Contribution ID: **2292** Contribution code: **SUPM028** Type: **Student Poster Presentation**

Tapering enhanced superradiance - tapering rate optimization using analytical magnetic field maps

Sunday 1 June 2025 14:00 (2 hours)

THz sources are typically very limited in power, making high-power sources scarce. One of the most promising THz sources are the Free Electron Lasers (FELs), which can generate high-power THz radiation using an undulator structure. Undulator radiation is an incoherent synchrotron spontaneous emission whose energy is proportional to the number of particles in the beam (☒). By longitudinally bunching the charged particle beam, a coherent spontaneous emission is generated and referred to as a super-radiant emission. Unlike spontaneous emission, super-radiant energy yield is proportional to N^2.
However, like typical FELs, the energy conversion efficiency is rather low. Here, we demonstrate a novel THz source structure based on a radiative interaction scheme of super-radiance –Tapered Enhanced Superradiance (TES), which employs a tapered (amplitude) undulator in the zero-slippage condition. This method yields a significantly more powerful and efficient THz radiation source. An optimization algorithm was developed to obtain a tapering rate that yields the most efficient energy conversion from the electron beam to the radiation field.

Footnotes

Paper preparation format

LaTeX

Region represented

Europe

Funding Agency

This work was supported by the Israeli Science Foundation Grant No. 1705/22

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Presenter: FEIGIN, Leon (Ariel University)

Session Classification: Student Poster

Track Classification: MC2: Photon Sources and Electron Accelerators: MC2.A06 Free Electron Lasers (FELs)