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Experimental Study of Coherent Smith-Purcell Radiation Monochromaticity

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Intense THz radiation is extensively used for different applications including diffraction and spectroscopy [1, 2]. Modern approach to generate high power THz is based on ultra-short pulse compact accelerators [3, 4] or free-electron lasers [1]. However, an optimal mechanism for THz production is still under discussion. The aim of designing of a compact and tunable THz source with short pulse duration has to be reached with additional provision of radiation monochromaticity. In this respect a THz source based on Smith-Purcell radiation (SPR) mechanism appearing when a charged particle moves above and parallel to a grating is promising. In this report the investigation of the spectral characteristics of coherent Smith-Purcell Radiation (SPR) which was performed both theoretically and experimentally is presented. The measurement of SPR spectral line shapes of different diffraction orders was done at KEK LUCX facility. A pair of room-temperature Schottky barrier diode (SBD) detectors with sensitivity bands of 60 - 90 GHz and 320 - 460 GHz was used. A good match of experimental results and simulations performed with CST Studio Suite justifies the use of different narrow-band SBD detectors to investigate different order SPR spectral lines. It was shown that the monochromaticity of the SPR spectral lines increases with diffraction order. The comparison of coherent transition radiation and coherent SPR intensities in sub-THz frequency range showed that the brightness of both radiation mechanisms is comparable. A fine tuning of the SPR spectral lines is discussed.

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