



Contribution ID: 39

Type: **Student Poster**

Effects of a plasma ramp on an electron bunch seeding self modulation of a proton bunch

Tuesday, 8 November 2022 17:00 (2h 30m)

We study the propagation of an electron bunch travelling within a proton bunch through a plasma density ramp. The proton bunch charge density in the ramp is higher than the plasma density. In this nonlinear regime the bunch generates a high density, on-axis plasma electron filament. The filament is defocusing the externally injected electron witness bunch that can therefore be lost along the ramp. At AWAKE we have measured this effect by changing the relative timing between electron and proton bunches. When the electron bunch propagates in front of the proton bunch, the electron bunch seeds self-modulation and reaches the energy spectrometer, downstream of the plasma. When propagating within the proton bunch, seeding stops and the electron bunch does not reach the spectrometer. These results indicate that the presence of a plasma density ramp could prevent on axis injection of an electron witness bunch into a following acceleration plasma. We will present latest experimental data.

Acknowledgments

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Session Classification: Poster Session and Reception

Track Classification: Poster Session: WG4 Poster: Beam-Driven Acceleration