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Smith-Purcell radiation of vortex electrons from a metasurface

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We present the theory of interaction between a metasurface and an electron with non-zero orbital angular momentum (OAM). The metasurface consists of meta-atoms –subwavelength particles –located at the nods of 2D lattice with periods comparable to the wavelength of radiation. Previously we constructed the theory of SPR from such a metasurface for an electron with zero OAM [1, 2]. We discuss the influence of the magnetic momentum of the vortex electron [3] and extend the theory for meta-atoms, made of material with high permeability. Inside such meta-atoms the external field of the free electron excites internal currents so that the magnetic momentum of each meta-atom might be as large as its dipole momentum. The efficiency of interaction between the metasurface and the electron increases with increasing OAM of the electron. Taking into account that OAM can reach 10^3, the effect can be observed experimentally. The results are compared with those for the conventional grating [4].
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