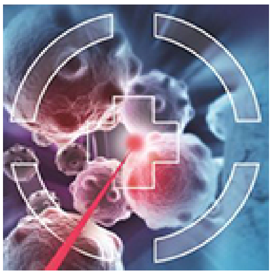

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A high repetition laser-plasma proton accelerator for radioisotope production

At present, radioisotope production for medical imaging and treatment is principally done at conventional accelerators. Over the last decades, the use of ultraintense lasers for this purpose has been proposed and studied [1], as an alternative in terms of availability an size. These compact systems can accelerate, via laser-plasma interaction, charged particles like protons, ions or electrons [2,3], as well as neutrons and x-ray generation [4], which can induce radioisotope production through nuclear reactions [5].
At the Laser Laboratory for Acceleration and Applications (L2A2) of the Universidad de Santiago de Compostela a high repetition rate femtosecond laser of 45 TW is used for proton acceleration. It can deliver pulses of 1.2 J and 25 fs at 10 Hz, which are then focused on a few micron spotsize area achieving intensities of 1019 W/cm2. The high repetition rate of the laser requires a positioning mechanical assembly that maintains the same focal incidence conditions while refreshing the target material at each shot. A wheel-like holder containing target sheets of few micron thickness is placed on a three mechanical stages assembly (two linear combined with a rotational one) to perform the positioning. A map of the target surface is generated by measuring the deviation of each shot point from the focal reference position with a laser-position sensor. The map is then programmed into the stages which automatically correct the laser focal position on the target shot-by-shot with micron resolution. This procedure allows to perform series of tens to hundreds of shots in a row in the same focal conditions.
Proton pulses of few MeV have been measured using a time-of-flight detector during the experiments, with an stability both in maximum energy and spectra temperature of about 3%. We expect to increase the proton maximum energy in future campains by optimizing this correction procedure and by using thinner target sheets. Once we reach protons of enough energy, we aim to achieve the production of radioisotopes like 11C for PET imaging and study its viability in relation to conventional accelerators.

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