

SMITH-PURCELL RADIATION FROM MICROBUNCHED MODULATED BEAMS

D.Yu. Sergeeva^{1,2}, A. Potylitsyn^{3,} A.A. Tishchenko^{1,2}, M.N. Strikhanov¹

¹National Research Nuclear University "MEPhI", Moscow, Russia ²National research Center "Kurchatov Institute", Moscow, Russia ³National Research Tomsk Polytechnic University, Tomsk, Russia

ABSTRACT

Smith-Purcell effect is well known as a source of monochromatic electromagnetic radiation. In this report the generalized theory of Smith-Purcell radiation from periodic beams is presented. The form-factors describing both coherent and incoherent regimes of radiation are calculated and investigated in two practically important frequency ranges, THz and X-ray, for two modulation profiles, most frequently used in practice: i) a train of microbunches and ii) a Gaussian-shaped one, characterized by sinusoidal modulation with an arbitrary modulation depth. On the base of the theory developed we show that a modulated electron beam consisting of a set of bunches makes it possible to improve significantly the spectral line monochromaticity of the light emitted, reaching values better than 1% for short gratings. We demonstrate as well that Smith-Purcell radiation can be used for non-destructive diagnostics of the depth of modulation for partially modulated beams. Also, we discuss pros and cons in terms of the idea of resonant (due to beam periodicity) amplifying the fields acting upon the subsequent electrons through wakefield mechanisms.

