6th European Advanced Accelerator Concepts workshop

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Undepleted Direct Laser Acceleration

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With the direct laser acceleration (DLA) method, the leading part of an intense laser pulse ionizes the target material and forms a positively charged ion plasma channel into which electrons are injected and accelerated. DLA has been realized over a wide range of laser parameters, using low-atomic-number target materials. The electron beam energy has been confirmed to scale with the normalized laser intensity up to values of a_0 ~1.5. However, the electron energies obtained with the highest laser intensities available nowadays, fail to meet the prediction of these scaling laws.

I will present experimental results followed by a numerical study, which show that for efficient DLA to prevail, a target material of sufficiently high atomic number is required to maintain the injection of ionization electrons at the peak intensity of the pulse when the DLA channel is already formed. Applying this new understanding to experiments on multi-petawatt laser facilities now coming online is expected to increase the electron energy overlap with the neutron production cross-sections of any material. These increased neutron yields are required to enable a wide range of research and applications, such as investigation of nucleosynthesis in the laboratory, performing non-destructive material analysis, and industrial applications.

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