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« Alpha detection : improvements of identification and localisation measurements techniques »

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Since 2009, CEA Marcoule has developed and implemented a compact alpha imaging system: the alpha camera. Inspired in part by feedback from the "Aladin" gamma camera, designed and developed by the CEA and then marketed in its industrial form, "Cartogam", the implementation and construction of the alpha camera prototype has taken advantage of the know-how acquired. This device has already produced very promising and interesting results, since the radiological data provided by it are complementary to the information provided by gamma cameras. This camera makes it possible to locate alpha emitters, including low-energy gamma emitting radioelements that are difficult to detect. Alpha imaging represents an obvious challenge for the radiological characterization of processes, the monitoring of remediation phases and the control of contaminated material.

The alpha camera has been developed to detect quickly and remotely the contamination areas of alpha emitting radionuclides such as Uranium or Plutonium isotopes and minor actinides mainly encountered in industrial or research processes for the fabrication of nuclear reactor fuels (current and future generation). The detection principle is based on the detection of the UltraViolet fluorescence radiation of gaseous nitrogen, contained in particular in the air, excited by alpha radiation. Considering the short path of alpha particles in a gas (a few cm), the UV radiation of nitrogen fluorescence is mainly emitted in the vicinity of alpha emitting sources. The location of the UV signal detected is therefore significant of an alpha contamination area. The fluorescence spectrum is a discrete spectrum of lines emitted in the near visible UltraViolet between 280 and 390 nm. This compact device allows superimposing on a visible black and white image (or color via an additional miniature camera) the zones of concentration of the alpha radioactivity.

In parallel with this development in imaging, the CEA has also studied and developed the possibility of detecting alpha by counting UV photons of radio luminescence. These studies have led to a patent in the field of radiation protection of workers ("Small alpha object monitor") and have prospects in the field of in situ radiological characterization through the implementation of compact detectors for the inspection of pipes, glove boxes, tanks, blind cells, etc..

This article describes the latest advances in the field of non-destructive alpha measurement with these characterization processes. A synthesis of the results obtained in laboratory, by modelling and during real operations will be exposed.