Contribution ID: **40** Type: **not specified**

Form-factor of hollow electron beams in Smith-Purcell radiation

Tuesday, 10 September 2024 18:35 (1 hour)

Hollow electron beams are actively studied now in view of their usage for high-intensity beam collimation at the Large Hadron Collider in CERN [1, 2]. Besides, the intensively studied today beams with non-zero orbital angular momentum (OAM) are also hollow. Usually hollow beams with OAM are described by Gaussian-Laguerre or Bessel functions. Yet, as a first step, the ring-shaped constant or Gaussian functions can also describe hollow beams. In our earlier paper [3] we have shown that properties of transition radiation are very close for solid and hollow Gaussian beams. It means that transition radiation is not the best tool for diagnostics of such beams.
Here we study Smith-Purcell radiation as a more promising type of radiation due to its sensitivity to the transverse properties of the beam. We report the theory of Smith-Purcell effect, generated by electrons from a metasurface, for which the theory can be constructed without additional problems [4, 5]. We consider the two-layer structure of the hollow beam with the current density is constant inside each layer. This is because the computer simulation of hollow beam dynamics performed in [6] has showed that the hollow electron beam obtain such structure. We demonstrate that the form-factor for the layered beam strongly differs from that for the solid beam, and based on that we propose a practical scheme for diagnostics of the internal structure of hollow beams.

The research is supported by the Foundation for the Advancement of Theoretical Physics and Mathematics BASIS, Project No. 23-1-3-2-1.

References

1. G. Stancari, A. Valishev, G. Annala, et al., Collimation with Hollow Electron Beams, Physical Review Letters 107, 084802 (2011).
2. S. Redaelli, R.B. Appleby, R. Bruce, et al., Hollow electron lenses for beam collimation at the High-Luminosity Large Hadron Collider (HL-LHC), Journal of Instrumentation 16, P03042 (2021).
3. D.Yu. Sergeeva, A.A. Tishchenko, Form factor in transition radiation from hollow beams, JETP Letters 117, 492 (2023).
4. D.Yu. Sergeeva, A.S. Aryshev, A.A. Tishchenko, K.E. Popov, N. Terunuma, J. Urakawa, THz Smith-Purcell and grating transition radiation from metasurface: experiment and theory, Optics Letters 46, 544 (2021).
5. D.I. Garaev, D.Yu. Sergeeva, A.A. Tishchenko, Theory of Smith-Purcell radiation from 2D array of small non-interacting particles, Phys. Rev. B 103, 075403 (2021).
6. Z.-W. Lu, L. Guo, Z.-Z. Li, et al., Manipulation of giant multipole resonances via vortex γ photons, Physical Review Letters 131, 202502 (2023).

Primary authors: TISHCHENKO, Alexey (National Research Nuclear University "MEPhI"); SERGEEVA, Daria

Presenter: SERGEEVA, Daria

Session Classification: Poster session 2