2023 Helmholtz – OCPC – Programme

for the involvement of postdocs in bilateral collaboration projects

PART A

Title of the project:

Studies of paper-based heritage objects like written artefacts using X-ray scattering techniques

Helmholtz Centre, division:

DESY-FS

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

DESY has started a collaboration with the *Understanding Written Artefact* excellent cluster (UWA) of the University of Hamburg (Germany). This collaboration is very important for both sides because it links completely different fields of research areas together mainly the natural sciences and humanities research. The new SAXSMAT beamline P62 of the PETRA III synchrotron at DESY is involved in this UWA-DESY collaboration. The subtopic where beamline P62 is involved deals with the understanding of the paper sheets of old manuscripts in terms of nanostructure and the paper-making process. A feasibility Small- and Wide-Angle X-ray Scattering (SAXS/WAXS) experiment has been done at the beamline P62 last semester with the result that distinct features can be identified for various manuscript papers. Because paper was invented in China, developed and spread to all other directions from there - thus a significant part of primary and secondary literature is in Chinese, not to mention material evidence of those manuscripts (which sometimes is not available for study in Western scholars but in China Universities). Anyhow in brief Chinese post-doc will be able to read Chinese sources and probably access more archaeological and manuscript logical data, which are important references. Besides, we will be working with Asian papers, which means a significant number of Chinese samples, etc. The project of the Chinese PostDoc would be to investigate several

hundreds of different manuscript sheets from different areas and centuries using X-ray scattering technologies.
Conservation science has developed a wide range of analytical methodologies aiming at the preservation and better understanding of deterioration processes to help conservators in their daily work. There is still however a need to develop both methods and reference data for fingerprinting specific types of papers, so we can detect the same or very similar paper in different heritage objects. Such ability would significantly help in the development of authentication and provenance studies. The PostDoc candidate should develop innovative experimental X-ray scattering-based approaches to complement current analytical methods of antique paper identification and raw materials characterization. Several beamtimes to perform SAXS/WAXS imaging on paper sheets are foreseen within the project. One aim of the project is to build up a database linked with the known information from the paper-making process and other useful information that the Chinese PostDoc candidate could be helpful to collect from old Chinese documents. The ultimate goal would be to prove that one can use SAXS/WAXS as a fingerprint of papers, especially within the framework of understanding old written artefacts and their origin. To reach these goals the PostDoc candidate should have experience in programming (the preferable language is Python) due to the big data sets of scattering data that have to be analyzed using the developed methodology within the project framework.
Besides the paper-related research program, other topics of the UWA-DESY collaboration, where SAXS/WAXS imaging can be useful, are in the scope of work e.g. understanding the interaction of ink's (iron inks, carbon-based inks, …) with the paper material. Therefore, the PostDoc candidate must work in close collaboration with the UWA cooperation partners.

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

Although currently there is no collaboration between our group (DESY) and a Chinese research Institute working in the field of cultural heritage research. The UWA excellent cluster indeed has a few collaborations. Anyway, we are interested to establish such collaboration with research groups dealing with the understanding of written artefacts. These groups should have a strong interest in understanding the objects in general but also in developing new methodologies for nondestructive characterization of cultural heritage objects such as written artefacts using X-rays as probing tool.

Required qualification of the postdoc:

- Ph.D. in Nano Science, Materials Science, Cultural Heritage Science, or related discipline
- Experience with scientific data analysis and programming techniques is required to deal with the X-ray data sets (preferred programming language: Python)
- Experience with X-ray scattering techniques such as Small- and/or Wide-Angle X-ray scattering is beneficial but not mandatory
- Experience with working with old manuscripts (not mandatory)
- Additional skills in working independently and in a team, with good organizational and communicative skills
- Language requirement: Excellent verbal and written communication skills in English