Access to neutron facilities

Title of proposed experiment

Calibration of new fiber-mounted scintillation neutron detectors in a well-characterized neutron flux for measuring the scalar flux and its gradient

Spokesperson

Prof. Imre Pázsit, Chalmers University of Technology
+46-31-772 3081, imre@chalmers.se

Preferred facility

BR1 reactor in SCK CEN

Contact person at ARIEL facility

Guido Vittiglio

Type of experiment

(incl. beam characteristics and experimental set-up of interest)
Neutron flux measurement

Requested beam time

3 days (24 hours)

Preferred measurement period

September/October 2021

Synergy with SANDA

(if applicable, Work package, task number)

Each experiment should support early stage researchers and lead to a publication in a peer-reviewed scientific journal and/or a conference presentation. In addition, validated data sets will be transferred to the NEA data bank /EXFOR. The PAC will assess the status of publications and will also monitor the transfer of nuclear data to the NEA data bank.

EURATOM support has to be acknowledged in all publications using: “This project has received funding from the Euratom research and training programme 2014-2018 under grant agreement No 847594 (ARIEL).

Participants list and access period requested. Please put on top the names of the early stage researchers that you would like to be supported. Only users from other European countries than the ARIEL host institute can be supported. Typically, support for travel (400 EUR on average per user) and a per diem (150 EUR) during a maximum of 7 experimental days can be granted for up to four users.
For the 'research status' please indicate: UND= Undergraduate, GRA=Graduate (student with a first University degree enrolled in Master or PhD studies), PDOC= Post-doctoral researcher less than 6 years after PhD, TEC= Technician, EXP=Experienced researcher (professional researcher).

Researcher	Institution	Research Status	Total number of days	Total number of visits	First-time user Y or N
Moad Al-dbissi	Chalmers	GRA	5	1	Y

Date

2021-05-03

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Signature of Spokesperson

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Signed applications must be sent to the ARIEL management board at the following address:
proposals@ariel-h2020.eu

Disclaimer: by submitting this proposal the group leader accepts that the text of his proposal will be put on the non-public PAC section of the ARIEL website. This password-protected section of the website will be accessible by the PAC members and all group leaders that have submitted a proposal.

Contact: Ralf Nolte Tel .: ++49-531-592-6420, Fax: ++49-531-592-6405, E-mail: ralf.nolte@ptb.

Background

Support of the PhD project of an early stage researcher

Goals of the proposal

The goals of the proposal are to test a new type of fiber based scintillation detectors in a well defined flux environment in the BR1 reactor, and a test of using a pair of fibers to estimate the gradient of the flux.

Description of work

The work will be performed at SCK CEN by PhD student Moad Al-dbissi, and the work will be led by Drs. Alessandro Borella and Riccardo Rossa. A description of the planned work is given in a separate file.

Time schedule and beam time estimate

We envisage three days of measurement time. The preparation work for to setup and dismantle the equipment should require about 2 hours. Measurements at different power levels and with and without Cd shielding are foreseen to study the gamma-ray sensitivity (see description of the work).

Justification for expenses

Support request:
*Number of days to be supported (typical 4*7 days) : 3 measurements days, 2 travel days*
Travel cost (4 400 EUR on average): 800 EUR*

Support from other resources:The PhD project is supported jointly by SCK CEN and Chalmers University of Technology

Education and training benefits

- The planned measurements will constitute an important part of the execution of the PhD project
- The student will gain valuable new experience, knowledge and training in experimental techniques by performing the experiments

Deliverables and Publication plan

Based on the results of the experiments, a journal publication and one or two conference contributions will be prepared.

Description of the work

The PhD project of Mr. Al-dbissi consists of the elaboration of a method of detecting and identifying missing/diverted fuel rods in a spent fuel assembly, which were replaced by dummy rods, in a non-intrusive way with measurements performed in the spent fuel pool. The method is based on performing measurements by thin fiber-based scintillation neutron detectors, inserted into either the detector channel positions in the assembly, or in between the fuel pins. The neutron flux, and possibly even its radial gradient, should be measured in several spatial positions, and compared to the neutron flux which is expected exist if the assembly was intact. From the deviation of the expected and the measured flux/flux gradients, one can draw conclusions on the possible diversion/missing of fuel rods.

At Chalmers, we have used such thin fiber based scintillation detectors in earlier work in simple pilot measurements, to measure the flux and its gradient. The recent PhD project is partly based on the experience gained with such fibers and such measurements. However, a new start is required for several reasons, this is why the present measurements are planned. First, our old fiber detectors have aged, and we acquired two brand new detectors with corresponding electronics and photomultipliers (PM tubes). Hence, there is a need to calibrate these new detectors, and gain experience with measurements based on them, in a high and well-defined flux. Second, our previous measurements of the gradient were performed by using one detector, moving it to different places, to measure the flux in different positions. In practice, at least in the planned application of finding partial defects in a fuel assembly, such a solution is not possible. Hence, measurements are planned in which two detectors are mounted together, their sensitive tips being about a 1cm or so apart, such that the flux gradient can be determined in one measurement.

For both above purposes, the BR1 reactor appears to be a highly suitable measurement testbed. The flux is high, which is important, since due to the small size of the detectors which is needed for the high spatial resolution, the detector efficiency is low. Also, the flux is well defined and known, such that the measurements can be immediately validated. There is a considerable experience in SCK CEN what regards the performing of such experiments in the BR1 reactor.

The measurements at BR1, would allow to calibrate the two avaialble fiber detector in a well known thermal flux. This can be carried out at different power level to study also the impact of dead time. Measurements with a Cd absorbers are foreseen as to account for the gamma-ray contribution. Measurements at different position are also envisaged to determine the detector response in presence of flux gradient.

Because of the novelty of the application, in case of successful measurement campaigns, they would give an important contribution to the PhD project of Mr. Al-dbissi, as well as that they would be suitable to present in journal articles and conference presentations.