2018 HGF – GSI – OCPC – Programme

For the involvement of postdocs in bilateral collaboration projects

Part A:
Title of the project:
Laser cooling of stored relativistic heavy ion beams
Helmholtz Centre and institute:
GSI Helmholtz Center for Heavy Ion Research GmbH
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Description of the project :
Laser cooling is mostly applied to light ions in low charge states and at low velocities. We address the opposite sides of these cases, *i.e.* heavy ions in high charge states and at very high velocities. Here, laser cooling implies reducing the longitudinal temperature (or velocity spread) of ions that travel with almost the speed of light. (Note: We do not slow down the ions, like in traps.) In this research field, accelerator physics meets atomic physics and laser physics. Therefore, we seek a candidate with a strong background in (at least) one of these fields in order to contribute to the ongoing and future activities. Laser cooling has already been successfully demonstrated with $^{12}C^{3+}$ ion beams stored at 47% of *c* (or 122 MeV/u) in the Experimental Storage Ring at GSI, see *e.g.* [1]. For this purpose, special laser systems have been developed in collaboration with our partners in Dresden (HZDR, TU-Dresden) and Darmstadt (TU-Darmstadt). We use either a CW laser system, which can quickly be scanned over a large range (28 GHz), or a pulsed laser system

(ps – ns) with a very high repetition rate (up to 1.5 MHz). In order to detect the fluorescence from the laser excited ions [2], special *in vacuo* detector systems are being developed in collaboration with the university of Münster [3]. Laser cooling and laser spectroscopy are strongly related, require almost the same experimental setup, and are both actively being pursued [4].

For the future Facility for Antiprotons and Ion Research (FAIR), to be constructed next to GSI in Darmstadt, laser cooling is also part of the Research Plan, and we are currently preparing for a dedicated facility at the large (1.1 km) heavy-ion synchrotron SIS100 [5].

[1] D. Winters *et al.*, JACOW Conf. Proc. COOL **THAM1HA04** (2013) 166.
[2] D. Winters *et al.*, Phys. Scr. **T144** (2011) 014013.
[3] V. Hannen *et al.*, JINST **8** (2013) P09018.
[4] www.gsi.de/sparc
[5] D. Winters *et al.*, Phys. Scr. **T166** (2015) 014048.

Description of existing or sought Chinese collaboration partner institute:

Our Chinese collaboration partner should have an interest and experience in either atomic physics, or accelerator physics, or laser physics/optics. Since the work to be performed at GSI will be mostly experimental, the partner institute should have topic-related laboratories on site to have provided the requested level of expertise to the postdoc. (These labs should house an accelerator, or a laser setup, or a detector setup.)

Required qualification of the post-doc:

- PhD in experimental physics, at best in one of the following fields: atomic physics, accelerator physics, laser physics/optics, or a related field.
- Experience (*hands-on*) with ultra-high vacuum techniques and equipment, or photon detection systems, or data acquisition systems, or laser systems.
- Language requirement: English (with certificate)
- The person should be motivated and able to communicate in English without problems. The person should be willing to attend group meetings and seminars and become part of the team.

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