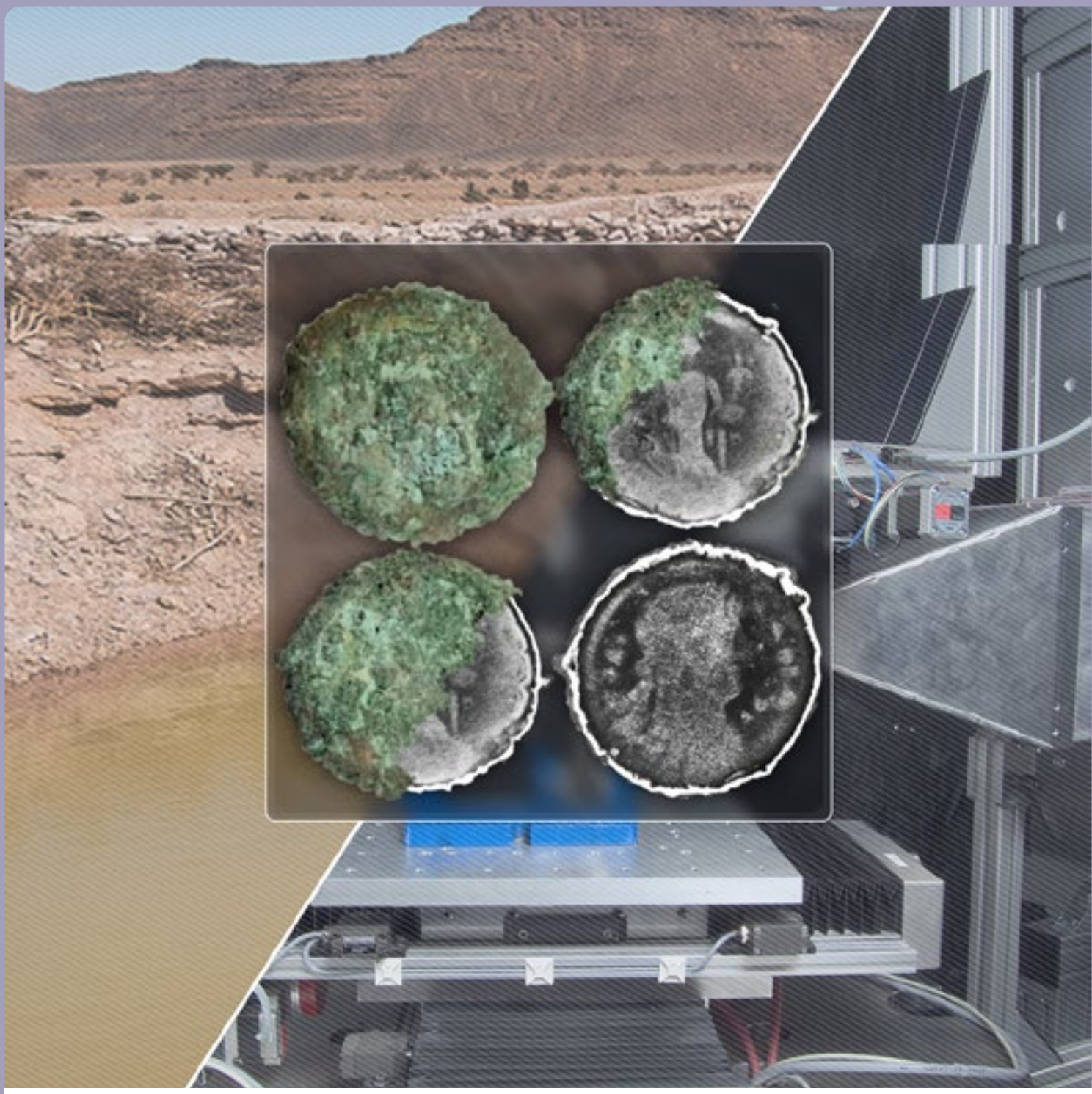
MLZ
Heinz Maier-Leibnitz Zentrum



Investigating cultural heritage

Neutrons reveal secrets

Neutrons for cultural heritage

Preservation and understanding are the essential aspects when it comes to cultural heritage. The Heinz Maier-Leibnitz Zentrum (MLZ) offers researchers the unique methods of neutron research for the multi-faceted examination of cultural objects.
Neutrons penetrate objects of cultural significance non-destructively, analyze the substances of which they are made and reveal hidden inner structures. They provide clues as to the origin of the substance, or the method by which the manufactured item was hand-crafted.

In this context neutrons support

- **research into provenance,**
- **conservation and restoration,**
- **the determination of authenticity,**
- **or provide information relating to the development of manufacturing processes.**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Measurements are carried out using the specific neutron instrumentation which is optimal for a particular application. Those for cultural heritage are mainly concerned with material analysis, imaging, and elemental analysis.

Materials science

The STRESS-SPEC instrument determines the distance between atoms within a defined small volume of the examined item, and thus determines residual stresses and textures. When moving the object in the neutron beam, information about a larger area can be obtained. This procedure is mainly applicable to metallic artefacts. The analysis of the resulting metallurgical phases gives insight into the manufacturing process and the origin of the materials used.


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Italian, British and German researchers investigated the microstructure of historical European swords. Then as now, armourers used the most recently developed metallurgical methods. The results allow conclusions to be drawn on the development and dissemination of these technologies.

More information

Dr. Michael Hofmann
materials-science@mlz-garching.de

Imaging methods

Neutrons can penetrate deep layers (to a depth of several centimetres) of very different materials, especially metals. The radiography at the instruments ANTARES and NECTAR thus provides high-contrast images, which can even be assembled into complex tomographies. Internal structures, such as an imprinted side of a coin under an oxide layer, become visible because neutrons are not only absorbed and scattered by heavy metals, but also by light elements.

Two wooden figures from the early 18th century from the St. Laurentius Church in Tönning/Schleswig-Holstein were disfigured due to an earlier wood preservative treatment. Neutron radiography at NECTAR revealed to the experts of the Rathgen-Forschungslabor how the poisonous carbolineum was distributed in the wood so that it could be removed with precision.

More information

Dr. Burkhard Schillinger
imaging@mlz-garching.de

Elemental analysis

Elemental analysis are based on the capture of neutrons in atomic nuclei generating characteristic gamma radiation. Its analysis enables the determination of the chemical composition non-destructively. Prompt Gamma Activation Analysis (PGAA) is performed in neutron beams mainly for the measurement of the major and minor components, while Neutron Activation Analysis (NAA) made in reactor irradiation channels is sensitive to trace elements down to the ppt range. The elemental composition can be used as a fingerprint of the artefact.

Italian scientists have examined a sealed Corinthian vase from the period 700-600 BC using both neutron radiography and PGAA. The powder found inside was presumably used for cosmetic purposes.

More information

Dr. Christian Stieghorst
activation-analysis@mlz-garching.de

Try-out Workshops

Historians of antiquity as well as geologists can get acquainted with the versatile use of X-Rays and neutrons in specific workshops, where users can bring their own samples for trial measurements. Complementary methods and combinations of different analytical methods are possible.
Registration can be requested by sending an email to **mlz@mlz-garching.de**. Current dates will be announced at **www.mlz-garching.de/en**.


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Application for beamtime

Beamtime at the Heinz Maier-Leibnitz Zentrum (MLZ) is available to guest researchers free of charge via an online application procedure. The MLZ board of directors decides on its allocation based on scientific relevance following recommendations by an external panel of reviewers. The User Office Team will be happy to answer questions regarding application and application deadlines.

More information

Dr. Ina Lommatzsch
useroffice@mlz-garching.de

On specific support for research into cultural heritage using neutrons, the MLZ participates in the consortium of the EU project **IPERION HS**. It offers access to further methods of analysis and archives. Information on application, application deadlines and cooperation partners of the project can be found under **www.iperionhs.eu**.

This project is funded by the European Union

Neutrons – Made in Germany

The Research Neutron Source Heinz Maier-Leibnitz (FRM II) is one of the most efficient and modern Neutron sources worldwide. As a central scientific facility of the Technical University Munich, the FRM II, financed by the Bavarian State Ministry for Science and the Arts (StMWK), provides neutrons up to 240 days a year for research, industry and medicine. Within this remit, the Heinz Maier-Leibnitz Zentrum (MLZ) manages and supervises applications for scientific use.

The Heinz Maier-Leibnitz Zentrum

The MLZ in Garching near Munich is the leading centre for top-level research with neutrons and positrons in Germany. As a service facility, the MLZ is able to provide unique, powerful instrumentation in the field of neutron research to the users. The MLZ is a cooperation of the Technical University Munich, the Research Centre Jülich and the Helmholtz Centre Geesthacht. It is jointly financed by the Federal Ministry of Education and Research, the StMWK as well as partners in the cooperation.

Technical University Munich
Research Neutron Source Heinz Maier-Leibnitz (FRM II)
Heinz Maier-Leibnitz Zentrum (MLZ)
Lichtenbergstr. 1
D-85748 Garching
mlz@mlz-garching.de
+49 (0) 89 / 289-14965
www.mlz-garching.de

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