



2023 HGF – OCPC – Programme for the involvement of postdocs in bilateral collaboration projects

Part A

Title of the project:

A wavelength-tunable extreme ultraviolet frequency comb for nuclear spectroscopy of Thorium

Helmholtz Centre and institute:

GSI GmbH - Helmholtz-Institute Jena

Project leader:

Dr. Christoph Heyl

Contact Information of Project Supervisor: (Email, telephone)

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Web-address:

Institute: <https://www.hi-jena.de/en/>

Research profile of the PI: <https://scholar.google.de/citations?user=Rozet04AAAAJ&hl=en&oi=ao>

Department: (at the Helmholtz centre or Institute)

Helmholtz-Institute Jena

Programme Coordinator (Email, telephone)

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Description of the project (max. 1 page):

Optical frequency combs, ultra-stable lasers emitting thousands of narrow lines of distinct color, form the key element for today's most precise measurements. These include the test of fundamental theories as well as everyday-life applications like GPS and telecommunication. While their potential is well explored in the visible spectral regime, great challenges are waiting within the extreme ultraviolet (XUV). These include the first laser excitation of a nucleus such as ^{229}Th .

Our laboratory hosts state-of-the-art frequency comb equipment such as modern frequency comb lasers operating in the near infrared spectral region including a newly developed 80 W frequency comb system. We are currently developing an XUV comb source, which will



complement existing large-scale XUV sources at the DESY campus, hosting some of today's world-leading free electron laser and synchrotrons. We will use this comb for the direct excitation of the ^{229}Th isomer with a low-energy transition located at about 8 eV.

This project aims at pushing the limits of XUV frequency comb technology aiming at dedicated spectroscopy goals. Considering recent advances in the field, we see great potential to push this technology towards Watt-level average powers in the XUV using a novel approach employing a high-power frequency comb [1] together with highly efficient post-compression methods [2] and novel frequency conversion concepts [3].

The main project focus can be adjusted depending on the candidate's research interest. You will be working under guidance of experts in the field: Dr. Christoph Heyl (Dep. group leader at DESY, Hamburg, and group leader at Helmholtz-Institute Jena, Germany), who pushed XUV comb technology into mW power regime together with researchers in Jun Ye's lab in Boulder, US [4,5]. Additional support will be provided on-site by Dr. Ingmar Hartl (Group leader at DESY, Hamburg, Germany), an experienced laser and frequency comb expert who pioneered the world's first 100 W frequency comb system.

We encourage outstanding applicants with a background in experimental nonlinear optics/laser physics to apply.

Recent related works by the PI:

[1] Salman et al, **CLEO 2022**, "Smart and agile 84 W Yb-fiber laser for spectroscopy"

[2] Viotti et al, **Optica 2022**: <https://doi.org/10.1364/OPTICA.449225>

[3] P. Balla et al., **Nature Photonics 2023**: <https://doi.org/10.1038/s41566-022-01121-9>

[4] Porat et al, **Nature Photonics 2018**: <https://doi.org/10.1038/s41566-018-0199-z>

[5] Zhang et al, **Phys. Rev. Letter 2020**:
<https://doi.org/10.1103/PhysRevLett.125.093902>

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

Not specified

Required qualification of the post-doc:

- PhD in Physics or Electrical Engineering
- Experience with lasers and nonlinear optics
- Additional skills in electronics / frequency combs are beneficial



PART B

Documents to be provided by the post-doc, necessary for an application to OCPC via a postdoc-station in China, which is affiliated to a research institution like a university:

- Detailed description of the interest in joining the project (motivation letter)
- Curriculum vitae, copies of degrees
- List of publications
- 2 letters of recommendation
- Proof of command of English language

PART C

Additional requirements to be fulfilled by the post-doc:

- Max. age of 35 years
- PhD degree not older than 5 years
- Very good command of the English language
- Strong ability to work independently and in a team