Status of the FIR FEL Design Study at the NHMFL-FSU

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Following the conceptual design review, the efforts in the FIR/THz FEL design study are directed towards: (1) improving the numerical modeling of rf-linac based waveguide for the THz-range FEL oscillators accounting for effects that were not included in the initial performance simulations or only treated them in an approximated way, and (2) investigating more elaborate schemes in designing system components that have a significant impact on the performance of the FIR/THz FEL.

Combined effects resulting from the use of picosecond short electron pulses in generating long wavelength radiation over a wide spectral range (100 microns - 1100 microns) and propagation of short optical pulses in a lengthy (dispersive) waveguide resonator, a combination specific to the FSU's FIR FEL design, necessitates a detailed analysis of the interplay between superradiant emission (spontaneous & stimulated), waveguide dispersion, slippage as well as cavity desynchronisation effects. The space-frequency model for waveguided short pulse FEL oscillators has been adopted as an additional numerical tool that accounts for the effects mentioned above by making only few approximations [1]. The formulation models in a more comprehensive way the spectral dynamics of the emitted radiation fields along the interaction and drift sections inside the cavity given the JLab injector beam parameters and the characteristics of the proposed waveguide resonator.

In parallel with the numerical performance analysis of the planned THz FEL, the design study focuses on the development of techniques that extend the capabilities of the system in terms of outcoupled power (peak and average) and the ability to manipulate the spectral bandwidth to meet the widest possible spectrum of user requirements. These efforts include development of various types of couplers with adjustable coupling ratio and enhanced efficiency as well as an external high-Q THz pulse stacker cavity.

References

[1] "Approaches in Modeling a waveguide rf-linac THz-FEL", Proc. of the 29th International FEL Conf., 2007