

O4.204 Achieving extreme light intensities using optically-structured plasma mirrors

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See the full abstract here <http://ocs.ciemat.es/EPS2019ABS/pdf/O4.204.pdf>

Achieving a light source delivering intensities up to the Schwinger limit of 10^{29}W/cm^2 would allow exploring novel regimes of strong-field Quantum Electrodynamics (QED) where vacuum would be ripped apart. A promising candidate to build such a light source would be to find a realistic implementation of the Curved Relativistic Mirror (CRM) concept which consists in: (i) inducing a Doppler upshift and temporal compression of a counter-propagating incident laser (ii) focusing the upshifted radiation down to a focal spot size much smaller than the one possible with the incident laser. Since its emergence in 2003 [1], many implementations of the CRM concept were proposed. However, none has led to a detailed and feasible experimental proposal, mainly because they make use of idealized experimental conditions that are either not realistic or beyond present experimental know-how. In this context, we propose a novel and realistic all-optical scheme [2] to implement the CRM concept using so-called relativistic 'Plasma Mirrors' (PM) formed when an ultraintense laser with high-contrast is focused on an initially-flat solid target. In this scheme, the PM surface is optically curved, either by radiation pressure or using secondary pre-pulse beams. As we demonstrate, this enables a considerably higher control of the PM shape than the one obtained with all other schemes proposed so far relying on the use of pre-shaped solid targets, which are beyond present State-Of-The-Art of manufacturing techniques. Besides and as opposed to previous implementations, our new scheme is validated using cutting-edge 3D PIC simulations at an unprecedented scale using the pseudo-spectral 3D PIC code WARP+PICSAR. These simulations show that intensities between 10^{25}W/cm^2 and up to 10^{28}W/cm^2 can be achieved with a 3PW laser. The very high robustness of this scheme to potential laser/plasma defects and its feasibility are demonstrated by inputting the measured spatio-temporal profile (amplitude and phase) of the BELLA PW laser in PIC simulations. To account for the QED effects occurring at such intensities, novel QED modules have been added in the code and will be discussed here. These modules will be essential to find clear signatures of the intensities achieved in experiments. As our scheme is achievable with current experimental know-how on a multi-PW laser, it should soon become a game-changer in high field Science.

[1] S. V. Bulanov et al, PRL, 91, 085001 [2] H. Vincenti, PRL, in review, ArXiv: 1812.05357

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