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PetaVolts per meter Plasmonics: a new paradigm based on quantum gas

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A new paradigm based on oscillations of quantum gas of conduction band electrons known as plasmons has opened unprecedented PetaVolts per meter fields [1,2,3,4]. PV/m fields can be attained using a class of non-perturbative plasmons uncovered in our work. This class of plasmons is excited by particle beams launched inside a conductive tube which makes it possible to control the excitation of large-amplitude oscillations up to the extreme limits while also mitigating various instabilities. We pursue extreme plasmons [2,5] for future high energy physics (HEP) accelerators and gamma-ray lasers through a dedicated experimental program at the SLAC national lab. The unparalleled field frontier enabled by extreme plasmons, also carries a great appeal for non-collider examinations of HEP. Our first experiments will characterize extreme plasmons in semiconductors doped to match with the FACET-II electron beam, paving the way towards broader goals outlined above.

[1] Sahai, A. A., *Nanomaterials Based Nanoplasmonic Accelerators and Light-Sources Driven by Particle-Beams*, IEEE Access, 9, pp. 54831-54839 (2021).
[2] Sahai, A. A., *Extreme plasmons*, arXiv:2404.02087 (2024).
[3] Sahai, A. A., *Nanostructure nanoplasmonic accelerator, high-energy photon source, and related methods*, PCT WO2021216424A1, WIPO (2021).
[4] Sahai, A. A., Golkowski, M., Katsouleas, T., et. al., *Approaching PetaVolts per Meter Plasmonics Using Structured Semiconductors*, IEEE Access, 11, pp. 476-493 (2023).
[5] Sahai, A. A., Golkowski, A. A., et. al., *PetaVolts per meter Plasmonics: introducing extreme nanoscience as a route towards scientific frontiers*, Journal of Instrumentation 18, P07019 (2023).

Working group

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