

# X-ray fluorescence imaging of ancient materials – from Archimedes to Archaeopteryx and beyond



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## Abstract:

The 10th century parchment document known as the Archimedes Palimpsest contains the oldest surviving copy of works by the Greek genius Archimedes of Syracuse (287 – 212 BC). To uncover his obscured writings we developed the technique of rapid-scan X-ray fluorescence (XRF) imaging at the Stanford Synchrotron Radiation Lightsource. Since its successful application in the Archimedes project, we further optimized the method over the last decade, enabling us to carry out numerous imaging studies of large objects of cultural, archaeological and paleontological importance.

I will describe the X-ray imaging method and present some of the most exciting results of our quest to uncover our cultural and natural heritage. These examples include the imaging of a seventh-century Qur'an palimpsest, the original



score of the opera *Médée* by Italian composer Luigi Cherubini and our most recent project to read the overwritten Syriac translation of work by the Greek physician, surgeon and philosopher Galen of Pargamon, arguably the most accomplished of all medical researchers of antiquity. Other examples include studies of so called dinobird fossils, such as the 150 million-year-old iconic *Archaeopteryx* and *Confuciusornis sanctus*, a 120-million-year-old fossil of the oldest documented bird with a fully derived avian beak. I will finish the lecture by introducing a complementary X-ray method to image carbonaceous species in ancient materials.