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Accelerators (3) : laser-plasma acceleration for medical applications

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Electrons and light ions have been accelerated following the interaction of an intense laser pulse with a plasma for about 30 years. Nowadays, Laser Plasma Accelerators (LPA) are versatile sources capable of producing energetic electron and ion bunches with remarkable propreties. LPA benefited from the constantly increasing repetition rates of high intensity lasers that increased from a shot per hour to the Hz firing rate today and 100 Hz is foreseen within the next 5 years. Indeed LPA can be tuned to deliver particles with kinetic energies of up to several GeV for electrons and that reach 10 s of MeV for ions with charges approaching the μC level over accelerating distances of less than 20 cm or a few μm respectively. In the near future, they are poised to become complementary to conventional accelerators for specific purposes. Fundamental investigations are still necessary to understand the non linear processes at play in some of these acceleration mechanisms but the vast potential for usage led to the study of a number of applications in the past two decades. After briefly describing the most common acceleration processes and the properties of the obtained particle beams, the focus of this course will be the generation of medical radio isotopes from the multi-particles LPA sources [3] for internal radiotherapy and imaging. External radiotherapy using LPA bunches will also be discussed as well as phase contrast imaging that benefits from the unprecedented characteristics of these beams.

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