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Propagation of gamma rays and production of free electrons in air

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A new concept of remote detection of concealed radioactive materials has been recently proposed \cite{Gr.Nusin.2010}-\cite{NusinSprangle}. It is based on the breakdown in air at the focal point of a high-power beam of electromagnetic waves produced by a THz gyrotron. To initiate the avalanche breakdown, seed free electrons should be present in this focal region during the electromagnetic pulse. This paper is devoted to the analysis of production of free electrons by gamma rays leaking from radioactive materials. Within a hundred meters from the radiation source, the fluctuating free electrons appear with the rate that may exceed significantly the natural background ionization rate. During the gyrotron pulse of about 10 microsecond length, such electrons may seed the electric breakdown and create sufficiently dense plasma at the focal region to be detected as an unambiguous effect of the concealed radioactive material.

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