap as well as the effective mass are extracted directly from the ARPES measurements. All results have been compared with previous research and turned out to be consistent.

Speaker: Antony DIEU
Supervisors: Joel Morf & Vincent Garrido, Group Monney
Title: **MBE Growth of SnS on Au(100) Studied by LEED and XPS**

Abstract:

Black Phosphorus (BP) is a promising material due to its high carrier mobility and thickness-dependent direct bandgap. Despite this, the synthesis of monolayer BP remains a major challenge. Direct growth on gold substrates is hindered by lattice mismatch, which promotes the formation of undesired structural phases. To address this limitation, a Tin Monosulfide (SnS) buffer layer is introduced, acting as a virtual substrate to enable monolayer growth. This work focuses on the growth of SnS layers on Au(100) using Molecular Beam Epitaxy (MBE) and their characterization by both X-ray Photoelectron Spectroscopy (XPS) and Low-Energy Electron Diffraction (LEED). While XPS analysis confirmed the SnS formation, LEED analysis using the inhouse custom simulation tool Diffract Lab suggests that the buffer layer does not form a smooth film. Instead, the SnS appears to grow as 3D clusters, characteristic of a Volmer–Weber (island) growth mode. Although the characterization workflows are robust, future work should focus on improving surface kinetics to achieve a more uniform film growth.

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