Contribution ID: **62** Type: **not specified**

Laser energised Travelling Charge Accelerator for nuclear medicine and beyond

Wednesday 9 July 2025 15:10 (15 minutes)

Proton accelerators are central to a wide range of applications, particularly in healthcare—for radioisotope production in nuclear medicine and precision cancer therapy. The Laser-Driven Travelling-Wave Accelerator (L-TWA) introduces a compact, high-gradient alternative to conventional RF-based systems. This approach leverages intense laser-plasma interactions to generate picosecond electromagnetic pulses (ps-EMPs), which are guided through a helical coil structure engineered to act as a miniature travelling-wave accelerator.

This centimetre-scale device captures, focuses, and post-accelerates broadband laser-driven proton beams, achieving accelerating gradients on the order of GeV/m—surpassing conventional RF technology by at least an order of magnitude. Crucially, the L-TWA provides phase-space rotation in picosecond time scales, enabling the generation of sub-nanosecond, quasi-monoenergetic proton pulses, a feature not attainable with traditional accelerator systems

The accelerator is modular and scalable, allowing staged configurations to reach therapeutically relevant energies (100–200 MeV). Its compact footprint, low shielding requirements, and on-demand operation make it particularly suited for point-of-care deployment in hospitals and decentralised production of medical isotopes. Additionally, the system's adaptability to other ion species, such as alpha particles or carbon ions, further broadens its biomedical utility.

With its high repetition rate potential and efficient laser-to-beam energy transfer, this novel platform offers a cost-effective and accessible pathway to next-generation ion beam sources. By bridging advancements in laser-plasma physics with accelerator science, the L-TWA paves the way for transformative applications in nuclear medicine, radiotherapy, and beyond.

Author: KAR, Satyabrata (Queen's University Belfast)

Presenter: KAR, Satyabrata (Queen's University Belfast)

Session Classification: Parallel talks