2017 HGF – GSI – OCPC – Programme

for the involvement of postdocs in bilateral collaboration projects

Part A:

Title of the project:

Hypernuclear Spectroscopy with Fragment Separator FRS at FAIR Phase 0

Helmholtz Centre and institute:

GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt

Project leader:

Dr. Takehiko R. Saito Email: t.saito@gsi.de, telephone: +49 6159 71 2032, telefax: +49 6159 71 2902

Web-address:

www.gsi.de

Department: (at the Helmholtz centre or Institute)

NUSTAR Department

Contact Information: (Email, telephone and telefax)

Dr. Pradeep Ghosh
Program Coordinator
GSI Helmholtzzentrum für Schwerionenforschung
Planckstrasse 1, 64291 Darmstadt
Email: Pr.Ghosh@gsi.de or Pradeep.Ghosh@fair-center.eu
Telephone: +49 – 6159 71 3257, Fax: +49 – 6159 71 3916

Description of the project (max. 1 page)**:**

Hypernuclear physics addresses the importance to understand the baryon-baryon interaction with up-, down- and strange-quarks under the flavoured-SU(3) symmetry. It also contributes for understanding the nature of extreme astronomical objects such as a deep interior of neutron-stars. Hypernuclei have been studied experimentally for more than 6 decades by means of induced reactions of secondary meson- and primary electron-beams. Recently, hypernuclei have also been successfully studied in the HypHI Phase 0 experiment at GSI with peripheral collisions of heavy ion beams. Hypernuclei have also recently been studied by the STAR and ALICE collaborations with central collisions of ultra-relativistic heavy ion beams. By the methodology with the peripheral collision performed by HypHI, heavier hypernuclei with the mass A>3 as well as hypernuclei with neutron- and proton-excess can be produced and studied in contrast to the hypernuclear production with central collisions. This method will enable to study 1) exotic hypernuclei at extreme isospin to investigate the isospin dependence of the ΛN-ΣN coupling and three-body force, and 2) hypernuclear lifetime at the best precision, which is very sensitive to the wavefunction of hyperons inside hypernuclei.

This proposed project will develop a new method to study hypernuclei with peripheral collisions of heavy ion beams by employing the forward ion spectrometer FRS at GSI. In this method, decay

residues of the π^--hypernuclear decay will be measured by a part of FRS in coincidence with π^- mesons measured by the dedicated π^- detection setup located inside of FRS. By this combination, the resolution of the hypernuclear spectroscopy is expected to be around 800 keV, being six times better than that of the HypHI Phase 0 experiment. We are planning to perform the first hypernuclear experiment with FRS in 2018 or later at FAIR Phase 0 by using projectiles of ^{6}Li or ^{12}C at 2 *A* GeV impinged in the carbon target. The physics subjects of this project are to further study the short lifetime of hypertriton and indications of the bound system with two neutrons and a Λ hyperon at the best resolution, that were observed formerly in the HypHI Phase 0 experiment. It should be noted that the hypernuclear experiment is defined as one of the day-1 experiments of NuSTAR at FAIR Phase 0 and 1. The proposed project will also contribute to develop the proposed hypernuclear project at the future Chinese accelerator facility HIAF, and it will make more strength in the collaboration between GSI/FAIR and Chinese institutions also in the field of hypernuclear physics.

The successful candidate will play a leading role in the design study of the proposed experiment with Monte Carlo simulations, development and preparation of the detector and electronics systems, conduction of the experiment, and data analyses. The project will be performed within the super-FRS Experiment Collaboration.

Description of existing or sought Chinese collaboration partner institute (max. half page)**:**

We are looking for Chinese partners with strong interest in the hypernuclear physics experiments with heavy ion beams. One of the potential collaboration partners is “Institute of Modern Physics (IMP)” in Lanzhou. The project leader of this application (T.R. Saito, TRS) already established a strong collaboration with IMP in 2016. TRS proposed a new hypernuclear project at Chinese Heavy Ion Accelerator Facility HIAF, which is currently under construction. Since then, TRS is leading the hypernuclear project for HIAF in China with a collaboration of IMP. IMP also shows their large interest to participate in the hypernuclear project with the Fragment Separator FRS at GSI. Therefore, the GSI/FAIR-IMP collaboration for hypernuclear physics can be stronger through this program both for GSI/FAIR and HIAF. Candidates in the other institutions are also welcome if the institutions would like to collaborate on this hypernuclear project at GSI/FAIR. The establishment of a stronger collaboration between GSI/FAIR and Chinese partners for the hypernuclear physics will give benefits to both GSI/FAIR and HIAF because of large synergies between GSI/FAIR and HIAF.

Required qualification of the post-doc:

- PhD in experimental nuclear or particle physics
- Experience with Monte Carlo simulations, data analyses, detectors and electronics in nuclear and particle physics
- Additional skills in reconstructing charged particle tracks will be plus
- Language requirement: fluent in English

Part B:

Documents to be provided by the post-doc:

- Detailed description of the interest in joining the project (motivation letter)
- Curriculum vitae (CV)
- copies of degrees as a proof of education qualification
- List of publications (if any)
- 2 letters of recommendation

Part C:

Additional requirements to be fulfilled by the post-doc:

- PhD degree not older than 5 years
- Very good command of the English language
- Strong ability to work independently and in a team