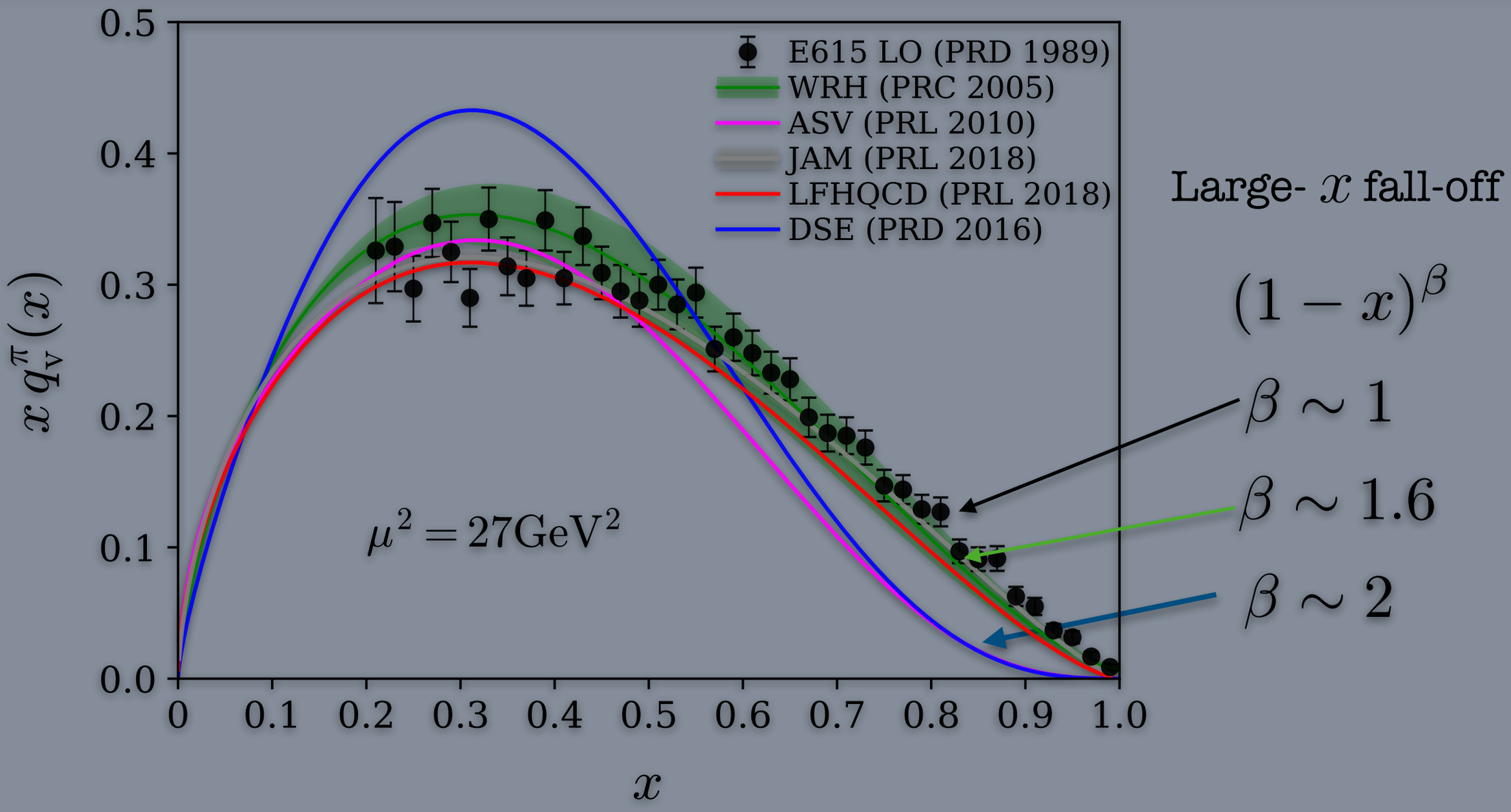
Pion Valence Quark Distribution



Large- x fall-off

$(1-x)^\beta$

$\beta \sim 1$

$\beta \sim 1.6$

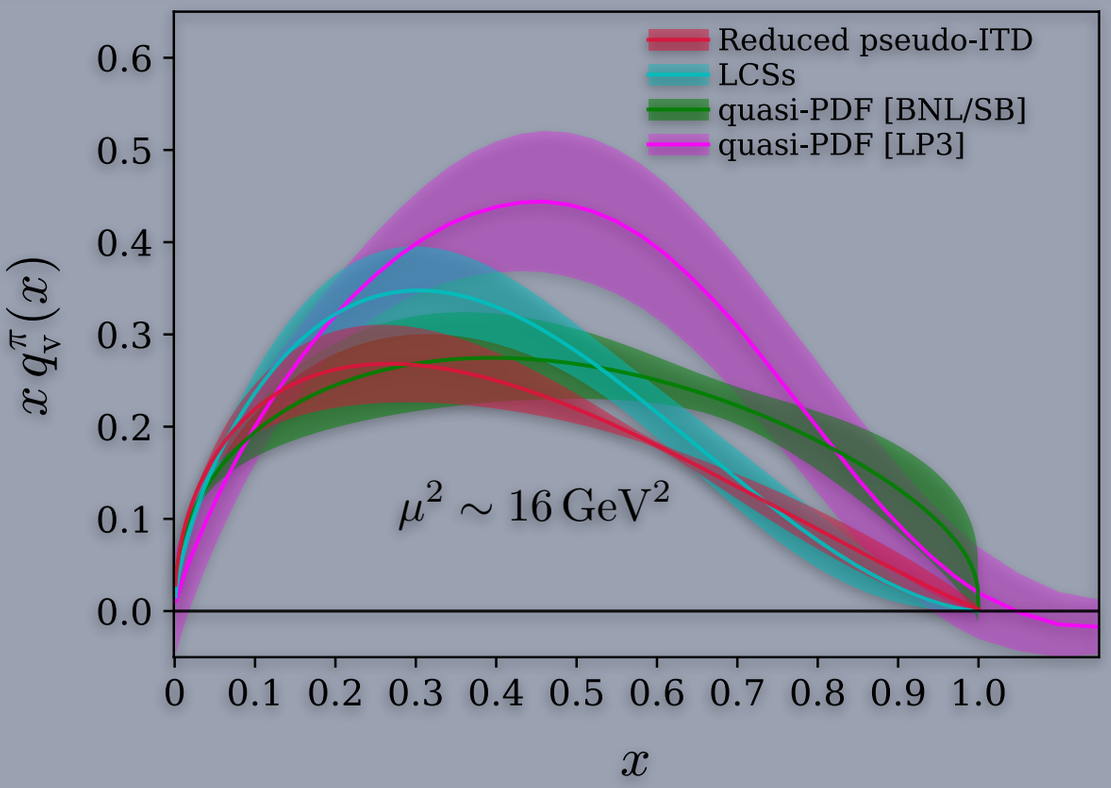
$\beta \sim 2$

- Large- x region: small config constrained by confinement dynamics
- From pQCD and different models : $(1-x)^2$ or $(1-x)^1$
- Experiment at JLab and COMPASS to explore large-x behavior

Jefferson Lab
Thomas Jefferson National Accelerator Facility

Raza Sabbir Sufian

Lattice QCD Calculations



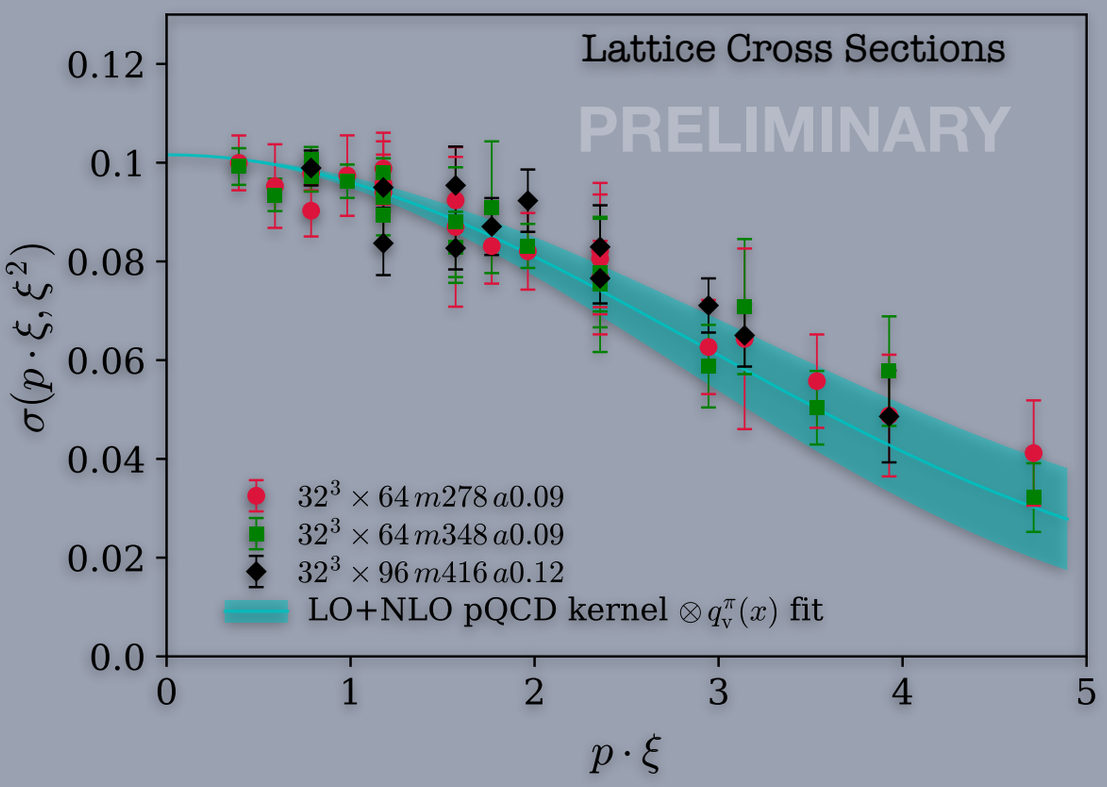
Quasi PDFs (Ji, 2013)

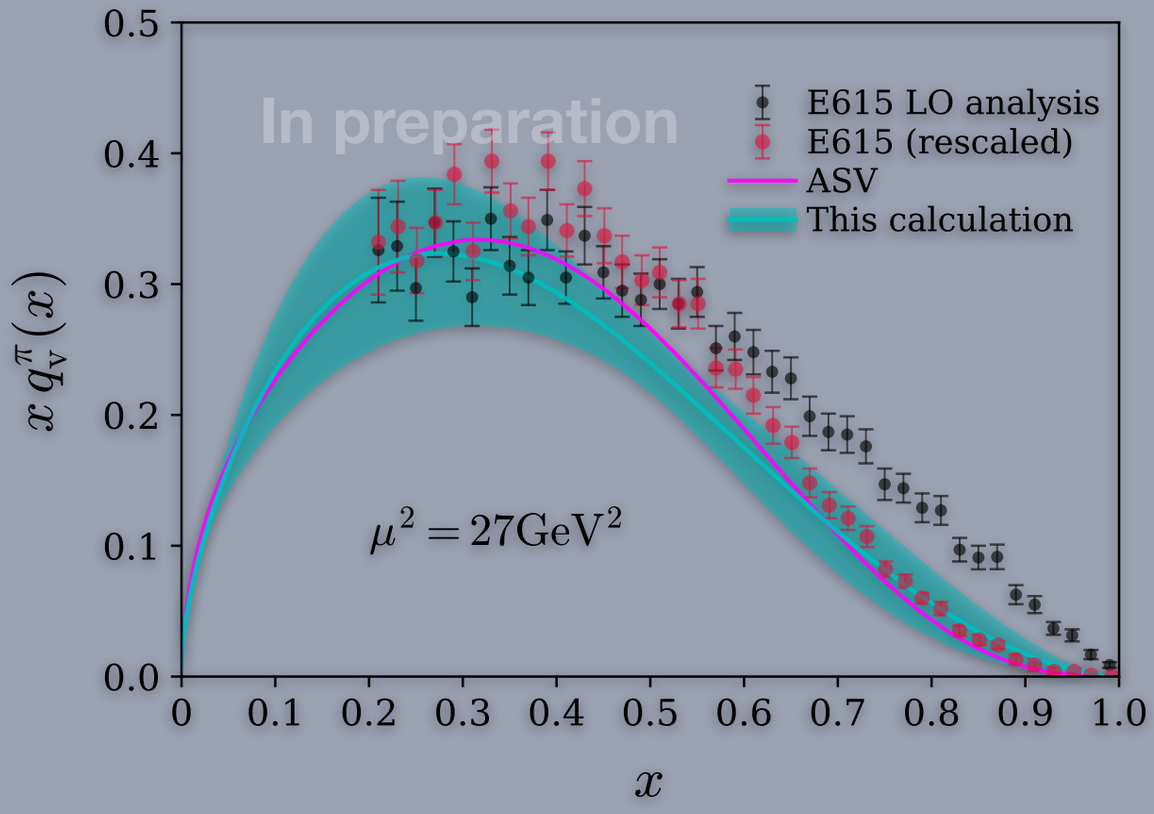
Pseudo-PDFs (Radyushkin, 2017)

Lattice Cross Sections (Ma & Qiu, 2014, 2017)

Collaboration: Karpie, Orginos, Radyushkin, Richards, Zafeiropoulos, RSS

arXiv:1909.08517



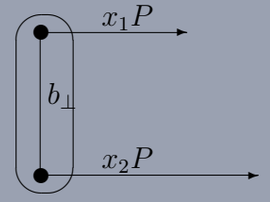


Collaboration: Edwards, Egerer, Karpie, Orginos, Ma, Qiu, Richards, RSS

Phys.Rev. D99 (2019) no.7, 074507

Pion PDF from Light-Front Holographic QCD

$$H\phi(\zeta) = \left(-\partial_\zeta^2 + \frac{4L^2-1}{4\zeta^2} + U(\zeta)\right)\phi(\zeta) = M^2\phi(\zeta)$$



$$\vec{\zeta} = \sqrt{x(1-x)}\,\vec{b}_{\perp i},\ \zeta = |\vec{\zeta}|$$

Modify conformal AdS space by a dilation profile $e^{\phi(z)} = e^{\kappa^2 z^2}$

$$U(\zeta) = \kappa^4\zeta^2 + 2\kappa^2(J-1)$$

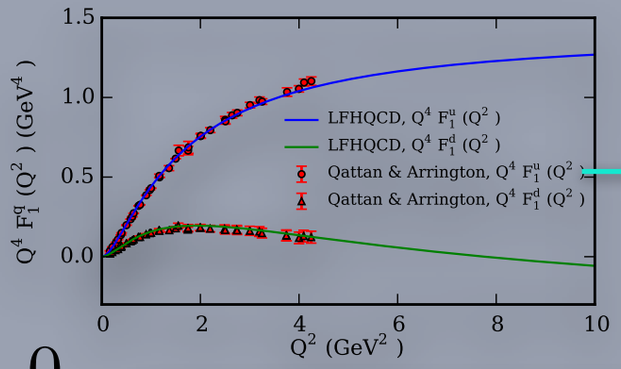
Mapping of AdS gravity to QCD quantized at fixed light-front time

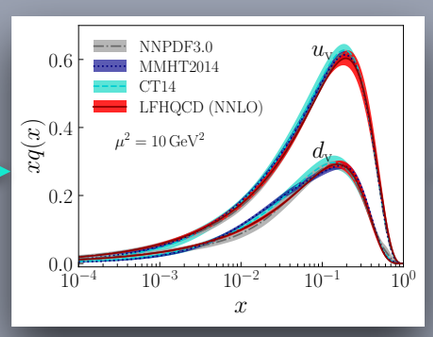
$$\zeta \Longleftrightarrow z$$

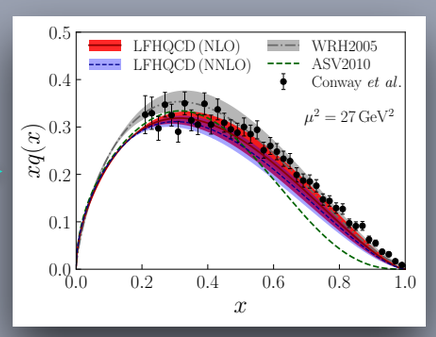
de Teramond, Brodsky PRL 2009

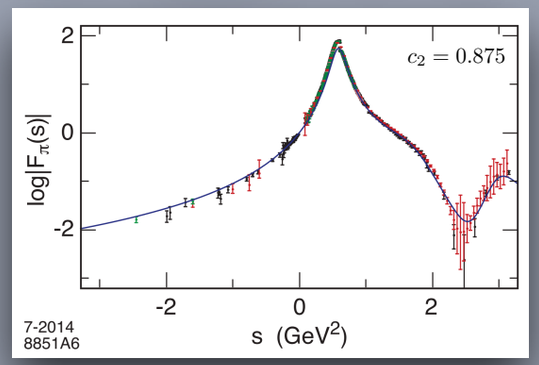
$\kappa \approx 0.52$ **GeV (emergent mass scale ! Same for mesons and baryons)**

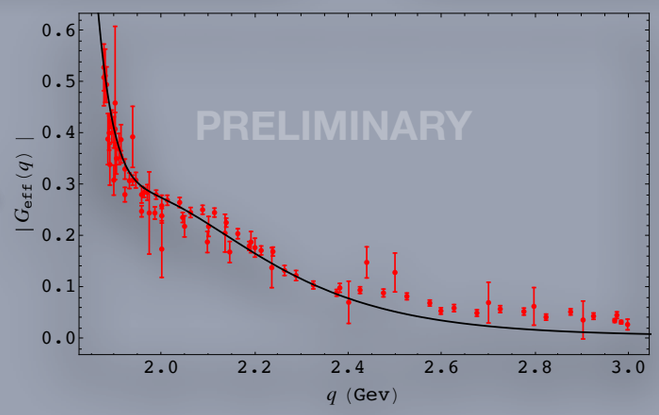
- A semiclassical approximation to QCD
- Relativistic, frame-independent
- Color confining, massless pion $m_q \to 0$
- Symmetry between observed mesons and observed baryons
- Regge behavior at low x, pQCD counting rule at large x











HLFHS Collaboration: Brodsky, de Teramond, Deur, Dosch, Liu, RSS

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Phys.Rev. D95 (2017) no.1, 014011

Phys.Rev. D98 (2018) no.11, 114004

arXiv:1909.13818