Synchrotron radiation-based X-ray techniques & cultural heritage objects: an integrated multi-material, multi-technique and multi-scale approach to study their composition and evolution

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Synchrotron techniques are widely used across the cultural heritage research community for investigating the phases, compositions, and morphologies of historical materials. These advance our knowledge of the artefacts themselves, the history of their cultures of origin, and our ability to preserve or restore them in an authentic state. As with many fields of research, utilising multiple different techniques to provide complementary information is important for fully understanding the available data. For heritage research, it is particularly important that this can be formed into a cohesive understanding of an artefact, or the historical practices of a culture, as education and accessibility is often a crucial requirement. However, there are unique difficulties that researchers face when measuring synchrotron X-ray data on items that are rare, fragile, or particularly large. This presentation introduces the main techniques, challenges, and successes of recent cultural heritage research conducted at synchrotrons, with a focus on work done at the European Synchrotron Radiation Facility (ESRF).

Examples of objects/artworks from heritage research conducted at ESRF: a. Beck 2026, b. Dalecky 2024, c. Gonzalez 2023, d. Gomez Lobon 2023, e. Holé 2025, f. Purdy 2024, g. Vitale 2025, h. Gonzalez 2025, i. Beauvoit 2023, j. Brunet 2026, k. Albert-Tortosa 2025, l. Villani 2024, m. Possenti 2025, n. de Mecquenem 2023, o. Broers 2023; De Keyser 2024; Raven 2026, p. Guanieri 2023, q. Carboni Marri 2025, r. Ghirardello 2022, s. Pastorelli 2024