## 20th Advanced Accelerator Concepts Workshop



Contribution ID: 20

Type: Contributed Oral

## Spin and polarization-dependent Osiris QED module for the future strong field QED laser-plasma experiment

Tuesday, November 8, 2022 2:30 PM (20 minutes)

With the rapid development of high-power petawatt class lasers worldwide, exploring the physics in the strong field QED regime will become one of the frontiers for laser-plasma interaction research. Particlein-cell codes including quantum emission processes are powerful tools for predicting and analyzing future experiments, where the physics of relativistic plasma is strongly affected by strong-field QED processes. Here, we present the development of a full spin and polarization-included QED module based on the particle-incell code OSIRIS. In this module, the dynamics of the lepton's spin involve both the classical spin precession process described by the classical T-BMT equation and the quantum radiation reaction-induced spin transition process. The photon polarization-resolved quantum radiation rate allows us to assign the polarization state for each generated photon in the simulation. We also consider the influence of the lepton spin and photon polarization on the Non-linear Breit-Wheeler pair production process calculation. Compared with stateof-the-art, most common spin/polarization averaged QED modules, this full spin/polarization distinguished quantum module is able to more accurately simulate multi-staged processes like avalanche and shower type electron-positron pair production cascade processes. We also use this module to explore possible routines for generating polarized gamma-ray and lepton bunch through laser-plasma interaction.

## Acknowledgments

This work is supported by the NSF (Award No. 2108075)

## Primary author: QIAN, QIAN

**Co-authors:** Prof. SEIPT, Daniel (Helmholtz Institut Jena, Fröbelstieg); Prof. THOMAS, Alexander (University of Michigan, Gérard Mourou Center of Ultrafast Optical Science); Prof. VRANIC, Marija (GoLP/Instituto de Plasmas e Fusão Nuclear, Instituto Superior Técnico, Universidade de Lisboa, ); Prof. GRISMAYER, Thomas (GoLP/Instituto de Plasmas e Fusão Nuclear, Instituto Superior Técnico, Universidade de Lisboa); Prof. BLACKBURN, Thomas (Department of Physics, University of Gothenburg); Prof. RIDGERS, Christopher (6York Plasma Institute, Department of Physics, University of York)

Presenter: QIAN, QIAN

Session Classification: WGs 2+7 Joint Session

**Track Classification:** Working Group Parallel Sessions: WG2 Oral: Computation for Accelerator Physics