Exploring Double-Layered Targets Efficiency in Laser-Driven Gamma Source Production using Particle-In-Cell code EPOCH

D. B. Dreghici[1,2] , V. Horny[1], B. Corobean[1,2], P. Tomassini[1], D. Doria[1]

[1] *"Horia Hulubei" National R&D Institute for Physics and Nuclear Engineering / Extreme Light Infrastructure – Nuclear Physics, 30 Reactorului Street, 077125 Magurele, Romania*

[2] *National University for Science and Technology POLITEHNICA Bucharest (UNSTPB), Bucharest, Romania*

The generation of high-energy synchrotron-like radiation through the Nonlinear Inverse Compton Scattering (NICS) mechanism and also bremsstrahlung radiation during the interaction of an ultra-intense laser pulse with a structured target is an area of intense study. Using state-of-the-art particle-in-cell (PIC) simulation code EPOCH, we investigate the laser-matter interaction with a focus on optimizing radiation yield in terms of photon density, energy and angular distribution. The study aims to extensively evaluate factors such as target configuration and geometry, and laser characteristics that govern the production efficiency of synchrotron-like radiation sources mainly. By analysing the complex dynamics of the laser-target interaction, we attain insight into the optimal conditions for NICS and the resultant radiation characteristics, paving the way towards guiding experimental setups and the interpretation of experimental results discerning the contribution of different mechanisms involved. Such study has clear implications for the development of next-generation photon sources and the advancement of fundamental research in high-energy-density physics with multi-petawatt laser systems, as the 10 PW laser infrastructure of ELI-NP.

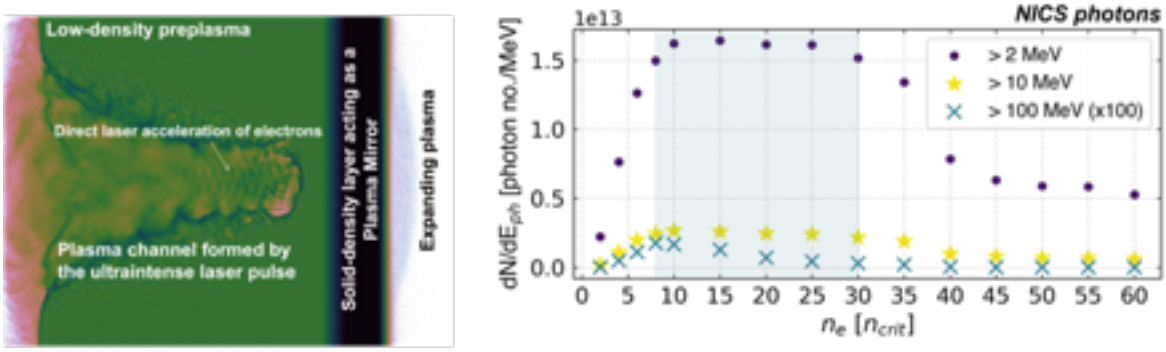

Figure 1. (Left) Schematic representation of electron density inside the proposed target setup showing a low-density plasma layer and the subsequent solid-density layer acting as a plasma mirror. (Right) Photon flux enhancement versus plasma density for structured targets (DLT).