Contribution ID: **190** Type: **Oral Presentation**

#10-190 SolarBlind: UV-imaging of alpha radioactivity with Micromegas and Timepix

Friday, June 13, 2025 10:20 AM (20 minutes)

Nuclear materials such as uranium and plutonium commonly used in industries or laboratories are major emitters of alpha particles (or α particles). Monitoring contamination of infrastructures and people in contact with them is a major radiation safety issue. Detectors currently in use for this purpose have to be close to the radiation sources. It increases the likelihood of contamination on workers handling the detectors.
The α particles as they travel a few centimeters through the ambient air ionize the nitrogen on their path. The nitrogen then de-excites, emitting UVB (280 nm - 315 nm) and UVC photons (100 nm - 280 nm) with a main UVB peak at 337.1 nm. At normal pressure, about twenty photons are emitted per one MeV of energy released. Detecting α particles through them indirectly by measuring the UVs is studied since those past years because photons have a significant longer path in air, allowing remote detection.
A key limitation is that UVB photons are part of the UV solar emission spectrum that reaches the ground, along with emissions from many commonly used light sources. This restricts detection capabilities to dark environment. In contrast, UVC photons could enable remote measurement of alpha contamination even in daylight or indoor lighting. In this context, the SolarBlind prototype, aimed at performing "alpha imaging", has been developed, with the ambition to perform measurements in daylight environment.
The alpha imaging part of SolarBlind is an important aspect of the detector. Characterizing alpha surface contamination on industrial infrastructures such as gloveboxes or storage spaces is a necessary aspect of dismantling planning and safe equipment use. Obtaining rapid images of the intensity and position of α emitters thanks to alpha imaging is an asset.
The SolarBlind prototype is the following step of the proof-of-concept developed in collaboration between CEA- List and CEA- Irfu in 2021. This proof of concept showed that α particles can be detected from a distance under indoor light by coupling a photocathode with a micropattern gaseous detector, Micromegas (MICRO MEsh GAseous Structure). An 11 MBq 241Am source was sucessfully detected through the UVC created by α particles. The 241Am source was located in front of the setup at distances varying from 10 cm to 40 cm. Duration of exposures were between 1 minute and 2 hours.
The current SolarBlind prototype is divided into three main parts. An UV grade lens with large aperture that focuses surrounding lights into a photocathode with a higher quantum efficiency in the UVC than in the UVB. When collected by the photocathode, UVs photons will be converted into photoelectrons that are amplified through the gas-filled box and the Micromegas inside. Finally, the photoelectrons interact within the sensitive area. The sensitive area is based on the Timepix technology, developed by the international collaboration Medipix led by CERN. It consists in a matrix of 256×256 pixels with a 55 µm pitch. Timepix is an ASIC whose specific function is photon counting. It's a time framed based detector. The readout electronic of the Timepix chip provides 2D frames. The position and intensity of the charges collected are observed on the frames. Coupled with knowledge of the setup, we can trace the direction in which the source is located.
SolarBlind prototype is currently undergoing robustification and each step of the manufacturing process is carefully characterized. Preliminary experiments are conclusive in terms of detection of UV particles from an UV spot, 30 cm apart from the lens. The setup faces lot of challenges in terms of measurement time and repeatability. A particular effort is also made regarding the coupling technics between the Micromegas and the Timepix chip, which is currently one of the major limitation. After improving the prototype, further experiments will be carried out with a 241Am source in laboratory.

Primary author: GUERRA-DEVIGNE, Alice (Laboratoire Capteur et d'Instrumentation pour la Mesure (LCIM), CEA Saclay, France)

Co-authors: Dr ATTIE, David (IRFU, CEA, Saclay, France); AMOYAL, Guillaume (LCIM, CEA-List, Saclay, France); Dr PAPAEVANGELOU, Thomas (IRFU, CEA, Saclay, France); MAS, Philippe (IRFU, CEA, Saclay, France)

Presenter: GUERRA-DEVIGNE, Alice (Laboratoire Capteur et d'Instrumentation pour la Mesure (LCIM), CEA Saclay, France)

Session Classification: #10 - Current Trends in Development of Radiation Detectors

Track Classification: 10 Current Trends in Development of Radiation Detectors