

# An optimized external beam setup for archaeological and arteometry research

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Within the several methods used to investigate archaeological and artistic objects the most used non destructive methods are EDXRF-Energy Dispersive X-Ray Fluorescence, PIXE and PIGE analysis. Ion Beam Analysis of this kind of samples is usually done in open air, hence an external beam setup was constructed and installed at LAMFI for the analysis of vacuum incompatible samples such as paintings, ceramics, bones, and rocks.

The new and enhanced external beam system allows simultaneous PIXE, RBS, PIGE and IBL analysis in open air. The setup is composed by a star-like assembly with 7 geometrically focused telescopes (figure 1): two for the alignment laser beams, 2 for the Si-PIN X-ray detectors, 1 for a SB detector, 1 for the optical spectrometer, and 1 for a CAM. The SB telescope is windowed with a thin Mylar film to vacuum it and reduce the energy loss in air. The telescopes with the X-ray detectors are also windowed, vacuum pumped and optimized with absorbers to measure low and high energy X-rays. The beam exit window with an  $8\mu\text{m}$  of aluminum foil is also used to monitor beam charge by the 843.74 and 1014.4 MeV gamma rays of the  $(p, \gamma)$  reaction by an external NaI detector. The geometry and materials of the assembly is such to shield the Si-PIN detectors from the X-ray emissions from the exit beam window as well as reduce the detection of Ar  $K\alpha$  from the air path, due to the narrow field of view of the X-ray detectors.

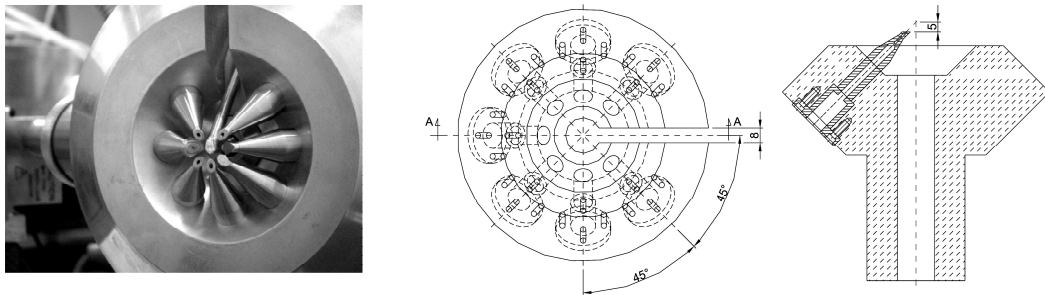


Figure 1. Star like assembly for the external beam setup at LAMFI-USP. Notice the Aluminum, Mylar and Be windows used to isolate and vacuum the telescopes while also filtering the X-Rays.

The external beam setup aims: a) to enable quantitative and analytical research in archaeology and arteometry; b) to supply results that subsidize the authenticity investigation of art objects and origin of archaeological artifacts, and; c) to stimulate the arteometric and archaeometric research in Brazilian Museums.