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Helical coil design with controlled dispersion for bunching enhancement of the TNSA protons

Helical targets [1] allow us to focus and post-accelerate a proton beam generated by Target Normal Sheath Acceleration (TNSA) [2]. This scheme uses the discharge current [3] generated by the charge ejection from the laser-plasma interaction. The current will be driven through a conducting helical coil (HC), generating a localised electro-magnetic pulse (EMP) inside the coil which will focus, post-accelerate and bunch part of the TNSA proton beam. This scheme was validated on several experiments [1, 4] and is of great interest for numerous applications, from isochoric heating of dense material to isotopes or neutrons production [5].

I will present the development of a new HC design surrounded by a metallic tube in order to strongly reduce the discharge current dispersion in the HC [6]. Large-scale Particle-In-Cell (PIC) Simulations via SOPHIE [7], a code developed at CEA-CESTA, and theoretical calculations with our own model DoPPLIGHT [8] show a drastic effect of the metallic sheath on the current propagation through the helical targets and, by extension, the EMP generation inside the coil, allowing us to strongly bunch a TNSA proton beam.

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