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Study of the Seeded Self-Modulation Growth in the AWAKE Experiment

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The Advanced Wakefield Experiment AWAKE develops the first plasma wakefield accelerator with a high-energy proton bunch as driver [1]. The 400 GeV bunch from CERN SPS propagates through a 10 m long rubidium plasma, ionized by a 4 TW laser pulse co-propagating with the proton bunch. The relativistic ionization front seeds a self-modulation process. The seeded self-modulation (SSM) transforms the bunch into a train of bunchlets resonantly driving wakefields [2,3]. Electrons are externally injected into, and accelerated by the wakefields [4].

We investigate the growth of the modulation and of the transverse wakefields amplitude near the ionization front. We measure the density modulation of the bunch, in time, with a streak camera with picosecond resolution. The observed effect corresponds to alternating focusing and defocusing fields. We attempt to measure the growth of the modulation along the bunch, the modulation depth and the charge in each bunchlet. This is important to understand the beam/plasma interaction as well as for the acceleration experiments. The latest experimental and analysis results will be presented.

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