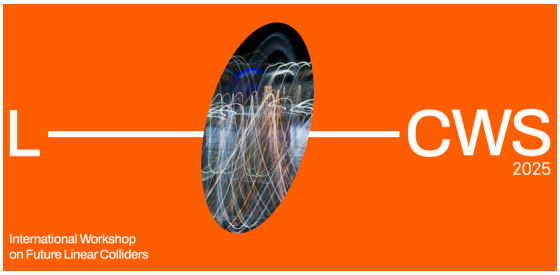

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HALHF: Recent updates, R&D, tools, insights, and plans

Thursday 23 October 2025 09:40 (20 minutes)

Plasma-wakefield acceleration holds great promise for particle physics due to its orders-of-magnitude higher accelerating gradients, which can result in significant cost reductions based on a sizeable reduction in footprint. However, plasma-based acceleration of positrons—required for an electron-positron collider—is much more difficult than for electrons. In 2023 a novel collider scheme, HALHF, was proposed that avoids positron acceleration in plasma, using a mixture of beam-driven plasma-wakefield acceleration to high energy for the electrons and RF acceleration to low energy for the positrons. Since first publication, an international collaboration has been built to progress the project towards a pre-CDR level. This process has led to the generation of new tools, for example to optimise the baseline collider design for total (build + run + carbon) cost, and has highlighted urgent topics for R&D, for example the plasma-heating and cell-cooling challenge. The status was recently submitted to the ESPPU process; the tools and insights developed are already proving beneficial to the 10 TeV collider effort in the US, and are expected to impact future plasma-based free-electron lasers and SFQED experiments. Here we present progress over the last two years and provide an outlook for the future.

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