Optimization of optical configurations for the detection of alpha-induced radioluminescence

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Successful detection of weak spectral fingerprints due to the alpha radioluminescence in the environment is a very challenging task that, definitely, goes beyond the current state-of-the-art measurement techniques applied for contamination detection. This requires an optimized optical setup that is capable of (a) collecting a large number of radioluminescence photons while (b) rejecting the background light. To comply with these requirements, lens- and mirror-based setups have been designed and developed within the RemoteALPHA project. PTB has developed some radioluminescence optical detection systems, three systems based on lens objectives, and a modular mirror system based on commercial laser line mirrors. Figure 1 shows three lens-based optical systems developed at the PTB, optimized for radioluminescence detection both in UV-A and UV-C spectral regions. All three systems will operate as mapping systems by producing the radioluminescence image of the alpha-emitting sources through remote scanning of the contaminated area. While the fused silica system (Fig. 1a) is intended for use as a scanning telescope on a tripod due to its relatively heavyweight, the Fresnel lens system (Fig. 1b) — due to its lightweight — will be used in an unmanned airborne monitoring system for mapping alpha contamination in the environment. These systems have been tested at the PTB Ion Accelerator Facility and with Am-241 sources provided by IFIN-HH. The results will be published soon in a peer-reviewed journal. The modular mirror system is currently being tested.

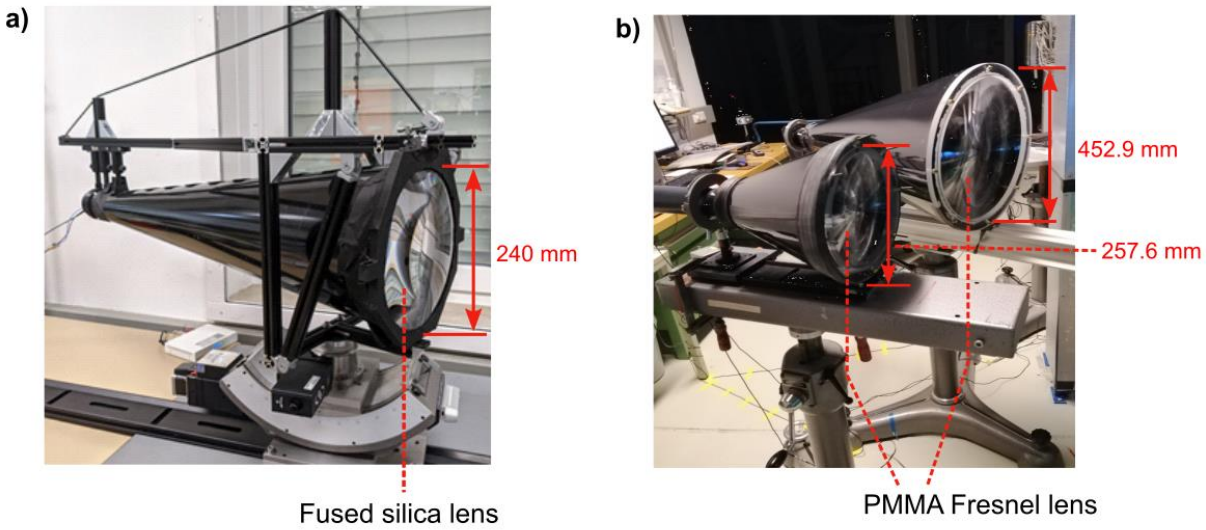

Figure 1: Lens-based radioluminescence detection setups developed at the PTB (M. Luchkov, V. Dagendorf, F. Krasniqi). (a) Fused-silica lens (Abet Technologies) system mounted on a goniometer and rotation stage (Newport M-BGM160PE and RVS80CC). (b) PMMA Fresnel lens (Orafol Fresnel Optics) systems. All lens systems can be coupled to selected PMTs and UV-C or UV-A interference filters.