IN2P3/IRFU Machine Learning workshop 2025

Rapport sur les contributions

https://indico.in2p3.fr/e/36597

ID de Contribution: **138** Type: **Non spécifié**

Deconvolution du signal de détecetur de R2D2 dans un FPGA par réseau de neurone convolutif 1D

jeudi 27 novembre 2025 16:05 (20 minutes)

A travers la R&T THINK, nous essayons de créer des modèles pouvant remplacer le traitement classique du signal au plus près des détecteurs. Je présenterais la problématique des modèles dans l'embarqué. Puis, je presenterai la problématique du signal de R2D2 pour la recherche sur la nature des neutrino. Je presenterai alors un modèle de déconvolution de la chaine électronique pour retrouver la forme d'onde créée dans le détecteur et son inference dans un FPGA. Ce modèle est un CNN avec dilatation pour comprendre la forme d'onde initiale et recréer la forme d'onde déconvoluée. Je montrerai les difficultés rencontrées et l'état d'avancement du modèle embarqué.

Auteur: DRUILLOLE, Frederic (CNRS-LP2IB)

Orateur: DRUILLOLE, Frederic (CNRS-LP2IB)

Classification de Session: AI at the edge

Classification de thématique: Analysis : event classification, statistical analysis and inference, anomaly detection

ID de Contribution: **139** Type: **Non spécifié**

Optimising the High Granularity Calorimeter trigger primitives for machine learning based particle identification in the CMS Level-1 trigger

jeudi 27 novembre 2025 16:25 (20 minutes)

As part of its upgrade for the High-Luminosity LHC (HL-LHC) , the CMS experiment is deploying a novel High Granularity Calorimeter (HGCAL) in the endcap regions. Designed with fine segmentation in both longitudinal and transverse directions, HGCAL will be the first calorimeter specifically optimised for particle-flow reconstruction to operate at a colliding-beam experiment. The calorimeter data will be part of the Level-1 Trigger (L1T) system of the CMS and, together with tracking information, will enable the use of particle-flow techniques in the trigger decision. The unprecedented granularity of the HGCAL leads to approximately six million sensor channels, from which around one million trigger cells (TCs) are derived for real-time processing at 40 MHz. This represents a significant challenge in terms of data manipulation and processing for the trigger system, given the stringent constraints on hardware resources. The HGCAL trigger primitive generation (TPG) system reconstructs 3D energy clusters from the particle showers and forwards them to the central L1T for particle identification. However, due to bandwidth limitations, only a subset of cluster features can be transmitted, thus making their optimisation an essential design decision.

To address this hardware limitation, we employ Boosted Decision Trees (BDTs) to optimise the primitives, specifically to classify photons and electrons against hadronic objects from jets and overlapping interactions. A multi-objective optimisation strategy is applied to balance identification performance with the hardware cost of feature encoding. The trained models are then compiled into FPGA-ready designs using Conifer, a toolchain to convert machine learning models into hardware description, and are evaluated in simulation to study the impact of feature choice on latency and FPGA resource usage. These developments are essential to fully exploit the full physics potential of the HL-LHC by enabling robust and efficient real-time particle identification in CMS. This talk will present an overview of these optimisation studies and their implications.

Auteur: DEBNATH, Trisha (LLR. École Polytechnique | CNRS)

Orateur: DEBNATH, Trisha (LLR. École Polytechnique | CNRS)

Classification de Session: AI at the edge

Classification de thématique: Fast ML : DAQ/Trigger/Real Time Analysis

ID de Contribution: **140** Type: **Non spécifié**

Shower shapes correction via normalising flows

vendredi 28 novembre 2025 09:40 (20 minutes)

Mismodeling of calorimeter shower shape observables has been present since the beginning of the ATLAS detector due to a mismodelling in the Geant4 detector simulation. Shower shape variables are discriminating observables used in the identification of electrons and photons, and accurate modelling of their distributions is essential for precision measurements and searches in high-energy physics. Traditionally, such discrepancies have been mitigated by procedures applying simple shifts and stretches to simulation, but these approaches neglect correlations between variables and are limited in accuracy.

A novel method that employs autoregressive normalizing flows to correct shower shapes in simulation to match data will be shown. Spline-based transforms parameterized by the outputs of an MPL are employed, providing flexible, high-dimensional density estimation while preserving correlations between observables. Results on the application of this method will be presented, demonstrating the potential of normalizing flows as a powerful tool for improving the agreement between simulation and experimental data. Such methods can be widely used in high-energy physics, where accurate modelling of complex multivariate distributions is required.

Auteur: KAZAKOVA, Katerina (CPPM, Aix-Marseille Université, CNRS/IN2P3 (FR))

Orateur: KAZAKOVA, Katerina (CPPM, Aix-Marseille Université, CNRS/IN2P3 (FR))

Classification de Session: Generative and Probabilistic Models

Classification de thématique: Analysis : event classification, statistical analysis and inference, anomaly detection

ID de Contribution: **141** Type: **Non spécifié**

Optimization of embedded neural networks for the energy reconstruction of the liquid argon calorimeter cells of ATLAS

jeudi 27 novembre 2025 16:45 (20 minutes)

The Large Hadron Collider (LHC) collides protons at nearly the speed of light, producing new particles observed by the ATLAS detector. In 2026, the LHC will undergo a major upgrade to the High-Luminosity LHC (HL-LHC), increasing luminosity by a factor of 5–7 and delivering up to 200 simultaneous collisions. To cope with the resulting data rates, ATLAS will replace the readout electronics of the Liquid Argon Calorimeter (LAr) as part of its Phase-II upgrade. The new LASP board, equipped with two FPGAs, will perform real-time energy reconstruction for 384 channels each, covering about 180,000 calorimeter cells in total.

At high pileup, overlapping electronic pulses challenge the current Optimal Filtering (OF) algorithm used to compute the energy. Neural network (NN)–based alternatives are being explored to surpass OF while respecting FPGA constraints: <125 ns latency and limited resource usage. After earlier studies of recurrent and convolutional architectures, a dense-layer design is proposed, reducing both latency and resource consumption.

Bayesian hyperparameter optimization is used to adapt the network size, balancing energy resolution with FPGA feasibility. The results show how to achieve optimal performance within hardware limits. In addition, deep evidential regression is employed to estimate uncertainties by fitting predicted energies to probability distributions, enabling quantification of both data noise and model imprecision with minimal overhead.

The talk will compare network architectures and present the Bayesian optimization results, as well as demonstrate uncertainty estimation with evidential regression.

Auteur: BERTRAND, Raphael (Aix Marseille Univ, CNRS/IN2P3, CPPM, Marseille, France)

Orateur: BERTRAND, Raphael (Aix Marseille Univ, CNRS/IN2P3, CPPM, Marseille, France)

Classification de Session: AI at the edge

Classification de thématique: Fast ML : DAQ/Trigger/Real Time Analysis

ID de Contribution: **142** Type: **Non spécifié**

Development of innovative methods for a fission trigger construction

jeudi 27 novembre 2025 15:45 (20 minutes)

The development of innovative methods for fission trigger construction addresses the challenge of recognising fission signature in very complex detector's response functions.
The fission recognition approaches available today have intrinsic limitations.
To draw a clearer picture, the existing dedicated detectors for fission triggering present constraints regarding experimental setup geometry and fissioning mechanism compatibility.
The numerical alternatives for fission signature recognition, such as calorimetry or n-fold gamma coincidence, if applicable, can cause a major loss in statistics.
Despite the fission tag approach, in fissioning systems that require the use of a primary beam, fission can become a minor nuclear reaction compared to other processes.
Additionally, with the increasing size of nuclear physics experimental setup and the need to recognise rarer reaction mechanism, one of the main challenges in nuclear physics is to develop more and more selective data analysis methods for more and more complex datasets.
With this scenario in mind, we envisaged an AI-based fission trigger model that recognises fission solely based on the detector response function, improving event recognition statistics and without the need of an ancillary detector. This AI model could be used to evaluate the impact of each observable into identifying fission.

This AI-based fission trigger (classification model) is being developed for the ν-Ball2 gamma spectrometer (PARIS configuration) to study correlations measured with the use of a spontaneous ^{252}Cf fission source. A dedicated training dataset was acquired using an ionisation chamber for a clean fission classification label. Another neural network model was developed to predict the fission event timing with enhanced time resolution (regression model). This result was achieved thanks to a user-custom loss function that allows to improve the ionisation chamber time resolution from 5-6 to ~3 ns with reduced computational cost. Further details will be presented at the talk.

Auteur: PERTILLE RITTER, Brigitte (Université Paris-Saclay / IJCLab)

Co-auteurs: LEBOIS, Matthieu (Université Paris-Saclay and Institut Universitaire de France); MEHDI, Malia (CNRS); OBERSTEDT, Stephan (JRC Geel); THISSE, Damien (CEA Paris-Saclay); GUILLOT, Julien (IJCLab - CNRS)

Orateur: PERTILLE RITTER, Brigitte (Université Paris-Saclay / IJCLab)

Classification de Session: AI at the edge

Classification de thématique: Analysis : event classification, statistical analysis and inference, anomaly detection

ID de Contribution: **143** Type: **Non spécifié**

AI for Science: towards a roadmap and strategy for the CNRS and IN2P3

mercredi 26 novembre 2025 14:20 (25 minutes)

Machine learning has been an integral part of scientific research for several decades. However, the rapid expansion of generative artificial intelligence (AI) in all fields in recent years has placed AI at the center of strategic discussions at both the national and international levels. Among the six interdisciplinary challenges identified by the CNRS, one focuses specifically on the role of generative AI in science. Throughout the past year, exchanges have been conducted within all scientific disciplines, leading to the preparation of a roadmap for the development of a platform dedicated to generative AI in scientific research. At the same time, IN2P3 recognized the maturity of the field and initiated the elaboration of its own institutional strategy for AI. These two initiatives will require collective discussion within our community to ensure their success. In this presentation, I will discuss these efforts and their implications for the perspectives of AI in the field of physics.

Auteur: DONINI, Julien (UBP/LPC/IN2P3)

Orateur: DONINI, Julien (UBP/LPC/IN2P3)

Classification de Session: Projets nationaux et européens

Classification de thématique: Other

ID de Contribution: **144** Type: **Non spécifié**

Physics-Informed Neural Networks for Astronomical Time-Series Analysis

jeudi 27 novembre 2025 10:45 (20 minutes)

Inverse problems in astronomy are often computationally expensive, and Markov Chain Monte Carlo (MCMC) routines become impractical for massive, heterogeneous datasets or when only limited data are available. With the advent of the Vera C. Rubin Observatory Legacy Survey of Space and Time (LSST), the astronomical community will receive millions of transient alerts daily, many of which evolve on very short timescales. Classifying and characterizing these events as early as possible is therefore crucial. In this work, we present a Physics-Informed Neural Network framework to model astronomical time-series. It combines physical assumptions from two different transient classes in order to guide the model development in the absence of abundant data. Using the Type II-P supernova SN 2022acko as a test case, we show that our method can correctly infer physical properties of the transient progenitor system, achieving reliable results within only a few days of observations. This approach offers a scalable path toward extracting physical parameters from the large volume of early-time data expected in the LSST era, enabling automatic physics-based characterization of transients.

Auteur: TEIXEIRA, Gabriel (Centro Brasileiro de Pesquisas Físicas)

Co-auteurs: Dr ISHIDA, Emille (Université Clermont Auvergne, CNRS/IN2P3, LPC); Dr DE BOM, Clécio (Centro Brasileiro de Pesquisas Físicas)

Orateur: TEIXEIRA, Gabriel (Centro Brasileiro de Pesquisas Físicas)

Classification de Session: Deep Learning for Detector Signal Reconstruction and Calibration

Classification de thématique: Analysis : event classification, statistical analysis and inference, anomaly detection

ID de Contribution: **145** Type: **Non spécifié**

JetParticle-JEPA: Self-Supervised Representation Learning for Jet Tagging in High-Energy Physics

vendredi 28 novembre 2025 12:40 (20 minutes)

The Large Hadron Collider (LHC) is designed to probe the limits of the Standard Model and search for new phenomena. Machine Learning (ML) has become a powerful tool in this endeavor, particularly for jet tagging tasks. Large-scale datasets such as JetClass, which contains over 100 million simulated jet events, enable not only the training of supervised models but also the development of foundation models that leverage self-supervised learning (SSL) to uncover the underlying structure of the data without relying on labels.

Our approach, JetParticle-JEPA, is a novel framework based on the Joint Embedding Predictive Architecture (JEPA). The model is trained to predict the properties of masked particles within a jet from their surrounding context, learning in a latent representation space rather than directly reconstructing the input. This design encourages the discovery of abstract and physically meaningful features of jet structure. At its core, JetParticle-JEPA builds upon the Particle Transformer (ParT) architecture, which is ideally suited for the permutation-invariant nature of particle clouds and naturally incorporates pairwise particle interactions. To ensure that the learned representations remain physically meaningful, we incorporate specialized output heads for particle identification, trajectory displacement, and physics-constrained losses. These components serve both to evaluate whether the model captures fundamental physics principles and to inject explicit inductive biases that guide its learning.

Although still under development, preliminary results already surpass concurrent approaches such as J-JEPA and HEP-JEPA on benchmark jet tagging tasks. By learning directly from the data in a self-supervised manner, JetParticle-JEPA offers a promising path toward more accurate and reliable ML models for particle physics, ultimately accelerating the pace of scientific discovery.

References:

- Qu, H., Li, C., & Qian, S. (2022, June). Particle transformer for jet tagging. In International Conference on Machine Learning (pp. 18281-18292). PMLR.
- Katel, S., Li, H., Zhao, Z., Kansal, R., Mokhtar, F., & Duarte, J. (2024). Learning symmetry-independent jet representations via jet-based joint embedding predictive architecture. arXiv preprint arXiv:2412.05333.
- Bardhan, J., Agrawal, R., Tilak, A., Neeraj, C., & Mitra, S. (2025). HEP-JEPA: A foundation model for collider physics using joint embedding predictive architecture. arXiv preprint arXiv:2502.03933.

Auteur: LETELLIER, Guillaume (Université de Caen Normandie | GREYC)

Orateur: LETELLIER, Guillaume (Université de Caen Normandie | GREYC)

Classification de Session: Transformers and Attention-Based Models

Classification de thématique: Analysis : event classification, statistical analysis and inference, anomaly detection

ID de Contribution: **146** Type: **Non spécifié**

Jet Classification with Particle Transformers: A Multiclass Learning Approach

vendredi 28 novembre 2025 12:00 (20 minutes)

In high-energy collisions, jets, which are collimated sprays of particles, can originate from various fundamental particles, including W and Z bosons, top quarks, and the Higgs boson. Accurately identifying these jets is crucial for studying Standard Model processes and investigating new physics beyond its framework. This study, conducted within the ATLAS collaboration at the Large Hadron Collider, focuses on multi-class jet tagging utilizing the Particle Transformer (ParT). ParT employs attention mechanisms to capture correlations among jet constituents, the particles that constitute a jet. By representing jets as unordered sets of particles, ParT achieves superior discriminative performance compared to other constituent-based architectures such as ParticleNet and PFN. Its performance is evaluated across multiple jet classes, demonstrating robustness under various Monte Carlo generators and against binary classifiers, thereby showcasing both high accuracy and stability. These findings underline the ability of attention-based transformers to efficiently process unordered data, unveil valuable insights into feature representation, and exhibit satisfactory performance when extended from binary to multi-class jet classification.

Auteur: DUQUE, Andrés (Laboratoire de Physique de Clermont Auvergne)

Co-auteurs: DONINI, Julien (Laboratoire de Physique de Clermont Auvergne); CALVET, Samuel (Laboratoire de Physique de Clermont Auvergne)

Orateur: DUQUE, Andrés (Laboratoire de Physique de Clermont Auvergne)

Classification de Session: Transformers and Attention-Based Models

Classification de thématique: Object detection and reconstruction

ID de Contribution: **147** Type: **Non spécifié**

Designing superconducting magnets using machine learning and evolutionary algorithms

jeudi 27 novembre 2025 14:35 (20 minutes)

We showcase recent advancements from the magnet laboratory at CEA/IRFU in designing superconducting magnets.

Auteur: MINENNA, Damien (CEA, Irfu)

Co-auteurs: PENAVAIRE, Robin (CEA/IRFU); Dr CALVELLI, Valerio (CEA/IRFU); BAGNIS, Simon (CEA/IRFU); DILASSER, Guillaume (CEA/IRFU); DUROCHAT, Mathias; FAZILLEAU, Philippe (CEA/IRFU); JERANCE, Nicolas (CEA/IRFU); LEMERCIER, Thibault; LENOIR, Gilles (CEA/IRFU); LOTTIN, Jean-Pierre (CEA/IRFU); SEGRETI, Michel (CEA/IRFU); SIMON, Damien (CEA/IRFU); STACCHI, Francesco (CEA/IRFU); TAYLOR, Max; TUSKE, Olivier (CEA/IRFU); ZGOUR, Hajar (CEA/IRFU)

Orateur: MINENNA, Damien (CEA, Irfu)

Classification de Session: ML in Experimental Design and Control

Classification de thématique: Simulations and surrogate models : replacing an existing complex physical model

ID de Contribution: **149** Type: **Non spécifié**

Advanced stereoscopy applied to CTAO

vendredi 28 novembre 2025 11:40 (20 minutes)

The Cherenkov Telescope Array Observatory (CTAO) is an international observatory currently under construction, which will consist of two sites (one in the Northern Hemisphere and one in the Southern Hemisphere). It will eventually be the largest and most sensitive ground-based gamma-ray observatory. In the meantime, a small subarray composed of four Large-Sized Telescopes (LSTs) at the Northern site will begin collecting data in the coming year. In preparation, we present a stereoscopic event reconstruction using graph neural networks (GNNs) to combine information from several telescopes of this subarray. In our previous work, we explored the use of GNNs for the stereoscopic reconstruction of gamma-ray events on simulated data from the Prod5 sample and showed that GNNs provide a better stereoscopic reconstruction. We now compare this approach to the currently foreseen method that analytically combines the output of monoscopic random forests, and explore how GNNs can be used in fusion with the Random forest algorithm in order to provide a more sensitive stereoscopic system.

Auteur: ALI MESSAOUD, Hana

Orateur: ALI MESSAOUD, Hana

Classification de Session: Graph and Geometric Deep Learning for Event and Particle Analysis

Classification de thématique: Analysis : event classification, statistical analysis and inference, anomaly detection

ID de Contribution: **150** Type: **Non spécifié**

Parameterized neural networks for the High mass searches in the CMS experiment

jeudi 27 novembre 2025 09:55 (20 minutes)

Searching for new physics often requires testing many different signal hypotheses across an extensive parameter space, such as signal mass or width. Traditional approaches typically involves the training of one classifier per hypothesis, which quickly becomes impractical when scanning over a broad range of parameters. At higher masses, where event yields are low, limited training data leads to unstable classifiers and poor generalization.
A possible solution is to use Parameterized Neural Networks (pNN) [[1],[2]], in which the signal parameters are provided as an additional input alongside the input features. The network learns from multiple hypotheses at once, making it robust to low statistics regime, and capable of smoothly interpolating between trained mass points and generalize to unseen ones. We present a practical use of pNNs for signal-background discrimination in a search for high-mass diphotons resonances with the CMS run-3 dataset. Different strategies for assigning background events are explored, and we show that our model preserves the background mass distribution without introducing artificial shaping.

References

[[1]] P. Baldi, K. Cranmer, T. Faucett, P. Sadowski, D. Whiteson, *Parameterized Machine Learning for High-Energy Physics*
[[2]] L. Anzalone, T. Diotalevi, D. Bonacorsi, *Improving Parametric Neural Networks for High-Energy Physics (and Beyond)*

Auteurs: COUDERC, Fabrice (CEA Saclay); MALCLÈS, Julie (CEA Saclay); SAHIN, Ozgur (CEA Saclay); DEVOUGE, Paul (CEA Saclay); KAMBLE, Samadhan (IIT Madras)

Orateur: DEVOUGE, Paul (CEA Saclay)

Classification de Session: Deep Learning for Detector Signal Reconstruction and Calibration

Classification de thématique: Analysis : event classification, statistical analysis and inference, anomaly detection

ID de Contribution: **151** Type: **Non spécifié**

FAIR Universe Challenge and Benchmark

jeudi 27 novembre 2025 14:55 (20 minutes)

This competition in high-energy physics (HEP) and machine learning was the first to strongly emphasise uncertainties in ($H \to \tau^+\tau^-$) cross-section measurement. Participants were tasked with developing advanced analysis techniques capable of dealing with uncertainties in the input training data and providing credible confidence intervals. The accuracy of these intervals was evaluated using pseudo-experiments to assess correct coverage. The dataset is now published in Zenodo, and the winning submissions are fully documented. This work has been Accepted in the Benchmark and Dataset session of NeurIPS 2025 https://neurips.cc/virtual/2025/poster/121764

Dataset link
ArXiv pre-print

Auteurs: CHAKKAPPAI, RAGANSU (IJCLab-Orsay); Dr ROUSSEAU, David (IJCLab-Orsay)

Orateur: CHAKKAPPAI, RAGANSU (IJCLab-Orsay)

Classification de Session: ML in Experimental Design and Control

Classification de thématique: Training, courses, tutorials, open datasets and challenges

ID de Contribution: **152** Type: **Non spécifié**

Calorimeter energy calibration using differentiable programming

jeudi 27 novembre 2025 09:15 (20 minutes)

Accurate energy calibration of calorimeters is essential for the physics goals of collider experiments, particularly at the CERN Large Hadron Collider. Conventional calibration strategies encounter growing limitations as calorimeter granularity increases. We propose a novel calibration method that simultaneously calibrates individual detector cells within a particle shower by targeting a well-controlled energy reference. This approach bypasses several challenges inherent to traditional techniques and is implemented using differentiable programming. We evaluate the method on simulated energy deposits in the electromagnetic section of a high-granularity calorimeter and demonstrate that it reasonably mitigates injected biases in the energy response. These results highlight the potential of differentiable programming as a useful tool for calibration in future granular calorimeters.

Auteurs: BECHEVA, Emilia (LLR); MAGNIETTE, Frédéric (LLR); SAUVAN, Jean-Baptiste (LLR); RABOUR, Léa-Maria (LLR); DAVIGNON, Olivier (LLR); GHOSH, Shamik (LLR)

Orateur: RABOUR, Léa-Maria (LLR)

Classification de Session: Deep Learning for Detector Signal Reconstruction and Calibration

Classification de thématique: Object detection and reconstruction

ID de Contribution: **153** Type: **Non spécifié**

From Prototyping to Production: Integrating and Scaling GNN Tracking for the HL-LHC within the ATLAS Software Framework

vendredi 28 novembre 2025 09:00 (20 minutes)

From Prototyping to Production: Integrating and Scaling GNN Tracking for the HL-LHC within the ATLAS Software Framework

The High-Luminosity LHC (HL-LHC) upgrade of the ATLAS Inner Tracker (ITk) presents unprecedented challenges for track reconstruction, driven by the large number of silicon cluster readouts and the high throughput required under tight computing constraints. Graph Neural Networks (GNNs) have emerged as a promising solution to address these challenges [1–3], delivering competitive reconstruction performance at sub-second inference time.

This contribution presents recent progress in deploying the GNN-based tracking pipeline within the ATLAS software framework [4]. Advances include inference optimizations (mixed precision, model reduction, compilation technologies) - as well as the implementation of dedicated GPU kernels to accelerate graph building and segmentation. We will present the first studies of end-to-end throughput in the ATLAS production environment, highlighting the integration of the GNN pipeline into existing workflows, its robustness under realistic detector conditions, and its ability to scale to the data volumes expected at the HL-LHC. These results demonstrate the maturity of the approach and its readiness for large-scale deployment in preparation for HL-LHC data taking.

1 C. Rougier et al., Towards a realistic track reconstruction algorithm based on Graph Neural Networks for the HL-LHC, CHEP 2021, https://doi.org/10.1051/epjconf/202125103047

2 C. Rougier et al., ATLAS ITk Track Reconstruction with a GNN-based Pipeline, CTD 2022, https://doi.org/10.5281/zenodo.8119864

3 A. Lazar et al., Improving Computational Performance of ATLAS GNN Track Reconstruction Pipeline, to appear in CHEP 2024 proceedings

[4] B. Huth et al., Expected physics and computing performance of the ATLAS ITk GNN-based Track Reconstruction Chain, CTD 2025, available at https://indico.cern.ch/event/1499357/contributions/6621928/

Auteur: CAILLOU, Sylvain (L2I Toulouse, CNRS/IN2P3, Université de Toulouse)

Orateur: CAILLOU, Sylvain (L2I Toulouse, CNRS/IN2P3, Université de Toulouse)

Classification de thématique: Object detection and reconstruction

ID de Contribution: **154** Type: **Non spécifié**

B-hadron identification in b-jets using novel deep learning technique in pp and PbPb collisions in CMS

vendredi 28 novembre 2025 11:20 (10 minutes)

Advancements in geometric deep learning offer powerful tools to study the internal structure of jets initiated by heavy quarks, particularly in the context of dead-cone effect and jet quenching. The kinematics of b-hadron decays present a challenge for substructure measurements with inclusive b-jets, which are essential for quantum chromodynamics (QCD) studies. We propose an approach using graph-based deep learning that utilises charged decay products of the jets represented as point clouds to simultaneously identify tracks associated with b-hadron decay and perform b-jet tagging. The method is demonstrated in simulated p-p and Pb-Pb collisions passed through the CMS detector framework, in Run 2 conditions. We benchmark our method against traditional boosted decision tree classifiers, showcasing significant performance improvements in b-hadron identification of tracks.

Reference: CMS Collaboration, "A novel track finding algorithm to identify b hadron in b jets using FusionNet: a geometric deep learning model", CMS-DP-2025/035

Auteurs: GHOSH, Shamik ({CNRS}UMR7638); NGUYEN, Matthew

Orateur: GHOSH, Shamik ({CNRS}UMR7638)

Classification de Session: Graph and Geometric Deep Learning for Event and Particle Analysis

Classification de thématique: Object detection and reconstruction

ID de Contribution: **156** Type: **Non spécifié**

Machine Learning for Event Reconstruction in the CMS Phase-2 High Granularity Calorimeter Endcap

jeudi 27 novembre 2025 14:15 (20 minutes)

The High-Luminosity LHC (HL-LHC) will provide unprecedented opportunities for precision measurements and new physics searches, but it will also bring extreme challenges for event reconstruction in the dense pile-up environment. To meet these challenges, the CMS detector is undergoing major upgrades, including the replacement of its endcap calorimeters with the High-Granularity Calorimeter (HGCAL), which combines fine spatial granularity with precision timing capabilities. Fully exploiting this detector requires reconstruction strategies that go beyond traditional approaches. A dedicated framework, The Iterative CLustering (TICL), is being developed within the CMS Software (CMSSW) to reconstruct particle showers by integrating information from HGCAL and other subdetectors such as the Tracker and the MIP Timing Detector. Machine Learning (ML) plays a central role in this effort: ML-based methods are used for shower classification, for combining multiple calorimeter clusters into a single reconstructed object, and for the association of tracks with calorimeter clusters. In this presentation, the current use of ML in TICL will be outlined, recent results will be shown, and future directions will be discussed.

Auteurs: BEAUDETTE, Florian (Centre National de la Recherche Scientifique (FR)); SOKMEN, Gamze (LLR/CNRS); BIRIUKOV, Kirill (LLR / École Polytechnique (FR)); GHOSH, Shamik; CUISSET, Theo (LLR / École Polytechnique (FR))

Orateur: SOKMEN, Gamze (LLR/CNRS)

Classification de Session: ML in Experimental Design and Control

Classification de thématique: Object detection and reconstruction

ID de Contribution: **157** Type: **Non spécifié**

Enhancing low energy reconstruction and classification in KM3NeT/ORCA with transformers

vendredi 28 novembre 2025 12:20 (20 minutes)

KM3NeT is a new research infrastructure housing the next generation of neutrino telescopes in the Mediterranean deep sea. This facility comprises two detectors: KM3NeT/ARCA and KM3NeT/ORCA, consisting of vertically-arranged detection units, 230 and 115, respectively, each equipped with 18 digital optical modules. The photomultipliers within each optical module detect Cherenkov light emitted by charged particles propagating in the seawater. KM3NeT/ARCA is optimized for the search of astrophysiscal neutrino sources in the range of TeV to PeV; whereas KM3NeT/ORCA is used to study the neutrino oscillation phenomena in the 1-100 GeV energy range.

The current KM3NeT/ORCA telescope, with 24 deployed detection units, is still under construction and has not yet reached its full potential in neutrino reconstruction capability. When training any deep learning model, no explicit information about the physics nor the detector is provided, nor it is already embedded in the data, thus remaining unknown to the model. This study demonstrates the efficacy of transformer models, as large representation models, on retaining valuable information from the simulations of the complete detector when evaluating data from various smaller KM3NeT/ORCA configurations. The study leverages the strengths of transformers, with respect to other models, by incorporating attention masks inspired by the physics and detector design. This allows to filter out irrelevant background light pulses and focusing on those resulting from a neutrino interaction, at the same time it captures the physics measured on the telescope.

Refs:
https://indico.in2p3.fr/event/33412/contributions/143141/
https://doi.org/10.1051/epjconf/202531913012
https://agenda.infn.it/event/43565/contributions/260014/

Auteur: MOZUN, Ivan

Orateur: MOZUN, Ivan

Classification de Session: Transformers and Attention-Based Models

Classification de thématique: Analysis : event classification, statistical analysis and inference, anomaly detection

ID de Contribution: **158** Type: **Non spécifié**

Reconstruction of Gamma events by Deep learning: results of integrating NSB and pointing as conditional variables via the Condition Batch Norm method

jeudi 27 novembre 2025 09:35 (20 minutes)

Within the CTAO collaboration, GammaLearn is a project to develop deep learning solutions for the event reconstruction of Imaging Atmospheric Cherenkov Telescopes directly from the acquired images. Previous work demonstrated very good performances of the developed architecture network ganma-PhysNet on simulated and real data in constrained conditions. However, image acquisition covers heterogeneous observation conditions that are not explicitly included in the learning process and from which the model does not benefit to improve performances. How to take these additional variables into account during the training and inference processes?

We tested two different architectures and compare their performances: a Vanilla architecture, without conditional variables, and an architecture implementing Conditional Batch Norm (CBN) with NSB and/or pointing direction as conditioning variables. We used data covering the sky from 6deg to 30deg zenith and on top of which we simulated NSB as added noise.

Our results show that the CBN architecture does not significantly improve energy and angular resolutions while increasing variability, thus reducing model robustness to different acquisition conditions. Furthermore, it brings more complexity in the architecture and in the training and inference phases. Our study concludes that in our case study, a simpler architecture with enough training data is a preferable solution.

Auteurs: TALPAERT DAUDON, Justine (LAPP); M. VUILLAUME, Thomas (LAPP CNRS)

Orateur: TALPAERT DAUDON, Justine (LAPP)

Classification de Session: Deep Learning for Detector Signal Reconstruction and Calibration

Classification de thématique: Analysis : event classification, statistical analysis and inference, anomaly detection

ID de Contribution: **159** Type: **Non spécifié**

Dual-Decoder Convolutional Autoencoder for Unsupervised Anomaly Detection and Denoising in BPM Data

vendredi 28 novembre 2025 10:00 (20 minutes)

Turn-by-turn beam position monitor (BPM) data are vital for fast optics diagnostics in modern colliders, but they are often degraded by noise, spikes, and signal dropouts. We present ongoing work on a dual-decoder convolutional autoencoder that addresses these issues in an unsupervised setting. A shared encoder compresses BPM waveforms into a latent representation. Two decoders then serve distinct roles. The anomaly decoder, trained on nominal data, provides reconstruction-based scores for automatic fault detection. The denoiser decoder, trained with injected faults, reconstructs clean signals for spectral analysis. Early results on SuperKEKB BPM traces show that the denoiser enhances harmonic peaks and improves tune extraction, while the anomaly branch identifies faulty channels without labels. We outline training strategies that combine simulated and experimental data, describe evaluation metrics, and discuss prospects for integration into optics workflows.

Auteur: NDEGWA, Charles (CentraleSupélec / LISN / CNRS, Paris-Saclay University, Gif-sur-Yvette, France)

Co-auteurs: BRUANT, Quentin (Commissariat à l'énergie atomique - Institut de Recherche sur les lois Fondamentales de l'Univers (CEA/Irfu), Saclay, France); Prof. DALENA, Barbara (Commissariat à l'énergie atomique - Institut de Recherche sur les lois Fondamentales de l'Univers (CEA/Irfu), Saclay, France); Prof. BUGIOTTI, Francesca (CentraleSupélec / LISN / CNRS, Paris-Saclay University, Gif-sur-Yvette, France)

Orateur: NDEGWA, Charles (CentraleSupélec / LISN / CNRS, Paris-Saclay University, Gif-sur-Yvette, France)

Classification de Session: Generative and Probabilistic Models

Classification de thématique: Analysis : event classification, statistical analysis and inference, anomaly detection

ID de Contribution: **160** Type: **Non spécifié**

DBSCAN for anomaly detection of Turn-by-turn Beam Position Monitors

jeudi 27 novembre 2025 17:05 (20 minutes)

Collider rings need to have several sensors all around the ring to operate. One of these sensors is the Beam Position Monitor (BPM), which allows operators to measure if the beam travelling in the ring is well centered between the different magnets. One specific category of BPMs, which stands out because of its high acquisition rate, is called the Turn-by-turn BPMs (TbTBPMs). Several methods exist to reconstruct the magnetic lattice and the associated optical functions, which needs reliable data from the TbTBPMs. The FCC will deploy several thousand sensors along a 91-km ring, operating in a challenging environment primarily due to radiation effects on the electronics. To maximize the duty cycle of this large-scale accelerator, operations may continue even if some sensors are not functioning. It is thus important to quickly detect faulty TbTBPMs that hamper the optics functions reconstruction. This poster presents a proposition of an unsupervised machine learning method aiming to detect faulty TbTBPMs in SuperKEKB—the world's largest operating e+/e− collider 1 ; still retaining a high degree of explainability (i.e limit the blackbox effect, current in unsupervised learning techniques). It present the processing pipeline built, the main pivots over which the method revolves (feature extraction and selection) and the first tunings of the algorithm for detection purity on tracking simulation. The paramount objective is to have an algorithm efficient enough to be useful for quick surveys in SuperKEKB and/or scalable to the FCC.

Auteurs: DALENA, Barbara (CEA/IRFU/DACM); BUGIOTTI, Francesca (CentraleSupélec/LISN); BRUANT, Quentin (CEA/IRFU/DACM); GAUTARD, Valérie (CEA/IRFU/DEDIP)

Orateur: BRUANT, Quentin (CEA/IRFU/DACM)

Classification de Session: AI at the edge

Classification de thématique: Analysis : event classification, statistical analysis and inference, anomaly detection

ID de Contribution: **161** Type: **Non spécifié**

End-to-End reconstruction using machine learning to search for exotic decays of Higgs

vendredi 28 novembre 2025 11:30 (10 minutes)

Exploring exotic Higgs boson decays often requires access to challenging regions of phase space where standard reconstruction techniques become limited, making potential signals effectively invisible. In particular, when decay products become highly collimated and overlap in the calorimeter, conventional algorithms lose sensitivity. We present a novel machine learning based technique for reconstructing the decays of highly Lorentz-boosted particles directly from raw detector information. We use a Graph Neural Network to directly reconstruct exotic light particle decays to photons using minimally processed calorimeter hits, bypassing conventional reconstruction steps. The method is applied in the CMS search for exotic Higgs boson decays $H \to AA \to 4\gamma$, where the decay of a light pseudoscalar $A \to \gamma\gamma$ often produces complicated photon decay patterns. The model significantly improves mass reconstruction in the semi-merged regime and achieves sensitivity beyond traditional techniques, enabling stronger constraints than comparable analyses. In this talk we discuss the challenges of reconstructing such exotic decays, the model developed for this purpose, training strategies and the results.

Auteur: GHOSH, Shamik ({CNRS}UMR7638)

Orateur: GHOSH, Shamik ({CNRS}UMR7638)

Classification de Session: Graph and Geometric Deep Learning for Event and Particle Analysis

Classification de thématique: Analysis : event classification, statistical analysis and inference, anomaly detection

ID de Contribution: **162** Type: **Non spécifié**

Machine Learning for Next-Generation Gravitational Wave Observatories: The MANGO Project

jeudi 27 novembre 2025 13:55 (20 minutes)

The next generation of gravitational wave observatories—the Einstein Telescope (ET), Cosmic Explorer (CE), and LISA—will revolutionize astrophysics but present unprecedented data analysis challenges. LISA will detect tens of thousands of overlapping signals requiring simultaneous inference in high-dimensional Bayesian settings, while ground-based detectors will face thousands of overlapping compact binary coalescences annually. Traditional MCMC methods suffer from poor scalability and slow convergence, making them impractical for the expected detection rates and computational demands of third-generation facilities.

The MANGO project addresses these challenges through a comprehensive ML framework. Central to our approach is GWINESS (Gravitational Wave Inference using NEural Source Separation), which uses encoder-decoder architectures inspired by music source separation to disentangle overlapping gravitational wave signals and accelerate classical inference pipelines. MANGO extends this across five objectives: reproducible ML pipelines aligned with Data Challenges; automated detector characterization with denoising diffusion models; source separation in confusion regimes; neural surrogates and normalizing flows for rapid parameter estimation; and scalable population inference with anomaly detection. Recent progress encourages this approach—CNNs achieve matched-filtering sensitivity with orders-of-magnitude faster latency, while normalizing flows produce posteriors in seconds rather than hours.

This talk will present the GWINESS framework for LISA's Global Fit problem, demonstrate how hybridizing physics-based inference with deep learning dramatically reduces computational costs, and discuss MANGO's broader strategy to prepare the community for the transformative science of next-generation gravitational wave astronomy.

Auteur: RASAMOELA, Antsa (L2I Toulouse, CNRS/IN2P3, Université de Toulouse)

Orateur: RASAMOELA, Antsa (L2I Toulouse, CNRS/IN2P3, Université de Toulouse)

Classification de Session: ML in Experimental Design and Control

Classification de thématique: Analysis : event classification, statistical analysis and inference, anomaly detection

ID de Contribution: **163** Type: **Non spécifié**

Probabilistic Inference of Galaxy Properties from Multi-Modal Latent Space Representations

vendredi 28 novembre 2025 09:20 (20 minutes)

Cosmological research in the era of deep, wide-area surveys such as Euclid and Rubin/LSST benefits greatly from combining datasets collected with different instruments. However, the large volume of data makes analysis increasingly challenging. To address this, we developed a package based on the Variational Autoencoder (VAE) architecture that enables compact representations of spectroscopic and photometric datasets in a common latent space. This framework allows us to infer probability distributions for key galaxy parameters—such as redshift and stellar population properties—by jointly modeling spectral and photometric modalities. Our method provides a scalable probabilistic approach to galaxy property inference across large photometric and spectroscopic datasets, and we have successfully applied it to spectroscopic data from DESI and photometric data from HSC within the HSC-SSP survey area.

Auteurs: Dr ROSSET, Cyrille (Astroparticle and Cosmology Lab., CNRS, France); Dr ROUCELLE, Cécile (Astroparticle and Cosmology Lab., CNRS, France); Dr AUBOURG, Eric (Astroparticle and Cosmology Lab., CNRS, France); GRISHIN, Kirill (Astroparticle and Cosmology Lab., CNRS)

Orateur: GRISHIN, Kirill (Astroparticle and Cosmology Lab., CNRS)

Classification de Session: Generative and Probabilistic Models

Classification de thématique: Analysis : event classification, statistical analysis and inference, anomaly detection

ID de Contribution: **164** Type: **Non spécifié**

IDEFICS: A Framework for Accelerating Deep Learning Adoption in Industry

jeudi 27 novembre 2025 11:55 (20 minutes)

The rapid advancements in deep learning, particularly in computer vision, present significant opportunities for industrial innovation. However, many companies face substantial barriers to entry, including the high cost of computational resources and a shortage of specialized machine learning talent. The IDEFICS project aims to address these challenges by providing a comprehensive framework that offers both state-of-the-art computational infrastructure and the expertise of skilled machine learning engineers and researchers. This initiative serves as a catalyst for businesses to integrate advanced AI technologies into their operations without prohibitive upfront investment.

This presentation will first outline the global vision and operational model of the IDEFICS project, detailing how we collaborate with companies to identify and execute research and development projects. We will then delve into a specific case study: an object detection project developed for an industrial partner. This section will cover the practical implementation of a solution using YOLOv7, and some of the directions we decided to explore.

Keywords: Deep Learning, Computer Vision, Object Detection, YOLOv7, Technology Transfer, Industrial AI

Auteur: FRANCOIS, Tom (CTA, LAPP, IN2P3)

Orateur: FRANCOIS, Tom (CTA, LAPP, IN2P3)

Classification de thématique: Other

ID de Contribution: **165** Type: **Non spécifié**

Deep Learning and Bayesian Optimization for Enhanced Sensitivity and Real-Time Control in GANIL Experiments

jeudi 27 novembre 2025 11:05 (20 minutes)

Maximizing the scientific discovery rate in complex modern experiments demands advanced data analysis and real-time control. We present a suite of recently developed Artificial Intelligence (AI) and Machine Learning (ML) applications that can transform the precision and efficiency of experimental work at GANIL.

Our efforts are focused on two critical areas:

1. Deep Neural Networks (DNNs) for Enhanced Data Fidelity:
2. Precision Spectrometry: DNNs were deployed to solve the highly non-linear, multi-parametric problem of ion trajectory reconstruction in the large-acceptance magnetic spectrometer VAMOS++. By training on theoretically generated ray-tracing data, the network drastically improves the handling of complex fringe-field and acceptance effects, leading to a more accurate determination of relevant quantities.
3. Heavy Ion Identification: We implemented DNNs to determine the atomic charge state and atomic number of heavy ions from VAMOS++ focal-plane multi-parametric detector data (e.g., ionization chamber). This approach utilizes semi-supervised learning, leveraging a small fraction of precisely labeled experimental events to effectively classify the majority of unlabeled data, addressing a long-standing challenge in robust event tagging.
4. Light Ion Particle Identification: DNNs were successfully used for robust particle identification in highly-segmented silicon telescopes, significantly improving event clarity in complex reaction channels.
5. Bayesian Optimization (BO) for Real-Time System Control of Multi-Parametric Systems:
    - Beam Transport: We demonstrate the effectiveness of the BO technique with an optimization study of the beam optics transport through a quadrupole triplet, confirming its potential for real-time autonomous control of the slow control system like beam transmission, beam extraction efficiency and other.
    - Spectrometer control: The BO approach is also envisaged for optimizing ion transport through the High-Resolution Separator (HRS) at the DESIR facility.

These tools collectively deliver unprecedented levels of precision in data analysis and system stability at GANIL, directly enhancing the scientific output of the facility.

Auteurs: LEMASSON, Antoine (GANIL); Dr LEMASSON, Antoine (GANIL / CNRS); Dr REJMUND, Maurycy (GANIL)

Orateur: LEMASSON, Antoine (GANIL)

Classification de Session: Deep Learning for Detector Signal Reconstruction and Calibration

Classification de thématique: Analysis : event classification, statistical analysis and inference, anomaly detection

ID de Contribution: **166** Type: **Non spécifié**

Introduction from GANIL director

jeudi 27 novembre 2025 09:00 (15 minutes)

Orateurs: FARGET, Fanny ({CNRS}INS1618); FARGET, Fanny (GANIL)

ID de Contribution: **167** Type: **Non spécifié**

Interdisciplinary Digital Twin Engine InterTwin for calorimeter simulation

vendredi 28 novembre 2025 10:20 (20 minutes)

The interTwin project develops an open-source Digital Twin Engine to integrate application-specific Digital Twins (DTs) across scientific domains. Its framework for the development of DTs supports interoperability, performance, portability and accuracy. As part of this initiative, we implemented the CaloINN normalizing-flow model for calorimeter simulations within the interTwin framework. Calorimeter shower simulations are computationally expensive, and generative models offer an efficient alternative. However, achieving a balance between accuracy and speed remains a challenge, with distribution tail modeling being a key limitation. CaloINN provides a trade-off between simulation quality and efficiency. The ongoing study targets introducing a set of post-processing modifications of analysis-level observables aimed at improving the accuracy of distribution tails.

Auteurs: MAIBORODA, Vera (IJCLab, CNRS); Dr ALLAIRE, Corentin (CNRS, IJCLab); Dr ROUSSEAU, David (CNRS, IJCLab)

Orateur: MAIBORODA, Vera (IJCLab, CNRS)

Classification de Session: Generative and Probabilistic Models

Classification de thématique: Simulations and surrogate models : replacing an existing complex physical model

ID de Contribution: **168** Type: **Non spécifié**

Introduction and welcome

Classification de Session: Welcome address

ID de Contribution: **169** Type: **Non spécifié**

LPC Presentation

Orateur: LOPEZ, Olivier

Classification de Session: Welcome address

ID de Contribution: **170** Type: **Non spécifié**

AI for the Design and Operation of Particle Accelerators

jeudi 27 novembre 2025 13:30 (25 minutes)

Artificial intelligence (AI) is emerging today as a major driver of innovation for research infrastructures. In the field of particle accelerators, it opens up unprecedented opportunities for real-time control, predictive diagnostics, beam optimization, and the design of new devices. This presentation will provide an overview of current AI approaches and applications in accelerator science, with a focus on projects and initiatives led by IN2P3 laboratories (GANIL, IJCLab, LPSC, etc.), while situating them within a broader European dynamic (TwinRISE, ARTIFACT, MLAcc).
The talk will highlight the technical and organizational challenges of this transformation: integration with control systems (EPICS, TANGO), data management and annotation, model reproducibility and explainability, and alignment with regulatory and ethical frameworks (AI Act, safety, traceability).

Auteur: Dr GHRIBI, Adnan ({CNRS}UPR3266)

Co-auteurs: DALENA, Barbara (IRFU); GULER, Hayg (IJCLAB); CASSOU, Kevin (CNRS/IN2P3/IJClab)

Orateur: Dr GHRIBI, Adnan ({CNRS}UPR3266)

Classification de Session: ML in Experimental Design and Control

Classification de thématique: Accelerator control

ID de Contribution: **171** Type: **Non spécifié**

Hybrid Autoencoder-Isolation Forest Approach for Time Series Anomaly Detection in C70XP Cyclotron Operation Data at ARRONAX

vendredi 28 novembre 2025 10:40 (20 minutes)

The Interest Public Group ARRONAX's C70XP cyclotron, used for radioisotope production for medical and research applications, relies on complex and costly systems that are prone to failures, leading to operational disruptions. In this context, research is being conducted to develop an active machine learning method for early anomaly detection to enhance system performance. One of the most widely recognized methods for anomaly detection is Isolation Forest (IF), known for its effectiveness and scalability. However, its reliance on axis-parallel splits limits its ability to detect complex anomalies, especially those occurring near the mean of normal data. This study proposes a hybrid approach that combines a Multi-Layer Perceptron Autoencoder (MLP-AE) with Isolation Forest to enhance the detection of complex anomalies. The Mean Cubic Error (MCE) of the data reconstructed by the MLP-AE is used as input to the IF model. Validated on beam intensity time series data, the proposed method demonstrates a significant performance improvement, as indicated by the evaluation metrics, specifically the Area Under the Precision-Recall Curve (AUC-PR) and the F1 score.

Auteur: BASBOUS, Fatima (Arronax)

Co-auteurs: MATEUS, Diana; POIRIER, Freddy; HADDAD, Ferid

Orateur: BASBOUS, Fatima (Arronax)

Classification de Session: Generative and Probabilistic Models

Classification de thématique: Analysis : event classification, statistical analysis and inference, anomaly detection

ID de Contribution: **172** Type: **Non spécifié**

Le calcul au CC-IN2P3

mercredi 26 novembre 2025 15:40 (30 minutes)

Orateur: KACHELHOFFER, Thomas (CC-IN2P3-CNRS)

Classification de Session: Infrastructure de calcul et de stockage

ID de Contribution: **173** Type: **Non spécifié**

Contexte européen

mercredi 26 novembre 2025 15:05 (20 minutes)

Orateur: ROUSSEAU, David (IJCLab-Orsay)

Classification de Session: Projets nationaux et européens

ID de Contribution: **174** Type: **Non spécifié**

AISSAI

mercredi 26 novembre 2025 14:45 (20 minutes)

Orateurs: FADILI, Jalal (AISSAI); DONINI, Julien (UBP/LPC/IN2P3)

Classification de Session: Projets nationaux et européens

ID de Contribution: **175** Type: **Non spécifié**

Intégration du Machine Learning dans une infrastructure régionale HPC : retour d'expérience du CRIANN

mercredi 26 novembre 2025 16:30 (15 minutes)

Depuis une dizaine d'années, les mésocentres ont vu émerger une nouvelle communauté d'utilisateurs autour de l'intelligence artificielle et du Deep Learning, portée initialement par les laboratoires d'informatique.
Cette évolution a été stimulée par la montée en puissance des GPU, ouvrant la voie à de nouveaux usages sur les infrastructures HPC régionales.
Aujourd'hui, le Machine Learning est en plein essor dans les mésocentres et concerne désormais des domaines de recherche variés.
Cette présentation propose un retour d'expérience du CRIANN sur l'accompagnement de la communauté d'utilisateurs du Machine Learning, à travers l'évolution de son service.
Celui-ci s'appuie non seulement sur l'accès à des ressources de calcul performantes, mais aussi sur la mise à disposition de frameworks dédiés au Machine Learning, un accompagnement technique avancé, et le déploiement de nouveaux services tels que JupyterHub.
Cette démarche s'inscrit dans le respect des standards de robustesse, de performance et de mutualisation propres au HPC, tout en assurant la convergence entre calcul scientifique classique et intelligence artificielle.

Orateur: M. GASTON, Benoist (CRIANN)

Classification de Session: Infrastructure de calcul et de stockage

ID de Contribution: **176** Type: **Non spécifié**

Infrastructures GENCI et EuroHPC / AI Factories

mercredi 26 novembre 2025 16:10 (20 minutes)

Orateur: BOYER, Eric (GENCI)

Classification de Session: Infrastructure de calcul et de stockage

ID de Contribution: **177** Type: **Non spécifié**

Table ronde

mercredi 26 novembre 2025 17:00 (1 heure)

- La problématique du calcul et des données
- La connexion entre les centres de calculs
- La stratégie nationale et européenne

Orateurs: Dr GHRIBI, Adnan ({CNRS}UPR3266); CRÉPÉ-RENAUDIN, Sabine (CNRS/IN2P3/LPSC)

ID de Contribution: **178** Type: **Non spécifié**

Understanding nuclear charge radii with machine learning

jeudi 27 novembre 2025 11:25 (20 minutes)

We present a hybrid machine-learning framework that combines high-accuracy numerical regression with symbolic regression to model and interpret nuclear charge radii. Using Light Gradient Boosting and Gaussian Process Regression with rigorous cross-validation, the method reproduces experimental trends across the nuclear chart and distills them into simple analytical expressions. These formulas naturally recover liquid-drop–like dependencies and reveal new correlations from pairing and binding energies, demonstrating data-driven discovery of physical laws in nuclear structure.

Auteurs: MAHESHWARI, Bhoomika (GANIL); M. VAN ISACKER, Pieter (GANIL)

Orateurs: MAHESHWARI, Bhoomika (GANIL); M. VAN ISACKER, Pieter (GANIL)

Classification de Session: Deep Learning for Detector Signal Reconstruction and Calibration

Classification de thématique: Theory and phenomenology

ID de Contribution: **179** Type: **Non spécifié**

Using a Neural Network for Classification of Alerts from the SVOM Gamma-Ray Burst trigger using Sub-images transmitted in realtime over the VHF network

jeudi 27 novembre 2025 11:45 (10 minutes)

The SVOM satellite mission, launched in June 2024 is dedicated to Gamma-Ray Burst (GRBs) studies. The ECLAIRs trigger onboard SVOM, which reorients the satellite for GRB follow-up observations, also provides a real-time Alert Sequence for each detected GRB, transmitted to ground over the SVOM VHF receiver network. One of the two trigger algorithms, the Image Trigger (IMT) transmits at the end of each Alert Sequence a Sub-Image centered on the detected source, which is currently used by the trigger team on ground to manually identify a true point-like source from a false alert, by observing the shape in the Sub-Image. We study a machine learning algorithm, based on a pre-trained Convolutional Neural Network (CNN), to perform the automatic classification of the transmitted Sub-Image and rapid identification of False Alerts. This algorithm is intended to be first used on ground at the SVOM French Science Center, and in a later stage may be implemented on board in a future flight software update.

Orateur: M. HUBERT, Baptiste (CEA Saclay, IRFU/DAp)

Classification de Session: Deep Learning for Detector Signal Reconstruction and Calibration

ID de Contribution: **180** Type: **Non spécifié**

Welcome to LPC

mercredi 26 novembre 2025 14:00 (10 minutes)

Orateur: LOPEZ, Olivier

ID de Contribution: **181** Type: **Non spécifié**

Welcome from organisers

mercredi 26 novembre 2025 14:10 (10 minutes)