Ultra-intense laser interaction with nanostructured near-critical plasmas

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Ultra-intense laser interaction with near-critical plasmas is characterized by a rich physics and is actively investigated for a wide range of applications, from laser-driven secondary sources[1, 2] to the exploration of astrophysically relevant scenarios[3]. An appealing solution to produce near-critical plasmas with finely controlled properties is to irradiate nanostructured low-density materials[4]. Due the combined extremely fast dynamics and high temporal contrast of modern-day ultra-intense lasers, the nanostructure can survive long enough to affect the interaction.

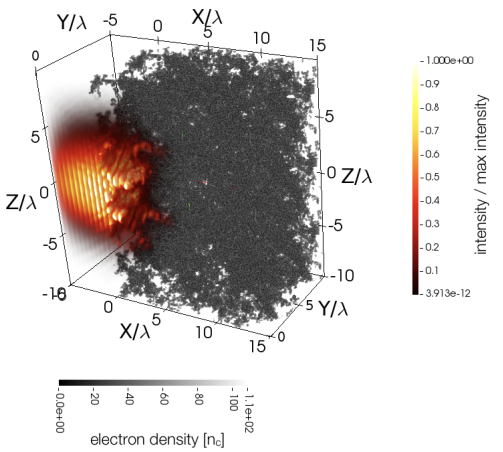

Figure 1: *Nanostructured foam irradiated at* $a_0 = 5$. *Electron density is shown in greyscale, while EM field intensity is shown in colorscale.*

In this contribution we present a thorough investigation of laser-interaction with near-critical nanostructured plasmas, via 2D[5] and 3D[6] Particle-In-Cell (PIC) simulations[7]. For the plasma we consider both simplified models (i.e. a collection of nanospheres) and realistic 3D nanostructured morphologies (i.e. fractal-like foam aggregates, ordered and random arrays of nanowires). We compare their behavior with that of a homogeneous near-critical plasma. We find that several important observables are influenced by the nanostructure and so a realistic description of its morphology is essential to properly understand the physical processes at play in this scenario. These results suggest possible paths to guide the design of future experiments involving near-critical plasmas.

References

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