Karlsruhe Institute of Technology

ETP
Institute of Experimental Particle Physics

CMS

ArXiV review

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50 GeV π^- in, nothing out: a sensitive probe of invisible η and η' decays with NA64h

Searches for new physics through decay of pseudoscalar neural mesons

- Usage of 50 GeV π^- beam at CERN SPS

- Targeting: $\pi^- + A(Z) \rightarrow \eta^{(')} + n + A(Z-1); \eta^{(')} \rightarrow$ invisible
  - SM decay in 4ν highly suppressed
  - DM candidates with $m_\chi \ll \Lambda_{EW}$ possible options

- Collected dataset $2.93 \cdot 10^9$ pions

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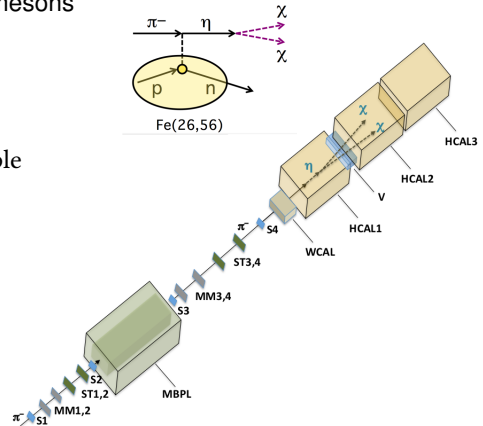
# 50 GeV π^- in, nothing out: a sensitive probe of invisible η and η' decays with NA64h

Results:

- $\mathcal{B}(\eta \to \text{invisible})1.1 \cdot 10^{-4}$
- $\mathcal{B}(\eta' \to \text{invisible})2.1 \cdot 10^{-4}$

- More stringent limit by factor of ≈ 3 for η' w.r.t. BESIII
- Further improvement possible trough detector upgrades

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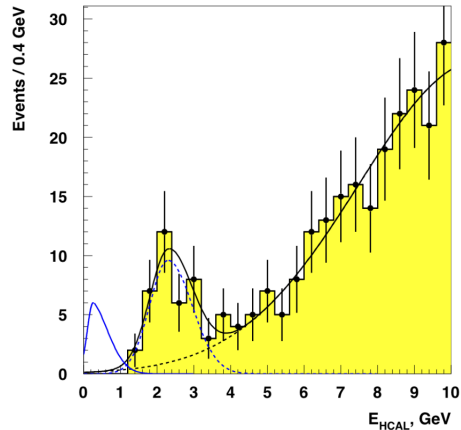
ReLU-KAN: New Kolmogorov-Aarnold Networks that only need matrix addition, dot multiplication, and ReLU

- Builds upon initial KAN
  - From Kolmogorov-Arnold theorem: Every high dimensional function can be represented as a composition of one-dimensional function

    $\rightarrow$ Learnable activation function possible

  - Usage of B-splines construction

- This work reformulates using ReLU
  - Parallelizable: up to 20 times faster training time
  - Improves the convergence
  - Lightweight implementation (code example given)
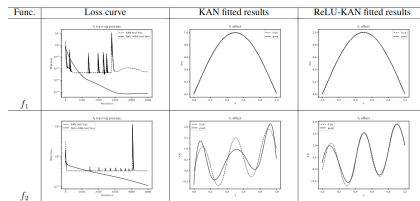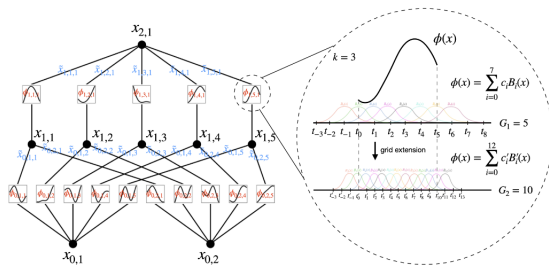
The Final Frontier for Proton Decay

Search for *p*-Decay on earth:
- High contribution by atmospheric-neutrino-induced backgrounds
- Requirement of highly pure material

Search for *p*-Decays on the moon:
- No atmosphere: high suppression of backgrounds
- Abundance of natural (ground) redioactivity
- Decay $p \rightarrow^+ \bar{\nu}$ easily visible in comparison to earths measurement
- catch point: material from high depth is required (5km)

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Backup