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Title:On the sensitivity of terahertz gyrotron based systems for remote detection of concealed radioactive materials
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Abstract:This paper analyzes some features of systems intended to remotely detect concealed radioactive materials by using a focused THz radiation. This concept is based on possibility to focus high-power THz radiation in a small spot where the wave field exceeds the breakdown threshold. However, in the absence of any sources of ionization, the probability to have in this breakdown-prone volume any seed electrons is very low. Thus, high breakdown rate in a series of THz pulses will indicate the presence of concealed radioactive materials in the vicinity of a focused wave beam. The goal of the present paper is to determine by using the statistical theory THz pulse duration required for reliable initiation of the discharge. Then, the detectable mass of the radioactive material is determined as the function of distance and of the THz wave power and pulse duration. Lastly, possible benefits from using pulse compressors, which shorten the pulse duration but increase the wave power and, hence, the breakdown-prone volume, are analyzed. It is shown that the use of pulse compressors can significantly improve the sensitivity of THz gyrotron based systems for remote detection of concealed radioactive materials. © 2012 American Institute of Physics.
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