Contribution ID: **142** Type: **Oral**

Cherenkov particle detector based on resonant elements

Tuesday 19 September 2023 10:50 (20 minutes)

In modern particle physics, a variety of different detectors [1] is used for the particle identification, tracking [2, 3] and detecting their energy or other characteristics [4-6]. Each detector type can be characterized by the detection efficiency, temporal resolution, linearity of response, and energy and spatial resolutions. For example, for the time-of-flight positron emission tomography (PET), the most important parameters are the temporal and spatial resolutions, and the detection efficiency for 511 keV gamma photons [7, 8]. In this work, we show the simulation results obtained using Geant4 [9] for the time-of-flight PET detector based on Cherenkov radiation in a medium containing small resonant particles. The resonant behavior of the radiation in Geant4 is caused by introducing a special dispersion function of the dielectric permittivity, which we measure in the CST studio [10] for a material consisting of elements resonating in certain range. The resonance allows producing Cherenkov photons by secondary electrons with lower energy. We consider it as the way to increase the energy resolution as well as the efficiency of the detector. This detector should become the basis for a new technology of positron emission tomography.

[1] ECFA Detector R&D Roadmap Process Group, The 2021 ECFA detector research and development roadmap, Geneva, CERN-ESU-017 (2020).
[2] A. Andronic, J.P. Wessels, Nucl. Instr. Meth. A 666, 130 (2012).
[3] C. Lippmann, Nucl. Instr. Meth. A 666, 148 (2012).
[4] M. Beddo, E. Bielick, T. Fornek, et al., Nucl. Instr. Meth. A 499,725 (2003).
[5] N. Akchurin et al., Nucl. Instr. Meth. A 537, 537 (2005).
[6] L. Bandiera, V. Haurylavets, V. Tikhomirov, Nucl. Instr. Meth. A 936, 124 (2019).
[7] D. R. Schaart, Phys. Med. Biol. 66, 09TR01 (2021).
[8] A.A. Savchenko, A.A. Tishchenko, Rad. Det. Tech. Meth. (2023) https://doi.org/10.1007/s41605-023-00399-9
[9] J. Allison, K. Amako, J. Apostolakis et al., IEEE Trans. Nucl. Sci. 53, 270 (2006).
[10] CST Studio Suite, "CST Microwave Studio,"2023. https://www.3ds.com/products-services/simulia/products/cst-studio-suite/

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Session Classification: e–/e+ beams interaction in solids

Track Classification: e−/e+ beams interaction in solids: Transition Radiation, Cherenkov Radiation