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Solving the external injection problem: H3$^+$Beams, High-quality High-gradient acceleration for HEP

Tuesday, 23 September 2025 19:00 (1h 30m)

The H3$^+$Beams project seeks to solve the many challenges of external injection from an RF-injector into a high-gradient LWFA structure, and to explore the physics of beam quality preservation in injection and staging.

Principal amongst the obstacles of injection from an RF-injector are the few-femtosecond synchronisation and bunch length requirements.
We address these through THz-driven bunch compression, were a laser-derived THz pulse provides a chirp to the RF-injector bunch. Subsequent compression in a magnetic arc leads to femtosecond temporal-locking between the laser and the (compressed) electron bunch. This temporal-locking is robust against RF injector jitter, and the timing jitter of the THz and LWFA drive laser.
Transverse focusing into the LWF channel is via PMQ triplets and plasma gradient lensing. Simulations indicate high preservation of bunch emittance and energy spread preservation.
Preliminary results in THz compression and temporal-locking will be discussed in detail, together with an overview of the full capability for GeV acceleration and beam quality preservation.

The project, a consortium of Lancaster, Liverpool, Manchester and Oxford Universities, and Daresbury National Laboratory, has been proposed for implementation on the CLARA electron beam facility. Discussion of wider engagement across Europe is welcomed, including potential for alternative host locations.

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