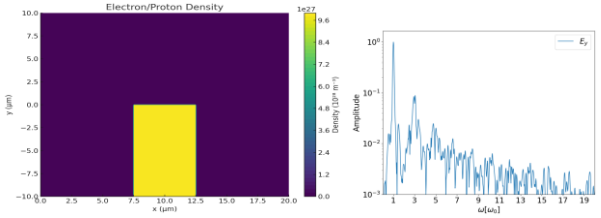
9th Asia-Pacific Conference on Plasma Physics, 21-26 Sep, 2025 at Fukuoka

High Harmonic generation from plasma wedge

Amar Pal[1], Bhuvanesh Ramakrishna[2],
[1] Department of physics, Indian Institute of Technology Hyderabad, India, [2] Indian Institute of Technology Hyderabad
e-mail (speaker): ph20resch11004@iith.ac.in

Abstract: this study, we investigate the generation of high-order harmonics through laser-plasma interaction using both planar and wedge-shaped targets by EPOCH PIC 2D simulation. The focus of the research is to compare the efficiency and spectral characteristics of High Harmonic Generation (HHG) from these two target geometries. A high-intensity femtosecond laser is used to ionize the surface of the targets, creating plasma where the harmonic generation occurs. In the case of the wedge-shaped target, the plasma density varies along the interaction surface, providing a unique environment for enhancing phase matching and boosting the harmonic yield, especially at higher orders.

We systematically vary the laser-wedge interaction angle to explore its influence on the harmonic generation process. By adjusting the angle of incidence, we control the laser's interaction with the plasma density gradient, which directly impacts the efficiency of HHG and the emission direction of the harmonics. Our results show that the wedge target significantly enhances the generation of high-order harmonics compared to the planar target, particularly in the extreme ultraviolet (XUV) region, due to better phase matching and optimized electron dynamics. Additionally, the variation in laser-wedge interaction angle enables fine-tuning of the harmonic spectrum, with sharper and more intense harmonic peaks observed at optimized angles. This study highlights the potential of structured targets like wedges in achieving more efficient HHG for applications requiring coherent XUV or soft X-ray sources and offers insights into the role of interaction geometry in optimizing plasma-based harmonic generation.



Electron proton density and HHG spectrum for proposed Epoch2D simulation setup.

Figure1: Electron and proton density for plasma wedge target in Epoch 2D simulation

References:

[1] C. Thaury and F. Quéré, *Journal of Physics B: Atomic,Molecular and Optical Physics*, **43**, 213001 (2010), https://doi.org/10.1088/0953-4075/43/21/213001.

[2] P. Gibbon, *Physical Review Letters*, **76**, 50-53 (1996), https://doi.org/10.1103/PhysRevLett.76.50.

[3] U. Teubner and P. Gibbon, *Reviews of Modern Physics*,**81**,445-479(2009),https://doi.org/10.1103/RevModPhys.81.445.

[4] B. Dromey, D. Adams, P. Héroux, S. Rykovanov, and M.Zepf, *Nature Physics*,**8**, 804-808 (2012), https://doi.org/10.1038/nphys2433

[5] H. Vincenti and F. Quéré, *Physical Review Letters*, **108**, 113904(2012),https://doi.org/10.1103/PhysRevLett.108.113904.