Contribution ID: **150** Type: **not specified**

QED effects in future TeV class laser wakefield accelerators

Monday, 22 July 2024 14:10 (20 minutes)

Laser Wakefield Acceleration (LWFA) offers a promising alternative to conventional accelerators, offering superior acceleration gradients. However, the effect of radiation reaction inside the wakefield can be detrimental to their operation. The transverse focusing field in the wakefield can drive betatron oscillations and cause radiation emission, with radiation back-reaction effects on the electron dynamics becoming stronger as the beam energy gradually increases during acceleration. As the beam energy exceeds 100 GeV, the radiation reaction behavior will deviate from the classical beavior and quantum radiation effects will cause a "stochastic heating," which can be an intrinsic beam energy spread mechanism for high-energy accelerators. The radiation can also dampen the transverse energy spread of the beam, causing radiative emittance reduction. Due to the dephasing and laser depletion, the operation of TeV class beam collider based on LWFA technology will require multiple LWFA stages, or using structured light as a driver. The coupling efficiency between two acceleration stages depends highly on the beam emittance and energy spread. Thus, understanding how radiation reaction effects influence the evolution of beam energy spread and emittance is an essential factor for constructing an LWFA-based TeV class beam collider. We also investigate the evolution of spin polarization in LWFA's by employing our spin and polarized resolved QED module based on a particle-in-cell (PIC) code OSIRIS to predict the effect of radiation emission on the transport and acceleration of polarized beams.

This work is supported by the US National Science Foundation Award # 2108075.

Working group

WG1 : Laser-driven plasma wakefield acceleration

Primary authors: THOMAS, Alexander G. R. (University of Michigan); SEIPT, Daniel (Helmholtz Institut Jena); QIAN, Qian (University of Michigan); BULANOV, Stepan (LBNL); MA, Yong (University of Michigan)

Presenter: QIAN, Qian (University of Michigan)

Session Classification: WG1