Contribution ID: **36** Type: **Contributed Oral**

Proof of principle experiments of PV/m plasmonics using structured semiconductors

Thursday, November 10, 2022 11:15 AM (15 minutes)

A new paradigm of extreme plasmonics unearthed by our work opens the unprecedented possibility of Peta-Volts per meter fields that make it possible to access 1,000,000 times the acceleration gradient in RF accelerators. Plasmonic accelerators and light-sources put forth in our work rely on these extreme plasmons over timescales where the ionic-lattice remains largely unperturbed. A specific realization of this concept uses ultrashort particle beams propagating inside tubes made of conductive walls. Beam fields excite the conduction band electrons and sustain a large-amplitude surface crunch-in plasmon which is critical to mitigate collision of the beam with the ionic lattice but at the same time access strong focusing fields along with acceleration gradient. We elucidate our proof-of-principle experiments based on "tunable semiconductor plasmons"excited in n-type doped Silicon tube to match with currently accessible beams from linacs such as FACET-II or laser wakefield accelerators. Experimental verification of principles underlying extreme plasmons will pave the way towards PV/m plasmonics.

Acknowledgments

This work was supported by the Department of Electrical Engineering at the University of Colorado Denver. The NSF XSEDE RMACC Summit supercomputer utilized for computational modeling was supported by the NSF awards ACI-1548562, ACI-1532235 and ACI- 1532236, the Univ. of Colorado Boulder, and Colorado State Univ.

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Session Classification: WG4: Beam-Driven Acceleration

Track Classification: Working Group Parallel Sessions: WG4 Oral: Beam-Driven Acceleration