



Contribution ID: 210

Type: **Contributed Oral**

Modulation of dense electron beams in nanostructures: A simulation study in preparation of the FACET-II E-336 experiment

Tuesday, 8 November 2022 16:30 (30 minutes)

Fields arising during the propagation of highly intense electron beams in structured targets of nanometer scale such as carbon-nanotubes can contain accelerating gradients of up to 10 TV/m with similarly strong focusing fields. Studies of beam-nanotarget interaction are therefore of interest as they may lead to an acceleration method with extremely high single-stage energy gains for electron or muon beams. The FACET-II E-336 experiment at the SLAC National Accelerator Laboratory aims to take advantage of the extreme beam densities available with the FACET-II electron beams to study its interaction with a grid of nanotube material. A simulation study with the Particle-In-Cell code CALDER was performed in preparation of the experimental campaign, illuminating transverse dynamics, such as magnetic trapping of beam particles in the tubes or deflection of the beam as a consequence of nanotube tilt. Additionally, the simulations indicate that nanotubes can act as an effective seed for beam-plasma instabilities. We will present the scientific goals of the project, report on simulations results and discuss how the observations can be translated into accessible observables.

Acknowledgments

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Session Classification: WG3: Laser and High-Gradient Structure-Based Acceleration

Track Classification: Working Group Parallel Sessions: WG3 Oral: Laser and High-Gradient Structure-Based Acceleration