Jagiellonian University (JU, Krakow, Poland) and
Institut Laue-Langevin (ILL, Grenoble, France)

jointly invite applications for a three-year PhD position focusing on

Optimization and characterization of the polarized cold neutron beam of the BRAND apparatus for precision measurements of angular correlations in neutron beta decay

The BRAND project aims to measure 11 correlation coefficients in the decay of polarized neutrons. These coefficients quantify correlations between momenta and spins of the neutron and its decay products (electron, neutrino and proton). Five of them (*H, L, S, U, V*) will be attempted for the first time. Such measurements enable searches for scalar and tensor couplings not existing in the Standard Model of particle physics that are complementary to and competitive with ongoing and planned high-energy experiments (like e.g. at the LHC).

The PhD project is a part of the collaboration between the JU and the ILL on this topic. In the course of the doctoral work, the first measurement of *H, L, S, U, V* is planned with accuracies of the order of 0.02 or better, together with measurements of the "classical" neutron decay correlations *a, b, A, B* and *D*. The thesis is focused on the beam-related systematic uncertainties of the BRAND project which are essential for the analysis of this measurement as well as for the preparation of future measurements at the ultimate accuracy of BRAND of about 5×10^{-4} for the "new" correlations.

The primary tasks of the PhD student are to study and optimize the neutron beam related aspects of the BRAND experiment, to setup and characterize the neutron beam and its polarization in the fiducial volume of the experiment and to quantify beam-related systematic effects. This is an important ingredient and contribution for the BRAND physics results and will profit from the ILL neutronics expertise and a close collaboration with the JU group in Cracow. In particular, the student will simulate the cold neutron beam through the polarizer, shielding and collimators, up to exit of the BRAND polarimeter. The student should determine the best position for the detection segment by testing various options of collimation system and examining the beam halo. The beam polarization is one of the crucial parameters for reduction of the systematic uncertainties in the BRAND experiment. Another important question is the precise alignment of the beam polarization with respect to the apparatus central axis which requires compensation of the external magnetic field and production of a weak, uniform guiding field in the fiducial volume. The student will be involved in work on the magnetic guiding field and its impact on the electron tracks and in the optimization of the active magnetic shielding.

The project is embedded in a collaboration with further partners (KU Leuven, Paul-Scherrer Institut, Villigen, North Carolina State University, Rayleigh).

We are looking for a highly motivated candidate with a MSc in nuclear physics or particle physics. Applications (including brief motivation letter, CV, Bachelor/Master certificate or score excerpt, pdf of master thesis if available and a two contact persons for a reference) should be sent to Dagmara Rozpedzik (dagmara.rozpedzik@uj.edu.pl), Kazimierz Bodek (kazimierz.bodek@uj.edu.pl), and Torsten Soldner (soldner@ill.fr). The applications will be evaluated by a three-person commission. Only selected candidates will be informed individually about the initial interview date. The candidate has to pass the examination for admission to the Doctoral School of Exact and Natural Sciences at the Jagiellonian University, Krakow, Poland. She/he will spend the first 1,5 (or 2) years in Grenoble, France, and 1,5 (or 1) year in Krakow, Poland, with a possible extension of 1 year.

Deadline: 5 June 2024