

# Machine Learning for Correcting Simulation Outputs in Alpha Particle Measurements with Hybrid Semiconductor Detectors

## List of authors:

Kamilla Sabirzanova, Katerina Sykorova, Lukas Marek

## Affiliation:

**Kamilla Sabirzyanova:** Advacam, Prague, Czech Republic; Faculty of Nuclear Sciences and Physical Engineering, Czech Technical University in Prague, Czech Republic

**Katerina Sykorova:** Advacam, Prague, Czech Republic

**Lukas Marek:** Advacam, Prague, Czech Republic

## Abstract

Accurate modeling of alpha particle interactions in hybrid semiconductor detectors remains challenging, as standard simulation tools like Geant4 and Allpix Squared (CERN) often fail to simulate specific sensor and detector electronics responses. This results in discrepancies between simulated and experimental data, particularly in reproducing key features such as the "halo" effect surrounding particle tracks.

To mitigate these differences, we employ a machine learning approach to refine simulation outputs, making them more consistent with experimental measurements. Using alpha particle data in the 1–5 MeV energy range recorded with a Timepix 3 ASIC chip and a 500  $\mu\text{m}$  silicon sensor, our model learns to correct structural and intensity variations without requiring explicitly paired training data.

Our results demonstrate that machine learning methods effectively enhance the realism of simulated data, improving their agreement with experimental observations. This approach provides a scalable method for generating synthetic experimental datasets, aiding in detector characterization and improving the accuracy of future simulations.