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DEGLI STUDI
FIRENZE



Machine Learning for K^0_s Event Reconstruction in the LHCf Experiment

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collaboration

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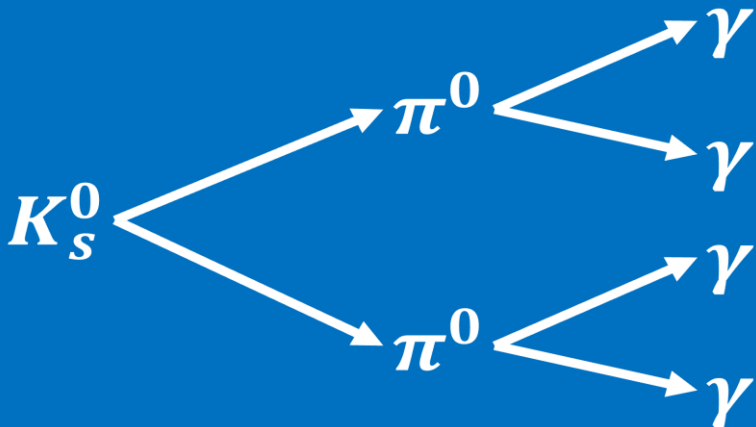
Physics motivation

- UHECR origin and mass composition are still unknown.
- Hadronic interaction models → key uncertainty in shower simulations.
- LHCf provides forward data to tune these models ($|\eta| > 8.4$).
- Forward K_S^0 :
 - probes strange-quark dynamics.
 - connected to high-energy atmospheric neutrinos.

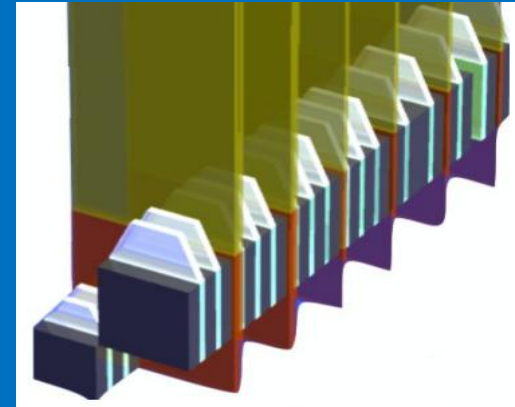
Goal: identify K_S^0 candidates in complex multi-photon events using a multi-stage neural network approach.

Branching ratio:

- $K_S^0 \rightarrow \pi^0 \pi^0 \rightarrow 4\gamma$: 30.7%



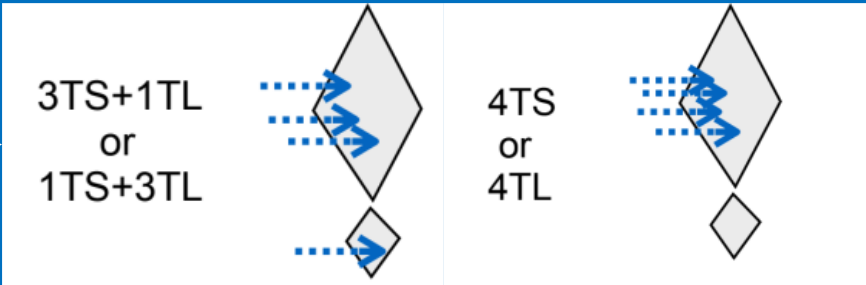
- **Two calorimetric towers:**
 - Sizes: $25 \times 25 \text{ mm}^2$ (short), $32 \times 32 \text{ mm}^2$ (long)
 - Structure: 16 GSO scintillator layers + 22 tungsten plates
 - Total depth: $44 X_0$, $1.6 \lambda_I$
- **4 XY silicon microstrip layers:**
 - Pitch: $160 \mu\text{m}$
 - Views: X and Y
 - Granularity: 384 channels per view



*The Arm2
detector*

Multi-Stage Neural Network Architecture

Events of interest



Poster
Link



Relevant Event



Neutron Filter

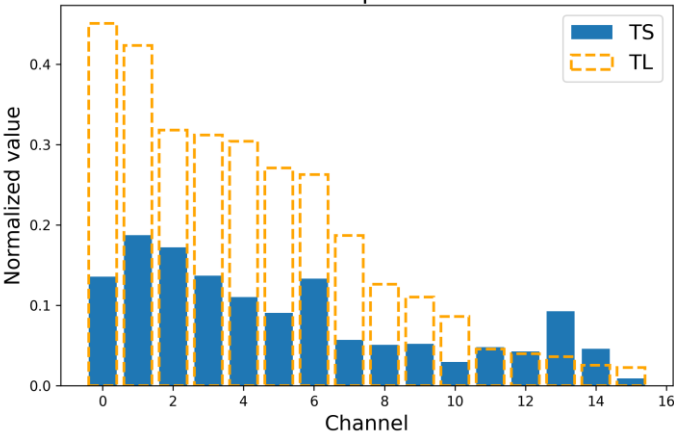


Topology Tagger

Network Input Structure (multi-input model)

| Input Type | Shape | Description |
|---------------------|--------------|--|
| Calorimeter signals | (16, 2) | Energy deposition per layer (long/short) |
| Silicon planes | (384, 4) x 2 | X/Y views from 4 silicon layers |
| Global sums | (10,) | Total energy collected for each calorimeter and each silicon |

dE Calorimeters | 4 Photons Event



posdE_0123 x View | 4 Photons Event

