7th European Advanced Accelerator Conference

EAAC2025

Contribution ID: **628** Type: **Oral contribution**

Visualizing plasma waves and long-living soliton-like structures in a laser wakefield accelerator

Thursday 25 September 2025 17:40 (20 minutes)

In LWFA, the driving laser generates a high-amplitude plasma wave producing the electric field structure, which can trap and accelerate electron pulses. For a detailed investigation of the formation and evolution of the wave and the acceleration process we use a synchronized, ultra-short (few-cycle), ultra-broadband laser pulse, which probes the interaction region. In transverse geometry, shadowgraphic snapshots of the plasma can be taken [2]. Applying a linear chirp to the probe pulse and using a spatially resolving spectrometer allowed us to record short movies of the interaction during one single laser shot. In addition to visualizing the plasma wakefield, this technique also allowed us to observe and study the evolution and the lifetime of soliton-like structures generated during the interaction and emitting broad band electro-magnetic radiation. The experimental results will be presented and compared to numerical simulations pointing towards the origin of these structures.

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Session Classification: PS8: Plasma sources and related diagnostics

Track Classification: PS8: Plasma sources and related diagnostics