Contribution ID: **37** Type: **oral**

# Coherent Thomson backscattering and Cherenkov superluminal effect

*Tuesday, 10 September 2024 12:45 (20 minutes)*

Thomson backscattering of a laser beam on relativistic electrons is one of the most promising ways to generate bright quasi-monochromatic X-ray radiation. To achieve a high luminosity of such a source, it is possible to increase the intensity of the initial beams, but this will lead to nonlinear effects, which significantly degrade the radiation spectrum. Another approach is to optimize the geometry of collisions in order to maximize the beam interaction efficiency. In [1], we have derived an expression for the optimal geometry for the Thomson backscattering process by calculating the brightness for an arbitrary scenario. The cited article, however, does not take into account the effects of interference, which could potentially lead to considerably greater increase in intensity. Usually, implementation of coherent effects requires short beams with sizes smaller than the radiation length, which is challenging for the X-ray range. On the other hand, the luminosity approach used in [1] is not suitable for direct consideration of coherent effects.
In this work, we develop a theory describing the coherent luminosity of Thomson backscattering. We demonstrate that at certain angles of beam rotation, the "spot"of their geometric overlap moves with superluminal speed, resulting in the appearance of interference maxima in Cherenkov-like direction (see also [2]). It proves to be possible to keep two key issues: (i) to provide coincidence of superluminal Cherenkov peak with the direction of Thomson radiation, which leads to a sharp increase in the intensity of the backscattering; (ii) the laser front can be kept straight, while only the electron beam has been rotated. The latter is beneficial in terms of simplifying the laser system's setup. Interestingly, considering Cherenkov radiation in a vacuum we eliminate the effects of frequency dispersion typical of a medium. The direction of the cone is therefore determined solely by the ratio of the speed of light to that of the emitter.
The study was partially supported by the Ministry of Science and Higher Education of the Russian Federation, project FZWG-2020-0032 (2019-1569).

References

1. A. P. Potylitsyn, D. V. Gavrilenko, M. N. Strikhanov, A. A. Tishchenko, Phys. Rev. AB 26, 040701 (2023)
2. V.L. Ginzburg, Theoretical Physics and Astrophysics, Pergamon Press, 1979.


**Primary author:** GAVRILENKO, Dmitrii (National Research Nuclear University MEPhI)

**Co-author:** TISHCHENKO, Alexey (National Research Nuclear University "MEPhI", Belgorod National Research University)

**Presenter:** GAVRILENKO, Dmitrii (National Research Nuclear University MEPhI)

**Session Classification:** Radiation: Generation & Interaction