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Experimental Verification on Remote Detectability of Concealed Radioactive Material Based on the Plasma Discharge Delay Time using High-Power Millimeter-Wave[1] DONGSUNG KIM, DONGHO YU, ASHWINI SAWANT, MUN SEOK CHOE, INGEUN LEE, EUNMI CHOI, Ulsan Natl Inst of Sci Tech — We experimentally demonstrate a remote detection method of a radioactive source by plasma breakdown using high-power millimeter-wave source, gyrotron. A number of free electrons near the radioactive source are much higher than those of without the radioactive source (roughly 10 particles/cm^3) owing to the interaction of air molecules and strong gamma rays generated by radioactive material. The RF wave beam is focused in ambient air, and the plasmas discharge occurs involving random delay time which means a time interval between the RF wave and a fluorescent light caused by the plasma. We observed that the delay time decreased significantly due to the high density of free electrons in Ar plasma with an existence of Co60 radioactive material. This technique of delay time measurement shows 1000 times more sensitive than a method of detectable mass equation to identify the existence of radioactive source remotely. It is the first experimental verification of radioactive material detection using a high power gyrotron. This study shows that a remote detection of radioactive material based on analysis of precise delay time measurement could be feasible by using a high power millimeter/THz wave gyrotron.

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