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## THz Superradiant Waveguide FEL, Design Considerations

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Theoretical analysis and design considerations of a THz superradiant FEL are presented. The superradiant emission scales like the number of electrons  $N$  squared, enhancing spontaneous emission by a factor  $N$ . The longitudinal dimension (duration) of the beam diminishes the excited mode energy at high frequencies through the bunching coefficient.

We demonstrate the design considerations considering the parameters of the ORGAD compact (6 MeV) hybrid-accelerator of Ariel and Tel Aviv universities. The accelerator length in this setup is only 60 cm long and the undulator is 80 cm long. For this configuration it is possible to attain appreciable levels of radiation energy in the low frequency branch of the dispersion relation (below 1 THz) and in the high frequency branch (3.2-3.4 THz).

The analytical calculations of radiation excitation compare well with numerical computations using UCLA GPT-FEL including space-charge effects. The space charge effect can be mitigated by using a ribbon beam configuration. When the space-charge effect is negligible, the bunching parameter and the high frequency THz emission limits are still limited by the intrinsic energy spread of the gun.

### Footnotes

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**Author:** WEINBERG, Amir (University of Tel-Aviv)

**Co-authors:** FRIEDMAN, Aharon (Ariel University); FISHER, Andrew (Particle Beam Physics Lab (PBPL)); NAUSE, Ariel (Ariel University); GOVER, Avraham (University of Tel-Aviv); MUSUMECI, Pietro (University of California, Los Angeles); IANCONESCU, Reuven (Shenkar College of Engineering and Design)

**Presenter:** WEINBERG, Amir (University of Tel-Aviv)

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