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**Investigation of the interaction of an electron beam and metallic grating in a Smith-Purcell free electron laser (SP-FEL)** TENGIZ SVIMONISHVILI, CHRISTOPHER WATTS, EDL SCHAMILOGLU, STEVE BRUECK, The University of New Mexico — Smith-Purcell (SP) radiation is produced when an electron beam passes over a metallic periodic structure and a continuous spectrum of modes associated with the beam is scattered by the grating. Most of the scattered modes are evanescent, while some may propagate. The SP radiation wavelength is found to be proportional to the grating period, $L$, and inversely proportional to beam velocity, $V$. Therefore, the SP radiation wavelength can be varied by changing $L$ and $V$. Based on recent experimental reports and theoretical calculations, a compact SP-FEL promises to be an attractive and affordable source of THz radiation. The major drawback of the traditional SP-FEL approach is that the electron beam must propagate very close to the grating surface. Furthermore, as one scales the concept to the THz regime, the metallic gratings become more lossy. We had proposed to improve the coupling of the beam to the grating by taking advantage of surface plasma waves in the grating. Here, we evaluate several models for the SP-FEL, including the effects of coupling to the surface plasma wave. Parametric scans are made to suggest optimal regimes to test the concept of a SP-FEL invoking surface plasma wave coupling.

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