Abstract Submitted
for the MAR06 Meeting of
The American Physical Society

Spontaneous emission from accelerated Bloch electrons – Bloch oscillation radiation[1] VALERIY SOKOLOV, GERALD IAFRATE, Dept. of Electrical and Computer Engineering, NCSU, Raleigh, NC 27695-8617, JOSEPH KRIEGER, Dept. of Physics, Brooklyn College, CUNY, Brooklyn, NY 11210 — A theory of spontaneous emission of radiation for a Bloch electron traversing a single band in an external electric field is presented. The radiation field is described by a free space quantized electromagnetic field in the Coulomb gauge. It is shown that the spontaneous emission occurs with frequencies equal to integral multiples of the Bloch frequency without any *ad hoc* assumptions concerning the existence of Wannier-Stark levels. An explicit expression for the transition probability is derived in first-order perturbation theory relative to the radiation field. Although the output frequency of the radiation can be operationally tuned from the gigahertz to terahertz spectral range by varying the constant electric field, it is estimated that a spontaneous emission power output of only about 0.1 of a microwatt is available using GaAs-based superlattices. In this regard, it is noted that the atomic spontaneous emission probability and related transition rates can be enhanced by properly tailoring the surrounding electromagnetic environment. Therefore, considering Bloch oscillations in a resonant microcavity to enhance the spontaneous emission is a noteworthy alternative for exploring tunable gigahertz to terahertz radiation sources.

[1]This work is presently supported by the US Army Research Office.

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Date submitted: 14 Nov 2005 Electronic form version 1.4