PIXE applications for historical and material analysis of archaeological objects

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Making full use of the capabilities of PIXE in the field of archaeology and cultural heritage requires an appropriate balance between cultural, technological, and economic resources. This involves adapting the technique to the specific constraints of archaeological objects -such as handling and transportation criteria- optimizing measurement time, and designing sampling and measurement strategies that minimize potentially inconclusive results. However, articulating these requirements poses several challenges. Some are related to the intrinsic characteristics of the technique and instrumentation, while others arise from the inherent compositional complexity of archaeological materials and their degradation products, which differ substantially from standardized reference samples.

Additional challenges concern the need to link cultural questions and conservation-related problems with analytical techniques that provide compositional data. This connection requires an exchange of concepts and disciplinary languages, highlighting the necessity of an interdisciplinary approach. For this reason, this lecture presents an interdisciplinary methodological proposal aimed at improving the integral conservation of archaeological objects while maximizing the analytical potential of different techniques applied to a diverse range of materials composing heritage objects.

This proposal is presented through selected case studies based on PIXE results obtained from different materials -such as glass, ceramics, bones, copper and silver alloys, pigments- as well as from degradation products, including salts and minerals. Through each case study, methodological aspects related to the implementation of PIXE in the cultural heritage field are highlighted, including criteria for object selection, sampling and measurement design, data acquisition, and interpretation of results.

Intended Audience:
This lecture is intended for an interdisciplinary audience, including undergraduate and graduate students, early-career researchers, and professionals with backgrounds in cultural heritage studies, archaeology, conservation science, applied physics, chemistry, materials science, and related disciplines.

Learning Outcomes
After the lecture, participants will have gained a clear understanding of the type of information provided by PIXE and its potential for the study of archaeological cultural heritage, including its integration with complementary analytical techniques. They will be able to apply strategic criteria for implementing PIXE across different types of materials, from defining research-driven sampling and measurement designs to selecting appropriate instrumental settings, such as beam size and acquisition time. Participants will also become familiar with standard measurement conditions required by PIXE facilities and their implications for data quality and interpretation.