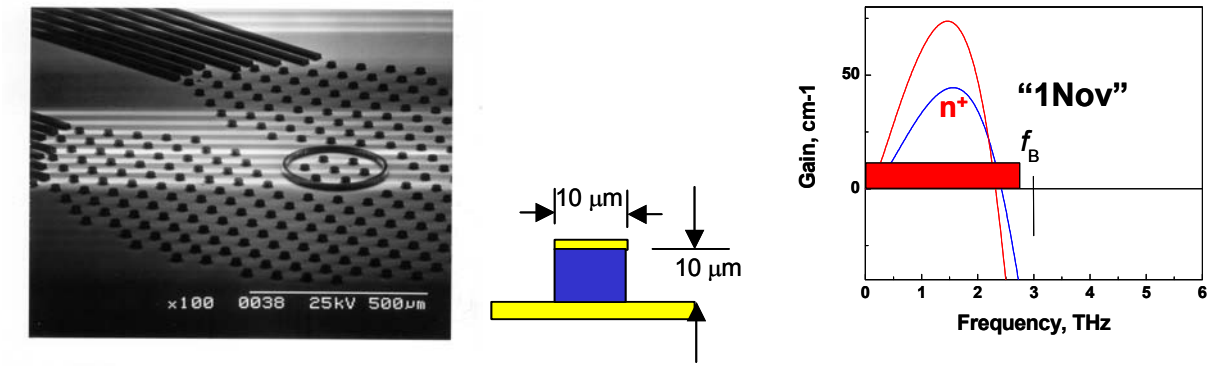
Terahertz Ring Oscillators based on Electrically Biased Super-superlattice.

Recent experiments [1] have demonstrated potential crossover from terahertz loss to terahertz gain in an electrically biased super-superlattice. The crossover occurs at a voltage that causes the spacing between rungs of the Stark ladder to exceed the measurement frequency. In essence the experiments demonstrate that the system may support sufficient gain below the Stark ladder splitting to overcome losses and make a coherent terahertz oscillator.

We propose to exploit these results by fabricating ring shaped ridge waveguides sandwiched between metallic floor and ceiling. These confine the radiation in the ring to a planar waveguide and provide electrical contact to the top and bottom of the superlattice for electrical excitation. The ring geometry requires no end reflectors; radiation leaks out through the evanescent wave whose strength is determined by the radius of curvature. (See Fig. 1)



a b c

Fig. 1 a). 10 µm high ring resonator confined by an in-plane terahertz photonic band gap structure. Waveguide ceiling removed. b) Schematic of metalized ridge. c) Estimated gain versus frequency compared to ridge waveguide loss.

Statement of work.

- Fabricate ring resonator structures like that shown in Fig. 1.
- Electrically excite and measure incoherent and potential coherent emission.
- Model and document electrical I-V characteristics, and terahertz emission.
- Assess potential for a solid-state coherent terahertz oscillator.

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1 "Resonant Crossover of Terahertz Loss to the Gain of a Bloch Oscillating InAs/AlSb Superlattice", P.G. Savvidis, B. Kolasa, G. Lee, and S. J. Allen, Phys. Rev. Lett., **92**, 196802 (2004).