Contribution ID: **1440** Contribution code: **TUPL177** Type: **Poster Presentation**

Increasing the flux of a Thomson source while maintaining a narrow bandwidth by using large energy spread primary particles

Tuesday, 9 May 2023 16:30 (2 hours)

Thomson/Compton scattering is a method to produce high energy photons through the collision of low energy photons in a laser pulse onto relativistic electrons. In the linear (incoherent) Thomson/Compton regime, the flux scales linearly with the number of primary particles and the bandwidth of the produced photons depend, amongst other factors, on the energy spread of them. In general, an increase of the primary particles is connected to a larger energy spread (e.g.non-constant acceleration gradients, collective effects, etc). Therefore their number is restricted by the desired bandwidth, and thus limits the flux.
In our previous (theoretical) studies we showed that the ideal Thomson spectrum can be retrieved when an electron bunch with a linear energy correlation of several percent collides with a matched linearly chirped laser pulse. Here we extend the scheme to allow for higher order energy correlations and quantify how the electron distribution influences the bandwidth. Furthermore we discuss the practical viability to maximize the primary particles, with the focus on linear accelerators (LINACS) for the electrons and laser pulses based on the chirped pulse amplification (CPA) scheme. These could potentially provide up to tens of nano-Coulomb electron bunches and tens, or even over a hundred, Joule lasers pulses respectively.

Funding Agency

Footnotes

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Session Classification: Tuesday Poster Session

Track Classification: MC2: Photon Sources and Electron Accelerators: MC2.A23: Other Linac Based Photon Sources