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Passage of energetic radiation through air: collisional kinetics of photons and electron production Y.S. DIMANT, Boston University, G.S. NUSINOVICH, University of Maryland, P. SPRANGLE, NRL, V.L. GRANASTEIN, University of Maryland — A novel technique for remote detection of concealed radioactive materials using a gyrotron-induced localized breakdown in air has been recently proposed. This technique requires an excessive density of free electron in a focused spot of the gyrotron radiation. Such electrons are produced at a multi-step process starting from the initial radiation of primary MeV photons by the radioactive material. On their passage through air, the photons undergo inelastic scattering and absorption accompanied by ionization of air molecules. The released free energetic electrons also collide with neutral molecules, initiating an avalanche release of other electrons. All free electrons undergo a sequence of further elastic and inelastic collisions leading to their gradual cooling down to sub-eV energies. Low-energy electrons that withstand recombination and attachment to neutral molecules can trigger the avalanche breakdown in the focused spot, provided the free-electron density exceeds the breakdown threshold. To assess how the breakdown conditions relate to the characteristics and location of the concealed radioactive material, one needs to model the coupled process of photon and electron collisional kinetics. This paper analyses the photon and electron momentum distributions as functions of the distance to the primary radiation source.

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