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Off-harmonic optical probing of high intensity laser interaction with solid-density cryogenic hydrogen jet targets

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High-intensity short-pulse lasers enable novel compact accelerator schemes for the generation of energetic ion beams. The experimental investigation of the process remains challenging due to the femtosecond timescale and micrometer size of the acceleration. Commonly, diagnostic results are explained by a comparison of the experimental findings with computationally expensive particle-in-cell simulations. Cryogenic hydrogen jet targets (~30 critical densities) with µm-scale transverse size are particularly well suited for this approach [1]. Time-resolved diagnostics like optical probing can infer the state of the target at the initialization time of the simulation and benchmark the simulation results. Here we present the implementation of an off-harmonic optical probing setup [2] at an experiment for laser proton acceleration with a cylindrical hydrogen jet target at the DRACO PW laser with plasma-mirror cleaned laser contrast. We show under which conditions the technique overcomes the problem of parasitic plasma self-emission, present technical aspects of the off-harmonic probing technique together with experimental results of the observed plasma dynamics.

References

[1] L. Obst et al. Efficient laser-driven proton acceleration from cylindrical and planar cryogenic hydrogen jets. Sci. Rep., 7:10248, 2017.

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