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First experimental results towards demonstrating the self-modulation instability at PITZ

Summary

The self-modulation instability is a plasma-particle beam interaction, where a long (in respect to the plasma wavelength) particle beam is separated into bunchlets. The bunchlets, which are about a plasma wavelength long, are generated when a steplike disturbance (e.g. co-moving ionization front, or sharp rise of the particle beam density) excites a plasma wave. The self-modulation is a key element in the design of the plasma acceleration experiment by the AWAKE collaboration at CERN, which is due to start operation later this year.
To study this instability in detail an experiment was conceptualized at the Photo-Injector Test Facility at DESY, Zeuthen site (PITZ) to inject a 6 mm long electron beam into a lithium plasma with a density of 10E15 cm-3. Here we report about first experiments with a novel cross-shaped plasma cell which was inserted into the PITZ beam line. The cell is prepared with lithium and argon buffer gas, then heated up to 700C to achieve a lithium atmosphere with the necessary density. The lithium is ionized with an ArF laser (193 nm wavelength) via sideports, creating a plasma channel with a length of up to 10 cm. The 22 MeV electron beam available at PITZ is focused tightly into the plasma, then guided from there to the diagnostics elements.

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