GSI Helmholtzzentrum für Schwerionenforschung

LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN

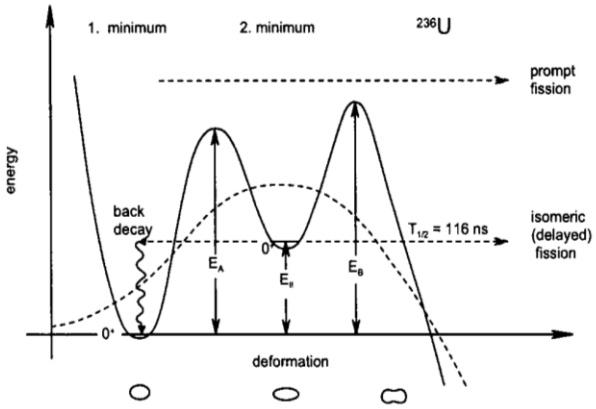
PhD Thesis in Nuclear Physics/Technology:

Fission isomer studies with the Fragment Separator (FRS) and the FRS Ion-Catcher and related technological developments at GSI/FAIR (Darmstadt)

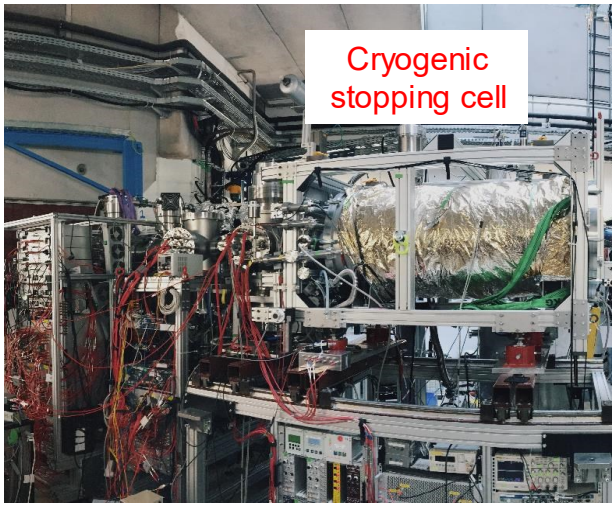
Cooperation between LMU Munich & GSI-FAIR, Darmstadt

Overview: In the context of a joint project between LMU Munich (group of PD Peter Thirolf, Garching) and the GSI-FAIR research center in Darmstadt a PhD project is offered that (i) will apply the existing infrastructure of the cryogenic buffer-gas stopping cell ('FRS Ion-Catcher') to perform nuclear structure studies of strongly deformed 'fission isomers' in actinide nuclei and (ii) will further develop the performance of the FRS Ion-Catcher. During the project the candidate will be based at GSI.

Physics background: The potential energy landscape in many actinide nuclei exhibits a 'superdeformed' second minimum ('double-humped fission barrier', see left Figure). The lowest excited nuclear state in this minimum is called a fission isomer, since it will preferably decay via isomeric (delayed) fission. So far an island of 35 actinide fission isomers with lifetimes between ps and ms is known. The goal of this project is to apply a new mechanism (projectile fragmentation) to populate fission isomers, to search for new isomers and to investigate the properties of so far only coarsely known cases. Improved physical insight into the potential landscape of heavy and strongly deformed actinides is expected to emerge from this project besides technological progress.



Experimental Method: At GSI (Darmstadt) an intense and fast ^{238}U ion beam will be fragmented on a Be target, the resulting projectile fragments (amongst them the targeted excited actinide nuclei) will be filtered from the cocktail of reaction products by the magnetic Fragment Separator FRS and then stopped inside a cryogenic stopping cell (FRS Ion-Catcher, see photograph) before being extracted into a diagnostics section for decay spectroscopy or Time-of-Flight mass spectrometry. Technological development for the stopping cell has to be performed (based on existing concepts and preparatory work) to reduce the ion extraction time from the cell down to <10 ms to allow for measuring the short–lived fission isomers.



Content of the thesis project:

Within the scope of this thesis project you will, while being contracted and registered as PhD student at LMU Munich, be based at GSI Darmstadt and work in the exciting environment of a large research center (being in the process of building the 2-billion international accelerator facility 'FAIR').

You will optimize the cryogenic stopping cell (FRS Ion Catcher) by modifying the FRS Ion Catcher's electrode system in order to allow for shorter extraction times (thus enabling shorter lifetimes of fission isomers to become experimentally accessible). Your work will be crucial not only for the investigation of fission isomers, but all experiments at the FRS Ion Catcher will benefit from the envisaged technical developments (shorter extraction times and higher rate capability), which will represent an important upgrade of this device.
You will become familiar with the diagnostics detector systems, operate them during a beamtime at the GSI Fragment Separator FRS and perform the spectroscopic data analysis.

Analyzing the data of fission isomers, you will study the nuclear properties of exotic heavy, strongly deformed nuclei. You will provide further insight into their structure and by improving our knowledge on fission barriers help to improve theoretical nuclear models, ultimately aiming at describing the elusive region of superheavy elements.

During daily work you will become part of the local FRS Ion Catcher group at GSI (led by Dr. Timo Dickel). Regular project meetings with the local team and the project leader (PD Peter Thirolf) and mutual on-site visits at GSI and in Munich will establish the link with LMU as your 'home institution'.

Ideally you have already a background in experimental nuclear physics and like to work in a collaborative environment. Experience in laboratory and technical-oriented work is desirable.

Depending on your availability the project could start with the beginning of the winter term.

Did we catch your interest ?

Contact:

If you are interested in working on this project and would like to get more detailed information, please send (latest until 31.8.) your application (motivation, CV, MSc transcript, if applicable a description of previous experiences in experimental and/or practical work and earliest availability) to:

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