Laser-plasma based hadron sources for materials science applications

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In this contribution we discuss the potential of moderate energy laser-plasma based hadron sources for a number of applications in the fields of materials and nuclear sciences. Few MeVs protons can be used to probe the composition of a sample with a variety of non-destructive Ion Beam Analysis techniques[1]. Among these, Proton Induced X-ray Emission (PIXE) is of particular interest to retrieve the concentration profiles of complex samples (e.g. cultural heritage artifacts[2]). Few MeVs protons can be used also to generate neutrons with a suitable converter for applications such as radiography and spectroscopy[3]. High intensity($I > 10^{18}$W/cm^2) lasers can drive ion sources[4] with properties in principle already suitable for some of these applications[5]. However, there are still considerable challenges from the experimental point of view, especially if the use of a compact laser system is desired.

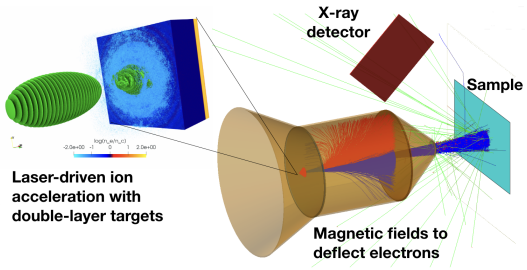

Figure 1: *Sketch showing a possible scheme to perform PIXE with a laser-driven source*

Here we present a thorough feasibility study of laser-driven PIXE[6] with a table-top 10s TW-class laser and we propose a complete, compact experimental setup. We also discuss enhanced laser-driven ion acceleration with advanced targets[7, 8], which could be beneficial both for PIXE and neutron sources. These results could pave the way for compact laser-driven hadron sources for materials science applications.

References

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