ILL WORK PLACEMENT OPPORTUNITIES 2018

The Institut Laue-Langevin (ILL, www.ill.eu), situated in Grenoble, is an international research centre at the leading edge of neutron science and technology. As the world’s flagship centre for neutron science, the ILL makes its facilities and expertise available to visiting scientists from all over the world. Every year we offer a large variety of highly interesting placement subjects allowing students to:

- Contribute to the development of scientific research
- Participate in the implementation of advanced technology projects
- Work in an international context while living in an area of outstanding beauty...(tourist info, photos)

Whilst most of the placements are scientific in content, there are also opportunities in other fields (computing, technical).

Please find our placement topics on the following pages and also on our internet site ILL Work placement opportunities

If a placement corresponds to your profile and requirements, please email directly the placement supervisor (as soon as possible, preferably before the end of February 2015). Please enclose your CV and a covering letter, quoting the appropriate reference. Before applying, please check on the ILL web site whether the placement you are interested in is still available.

We care about Equal Opportunity and Diversity: we therefore encourage anyone with the relevant qualifications to apply.
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Gravitational and whispering-gallery quantum states were discovered at the ILL, Grenoble, in experiments with slow neutrons. These phenomena provide a unique example of the so-called quantum bouncing of particles of matter on a surface. On the one hand, they allow us to constrain/explore fundamental physics phenomena beyond the Standard Model of particle physics. On the other hand, they are extremely sensitive to changes to surface potentials and, thus, provide an excellent tool for materials science.

A recent textbook [1] explains the whole of quantum mechanics using this single phenomenon and justifies why it should be the subject of precision studies. It describes in detail the phenomena involved and the experimental methods used. In short, the neutron whispering gallery is a quantum phenomenon which may appear, for instance, when a neutron with a velocity of $\sim 10^3$ m/s moves near a concave cylindrical mirror with a radius of a few cm at a distance of $\sim 10^1-10^2$ nm. It can be explored by simultaneously measuring, under certain conditions, the longitudinal and tangential neutron velocities. The figure shows a typical interference pattern. Even minor changes to the mirror surface potential (thin surface films, gas adsorption, etc.) would affect some features of such an interference pattern.


**Activities of the trainee:**
This Master’s thesis internship proposal consists of measuring such interference patterns for various mirror surfaces, treating the data, and analysing them with a view to evaluating the surface potentials. We have obtained cylindrical mirrors of sufficient quality and investigated them experimentally. The student will apply surface coatings to the mirrors, study the mirrors with/without the coatings using neutron reflectometers (D17), treat the data using standard programs and analyse them using existing theoretical formalism. Such an analysis is relatively complex when a high precision is required. It might therefore be associated with further development of the software. This makes the work interesting and challenging. Furthermore, the results expected from this project will provide an unprecedented insight into sensitivity to surface phenomena.

**Key words:** neutron whispering gallery; cold neutrons; neutron reflection; surface potentials; thin films; extreme sensitivity

**Level required:** 5th year university studies in physics

**Notes:** This post is an internship with a maximum duration of 5 months

**How to apply:** Please send your application directly to the supervisor: Valery Nesvizh, e-mail: nesvizh@ill.eu

**INTERNSHIP (REF. NPP_2) OCTUPOLE EXCITATIONS IN EXOTIC NUCLEI: LIFETIME MEASUREMENTS IN FISSION FRAGMENTS USING THE FIPPS ARRAY**

All along the chart of nuclei, different structures are observed that are manifestations of the underlying nucleon-nucleon interaction. Important nuclear information can be extracted from the measurement of the gamma radiation emitted by excited nuclear states. In particular, the transition probabilities, one of the most stringent tests of nuclear models, can be determined from lifetime measurements of nuclear levels.

The first negative parity state of spin $J=3$ in the doubly magic 132Sn nucleus is considered to be one of the best examples of octupole vibrations in nuclei. However, to date the strength of the gamma transition from this state to the ground state has never been measured. The structure of nuclei around 132Sn is important not only for testing theoretical models but also for understanding the r-process nucleosynthesis.

This lifetime can be measured at the FIPPS spectrometer at the ILL by producing nuclei in this mass region through neutron-induced fission. From the Doppler broadening of the gamma line in the energy spectrum emitted while the
fissione fragments are slowing down in the target/support material, the lifetime can be determined and thus the octupole vibration nature of the nuclear state possibly demonstrated.

**Activities of the trainee:**
The trainee will participate in the fission measurements planned for next year at the FIPPS instrument. He/she will analyse the data and run Monte Carlo simulations for the slowing-down of the emitting nuclei and emission of gamma rays in order to determine the lifetimes of nuclear states around 132Sn.

**Key words:** octupole vibrations; nuclear structure; doubly magic nuclei; transition probabilities

**Level required:** 5th year university studies in physics

**Notes:** This post is an internship with a maximum duration of 5 months

**How to apply:** Please send your application directly to the supervisor: Caterina Michelagnoli, email: michelagnolic@ill.fr

**INTERNSHIP (REF. NPP_3) DETERMINING SPIN AND PARITY OF NUCLEAR STATES USING FIPPS: TEST MEASUREMENTS AND SIMULATIONS**

The detection of gamma rays emitted by excited nuclear states using a symmetric system of Ge detectors such as the FIPPS array at the ILL makes it possible to determine the spin and parities of the states through angular correlation measurements. This information is used to benchmark the theoretical models describing the structure of nuclei. FIPPS is a new instrument and ran its first experimental campaign at the beginning of 2017. A systematic study of source/in-beam data and Monte Carlo simulations are needed in order to determine the geometry factors to be used to account for the finite dimensions of the detectors and the variation of the detector response as a function of energy.

**Activities of the trainee:**
The trainee will learn how to measure angular correlations between coincident gamma rays. He/she will analyse source/in-beam data from the first FIPPS experimental campaign. He/she will conduct a systematic study of such correlations as a function of gamma-ray energy and develop the part of the Monte Carlo simulation code for establishing the geometrical corrections to the experimental data.

**Level required:** 3rd year university studies in physics

**Notes:** This post is an internship with a maximum duration of 3 months

**How to apply:** Please send your application directly to the supervisor: Caterina Michelagnoli, email: michelagnolic@ill.fr

**INTERNSHIP (REF. NPP_4) CROSS-TALK PROPERTIES OF A FIPPS CLOVER DETECTOR**

High-resolution nuclear structure studies rely on the sensitivity of germanium detectors. The co-axial geometry is commonly used for gamma-ray spectroscopy studies at accelerator and neutron beam facilities. In detector arrays such as FIPPS at the ILL, 4 co-axial germanium crystals share the same cryostat in the so-called “clover” configuration. The energy deposited in the different crystals of the same clover by Compton-scattered gamma rays is “added-back” in order to recover the full energy of the gamma rays. This procedure dramatically improves the peak-over-background and efficiency of such devices.

In order to preserve resolution and adequate energy calibration in the energy spectra after add-back, the cross-talk among the different detectors of the same clover has to be taken into account. Due to this effect, when multiple crystals in a clover are hit at the same time, the measured energy in each crystal is less than the actual energy. This is due, on the one hand, to the presence of transient signals induced in neighbouring crystals and, on the other hand, to a capacitance effect in the signal readout electronics circuit. The cross-talk effect must be corrected in order to guarantee the energy resolution needed for spectroscopic studies. A systematic study as a function of gamma-ray energy is needed as well as a modelling of the effect by analysing the shapes of digitized signals.
Activities of the trainee:
The trainee will analyse FIPPS source and in-beam data in order to study the cross-talk effect of FIPPS clovers. He/she will use analysis programs already developed at FIPPS and improve them on the basis of his/her own investigation. He/she will analyse raw waveforms in order to model the effect.

Level required: 3rd year university studies in physics

Notes: This post is an internship with a maximum duration of 3 months
How to apply: Please send your application directly to the supervisor: Caterina Michelagnoli, email: michelagnolic@ill.fr

INTERNSHIP (REF. NPP_5) GAMMA-RAY IMAGING: CHARACTERISATION OF A SEGMENTED GERMANIUM DETECTOR

Nuclear structure studies through gamma-ray spectroscopy as well as many applications rely on a knowledge of the position of the gamma-ray emitting source. With standard germanium detectors (such as the ones of the FIPPS array at the ILL), the backtracking of the gamma-ray emitting source is limited by the finite size of the detectors. New-generation arrays (such as AGATA, the result of the efforts of a European collaboration) are made up of segmented germanium detectors and pulse-shape analysis techniques are used to reconstruct the gamma interaction points in the germanium medium with a precision down to 5mm. One of these detectors is available at the ILL, and, once put in operation and tested, could be used for reconstructing the gamma-ray source position at FIPPS. If this technique were successful, this would pave the way for a new ancillary system at FIPPS that would help to suppress the gamma background (by identifying the gamma rays that are not coming from the source) as well as for applications requiring the localisation of the source of gamma rays.

Such a detector can also be used for neutron scattering experiments. The tracing of gamma rays described above will make it possible to identify the neutrons that are captured by the sample, which are not usually taken into account. At the same time, the gamma-ray signal would provide information on the chemical/isotopical composition of the sample as it is irradiated by the neutron beam of the scattering experiment. A similar technique, but with a simple Ge detector, has already been used in reflectometry experiments (D17, Figaro). From these experiments, it is clear that the ability to distinguish gamma rays from the sample and the background would boost sensitivity enormously.

Activities of the trainee:
The trainee will become familiar with segmented HPGe technology both from a theoretical and an operational point of view. He/she will deal with the cooling of the detector and the testing of the different channels. He/she will test the electronic chain for treatment of the signals and storage of the raw traces. He/she will determine the cross-talk properties of the detector and perform Pulse-Shape Analysis of source data. He/she will develop his/her own imaging code for source position reconstruction.

Level required: 3rd year university studies in physics
Notes: This post is an internship with a maximum duration of 3 months
How to apply: Please send your application directly to the supervisor: Caterina Michelagnoli, email: michelagnolic@ill.fr

INTERNSHIP (REF. SPEC_1) HYDROGEN DIFFUSION IN NOVEL CATALYST MATERIALS

Hydrogen is an important energy carrier in connection with carbon-free energy production. Unfortunately, hydrogen reactions in fuel cells and water electrolyser require the use of catalysts, which generally contain substantial amounts of expensive noble metals such as platinum. To reduce the need for platinum and to lower catalyster costs, several materials are being studied, among which our group - in collaboration with research groups from Germany – is concentrating on molybdenum disulphide (MoS2). In fact, MoS2 is a promising candidate for the cathode of the polymer electrolyte membrane (PEM) electrolyser, but it is not clear how hydrogen moves in MoS2 and at which sites of the material the catalytic activity is located. We have already performed diffraction, diffusion and spectroscopy experiments on this system and further experiments are planned for 2018. The data obtained has
given us an insight into the location and motion of hydrogen from Å to micrometre length scales. Based on this data and using computational modelling, we aim to find out how MoS\textsubscript{2} catalysts can be optimised.

**Activities of the trainee:**
The trainee will take part in a new project on hydrogen catalyst materials that has been started in collaboration with research groups from Germany. The trainee will perform classical molecular dynamics simulations as well as density functional theory calculations of hydrogen in MoS\textsubscript{2}. He/she will also analyse neutron spectroscopy data and, provided the internship takes place during reactor operations, will have the opportunity to participate in a neutron scattering experiment. The internship will provide an opportunity to gain an inside view of the power and limitations of present theoretical and experimental techniques for the study of energy materials via the study of molecular dynamics.

**Key words:** self-assembly; surfactants; small-angle scattering

**Level required:** 3\textsuperscript{rd} year university studies in chemistry or physics with some computing background

**Notes:** This post is an internship with a maximum duration of 3 months

**How to apply:** Please send your application directly to the supervisor: Peter Fouquet, email: fouquet@ill.eu

**INTERNSHIP (REF. SPECT_2) MEASUREMENTS OF TEMPERATURE INHOMOGENEITIES IN CRYSTAL OPTICS COMPONENTS FOR NEUTRON SPECTROSCOPY**
The recently commissioned GaAs prototype for the backscattering spectrometer IN16B has achieved a world record in energy resolution. Nevertheless, the measured resolution was larger than estimated. A probable deteriorating factor is the presence of temperature inhomogeneities over the surface of the monochromator, which need to be investigated.

In addition, more GaAs crystals have been ordered for the next stage in the construction of the monochromator. Neutron measurements using an established test setup need to be conducted on a sample of crystals to determine the structural quality as well as variations of the lattice parameter.

**Activities of the trainee:**
- Measurement and quantitative evaluation of temperature maps of the GaAs monochromator for IN16B under different conditions.
- Neutron diffraction measurements of GaAs crystals.

**Level required:** 3\textsuperscript{rd} year university studies in physics, chemistry or mechanical engineering with some computing background

**Notes:** This post is an internship with a maximum duration of 2 months

**How to apply:** Please send your application directly to the supervisor: Kristijan KUHLMANN, email: kuhlmannk@ill.fr

**INTERNSHIP (REF. SPECT_5) DESIGN STUDY OF A TIME-OF-FLIGHT SPECTROMETER FOR EXTREME-CONDITION EXPERIMENTS WITH MONTECARLO METHODS**
The growing scientific interest in the physical properties of matter in extreme conditions such as very high pressure and temperature calls for dedicated and optimized experimental tools. Time-of-Flight (ToF) spectrometers are in principle the instruments of choice to meet the scientific interests and quality standards required for extreme-condition experiments. However, the ToF instruments currently available have not been optimized for such studies. We are planning to perform a design study of a hybrid ToF spectrometer, i.e. a ToF instrument equipped with a monochromator and chopper system, for optimum performance in extreme conditions and with small samples. This design study will be based on Monte Carlo simulation techniques (McStas) developed and optimized for neutron ray-tracing computation. The necessary software packages are available at the ILL and can be run in a standard operation mode. Expertise in, and hardware components for, running the software packages are present. Preliminary design studies of an instrument called RAMSES (RApid Measurement and Special Environment time-of-flight Spectrometer) have been already performed. For these reasons, we believe it will be possible to complete the optimization work within four months, a period well suited to a student internship.
Activities of the trainee:
The trainee’s activities will primarily involve computer simulations, together with a few analytical analyses, for the design of the hybrid time-of-flight instrument located at the end position of a dedicated cold-neutron guide:

- Definition of a dedicated guide (new H15) for the hybrid ToF instrument RAMSES III (McStas calculations)
- Optimization of guide components for best performance in terms of flux and divergence (McStas calculations)
- Identification of central components of the primary spectrometer and their geometry for best performance in the time-focusing mode
- Optimization of the primary spectrometer components for best performance for experiments on mm³-sized samples.

Key words: computer simulation; ray tracing calculation; neutron spectroscopy
Level required: 4th year university studies in physics
Notes: This post is an internship with a maximum duration of 4 months
How to apply: Please send your application directly to the supervisor: Michael Koza, email: koza@ill.fr

INTERNSHIP (REF. SPECT_7) EFFECT OF CHEMICAL OR STRUCTURAL DISORDER ON THE LATTICE DYNAMICS OF THE BROWNMILLERITE IONIC CONDUCTORS Sr₁₋ₓCaₓFeO₂.₅ AND Sr₂ScGaO₅. AN AB-INITIO STUDY
Oxygen ion conductors at low temperatures are materials of major interest for a host of applications, such as fuel cells, battery electrodes and sensors. The discovery of oxygen reversible intercalation into Brownmillerite-type structures down to moderate temperatures is considered of paramount importance. Despite this, SrFeO₂.₅ has been shown to be a good conductor down to RT, while the iso-structural CaFeO₂.₅ material only conducts oxygen at high temperatures (over 1000 K). Inelastic neutron scattering (INS) studies on solid solutions of Sr₁₋ₓCaₓFeO₂.₅ (chemical disorder) have revealed dramatic differences in the low energy part of vibrational DOS (density of states). At the same time, Raman spectra on end members are also drastically different. Similarly, Sr₂ScGaO₅ shows good ionic conduction at moderate temperatures, but the Brownmillerite-type structure, with ordered Sc, Ga and vacancy sites, and the cubic-related structure, with random Sc Ga and vacancy positions, differ in the onset temperature of conduction and conduction mechanism. This is reflected again in the difference observed in the low energy part of vibrational DOS and Raman spectra.
To understand the microscopic origin of these differences, detailed DFT (density functional theory) calculations on several solid solutions of Sr₁₋ₓCaₓFeO₂.₅ and random vacancy supercells of Sr₂ScGaO₅ are necessary. The experiments will allow us to validate the calculations and the calculations can then be used to gain a better understanding of the material's properties. The results will shed light on the way that chemical or structural (other than oxygen) disorder affects the ionic conduction properties of this material, helping us to gain a deeper understanding of the factors which promote or hinder ionic conduction.

Activities of the trainee:
The trainee will run advanced level simulations (solid solutions and random vacancy supercells) with the CRYSTAL code, extract useful electronic and vibrational properties (band structure, vibrational DOS, Raman spectra), compare the data obtained with existing experimental data, and critically interpret the results. He/she will correlate all the experimental and simulated data to establish trends in electronic/vibrational properties. If the results of this work prove to be interesting, the trainee will take an active part in writing articles.

Key words: ionic conductors; chemical or structural disorder; ab-initio simulations; comparison with INS and Raman spectra
Level required: 5th year university studies in physics or theoretical chemistry
Notes: This post is an internship with a maximum duration of 5 months
How to apply: Please send your application directly to the supervisor: Andrea Piovano, email: piovano@ill.fr
INTERNERSHIP (REF. SPECT_8) ADSORPTION ENERGY AND GEOMETRY OF DIHYDROGEN ON A PT-SUBSTITUTED UIO-67 MOF

Microporous materials have proven to be highly valuable materials for industrial applications such as petrochemistry, catalysis, selective separation and gas storage. In this regard, metal-organic frameworks (MOFs) open up new possibilities for the design of both the geometrical shape and chemical properties of the internal surface, enabling very high pore volumes and surface areas. Moreover, they are in principle able to display novel functionalities, potentially exploitable for a number of applications in catalysis, as sensors, in gas separation, and/or storage.

The synthesis of a Pt-functionalised UiO-67 MOF creates exposed metal species from the PtCl2 functionalisation that are considered to induce enhanced adsorption properties during gas dosing. For this reason, the evolution of the rotational transition of H2 molecules (15 meV) during hydrogen uptake has been investigated by inelastic neutron scattering up to 25 bar pressure.

Simulations of the bare UiO-67 have been performed and the matching with experimental vibrational DOS (density of states) is remarkable, opening the way for a reliable and detailed study of the adsorption of H2 on the different adsorption sites. The calculation of the adsorption energies and geometries will make it possible to assign with consistency the features detected during the INS experiment.

Activities of the trainee:
The trainee will run advanced level simulations (adsorption of molecules on surfaces) with the CRYSTAL code, extract useful electronic and vibrational properties (band structure, vibrational DOS, Raman spectra, adsorption energies), compare the data obtained with existing experimental data, and critically interpret the results. If the results of this work prove to be interesting, the trainee will take an active part in writing articles.

Key words: metal-organic framework; UiO-67; H2 adsorption; ab-initio simulations; comparison with INS spectra
Level required: 5th year university studies in physics or theoretical chemistry
Notes: This post is an internship with a maximum duration of 3 months
How to apply: Please send your application directly to the supervisor: Andrea Piovano, email: piovano@ill.fr

INTERNERSHIP (REF. SMSS_1) USING CYCLODEXTRIN TO CONTROL THE AGGREGATION OF ALKYL ETHYleneOXIDe CARBoXYLIC ACID SURFACTANTS

The development of smart materials from renewable resources based on supramolecular interactions is attracting the interest of scientists and industry. A multidisciplinary approach is vital in order to determine the preparation route for complex materials based on the self-assembly of small molecules into functional supramolecular aggregates. Fatty ethoxylated carboxylic acids (see figure below) are biocompatible surfactants with temperature/pH responsive features [1-3]. These systems have been shown to assemble into hierarchal, complex structures with strongly responsive properties. The properties of surfactants can be further controlled by the addition of cyclodextrins, which are cyclic oligosaccharides [4]. The hydrophobic cavity of cyclodextrins can selectively thread the hydrophilic or hydrophobic part of the surfactant, thus breaking up or altering the self-assembling properties. This feature can be exploited in pollutant removal as well as drug delivery systems.

Activities of the trainee:
The trainee will deal with the preparation and characterization of supramolecular complexes formed by a temperature/pH-sensitive surfactant and cyclodextrins. In particular, cyclodextrins with different sizes can be investigated (α-, β- and γ-cyclodextrins). As regards the surfactant (CjEjCOOH), the role of alkyl chain length (C12 and C18) together with the ethoxylated block length (from 2 to 10 units) will be studied. The project can be subdivided into three main parts: 1) the determination of the phase behaviour, 2) the quantitative determination of the binding constants, and 3) the structural characterization of the supramolecular structures. In detail:
1) Optical inspection and turbidity measurements make it possible to determine the stability of the cyclodextrin/surfactant complexes. Temperature, pH and composition of the system will be varied systematically.
2) Densitometric experiments make it possible to determine the equilibrium constant and the stoichiometry of the complexation reaction. In combination with calorimetric measurements, this will allow the thermodynamic origin of the binding processes to be determined. 3) Static and dynamic light scattering, electrophoretic mobility, and possibly small-angle neutron scattering will allow investigation of the structural behaviour of the surfactant-cyclodextrin mixtures on various length scales.
The information obtained will be combined, leading to a complete picture of these binary systems. The correlation between the thermodynamic driving forces for the self-assembly process and the resulting structure and functionality will allow us to understand these systems and to fine tailor them for specific purposes. In summary, the trainee will encounter the major characterization techniques used for soft-matter systems. He/she will learn how to perform the experiments, analyse the data, and combine the information in order to produce a comprehensive picture.

References:

Key words: supramolecular self-assembly; surfactants; small-angle neutron scattering; thermodynamics
Level required: 4th year university studies in chemistry/physics
Notes: This post is an internship with a maximum duration of 5 months
How to apply: Please send your application directly to the supervisor: Leonardo Chiappisi, email: chiappisil@ill.eu

INTERNSHIP (REF. SMSS_2) ENVIRONMENTALLY FRIENDLY COUNTERIONS FOR CONTROLLING SURFACTANT SELF-ASSEMBLY PROPERTIES

Surfactants are among the most versatile compounds in the colloidal playground. The properties of their aqueous solutions do not depend only on the molecular structure of the hydrophilic and hydrophobic groups, but also on experimental parameters such as temperature, ionic strength, pH, etc. A further key element which determines the properties of ionic surfactants is the nature of the counterion. In particular, the use of bulky, cationic counterions, such as choline, guanidine, arginine or lysine, have been shown to greatly affect the behaviour of anionic surfactants, in particular of fatty acids [1-2]. The main aim of this internship is to characterize interesting arginine and choline as counterions. Fatty ethoxylated carboxylic acids are extremely surfactants, showing both temperature and pH-responsive behaviour. They assemble into globular micelles, wormlike micelles or vesicles, depending on the size of the blocks. Moreover, these surfactants are mild and low-toxic and can be used through the addition of environmentally friendly counterions, such as arginine or choline, can further widen their field of use.

Activities of the trainee:
The trainee will deal with the preparation and characterization of choline and arginine fatty ethoxylated carboxylates. Surfactants based on oleic acid and a variable number of ethylene oxide units will be employed. The project can be subdivided into three main parts: 1) the determination of the phase behaviour, 2) the quantitative determination of the surfactant self-assembly properties, and 3) the structural characterization of the self-assembled structures. In detail:
1) The phase behaviour of fatty acid salts will be investigated as a function of pH and surfactant concentration. In particular, complex behaviour is expected for the arginine salts, as both the surfactant and the counterion exhibit pH-dependent behaviour.
2) The physico-chemical properties of the salts, such as critical micelle concentration, cloud and Krafft point, will be determined.
3) Static and dynamic light scattering, electrophoretic mobility, and possibly small-angle neutron scattering will shed light on the size and shape of the self-assembled aggregates.

The information obtained will be combined, leading to a complete overview of the behaviour of these environmentally friendly surfactants with a large potential for practical applications. The trainee will encounter the major characterization techniques used for surfactant systems. He/she will learn how to perform the experiments, analyse the data, and combine the information in order to produce a comprehensive picture.


Key words: self-assembly; surfactants; small-angle scattering
Level required: 4th year university studies in chemistry/physics
Notes: This post is an internship with a maximum duration of 5 months
How to apply: Please send your application directly to the supervisor: Leonardo Chiappisi, email: chiappisil@ill.eu
INTERNSHIP (REF. SMSS_3) SHINING A LIGHT ONTO THE STRANGE ENERGY LANDSCAPE OF SURFACTANT SELF-ASSEMBLY

Over the past 20 years, many of the tremendous advances in the field of soft nanotechnology, from drug delivery to oil extraction, can be ascribed to a combination of two factors: progress in the chemical synthesis of macromolecules and, perhaps more importantly, a better understanding of the structure-function relationship in self-assembled materials. This understanding gives us the power to design self-assembling building blocks and control morphology on the nanometre scale. An interesting example of this is the surfactant AKYPO 45CA (polyoxyethylene lauryl ether carboxylic acid), which is composed of hydrophobic, hydrophilic and ionic components. This structure gives rise to a wide range of spontaneously self-assembled aggregates in solution ranging from large vesicles and thin discs through to smaller ellipsoidal micelles where the geometry depends on the degree of ionisation of the head-group, which can be controlled by adjusting the pH of the solution. During a recent small-angle neutron scattering experiment to investigate the pH dependence of the self-assembled structures, it was observed that the form of the aggregates also depends on the addition rate and concentration of the NaOH used to adjust the pH of the solution. This is a highly surprising result: as the self-assembled structures are dynamic and the exchange kinetics are fast, the presence of more than one final state would indicate a complex free energy landscape with deep local minima. For such an ostensibly simple molecule, this complex behaviour cannot be easily explained with currently available models. The aim of this project is therefore to determine how the preparation conditions affect the self-assembly. This will be done by observing the phase behaviour under various preparation conditions and comparing the behaviour of a commercial surfactant with that of a purified surfactant with a known number of ethylene oxide units. With sufficient data, we will hopefully be able to shed some light on this complex energy landscape.

Activities of the trainee:
The trainee’s activities will be conducted along two lines. The main task will be to explore the parameter space consisting of base concentrations, base addition rates, salt concentrations and temperatures to determine the effect of each parameter on the self-assembly behaviour of the surfactant. This will be done predominantly via turbidity and light scattering measurements with the possibility of small-angle X-ray and neutron scattering, if the opportunity arises. The second parallel line of investigation will be to purify the surfactant via distillation, fractionation or size exclusion chromatography and repeat some self-assembly experiments in order to probe the origins of the observed anomalous behaviour. The trainee will gain experience in solution self-assembly and learn to conduct static and dynamic light scattering (SLS and DLS, respectively) and small-angle scattering experiments. He/she will also learn to analyse and interpret the experimental data, which will then be used to steer the direction of the project.

Level required: 2nd year university studies in chemistry or physical chemistry
Notes: This post is an internship with a maximum duration of 3 months
Benefits: You will receive a monthly allowance of between 435 € and 1 050 €, depending on the duration of your internship and your profile.
How to apply: Please send your application directly to the supervisor: Dominic Hayward, email: hayward@i1l.eu

INTERNSHIP (REF. LSS_1) REGULATING FAT DIGESTION BY ENGINEERING LIPID EMULSIONS

The intake of dietary fats (lipids) and its effects on health have become a major focus of our modern societies since, over the past few years, changes in both lifestyle and eating habits have resulted in an increase of obesity levels. Consequently, developing solutions that may have beneficial impacts on health is urgently needed. Controlling the digestion of fats is key to addressing this ongoing health crisis but also to controlling the absorption of drugs in oral lipid-based formulations. The overall aim of this broad project is to develop a formulation strategy that slows down and thus reduces lipid absorption.

Bile salts (BS) are biosurfactants produced in the liver and released into the small intestine (duodenum) which play a key role in lipid digestion and absorption. BS facilitate the adsorption of the lipase/co-lipase complex to fat
droplet interfaces, thus promoting enzyme-catalysed lipolysis, and they also desorb from the interface and shuttle insoluble lipolysis products to the gut mucosa in mixed micelles, to facilitate their absorption. Therefore, given that BS are a key player in lipolysis, the strategy will consist in using appropriate emulsifiers that compete with BS for adsorption at the water/fat droplet interface and thus slow down lipase adsorption. Our work focuses on a candidate widely used in both the food and pharmaceutical industries: methylcellulose ethers (MC). Although MC have demonstrated potential as dietary fibres (reducing fat absorption), there is still a staggering lack of mechanistic understanding of the competitive interfacial processes leading to lipase inhibition, slower lipid digestion and the associated health benefits.

**Activities of the trainee:**
The specific project proposed will focus on characterising MC and studying their ability to inhibit BS activity, and thus enzyme activity, both at the interface and in solution. For this purpose, the interfacial properties of MC and their interaction with BS will be investigated at the air/water interface using different interfacial techniques, such as the Langmuir trough, tensiometer, Brewster angle microscope and ellipsometer. These measurements are a first step towards moving onto the more physiologically relevant oil/water interface studies, with the sessile drop method. In parallel, the impact of BS on the self-assembly, thermodynamic and rheological properties of both MC and MC-stabilised emulsions will be assessed using the techniques of dynamic light scattering (DLS), microcalorimetry and rheology. These studies will allow us to improve our understanding of the mechanisms leading to BS inhibition. These preliminary data will be of considerable interest since they will provide a basis for further neutron reflectivity (NR) and small-angle neutron scattering (SANS) experiments.

**Key words:** methylcellulose ethers; bile salts; interfacial studies; self-assembly, thermodynamic and rheological properties

**Level required:** 5th year university studies in physical chemistry / formulation

**Notes:** This post is an internship with a maximum duration of 5 months

**How to apply:** Please send your application directly to the supervisor: Olivia Pabois, email: pabois@ill.eu

**INTERNSHIP (REF. LSS_4) AN EFFICIENT AND VERSATILE MICROFLUID SYSTEM FOR ELECTROPHYSIOLOGY MEASUREMENTS**

Electrophysiology is a technique involving the measurement of the flow of ions across a lipid membrane, with the aim of assessing the membrane's permeability or of studying the proteins specifically devoted to the transport of the ions, including at the single molecule scale. This method is particularly challenging and requires special equipment capable of measuring electric current in pico amps. We use the technique on artificial membranes, created at the interface between two droplets surrounded by a lipid monolayer. Through the use of microfabrication techniques, we would like to improve our experimental setup in order to reduce the volume of reagents required and increase its sensitivity and the quality of the signal recorded.

**Activities of the trainee:**
After familiarising yourself with the equipment in the laboratory, you will design and produce milli/micro-fluidic devices by 3D printing and PDMS moulding, and then evaluate their efficiency:
- formation and characterisation of the artificial membrane,
- comparison with the current device, in terms of sample quantity, signal quality and ease of use
- estimation of the limits of the new device: membrane size, possibility of multiplexing, etc.

**Key words:** microfluids; 3D printing; electrophysiology

**Level required:** Equivalent of 1st year university studies in a general technical field (covering instrumentation and measurement techniques)

**Notes:** This post is an internship with a maximum duration of 2 months

**How to apply:** Please send your application directly to the supervisor: Anne Martel, email: martela@ill.fr
INTERNSHIP (REF. LSS_5) STIMULI-RESPONSIVE MICROCAPSULES MADE OF PNIPAM PARTICLES

Soft capsules with shells made of environmentally sensitive materials are receiving a lot of attention as a novel type of carrier for delivery or microreactors. They have unique and desirable properties such as controllable size or permeability. These can be triggered by changes to an ambient stimulus, for example involving pH, ionic strength, or temperature.

Poly N-Isopropyl Acrylamide (PNIPAM) microgels are stimuli-responsive colloids, changing size with pH or temperature. They do this because of a delicate balance of conformational entropy and hydrophobic interactions. This also plays a key role in their affinity for fluid interfaces (e.g. water/air, water/oil), enabling their adsorption and other processes coupled together. This fact makes them suitable candidates for controlling the stability of fluid-fluid interfaces (an example of what some people call "smart fluids"). Self-assembled PNIPAM particles at fluid interfaces are also building blocks for creating hollow microcapsules — also known as polymerosomes — whose size, permeability and mechanical strength can thus be controlled.

Hollow capsules with shells made of PNIPAM particles will be produced — by using a co-flow microfluidic chip — from oil/water emulsions. The capsules will be exposed to different external stimuli (T, pH and ionic strength) in order to correlate the behaviour found with the properties of the interfacial PNIPAM layers. To achieve our goal, we will use surface methods (pendant drop and Langmuir trough tensiometry) and imaging techniques (confocal and fluorescence microscopy).

Activities of the trainee:
- Preparation of ligand-coated PNIPAM particles and adsorption at fluid interfaces. Characterization by surface methods (pendant drop tensiometry, Langmuir trough tensiometry and interfacial shear rheology) and imaging techniques, such as fluorescence microscopy and AFM.
- Production of hollow capsules by a co-flow microfluidic chip. Further characterization by imaging (fluorescence) and rheology.

Key words: soft and biological matter; microfluidics; rheology; fluorescence microscopy; AFM; tensiometry
Level required: 4th year university studies in Physics, Chemistry or Physical-Chemistry
Notes: This post is an internship with a maximum duration of 5 months
How to apply: Please send your application directly to the supervisor: Armando Maestro, email: maestro@ill.fr

INTERNSHIP (REF. LSS_6) ENDOCYTOSIS ACROSS SCALES

Transport across a cell membrane is a key aspect of cellular biology. Clathrin-mediated endocytosis is a crucial mechanism, whereby cargo and proteins located at the plasma membrane are controllably incorporated into the cell. This is an example of a controlled multiscale choreography, in which several molecular players (proteins such as clathrin, clathrin adaptors and cargo, together with specific lipid molecules associated with the membrane) join forces in a cooperative effort to overcome the curvature energy of the membrane and make possible the invagination of a clathrin-coated vesicle (a supra-molecular assembly) in which cargo proteins are incorporated.

The presence of different length-scales — from the molecule (10’s Å) to the vesicle (100s nm) — and hence different processes coupled together, have so far prevented a full understanding of this process. What is proposed in this project involves a challenging bottom-up approach, focusing on the self-assembly, mechanics and rheology of precisely formulated in-vitro conditions. State-of-the-art surface methods — Langmuir trough tensiometry, rheology and particle tracking — and imaging techniques will be used. Starting from planar lipid monolayers and moving to supported lipid bilayers and giant unilamellar vesicles, the self-assembly of clathrin molecules on lipid monolayers and the role of adaptor proteins will be investigated.

Activities of the trainee:
- Sample preparation: Langmuir lipid monolayers, supported lipid bilayers and giant unilamellar vesicles (GUVs) by electroformation.
- Characterization of protein samples with the support of our collaborators at the Cambridge Institute for Medical Research CIMR.
- Characterization of the lipid-protein interactions by surface methods (Langmuir trough tensiometry and interfacial shear rheology) and imaging techniques such as fluorescence microscopy and AFM.
Key words: soft and biological matter; lipid-protein interactions; rheology; fluorescence microscopy; AFM; tensiometry

Level required: 4th year university studies in Physics, Chemistry or Physical-Chemistry

Notes: This post is an internship with a maximum duration of 5 months

How to apply: Please send your application directly to the supervisor: Armando Maestro, email: maestro@ill.fr

INTERNERSHIP (REF. LSS_7) BIO-INSPIRED EMULSIONS AND MICROEMULSIONS WITH CHOLESTERYL ESTERS AS MODEL SYSTEMS FOR LDL/HDL PARTICLES

Low-density lipoproteins (LDL) and high-density lipoproteins (HDL), commonly referred to as “bad” and “good” cholesterol, are biological assemblies of phospholipids and cholesterol, apolipoproteins and triglycerides. Their main role is to transport fat in the extracellular fluid of organisms. The role of HDL and LDL in common diseases is well known, the main distinction between the two being simply their size, i.e. the number of fatty molecules they transport: HDL particles are small (containing around 100 lipids and as many proteins), LDL particles are large (containing up to 1000s of lipids and far fewer proteins), while even larger particles exist. LDL have a low stability and therefore increase the risk of atherosclerosis (artery wall thickening) by deposition, while HDL take away these deposits as a hydrophobic cargo. The stability of these assemblies and therefore the associated risk of cardiovascular disease is, however, poorly understood.

HDL is in fact a microemulsion in soft matter terms (stable at equilibrium), while LDL is an emulsion (unstable at equilibrium). In between, a miniemulsion domain should be present (presenting long-term stability). Using simple models based on conventional phospholipids for the stabilizing shell, and various triglycerides and cholesteryl esters for the hydrophobic core, we aim to elucidate, in particular by Small-Angle Neutron Scattering (SANS), the lipoproteins (shape, size, size distribution), including the composition and organisation of their shell and core. Phase diagrams where the composition is varied will help us determine the loading thresholds in triglycerides between microemulsion, miniemulsion and emulsion, based on the choice of triglyceride, for a given composition in phospholipids and amount of cholesteryl esters. Finally, the influence of apolipoproteins (decorating the lipoprotein’s outer surface) on the phase diagram will be evaluated by the trainee.

Activities of the trainee:
Bibliography, sample preparation, phase diagrams from visual observations, Differential Scanning Calorimetry (melting of the triglyceride/cholesteryl ester core), Isothermal Titration Calorimetry (for the addition of apolipoprotein), Dynamic and Static Light Scattering (determination of overall dimensions), Zetametry (determination of surface charge), Small-Angle Neutron and X-ray Scattering (structural characterization).

Key words: small-angle neutron scattering; emulsions and microemulsions; high-density lipoproteins and low-density lipoproteins (HDL and LDL); cholesterol esters; model HDL/LDL particles

Level required: 5th year university studies in physical chemistry

Notes: This post is an internship with a maximum duration of 5 months

How to apply: Please send your application directly to the supervisor: Sylvain Prévost, email: prevost@ill.eu

INTERNERSHIP (REF. THEO_1) DYNAMICAL TRANSITION OF PROTEINS, AS A FUNCTION OF SPATIO-TEMPORAL SCALE

By dynamical transition we mean the deviation from linear behaviour of the variation in mean-square displacements of atoms, as a function of temperature. Several experiments have shown the existence of a dynamical transition in hydrated protein systems around 180 – 200 K. This transition reveals an activated change in the conformational states of the protein, as a function of temperature. We have a simple view of the dynamical transition as that of at least two conformational states corresponding to potential wells separated by a potential barrier. As, at low temperatures, the (harmonic) motion of the protein atoms is situated around the minimum of the conformational states of lower energies, the mean-square displacements rise linearly with temperature. At high temperatures the amplitude of the (anharmonic) motion increases, to the point that it crosses the barrier from low-energy conformational states to those of high energies. The result is a non-linear rise in mean-square displacements. A dynamical transition can therefore be summed up as the transition from harmonic motions to anharmonic motions, following the crossing of a potential barrier.
In practice, if we want to study dynamical transition in incoherent neutron scattering experiments, for example, we would classically use the mean-square displacement of the (hydrogen) atoms, obtained from the slope at the origin, as a function of $Q^2$ of the factor or function of the dynamical structure of the incoherent quasi-elastic ($\omega \approx 0$) scattering of neutrons. The mean-square displacements obtained depend neither on $Q$ nor time, and we therefore consider the protein system as an ensemble in equilibrium averaged over all spatial scales.

The aim of the placement is to study the dynamical transition as a function of $Q$ and of time, to gain a better understanding of how the dynamical transition evolves within a protein. This will require investigating the feasibility of using the multivariate statistical techniques of principal component analysis (PCA) to analyse the dynamical structure function (or mean-square displacements) on the $Q$ and time scales together. These are new techniques in this domain but are certainly promising. They have recently been used at the ILL in a Swedish-ILL collaboration to study the dynamics of an enzyme with and without inhibitor.

**Activities of the trainee:**
1. Use the Bicout-Zaccai dynamical transition model to develop the PCA methodology;
2. Apply the methodology to analyse the neutron scattering experimental data obtained for proteins by J. Peters (ILL).

**Key words:** incoherent neutron scattering, dynamical transition, ACP, PCA

**Level required:** 4th year university studies in physics

**Notes:** This post is an internship with a maximum duration of 5 months.

**How to apply:** Please send your application directly to the supervisor: Dominique Bicout, e-mail: bicout@ill.fr

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**INTERNSHIP (REF. THEO_2) THEORETICAL DETERMINATION OF EXCITED MAGNETIC STATES IN STRONGLY CORRELATED SYSTEMS**

For the last 20 years exotic states of matter, such as high temperature superconductivity, quantum critical points, spins liquids etc... have been discovered in strongly correlated systems. It is also in these compounds that can be found coupled properties highly desirable for applications, as for instance magneto-electric or magneto-optic couplings. The origin and variety of the properties found in strongly correlated compounds originates in the preservation in these systems of numerous degrees of freedom (spin, charge, network, orbital, etc...) that are hindered in more conventional systems. In Grenoble we have the chance to host several large scale facilities, such as neutrons diffraction, able to provide experimental insights in these systems. In order to build a complete and coherent picture one however needs some theoretical support. On this point, the need to treat on an equal footing many degrees of freedom increases the difficulty for the theoreticians.

The objective of this internship is to participate to the theoretical development of numerical methods able to describe strongly correlated systems. The methods that will be used are named ab initio as they aim is to solve the Schrödinger equation as exactly as possible while taking into account the whole complexity of its chemical composition and crystallographic structure.

The student will thus be initiated to
- the analytical development of controlled approximations for solving the Schrödinger equation
- the design and implementation of the associated algorithm
- the application of the methods to real examples

**Activities of the trainee:**
After a first initiation to the Configuration Interaction methods (allowing to solve in an approximate however controlled and accurate manner the Schrödinger equation for ground and excited states), the student will participate to the work in progress in the group around the development of a software aiming at computing the ground and excited (in particular magnetic) states of strongly correlated compounds and able to efficiently use hundreds or even thousands of processors. In this framework the student will have access to regional and national computer centres.

**Key words:** Theory; Magnetic excited states; Inelastic Neutrons Diffraction

**Level required:** 4th year university studies in physics, theoretical chemistry or computing

**Notes:** This post is an internship with a maximum duration of 4 months

**How to apply:** Please send your application directly to the supervisor: Marie-Bernadette Lepetit, email: lepetit@ill.fr
INTERNSHIP (REF. SON_1) NEUTRON OPTICS MULTILAYERS: CONSTRAINT ENGINEERING WITH MAGNETRON SPUTTERING

"Supermirrors" are multilayer structures; they are made up of up to thousands of nanometer-thin layers. Because of their optical characteristics they can be used to modify the properties of neutron beams. When reactive magnetron sputtering is used to deposit the layers, the internal constraints building up in the layers often lead to the destruction or delamination of the deposit. Previous trainees have studied several of the parameters which can be modified reasonably easily on our semi-industrial coating machine, and have managed to reduce the constraints significantly. These parameters are linked to the often complex physico-chemical mechanisms at play when a thin layer is deposited using a plasma. The aim of the placement is to study empirically the effect of certain parameters on the multilayers, and to use the results for "constraint-engineering" with a view to producing multilayers suitable for use in neutron optics. In addition to the deposits and constraint measurements, structural characterisations could also be performed, using specular X-ray and/or neutron reflectivity or diffraction if the occasion allows.

Activities of the trainee:
- Preparation of a strategy leading to plans for an experiment
- Deposition of multilayers and supermirrors using different parameters
- Determination of the constraints using contact surface profiling (curvature method)
- Characterisations: X-ray and/or neutron reflectivity or diffraction
- Analysis and summary of the results, confrontation with the scientific literature

Key words: Materials science, residual stresses, neutron optics, nanometric multilayers, supermirrors, Fe/Si, instrumentation, structure, interfaces, reactive magnetron cathode sputtering, plasma

Level required: 5th year university studies in materials engineering

Notes: This post is an internship with a maximum duration of 5 months.

How to apply: Please send your application directly to the supervisor: Thierry Bigault, e-mail: bigault@ill.fr

INTERNSHIP (REF.: SI_1) UPDATING OF A PHP/SYMfony APPLICATION IN SECURE CONDITIONS

The application to be worked on during this placement is written in PHP (Symfony framework); it has web-based user and administration interfaces (html5, JavaScript, CSS) and stores the application data in a relational database.

The aim of the placement is to perform a major maintenance update in conditions of total security:
- Migrate the application code from Symfony 2 to Symfony 3.2 and from PHP5 to PHP7
- Add logbook functionality
- Re-assess the measures in place to secure the application. This will involve intrusion testing and reviewing the protection, filter and alert systems.
- Particular emphasis will be placed on the security of the hosting infrastructure with dynamic filtering tools.

The placement will give the student an idea of the techniques used for maintaining applications and keeping them safe. S/he will be working in an international team for whom the operational security of the applications is a constant concern.

Activities of the trainee:
- Analysis of the existing system
- Migration of the technologies used by the application
- Installation of a logbook
- Review of server-side security measures

Key words PHP/Symfony3 development, JavaScript, CSS, Oracle, Git, logbook, security

Level required: 3rd year university studies in computing

Notes: This post is an internship with a maximum duration of 3 months.

How to apply: Please send your application directly to the supervisor: Ludovic Leroux, e-mail: leroux@ill.fr
INTERNSHIP (REF.: SI_2) ANALYSIS AND IMPLEMENTATION OF TOOLS FOR MANAGING AND MONITORING COMPUTER SECURITY ALERTS

Activities of the trainee:
- Researching, evaluating, testing and selecting tools for consolidation and management of IT security alerts
- Connection to the different alert feedback sensors
- Establishment of the technical procedures for acknowledging and processing alerts.

Keywords: SIEM (Security information and event management), IT security, Intrusion management, NDIS, OWASP, SSI.
Level required: 5th year university studies in computing
Notes: This post is an internship with a maximum duration of 4 months.
How to apply: Please send your application directly to the supervisor: Philippe Mourre, e-mail: mourre@ill.fr

INTERNSHIP (REF.: SI_3) DEVELOPMENT OF A SOFTWARE CATALOGUE PLATFORM

The PaNdata software catalogue (https://software.pan-data.eu) is a database of software used mainly for data analysis of neutron and photon experiments. The catalogue was developed using the Symfony 2 web framework, MySQL for the persistence, ElasticSearch for the search functionalities and GIT for the source control.

Activities of the trainee:
The trainee will help design and implement new features, upgrade the code base to the latest version of Symfony and develop tests.
The student must have strong communications skills and be enthusiastic about software development and best practices, including practical security.

Keywords: PHP, Symfony web framework, MySQL, ElasticSearch, GIT
Level required: 3rd year university studies in computing
Notes: This post is an internship with a maximum duration of 5 months
How to apply: Please send your application directly to the supervisor: Jamie Hall, email: hall@ill.eu

INTERNSHIP (REF SCI_1) DATA ANALYSIS INTERFACE

Production of a browser-style interface allowing an initial analysis to be made of the neutron spectra obtained from the crystals used as monochromators at the ILL.
The interface must meet the following criteria:
- it must be user-friendly
- it must provide a sufficiently detailed analysis of the diffraction spectra to be able to determine the principal characteristics of the crystals being measured (calculation of full width at half maximum, localization of the global maximum, estimation of background noise, integral calculation on a curve, etc...)
- it must allow for the presentation (formatting, charts, etc.) and saving of the data.

Level required: 3rd year university studies in computing
Notes: This post is an internship with a maximum duration of 4 months.
How to apply: Please send your application directly to the supervisor: Abdelali EL Aazzouzi, e-mail: elaazzouzi@ill.fr

INTERNSHIP (REF SCI_2) CONTROL MODULE FOR A PIEZO MOTOR

Incorporation of a Piezo motor power module in the control module of a stepper motor.
The Piezo power module must be controlled by an analog +10,-10V signal.
The control module currently on the stepper motor provides signals for frequency and direction.
The aim of the placement is to produce the PCB electronics for converting the frequency and direction control signal into an analogue +10,-10V signal.
Activities of the trainee:
- Development of the electronics required for converting the control signal
- Production of the files required for producing the printed circuit, using OrCAD.
- Incorporation and testing of the new electronics in the existing control module.

Level required: 4th year university studies in electronics engineering
Notes: This post is an internship with a maximum duration of 5 months.
How to apply: Please send your application directly to the supervisor: Franck Rey, e-mail: frey@ill.fr

INTERNSHIP (REF. SCI_3) DEVELOPMENT OF AN INTUITIVE 3D USER INTERFACE FOR A SPECTROMETER SIMULATOR
The open-source VEXP application provides a 3D simulator based on Three.js in which the user can interact with crystal unit cells displayed in a 3D reciprocal space.

The aim of the internship is to provide an intuitive and user-friendly UI (e.g. smooth transitions between different points of view, etc.) validated by feedback from the scientist users.
Other developments of the application are also planned: integration of an Android tablet, web application adaptation, testing of a virtual reality device, etc.

Activities of the trainee: Software development

Key words: 3D; Three.js; Electron; Node.js; Android; VR
Level required: 4th year university studies in computer science
Notes: This post is an internship with a maximum duration of 4 months
How to apply: Please send your application directly to the supervisor: Yannick Legoc, email: legoc@ill.eu

INTERNSHIP (REF. SCI_4) IMPLEMENTATION OF COLLISION DETECTION IN A SIMULATOR OF EXPERIMENTS ON LARGE-SCALE INSTRUMENTS AT THE ILL
experiments are currently simulated in an open-source software, Nomad 3D. For each instrument, Nomad 3D provides the link between Nomad (the ILL’s instrument control software) and the 3D SolidWorks model.

The aim of the internship is to extend Nomad 3D by providing two new functionalities:
- Integrate free objects in the instrument scene by providing an intuitive user interface.
- Study and implement different collision detection strategies by comparing precision and speed. Detection will take into account the three types of elements of the scene: instrument parts, walls, free objects.

This involves making significant improvements to the current viewer application. Some VR developments, including the testing of VR devices, are also being considered.

Demonstration videos of Nomad 3D can be viewed here: http://docs.sites.code.ill.fr/nomad-3d/videos/

Activities of the trainee: Software development

Key words: 3D; Three.js; Electron; JavaFX
Level required: 5th year university studies in computer science
Notes: This post is an internship with a maximum duration of 6 months
How to apply: Please send your application directly to the supervisor: Yannick Legoc, email: legoc@ill.eu
INTERNSHIP (REF. SRH_1) HR MARKETING AND EMPLOYER BRANDING

Employer branding is the process of promoting a company, or an organisation, as the employer of choice to a desired target group, one which a company needs and wants to recruit and retain.

**Duties:**
Within our HR department, you will help to create an Employee Value Proposition as a means of presenting the ILL’s Employment Brand to both internal and external audiences. This will include:

- Conducting research and proposing a strategy for Employment Branding.
- Reviewing, updating and developing existing information concerning HR on the career website,
- Designing and upgrading communication resources relating to recruitment & integration processes (job descriptions, kakemono, etc.),
- Developing community management (LinkedIn, Twitter, etc.).

**Profile:**
You are preparing a Master’s degree in Communication or Marketing or an MBA.
You are interested in Employer Branding and Community Management.
You are familiar with the Pack Office and Adobe Creative suites.
You have good writing skills and a sound knowledge of English.

**Duration:**
4 to 5 months.

**Benefits:**
You will be entitled to:
- A monthly allowance whose amount will depend on your profile and the duration of your internship.
- Have access to the ILL Works Council’s social, sports and cultural activities.
- Subsidised meals at our company restaurant.
- Subsidised transport if you use the local public transport system or hire a bicycle.
- A number of days of compensatory leave depending on the duration of your internship.

**How to apply:**
Please send your application directly to Liz Moulin: liz.moulin@ill.eu