

## 2018 HGF – GSI – OCPC – Programme

### For the involvement of postdocs in bilateral collaboration projects

<b>Part A:</b>
<b>Title of the project:</b>
Study of the nuclear reactions with the radioactive ions at the storage ring
<b>Helmholtz Centre and institute:</b>
GSI Helmholtz Center for Heavy Ion Research GmbH
<b>Project leader:</b>
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<b>Description of the project :</b>
<p>The investigation of light-ion induced direct reactions using stored radioactive beams interacting with internal targets of storage rings may lead to substantial advantages over external target experiments, in particular for direct reaction experiments at very low momentum transfer. In 2012, pioneering experiment at Experimental Storage Ring (ESR) at GSI demonstrated a possibility of making scattering experiments with the radioactive stored ions interacting the internal gas-jet target. Unique detector setup was operated in Ultra-High Vacuum (UHV) environment of the storage ring. For the first time proton elastic scattering on <math>^{56}\text{Ni}</math> allowed to extract nuclear matter distribution of <math>^{56}\text{Ni}</math> and a measurement of the <math>^{58}\text{Ni}</math> inelastic <math>\alpha</math> scattering demonstrated feasibility of studying Giant Resonances at the storage rings. Taking into account this experience we would like to continue a program on reaction studies at the CSRe storage ring at IMP and ESR. At the moment ESR and IMP are the only facilities world-wide which enable such challenging and unique investigations. We propose to study the <math>^{56}\text{Ni}(\alpha, \alpha')</math> reaction that leads to the investigation of the Giant Monopole</p>

Resonance. Experiments with the stable ions studying reactions like  $^{58}\text{Ni}(p,p)$  and  $^{58}\text{Ni}(\alpha,\alpha')$  at CSRe/IMP will be performed first demonstrating feasibility of more challenging experiment like  $^{56}\text{Ni}(\alpha,\alpha')$ . It should be pointed out that we consider the investigation of the location and strength of the giant monopole resonance in the doubly magic  $^{56}\text{Ni}$  nucleus by inelastic alpha scattering to be one of the future highlight experiments. Such an experiment which may give us direct input concerning the equation of state of nuclear matter, namely the compressibility, will not be possible with comparable quality within the nearest future at any other facility world-wide. The new concept of UHV compatible recoil detectors and corresponding ASIC-based readout electronics needs to be developed. The detector telescopes, consisting of a DSSD (Double Sided Silicon Strip Detector) and thick Si detectors are planned to be operated inside the UHV chamber without any vacuum pockets. In addition, UHV capable remote controlled moveable aperture in front of the target facing the detector telescope is planned. With such telescopes the deposited recoil energy versus scattering angle for elastic and inelastic proton- and  $\alpha$ -scattering can be measured.

**Description of existing or sought Chinese collaboration partner institute:**

The Institute of Modern Physics (IMP) of the Chinese Academy of Sciences is the natural collaborator of the GSI Darmstadt. As of 2013, the institute had 892 staff members including 403 researchers, as well as 284 master's and doctoral students. IMP operates, besides other facilities, the Heavy Ion Research Facility in Lanzhou (HIRFL) with heavy ion Sector Focusing Cyclotron, an in-flight fragment separator and the storage ring CSRe. GSI has a long-term collaboration with the IMP Lanzhou, both in the field of atomic and nuclear physics.

Several members of the IMP took part in the R&D project, preparations and performing of the experiment with on  $^{56,58}\text{Ni}$  at the storage ring ESR at GSI.

**Required qualification of the post-doc:**

- PhD in Nuclear Physics, Nuclear Reactions, Nuclear Engineering.
- Experience with the detectors, electronics, DAQ, vacuum systems
- Additional skills in mechanical (CAD) design
- Language requirement English in reading, writing and conversation

**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:**

- Very good command of the English language
- Strong ability to work independently and in a team