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Insights from the SIGMA Dataset: AI-Driven Radiation Detection in Complex Environments

Wednesday 5 March 2025 14:15 (30 minutes)

The SIGMA data challenge provided the academic community with unprecedented access to 1.5 billion gamma spectra collected in London, made available through NuSec. This extensive dataset enabled research into both detector performance and advanced machine learning methodologies. Multiple academic teams have engaged with the data, with the Surrey campaign supporting a postdoctoral fellowship, two master's dissertations, and four bachelor of science projects.

This talk presents key findings using the SIGMA dataset, including:

- the application of neural networks to sparse isotope signal detection,
- assessment of the impact of temperature variations on in-field detector performance,
- enhancement of Geant4 modelling for moving isotope signal prediction,
- curation of AI-compatible training datasets for user-defined isotope tracking scenarios, and
- development of genetic algorithms to falsify signals, compromising isotope recognition.

These results highlight the advancements made possible through open-access datasets. To support the growing use of artificial intelligence (AI) in applied nuclear physics, for both civil and defence applications, plans are advancing for a Centre in AI for Applied Nuclear Physics. Following an awareness event at Nuclear Forensics (NuFor) 2024, this talk will present the latest progress toward this initiative. The centre aims to foster a collaborative research space for data and AI code sharing, establish best practices in machine learning for nuclear applications, support career development across academia, industry, and government, and contribute to shaping AI-related nuclear policy.

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