Development of New Alpha Radiation Sensors Utilizing Painting Deposition Techniques

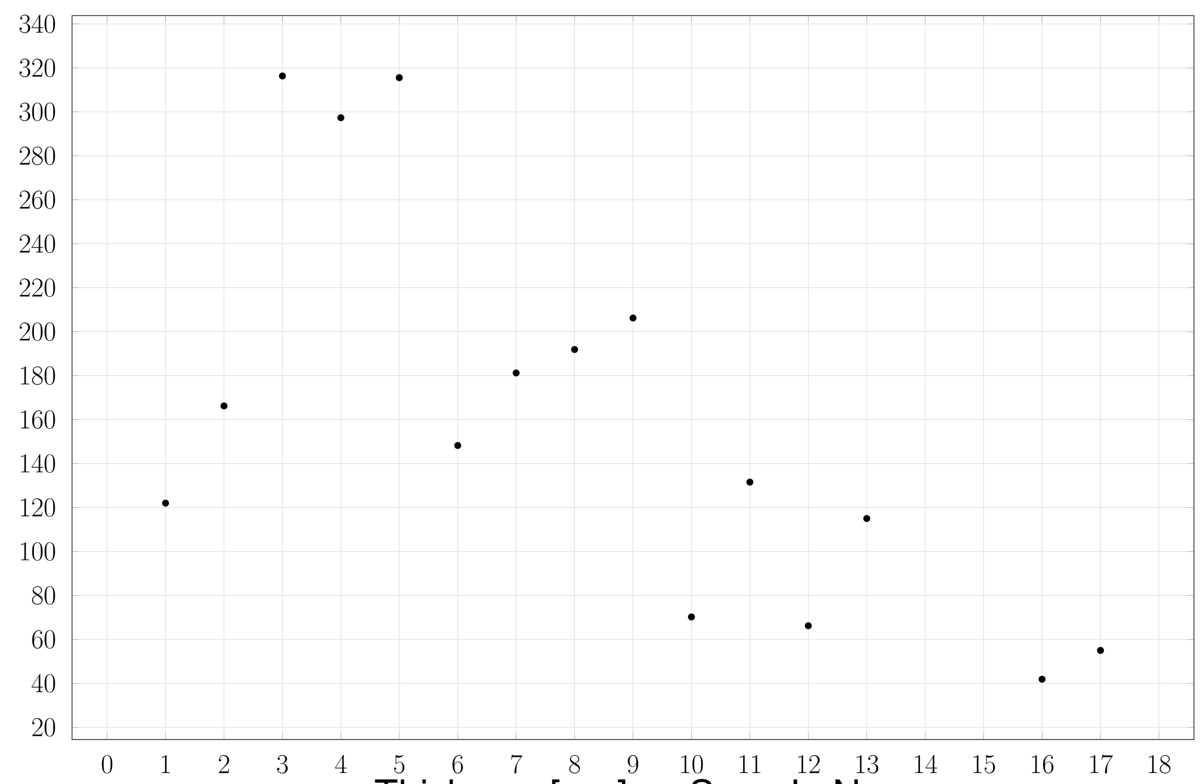
Vicente Lizana

SAPHIR Millennium Institute.

Andrés Bello University - Faculty of Exact Sciences, Department of Physics.

1. Deposition of scintillating paint

The purpose of this project is to explore new methods for implementing scintillator plastic in particle detection, with potential future applications in radon detection. In this study, scintillator plastic was used to create a paint by mixing it with epoxy resin and acetone. This paint can be applied using various techniques. The tested methods included the use of molds with a fixed depth and two types of airbrushes. These techniques were applied to Mylar sheets, and the thickness of each sample was measured using a micrometer:



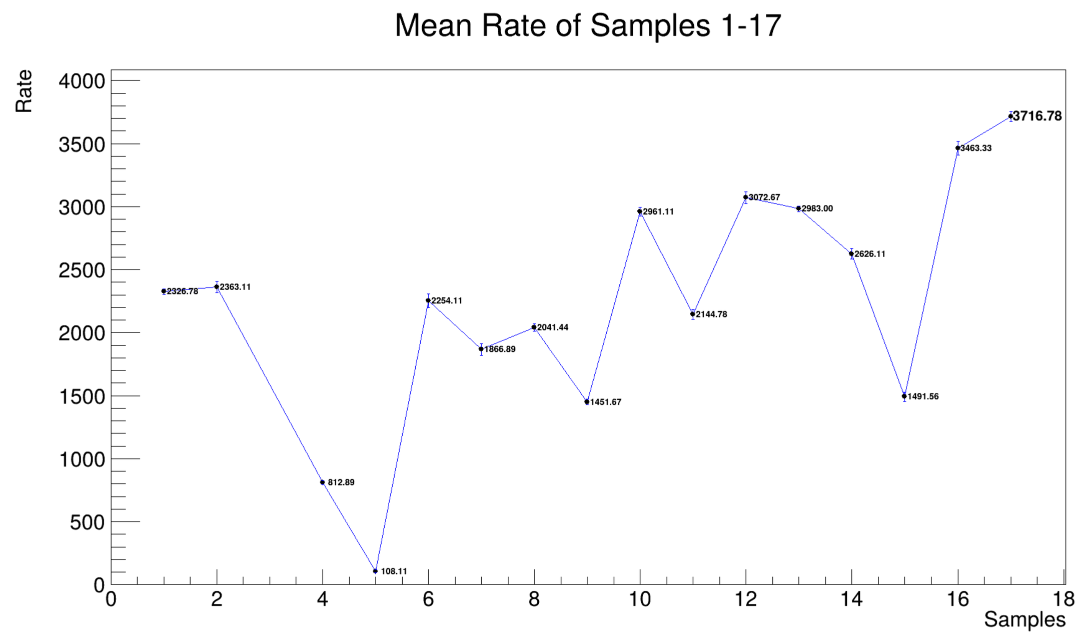
Thickness[μm] vs Sample No.

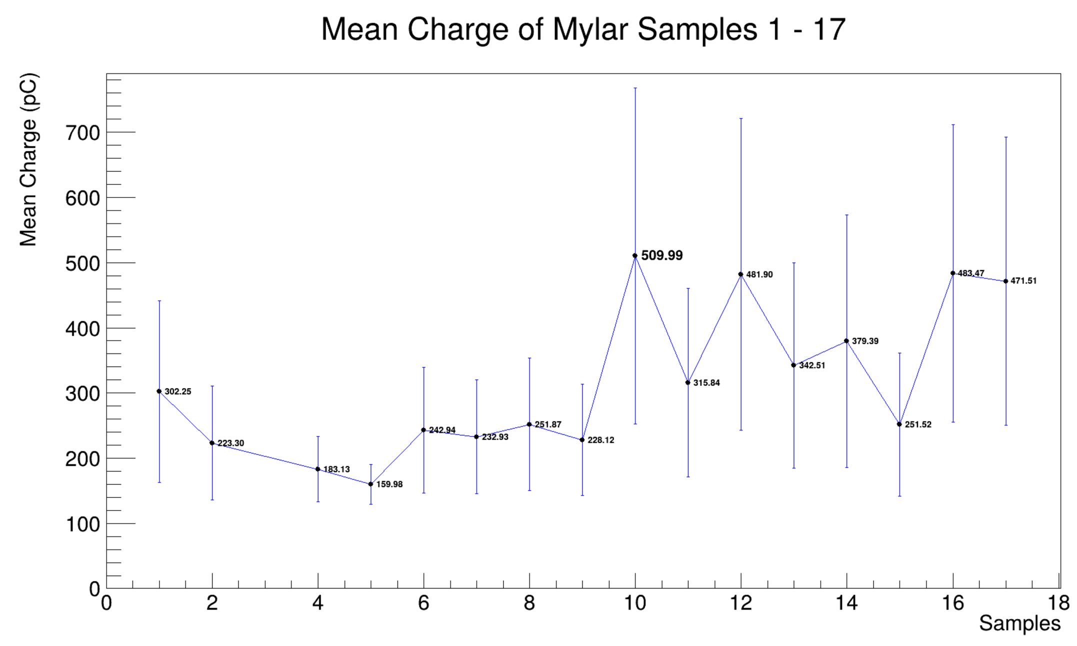
This table demonstrates that the airbrush is capable of delivering significantly thinner layers of paint. As we will see, this is crucial for the detection of alpha particles due to their low penetration capacity.

2. Measuring the effectiveness of each method

To measure the effectiveness of the methods, each sample was placed in front of a PMT with the painted side facing it. An alpha particle source, in the form of americium-241, was positioned behind the sample, pointing toward the PMT.

This setup is connected to an oscilloscope, which outputs the amplitude of the electrical signal. It can also be connected to a NIM Four-Fold Programmable Logic Unit, which counts events within defined time windows. This information helps determine which sample can detect the highest number of particles and with the greatest intensity:



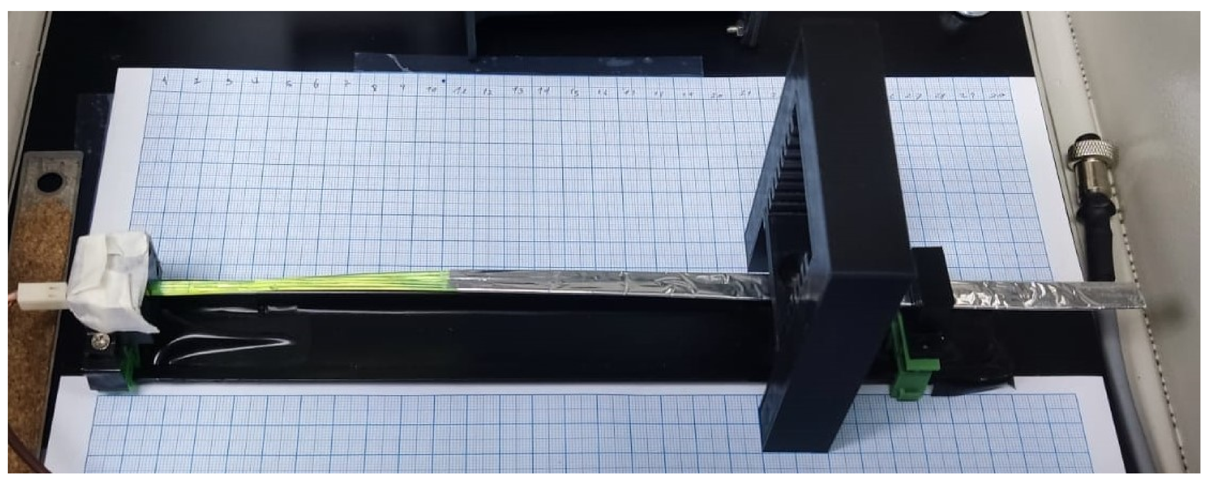


These graphs show that the airbrushed samples provide a higher number of detections per unit of time and produce signals with greater amplitude. This is useful for distinguishing between noise and true signals.

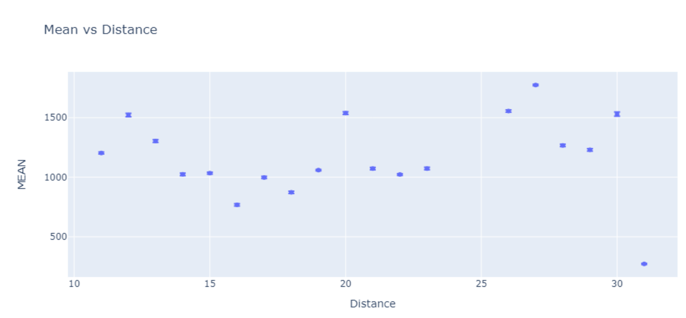
3. The use of painted Mylar in a complete detector

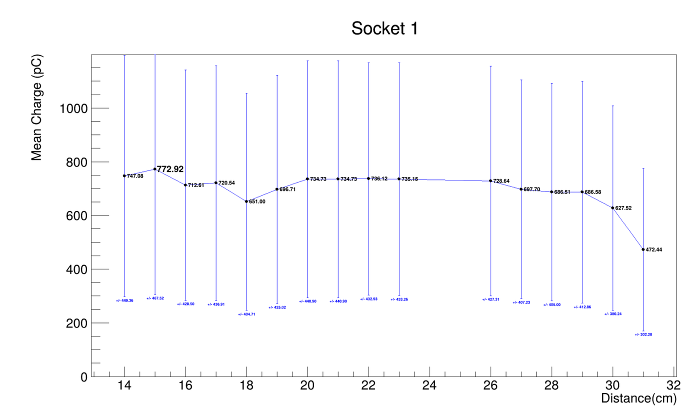
Once the best method is selected, it is used on a new sheet of Mylar to paint a 200 mm × 30 mm rectangle. This rectangle is then glued onto tensioned optical fibers, which are polished at the ends and arranged to direct the light output to an MPPC:

This results in a complete prototype that will be tested with the americium sample along the entire length of the prototype:



Each centimeter of the prototype is used to measure charge and rates, which help characterize the prototype. In the future, we hope to use more sophisticated methods to gather data from the entire sensitive area of the prototype.





“This work was financed by ANID - Millennium initiative program - ICN2019_044”.