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Laser wakefield accelerator-driven photonuclear reactions for the production of medical radionuclide 67Cu

Sunday 1 June 2025 14:00 (2 hours)

Recent results of production of the medical radionuclides 67Cu using a laser wakefield accelerator (LWFA) are presented. This emerging technique utilises powerful, ultrashort laser pulses that are focussed into a gas jet to create a plasma wake that traps and accelerates electrons to very high energies with large accelerating gradients. Accelerated electrons interact with high-Z material to produce high-energy photons by bremsstrahlung, which then produce 67Cu via the 68Zn(γ, p)67Cu photonuclear reaction.
67Cu, with 62 h half-life, is considered ideal radioisotope for treatment of lymphoma and colon cancer.* The production of 67Cu requires medium-energy (˜70 MeV) protons that are only available at limited number of facilities.
We present the experimental setup, maximising electron pulse intensity by optimising laser beam properties and target composition of gas jet. The gamma beam and the design of 68Zn are optimised using FLUKA simulations. We will also report on the development of detectors for online monitoring of the electron and gamma beams, and produced activities of the radionuclides.

Footnotes

- G. Hao et al., Scientific Reports. 11, 3622 (2021), doi: /10.1038/s41598-021-82812-1 ** Bidkar AP et al., Theranostics. 11;14(7) :2969-2992 (2024), doi: 10.7150/thno.96403.

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