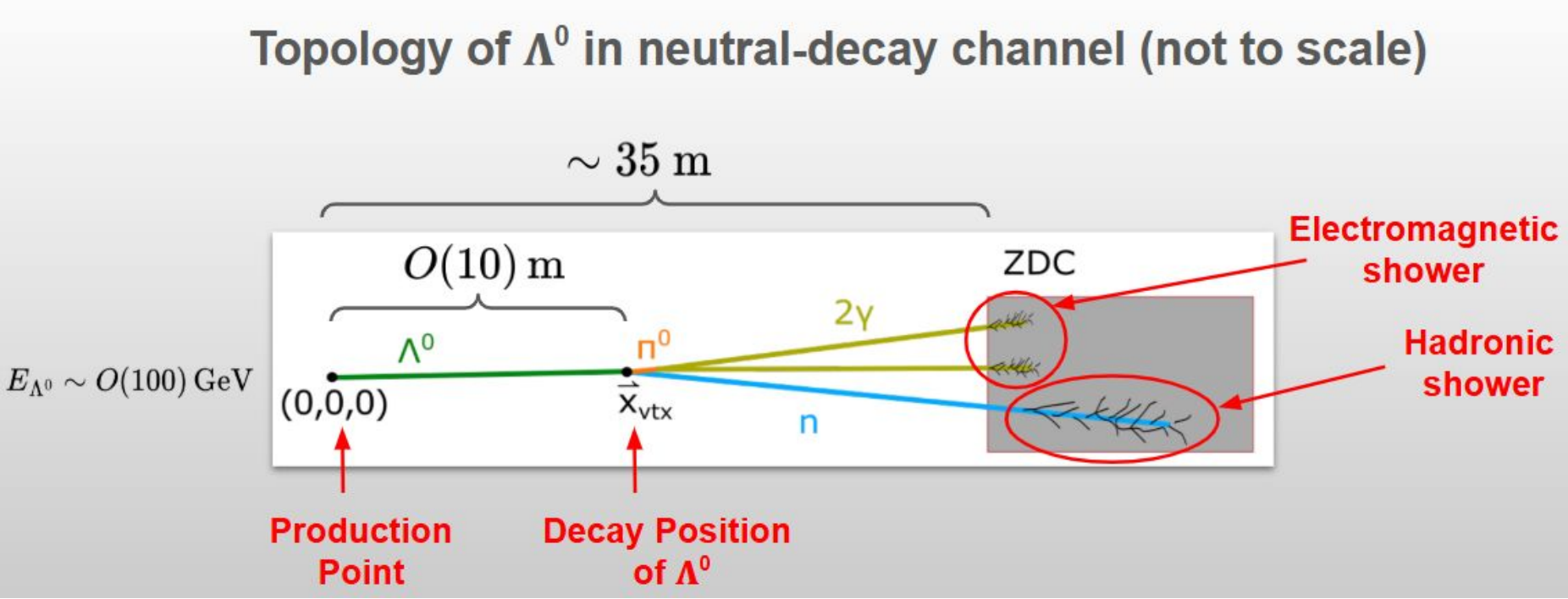
"The reconstruction of the Λ^0 event in the far-forward detection area is one of the most challenging tasks."
EIC YR



Examples of $\Lambda^0 \rightarrow n\pi^0$

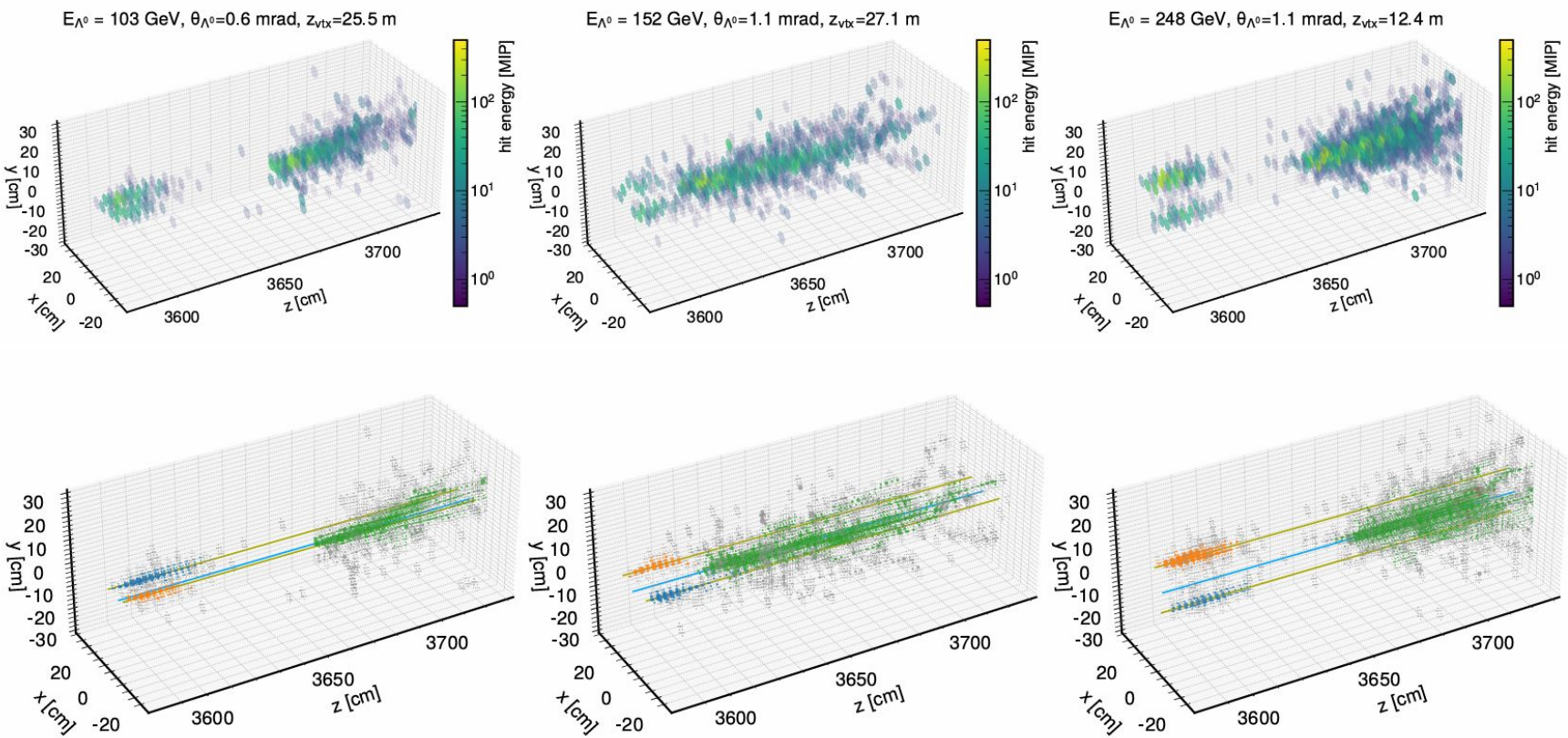
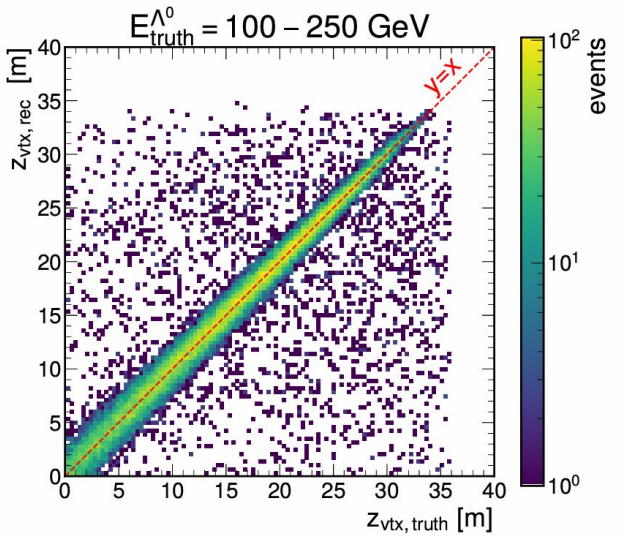
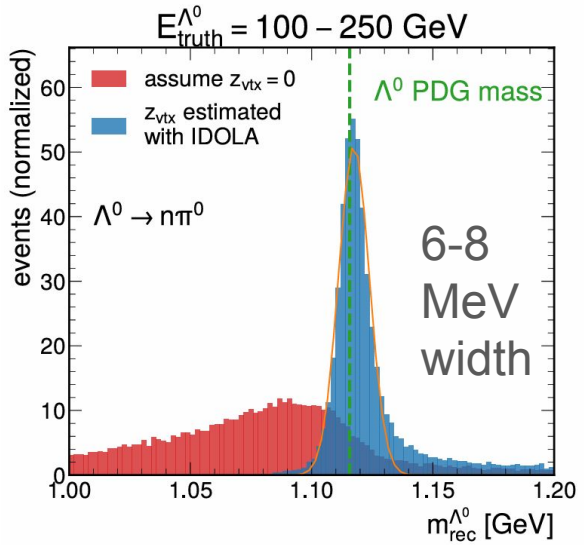
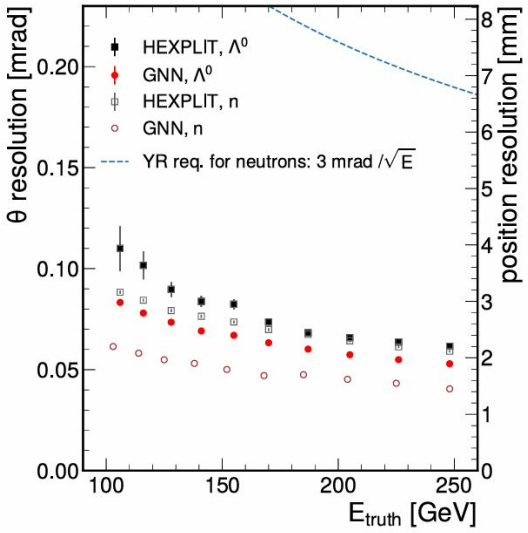


Figure 2: Top row: event display for example events, with the hits color coded by energy deposited, in units of MIPs. Bottom row: the same events, with subcell hits from HEXPLIT algorithm color-coded by which cluster the subcell hits have been assigned to by the 3D topological cluster described in the text.

Displaced Vertex and Mass Reconstruction. IDOLA algorithm, *R. Milton et al. arXiv:2412.12346*







Neutral decay channel is possible with ZDC only (no ZDC or B0 ECAL needed)
Complements charged-decay channel, which only works at low energy (41 GeV beam)

Science Case

From J. Arrington et al. *J.Phys.G* 48 (2021) 7, 075106 , EIC YR

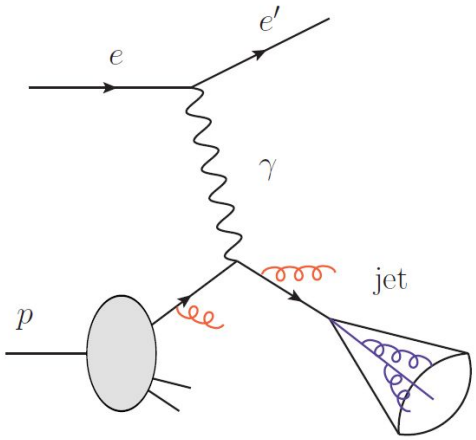
What is the size and range of interference between emergent-mass and the Higgs-mass mechanism?	Kaon form factor data for Q^2 = 10-20 $(\mathrm{GeV}/c)^2$.	• Need to uniquely determine exclusive process $e+p \to e'+K+\Lambda$ (low $-t$) • L/T separation at CM energy ~10-20 GeV • Λ/Σ^0 ratios at CM energy ~10-50 GeV
Are transverse momentum distributions universal in pions and protons?	Hadron multiplicities in SIDIS off a pion target as defined with Sullivan process.	• Need to uniquely determine SIDIS off pion $e+p \to e'+h+X+n$ (low $-t$) • High luminosity ($10^{34}\mathrm{cm}^{-2}\,\mathrm{sec}^{-1}$) • $e+p$ and $e+D$ at similar energies desirable • CM energy ~10-100 GeV

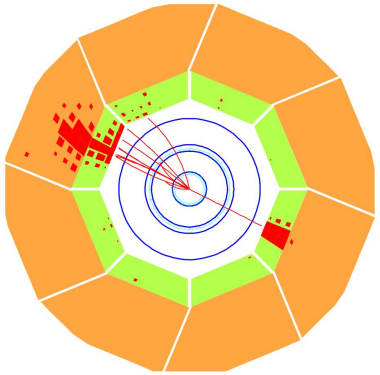
Table 7.1: Science questions related to pion and kaon structure and the understanding of the EHM mechanism accessible at the EIC, with the key measurements and some key requirements listed. Further requirements are addressed in the text.

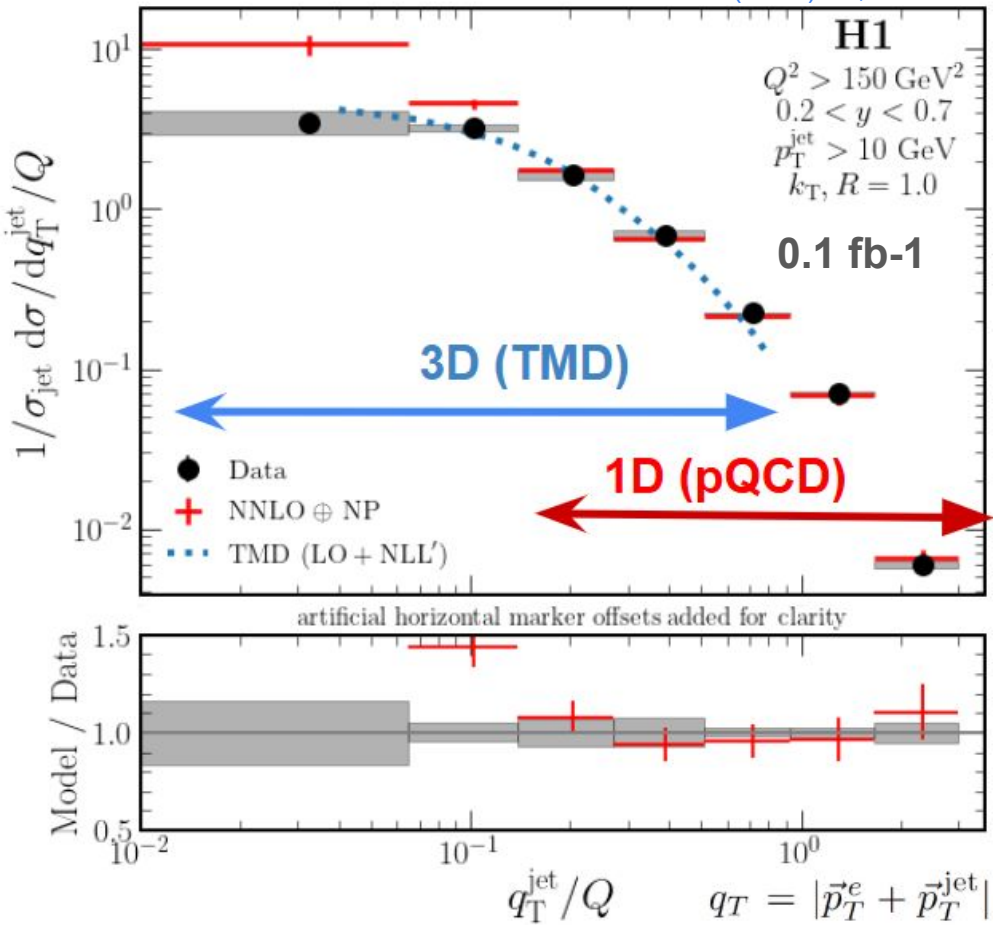
Science Question	Key Measurement	Key Requirements
What are the quark and gluon energy contributions to the pion mass?	Pion structure function data over a range of x and Q^2.	• Need to uniquely determine $e+p \to e'+X+n$ (low $-t$) • CM energy range ~10-100 GeV • Charged and neutral currents desirable
Is the pion full or empty of gluons as viewed at large Q^2?	Pion structure function data at large Q^2.	• CM energy ~100 GeV • Inclusive and open-charm detection
What are the quark and gluon energy contributions to the kaon mass?	Kaon structure function data over a range of x and Q^2.	• Need to uniquely determine $e+p \to e'+X+\Lambda/\Sigma^0$ (low $-t$) • CM energy range ~10-100 GeV
Are there more or less gluons in kaons than in pions as viewed at large Q^2?	Kaon structure function data at large Q^2.	• CM energy ~100 GeV • Inclusive and open-charm detection
Can we get quantitative guidance on the emergent pion mass mechanism?	Pion form factor data for Q^2 = 10-40 $(\mathrm{GeV}/c)^2$.	• Need to uniquely determine exclusive process $e+p \to e'+\pi^++n$ (low $-t$) • $e+p$ and $e+D$ at similar energies • CM energy ~10-75 GeV
What is the size and range of interference between emergent-mass and the Higgs-mass mechanism?	Kaon form factor data for Q^2 = 10-20 $(\mathrm{GeV}/c)^2$.	• Need to uniquely determine exclusive process $e+p \to e'+K+\Lambda$ (low $-t$) • L/T separation at CM energy ~10-20 GeV • Λ/Σ^0 ratios at CM energy ~10-50 GeV
What is the difference between the impacts of emergent- and Higgs-mass mechanisms on light-quark behavior?	Behavior of (valence) up quarks in pion and kaon at large x.	• CM energy ~20 GeV (lowest CM energy to access large-x region) • Higher CM energy for range in Q^2 desirable
What is the relationship between dynamically chiral symmetry breaking and confinement?	Transverse-momentum dependent Fragmentation Functions of quarks into pions and kaons.	• Collider kinematics desirable (as compared to fixed-target kinematics) • CM energy range ~20-140 GeV
More speculative observables		
What is the trace anomaly contribution to the pion mass?	Elastic J/Ψ production at low W off the pion.	• Need to uniquely determine exclusive process $e+p \to e'+J/\Psi+\pi^++n$ (low $-t$) • High luminosity ($\geq 10^{34}\mathrm{cm}^{-2}\,\mathrm{sec}^{-1}$) • CM energy ~70 GeV
Can we obtain tomographic snapshots of the pion in the transverse plane? What is the pressure distribution in a pion?	Measurement of DVCS off pion target as defined with Sullivan process.	• Need to uniquely determine exclusive process $e+p \to e'+\gamma+\pi^++n$ (low $-t$) • High luminosity ($\geq 10^{34}\mathrm{cm}^{-2}\,\mathrm{sec}^{-1}$) • CM energy ~10-100 GeV
Are transverse momentum distributions universal in pions and protons?	Hadron multiplicities in SIDIS off a pion target as defined with Sullivan process.	• Need to uniquely determine SIDIS off pion $e+p \to e'+h+X+n$ (low $-t$) • High luminosity ($10^{34}\mathrm{cm}^{-2}\,\mathrm{sec}^{-1}$) • $e+p$ and $e+D$ at similar energies desirable • CM energy ~10-100 GeV

Jets for TMDs

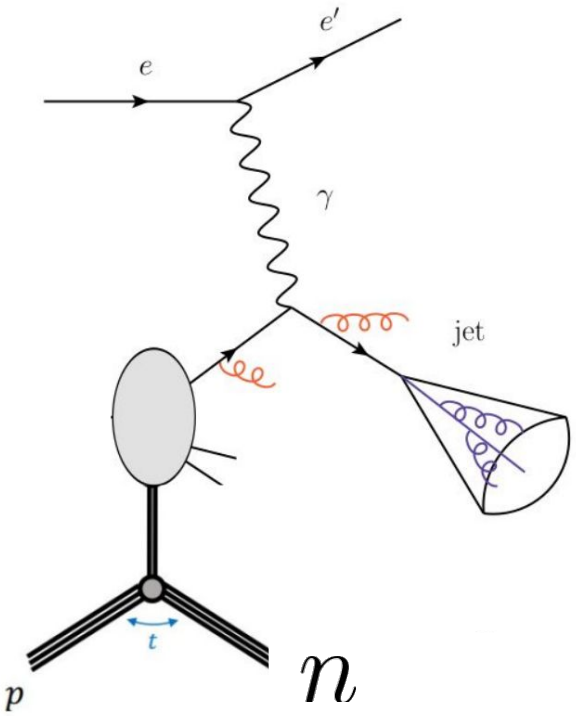
PRL 128 (2022) 13, 132002

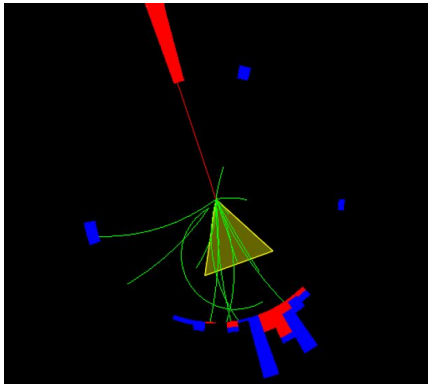




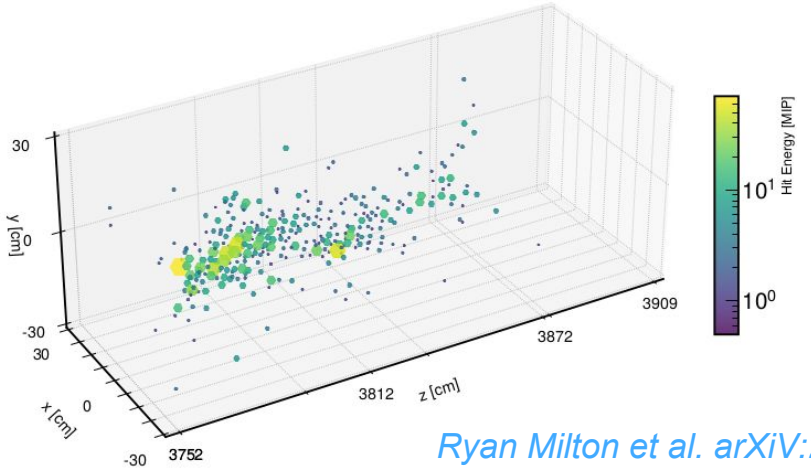


Jets in DIS off a Pion target





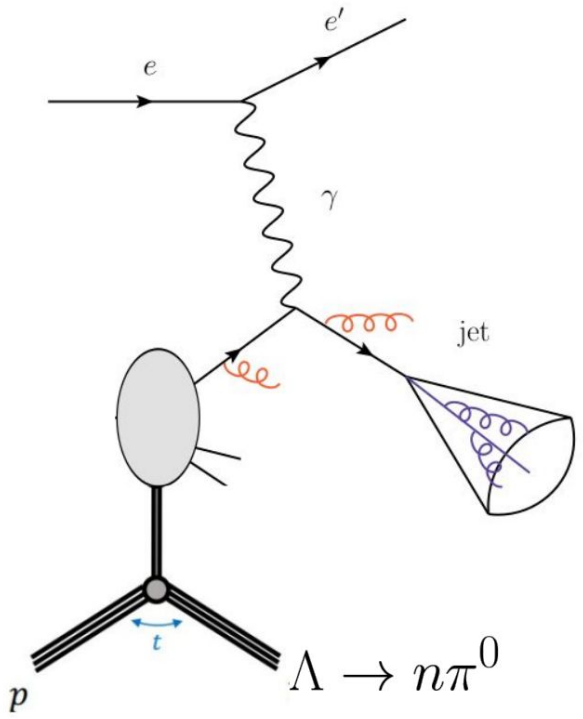
Main detector view

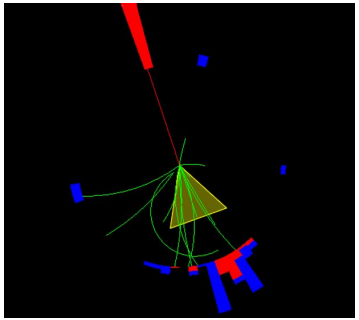


ZDC view

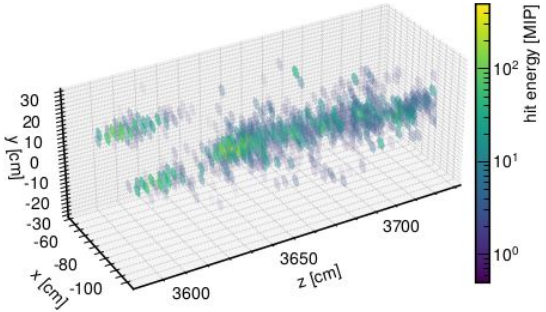
Ryan Milton et al. arXiV:2406:12877

Jets in DIS off a Kaon target

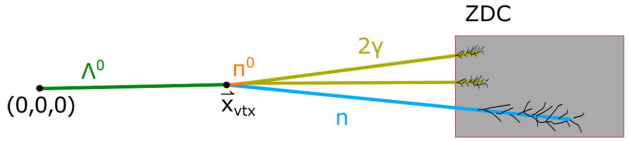




Main detector view

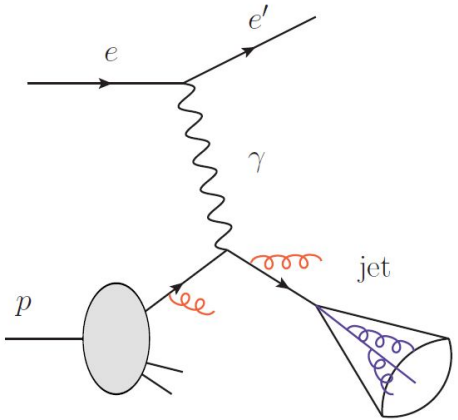


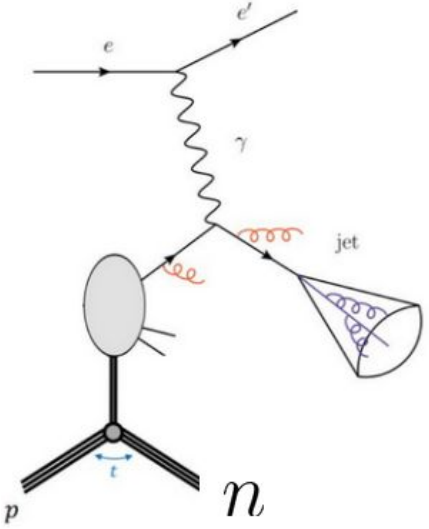
ZDC view

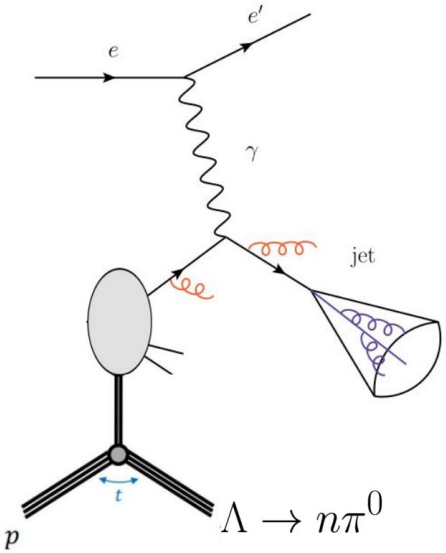


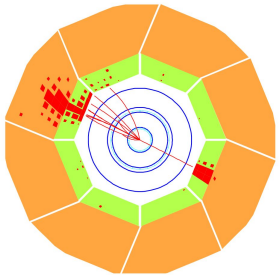
S. Paul et al. arXiv:2412.12346

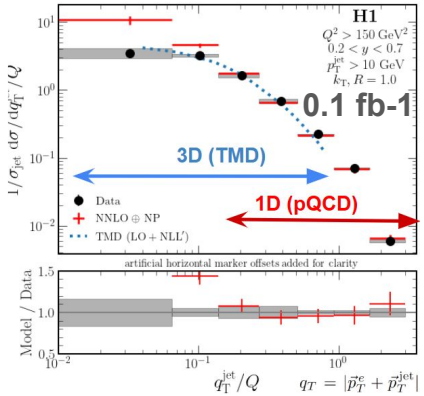
Jet tomography of proton, pion, kaon
→ Are TMD universal?











PRL 128 (2022) 13, 132002