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# Production of C-11 for PET imaging using a HRR laser-driven proton source

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In recent years, laser-driven ion accelerators have gained significant interest as an alternative to conventional accelerators. A promising application is the production of radionuclides for medical theragnostics, such as $^{11}C$ for PET imaging. Currently, these radionuclides are produced in cyclotrons, limiting availability to isotopes with longer lifetime. In this context, compact laser-driven accelerators offer an attractive option for in-situ generation of short-lived isotopes. Although the activities required for PET (>MBq) exceed those achievable from a single laser shot (~kBq), high-power, high-repetition-rate lasers enable continuous production if a suitable target system is developed.
Here, a target assembly based on a rotating wheel and automatic alignment has been designed and commissioned, achieving stable MeV proton acceleration at rates of up to 10 Hz using a 45 TW laser system. Moreover, continuous $^{11}C$ production via the $^{11}B(p,n)^{11}C$ reaction was recently demonstrated using the 1 Hz, 1 PW VEGA-3 system (CLPU, Spain), reaching activation levels above 4 MBq. The only current bottleneck to achieving pre-clinical (~10 MBq) PET activities is laser-induced optic heating. Scalability to next-generation laser systems is being explored to assess the feasibility of producing clinical-level (~200 MBq) activities.

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