

## **BLIN4: Magnetic beam line to transport a few MeV laser-produced protons in air for PIXE applications**

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We describe the latest progress towards the development of a laser-produced proton beam line for Particle Induced X-ray Emission (PIXE) applications. The specific aim of the project is the design, realization and test of a compact laser-based source of a few MeV protons to be used for PIXE measurements at atmospheric pressure.

The apparatus comprises a 14 TW 30 fs laser system, a laser-plasma target (typically a thin titanium or aluminum film) used to generate a few MeV protons via TNSA process, a magnetic beam line in vacuum, a thin Kapton window to extract the proton beam from the vacuum chamber into atmospheric pressure, a sample for the PIXE measurements (a high-purity copper or titanium foil), and a X-ray ccd camera.

The preliminary experiments were performed without the magnetic beam line, and with the TNSA target very close (few cm) to the Kapton window. Results from these tests revealed a X-ray spectrum typical of the material used as sample for the PIXE measurements after 35 laser shots. However, the PIXE spectrum shows a prominent low energy background typical of X-ray emission by bremsstrahlung due to energetic electrons from the laser-plasma target. Also, the vicinity of the TNSA target to the Kapton window resulted in an increase of the limit vacuum pressure in the chamber with time, indicating a degradation of the Kapton film itself.

In order to solve the above-mentioned issues a magnetic beam line based on magnetic quadrupoles comprising commercial Nd permanent magnets, has been designed, realized and implemented. The experimental test of the proton source with the magnetic beam line have shown transport up to a few MeV, with 3 MeV cut-off protons detected in air at the PIXE target location, while energetic electrons from the laser-plasma source are filtered out by the magnetic beam line.

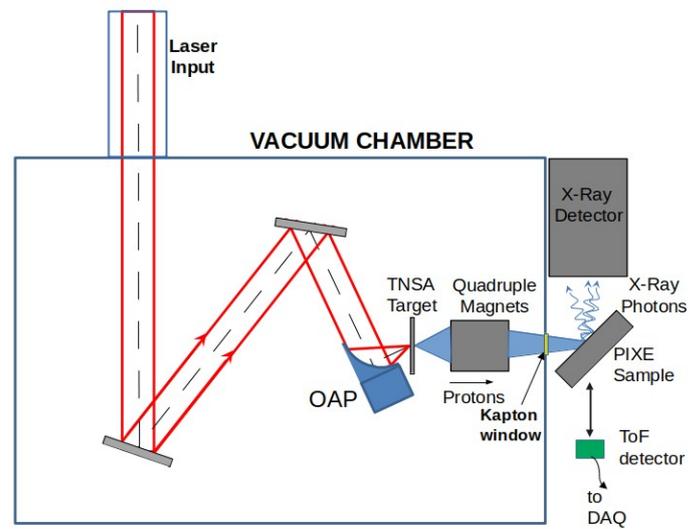


Figure 1: Sketch of the LaserPIXE apparatus