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GNN for Λ Hyperon Reconstruction in the WASA-FRS Experiment

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This research introduces a physics-driven graph neural network (GNN) [1] tailored for the identification and reconstruction of Λ hyperons in the WASA-FRS [2] experiment. The reconstructed Λ hyperons serve as calibration processes, essential for the primary objective of the experiment, namely to detect hypertritons. This GNN is based upon successfully developed machine learning algorithms by the High Energy Nuclear Physics Laboratory (HENP) at RIKEN, Japan, and it has shown to signficantly enhance the tracking and event election performances specific to Λ hyperon studies. Generally, it leverages off-vertex decay tracks of long-lived (weakly decaying) particles, providing a competitive alternative to, or benchmark for, traditional Kalman filter approaches. Furthermore, the performance of GNN can be validated on complementary channels recently studied with HADES [3] at GSI, Germany, such as $p + p \rightarrow \Lambda + {}^{0} + p + {}^{+}$ [4]. Ultimately, the success of this model enables the use of GNN across diverse experiments and physics analyses.

[1] H. Ekawa et al., Eur. Phys. J. A 59 103 (2023).
[2] T.R. Saito et al., Nature Reviews Physics 3, 803 (2021).
[3] G. Agakichiev et al., Eur. Phys. J. A 41 243–277 (2009).
[4] J. Adamczewski-Musch et al., Eur. Phys. J. A 57, 138 (2021).

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Session Classification: 3.1 Pattern recognition & Image analysis

Track Classification: Session B