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Title

Development of THz-range gyrotrons for detection of concealed radioactive materials

Source

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Abstract

The Center for Applied Electromagnetics (AppEl) at the University of Maryland had started development of a sub-THz gyrotron for detecting concealed radioactive materials. The concept is based on the use of a high-power gyrotron whose power being focused in a small spot with dimensions on the order of a wavelength exceeds the threshold level required for initiating a freely localized microwave breakdown in air. However, in the absence of radioactive materials, the ambient electron density is so small that there is a very small probability to find a free electron in this small volume to trigger the avalanche breakdown process. Therefore the fact that the breakdown was observed would indicate that there is a hidden radioactive material in the vicinity of a focused wave beam. We present the design data for a 200-300 kW, 670 GHz gyrotron operating with a pulsed solenoid and describe a single-shot pulsed solenoid producing 27-28 T magnetic fields. Also numerous issues in this specific application are discussed, viz. threshold conditions for initiating the breakdown, production of gamma rays by concealed radioactive materials and their role in producing low energy electrons outside a container, wave beam focusing in a small spot by a limited-size antenna, random walk of energetic electrons which may result in appearance of free electrons in a given volume during the RF pulse and comparison of diffusion time with the time required for competing processes, such as ionization and three-body attachment. (39 References).