Contribution ID: **30** Type: **Poster**

TeV/m Electron Acceleration in Carbon Nanotubes

We report the first numerical demonstration of electron self-injection and resonant acceleration in ordered carbon nanotube (CNT) structures. Using the PIConGPU code CNT bundles are modelled as 25-nm-thick carbon tubes of 1e22 cm^-3 plasma density. Following their ionization with 3-cycles-long laser pulse of 800 nm wavelength and 1ed21 W/cm^2 peak intensity, laser wakefield acceleration (LWFA) is triggered in the resulting carbon plasma with an effective density of 1e20-1e21 cm^-3. Simulation results indicate that self-injected fs-long electron bunches with hundreds of pC charge can be accelerated at gradients which exceed 1 TeV/m. Both charge and accelerating gradient figures are unprecedented when compared with LWFA in gaseous plasma.

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Session Classification: Poster Session & Industry Display