



Contribution ID: 124

Type: **Poster**

Third harmonic generation for two-color ionization injection in laser-plasma accelerators

Tuesday, 23 July 2024 18:00 (1h 30m)

Laser plasma accelerators (LPAs) have promise to be the next generation accelerator for colliders, as well as drive a number of basic science, industry, security and medical applications. Many applications require high brightness electron beams enabled by low emittance. One proposal to achieve ultra-low emittance from an LPA is a two color laser configuration, where a long wavelength laser, with large ponderomotive force, is used to excite a plasma wakefield, while another trailing short wavelength laser is used to ionize inner shell electrons, injecting them in the accelerating phase of the wake [1]. The short wavelength allows for a high electric field for ionization, with low ponderomotive force. Many LPAs use Ti:Sapphire based lasers with central wavelength 0.8 μm . We will present experimental results and simulations performed at the BELLA Center on generating the third harmonic of short (45 fs), high fluence (30 mJ/cm²), Ti:Sapphire based laser pulses for the purpose of ionization injection in a quasi-linear wake. Features and challenges unique to short pulse, high fluence harmonic generation and characterization as well as how those challenges were addressed will also be presented.

[1] L.L. Yu, Two-Color Laser-Ionization Injection, PRL 112, 125001 (2014)

This work was supported by the U.S. Department of Energy (DOE), Office of Science, Offices of High Energy Physics, under Contract No. DE-AC02-05CH11231 and by the National Science Foundation (NSF) under grant DGE 1752814.

Working group

WG1 : Laser-driven plasma wakefield acceleration

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Session Classification: Poster [Atrium]