Opening position at the **Laboratoire Léon-Brillouin** (CEA Saclay, France)

12 months POST-DOCTORAL FELLOWSHIP

monthly gross income 3400-3600 €

TOF-SANS data REduction applied to Strongly Oriented Nanostructures

Research Objectives: The increasing use of pulsed neutron sources in small-angle neutron scattering (SANS) has significantly changed how raw data from instruments are processed. The variety of wavelengths detected at each point on the 2D detector extends the scattering vector range for a given instrumental configuration and also enables the acquisition of scattering signals at different experimental resolutions for a given scattering vector. For highly structured systems, combining contributions at different experimental resolutions must be done carefully to avoid degrading the quality of the reduced data and complicating, or even distorting, their analysis.

The objective of this post-doc project is **to develop comprehensive framework for Time-of-Flight Small Angle Neutron Scattering (TOF-SANS) data reduction and analysis** in order to maximize the scientific output from SANS data. To achieve this goal, we plan to conduct both experimental and theoretical studies on a representative scientific case where resolution effects, longitudinal coherence lengths, multiple scattering, and refraction at grazing incidence can significantly impact the measurements. We intend to use Anodized Aluminum Oxide membranes (AAO), whose synthesis is mastered at the PHENIX laboratory, to gain a better understanding of artifacts during TOF-SANS data reduction on strongly oriented nanostructures. This experimental work will be complemented by neutron simulation studies, which will contribute to the design of a SANS instrument for ICONE project aiming to develop a new neutron facility in France.

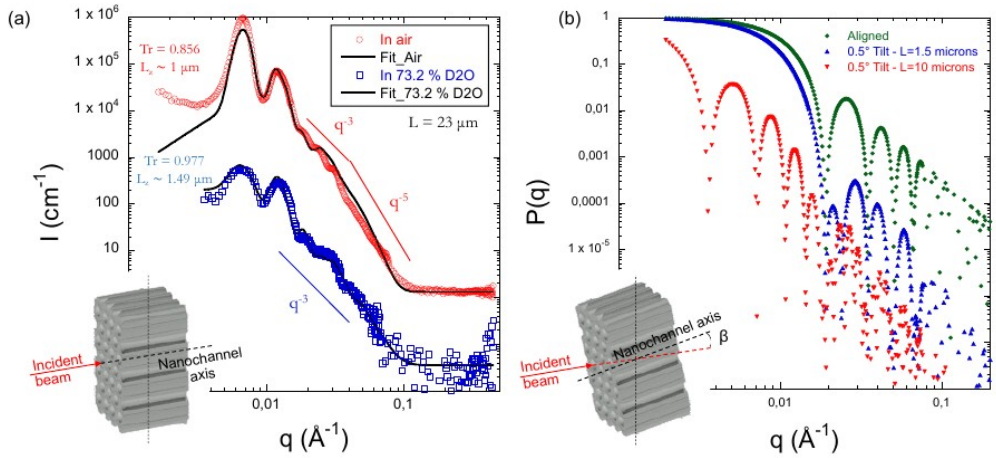

***Figure 1**: (a) Scattering intensities I(q) of aligned AAO (L=23 µm) measured in air (red circles) and in H2O/D2O mixture (blue square). Transmissions (Tr) and Lz are indicated for both contrasts. The continuous lines are the best fits by using the methodology we developed. (b) Simulated P(q) using eq.1 for different characteristic length (L = 1.5 or 10µm) compared to an aligned AAO (green). ß is the angle between the incident beam and the nanochannel axis and is 0° for aligned AAO and fixed at 0.5° here for tilted AAO.*

Context: The project is funded by the APICONE call for research funding for 12 months. The ICONE project proposes to build a HiCANS (High Current Accelerator-based Neutron Source) in France. The aim of the ICONE project is to be able to provide the French neutron user community sufficient instrumental capacity to continue performing neutron scattering experiments for their research programs. The baseline goal is to offer performances equivalent to a medium power research reactor

or spallation source (such as Orphée or ISIS).

The work will be performed at the Laboratoire Léon-Brillouin (LLB) in Saclay (close to Paris), in strong collaboration with Nicolas Jouault (PHENIX Laboratory, Sorbonne Universités, Paris).

Research Program:

The candidate will simulate raw scattering data from AAO membranes using both McStas simulations and Python programming, with a particular focus on the proposed configuration and design for the SANS apparatus at ICONE. A Python library will also be developed to test different data reduction schemes and to highlight their advantages and drawbacks, depending on the sample structure and instrument design.

This work will be used to develop and test new desmearing algorithms based on multi-channel constraints. Special attention will be given to quantifying the influence of the signal-to-noise ratio on the accuracy of the desmearing procedure and evaluating its advantages in terms of structural analysis compared to standard data fitting performed on reduced data.

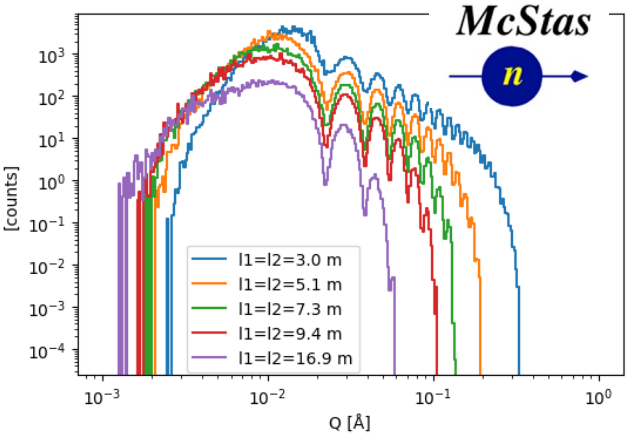

Figure 2: Mctas Simulation of nanospheres suspension with TOF-SANS after data reduction

Finally, the data reduction schemes and the desmearing algorithms developed will be tested experimentally. We plan to synthesize a large set of AAO membranes with varying structural features and measure them using TOF-SANS in different neutron facilities.

Required qualifications:

- PhD in Physics in a related field
- Python programming and data treatment and analysis skills
- Expertise in neutron scattering (experimental or not) is very welcome
- Previous experience in McStas programming is also a plus.

If prospective applicants would like to discuss the post informally, please contact:

Dr. Nicolas Jouault (nicolas.jouault@sorbonne-universite.fr)
Dr. Alexis Chennevière (alexis.chenneviere@cea.fr)

Starting date and location: As soon as possible but before February 2025 in Laboratoire Léon Brillouin (LLB) in collaboration with PHENIX lab in Sorbonne Universités.

Send applications to the above emails, include CV with names and addresses of two referees, motivation letter required (deadline to apply: December 6th, 2024)