Kaon Fragmentation Function from NJL-Jet

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CSSM

Outlook

- Motivation
- Kaon Distribution Function with NJL
- Strange NJL-Jet: Fragmentation Functions

Motivation

- Effective quark model descriptions of fragmentation functions usually employ "elementary" one-step process.
- The resulting fragmentation functions are too small compared to data (e.g. M. Hirai et al: PRD **75** (2007) 094009.).
- The "chain" process is mimicked by introducing "normalization factors".
- Direct calculation using Quark-Jet model without any new parameters

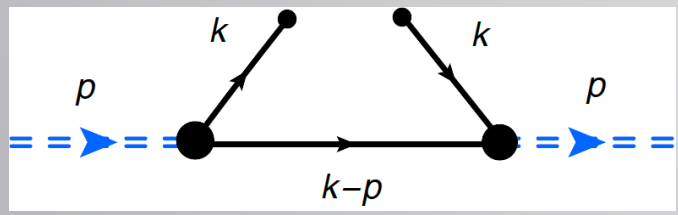
Distribution and Fragmentation Functions

Ito et al. Phys.Rev.D80:074008,2009

Probability of finding quark q(x) in hadron h

$$f_q^h(x) = p_- \int d^2k_T \sum_\alpha \frac{\langle p|b_\alpha^\dagger(p) b_\alpha(p)|p\rangle}{\langle p|p\rangle}$$

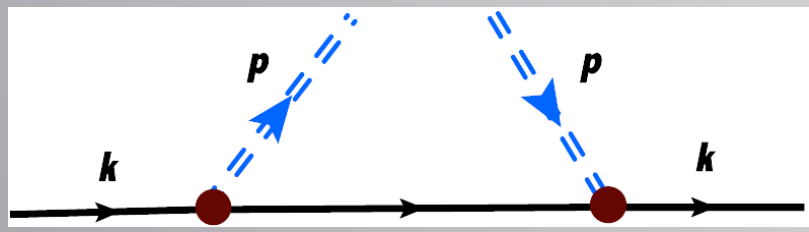
$$x = k_-/p_-$$



Probability of finding hadrons h(z) in cloud of q

$$D_q^h(z) = \frac{1}{6} dp_- \int d^2p_\perp \sum_\alpha \frac{\left\langle k(\alpha)|a_h^\dagger(p) a_h(p)|k(\alpha)\right\rangle}{\langle k(\alpha)|k(\alpha)\rangle}$$

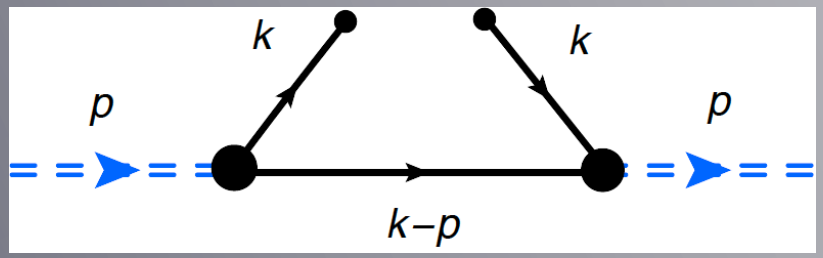
$$z = p_-/k_-$$

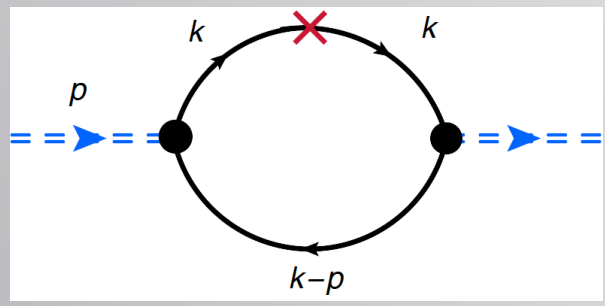


K Distribution Function in NJL

Bentz et al.: Nucl.Phys.A651:143-173,1999.

- Fixing Model Parameters: M_s from f_k





Regularization:

Invariant Mass Cutoff (fixed from pion)

g_{kqq}:

residue of qqbar t-matrix at kaon pole

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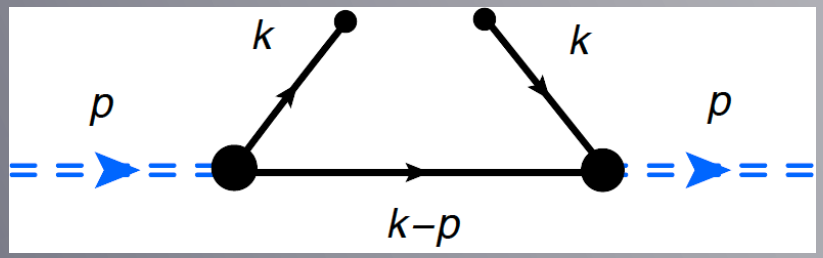

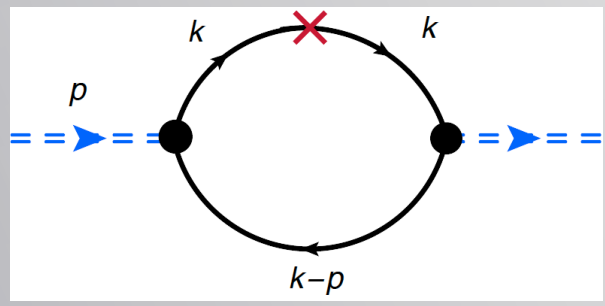

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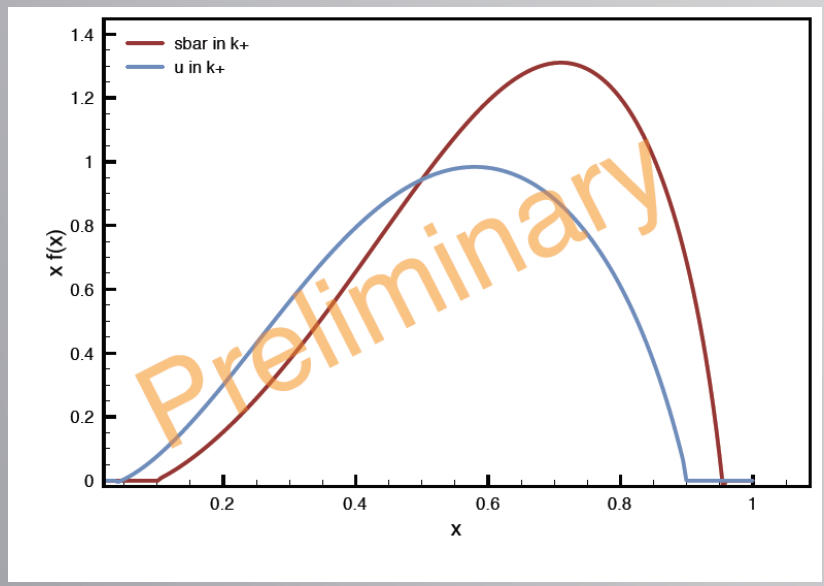
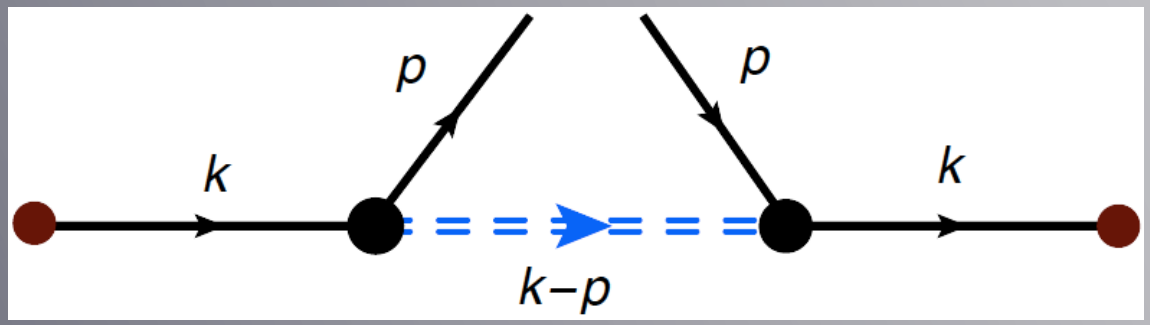


Elementary Fragmentations

$$d_q^Q(z) : q \to Qm$$



$$u \to d\pi^+$$
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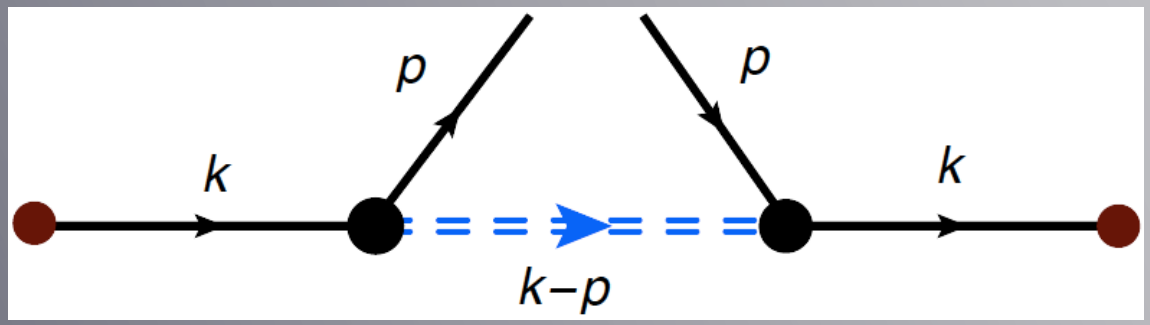

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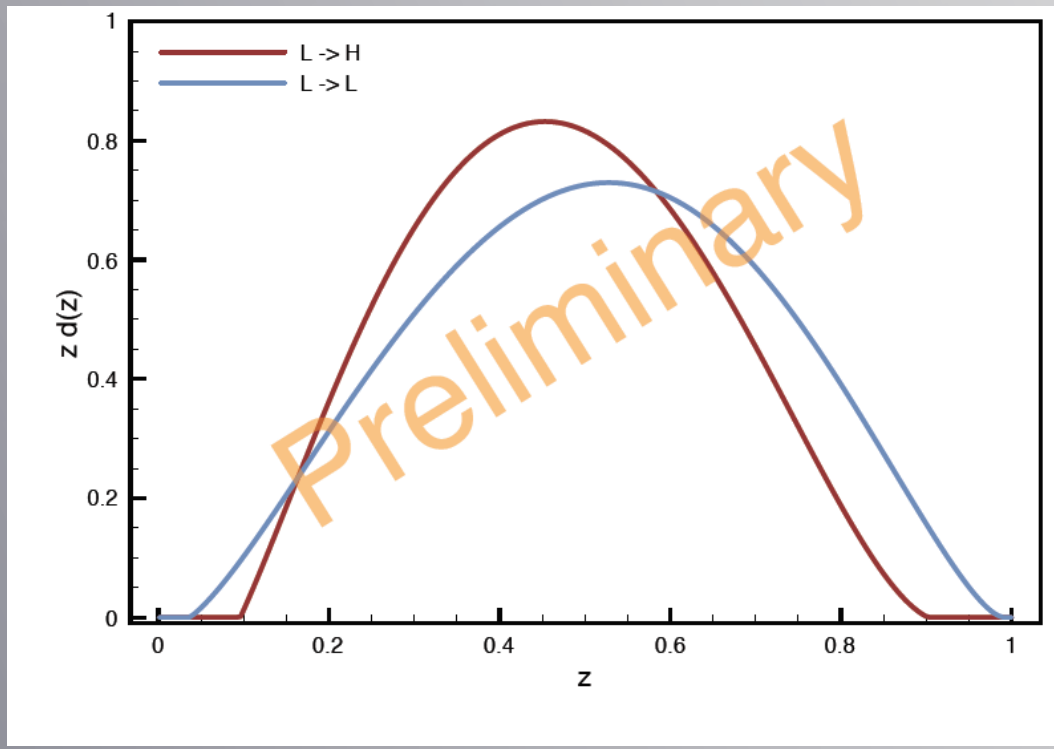
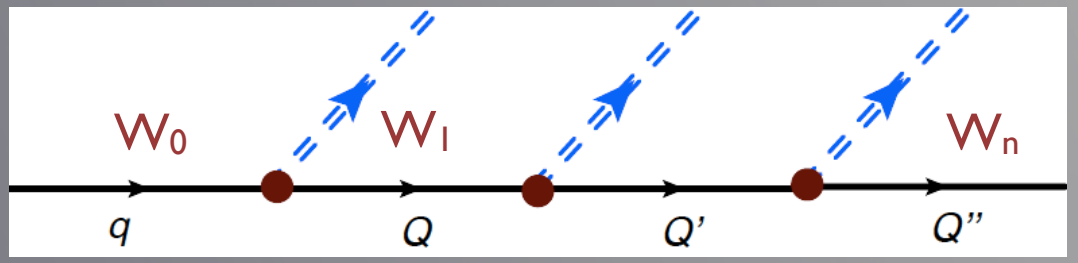


NJL-Jet Ansatz for Fragmentation Function

Ito et al. Phys.Rev.D80:074008,2009

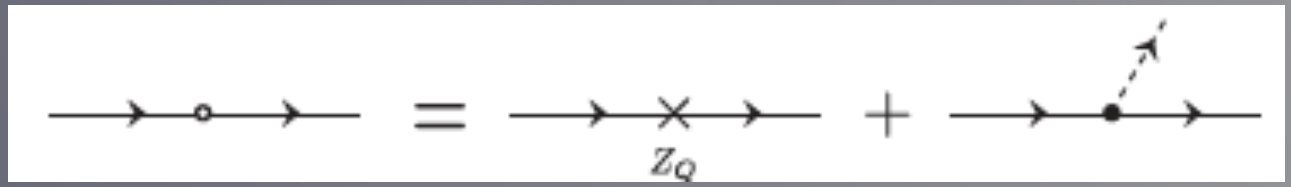
$$\eta_m = \frac{W_m}{W_{m-1}}$$



$$D_q^\pi(z) = \int_0^1 d\eta_1 \ldots \int_0^1 d\eta_n 6d(\eta_1) \cdot \ldots \cdot 6d(\eta_n) \left(\sum_{m=1}^{n} \delta(z - z_m) \right)$$

$$z_m = \frac{W_{m-1} - W_m}{W_0}$$

d_q^Q



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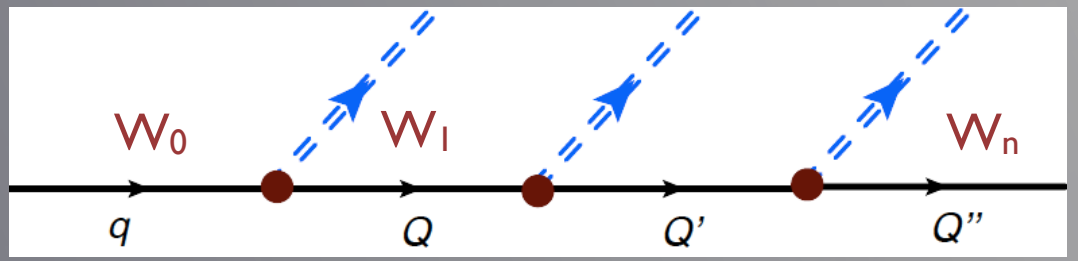

$$D_q^m(z) = \hat{d}_q^m(z) + \int_z^1 \frac{dy}{y} \hat{d}_q^Q(\frac{z}{y}) \cdot D_Q^m(y)$$

$$\hat{d}_q^m(z) = \hat{d}_q^{Q'}(1-z)|_{m=\bar{Q}'q}$$

Probabilistic Interpretation of Integral Equation Ansatz

Field, Feynman.Nucl.Phys.B136:1,1978.

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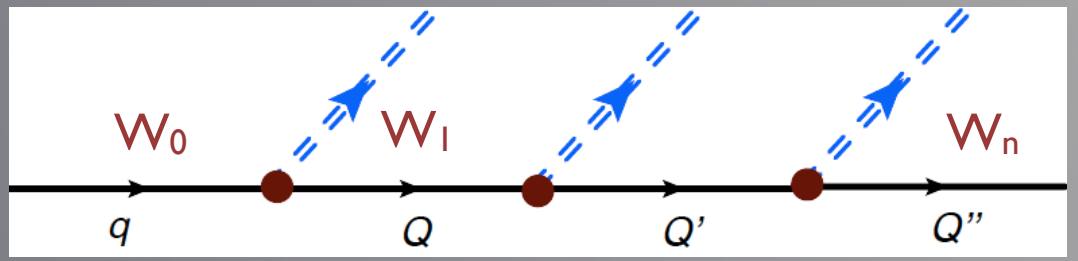

The probability of finding mesons m with mom. fraction z in a jet of quark q

$$D_q^m(z)dz = \hat{d}_q^Q(1-z)dz + \int_z^1 \hat{d}_q^Q(y)dy \cdot D_Q^m(\frac{z}{y})\frac{dz}{y}$$

$z = (W_0 - W_1)/W_0 = 1 - \eta_1$

Probability of Momentum fraction y is transferred to jet at step 1

The probability scales with mom. fraction

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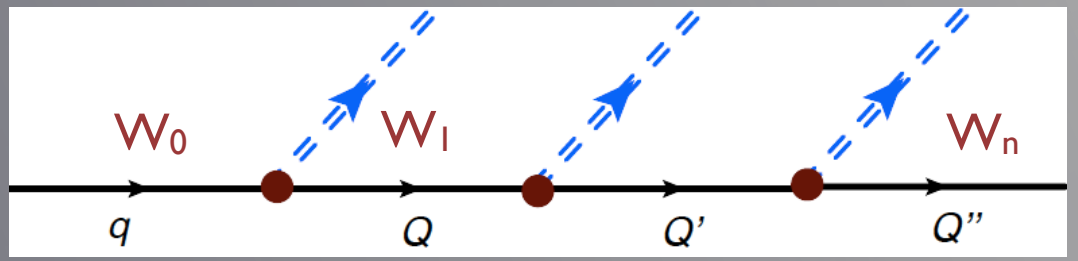

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Strangeness Effect in Pion

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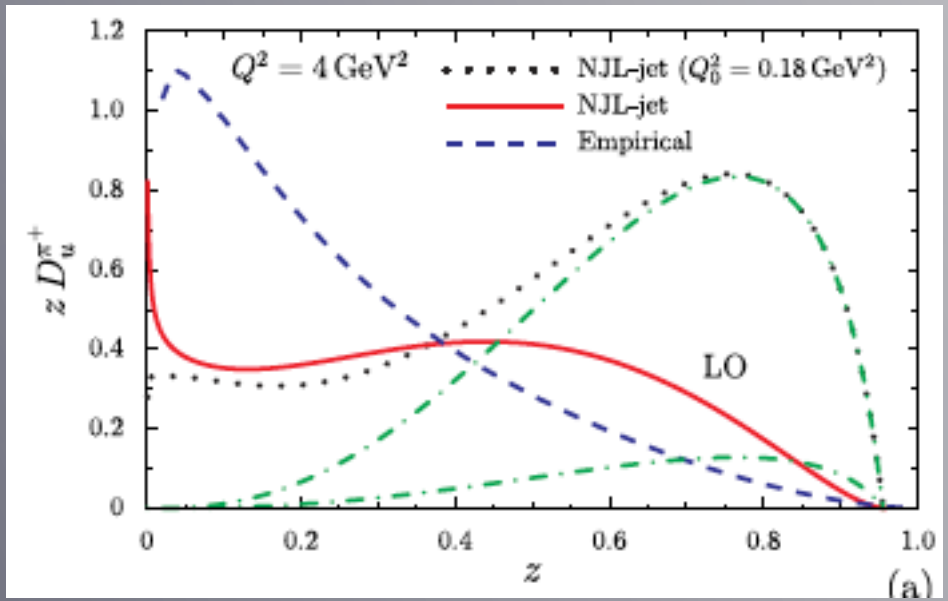

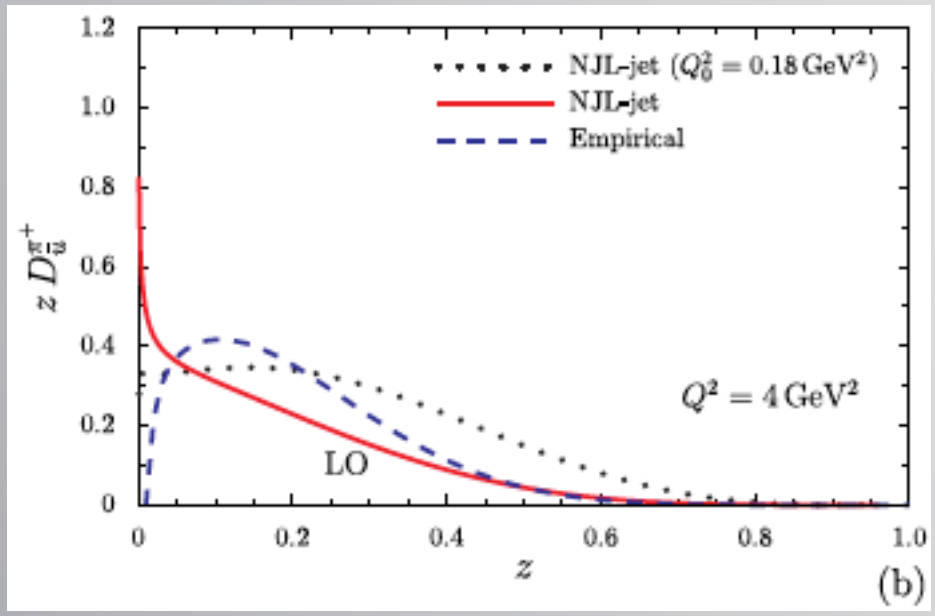

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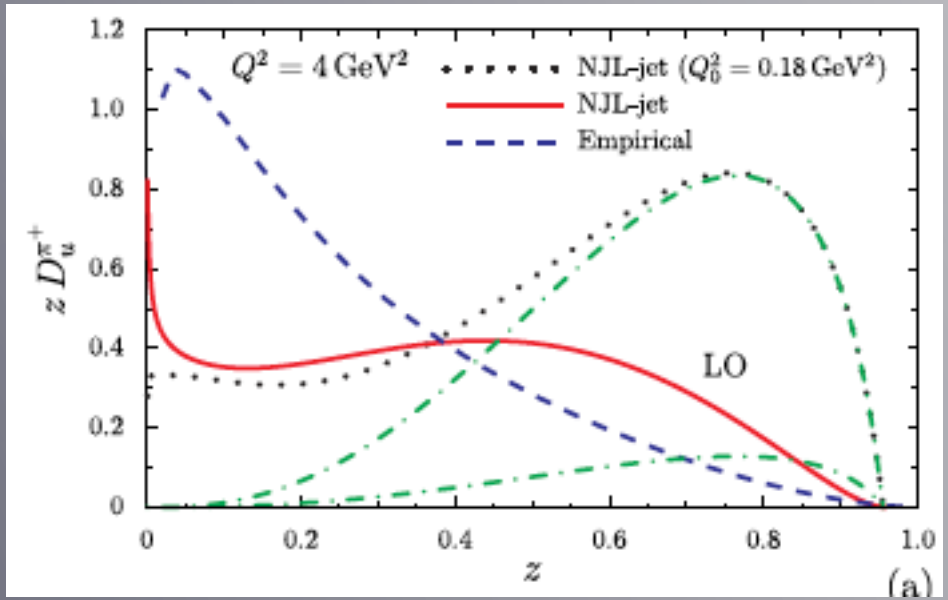
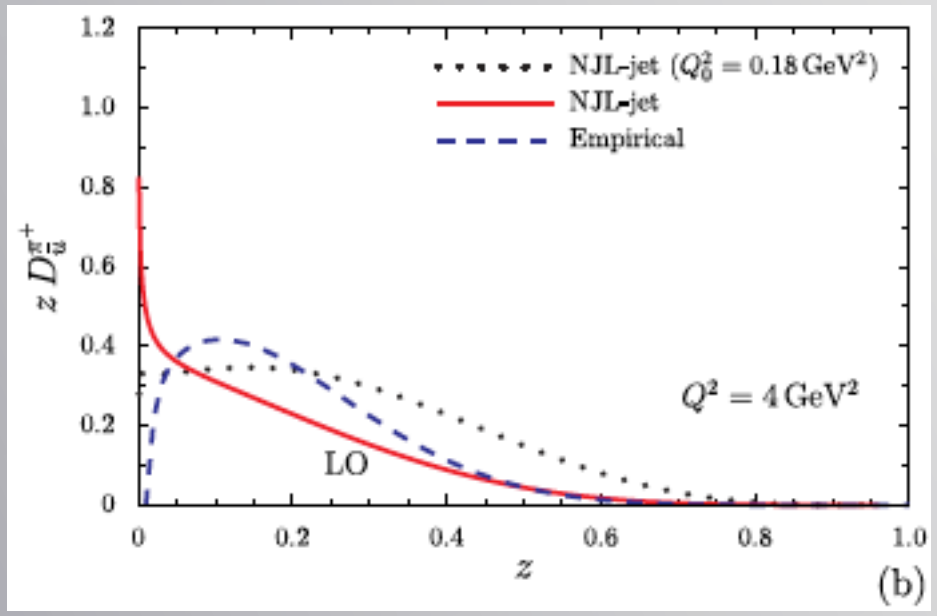
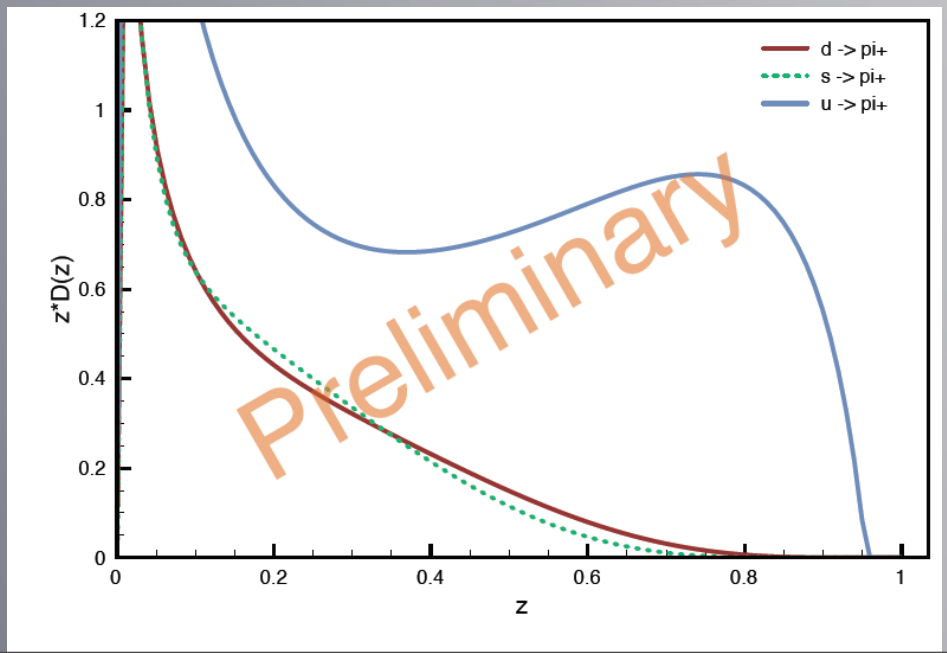
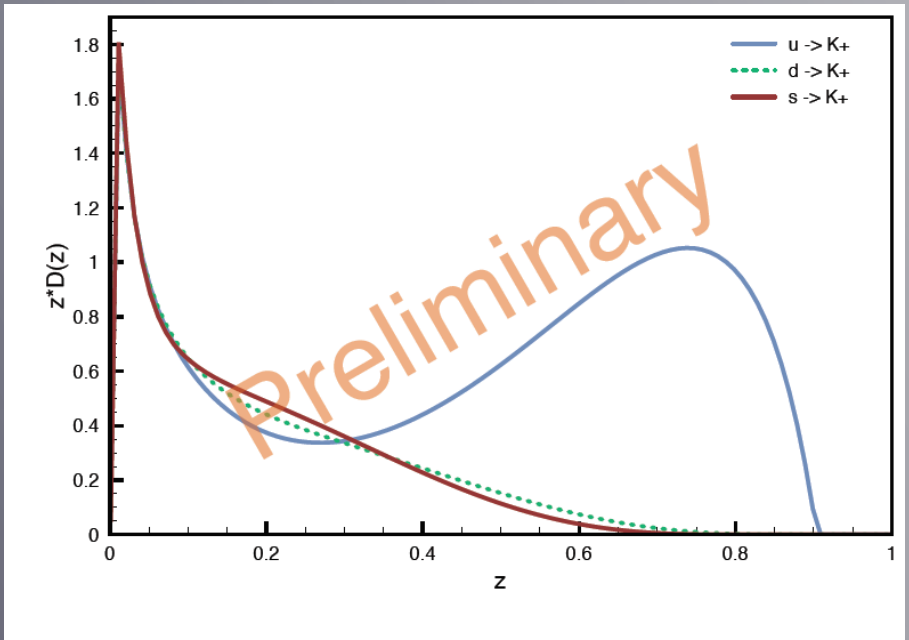
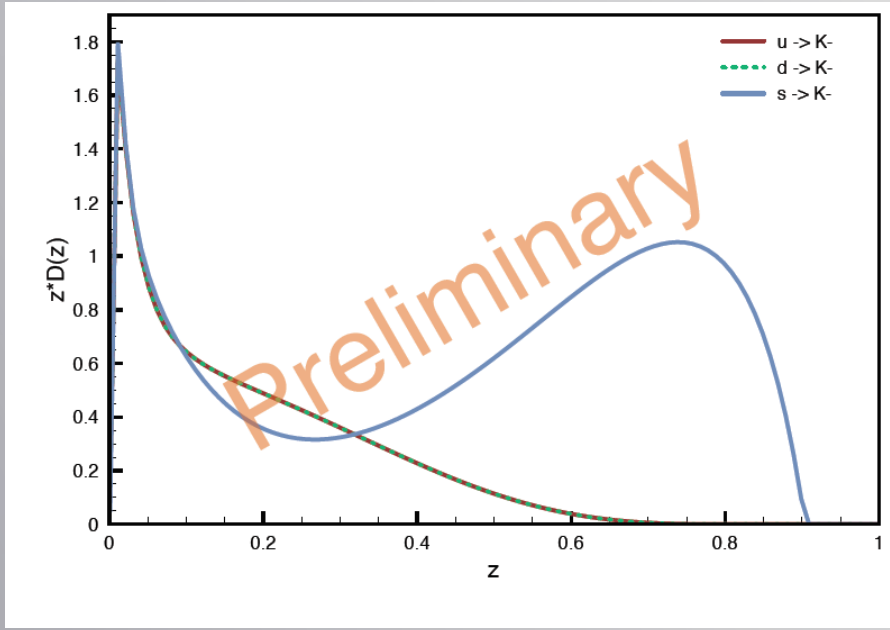




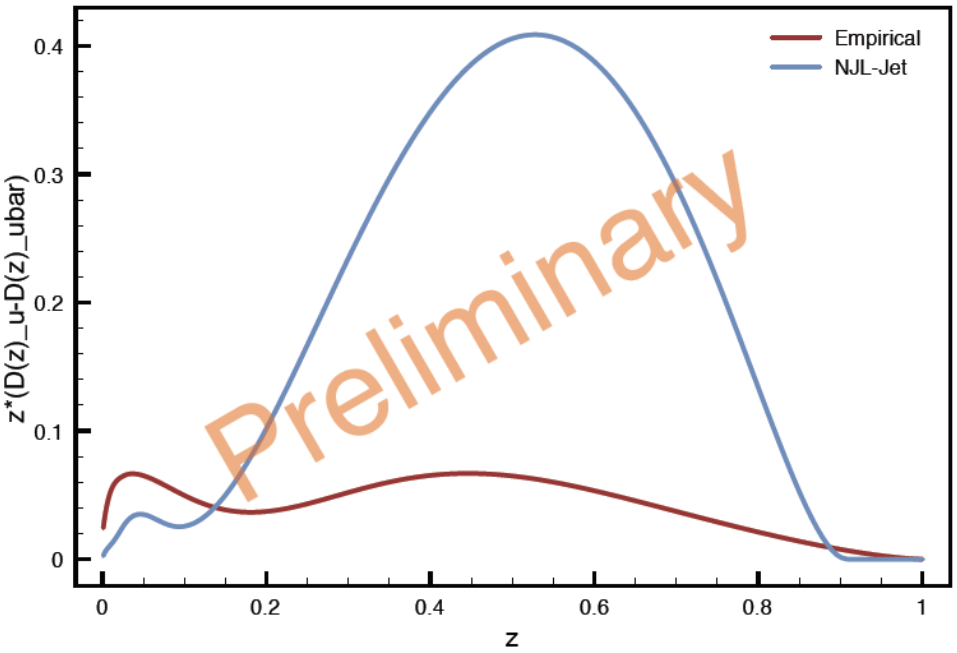


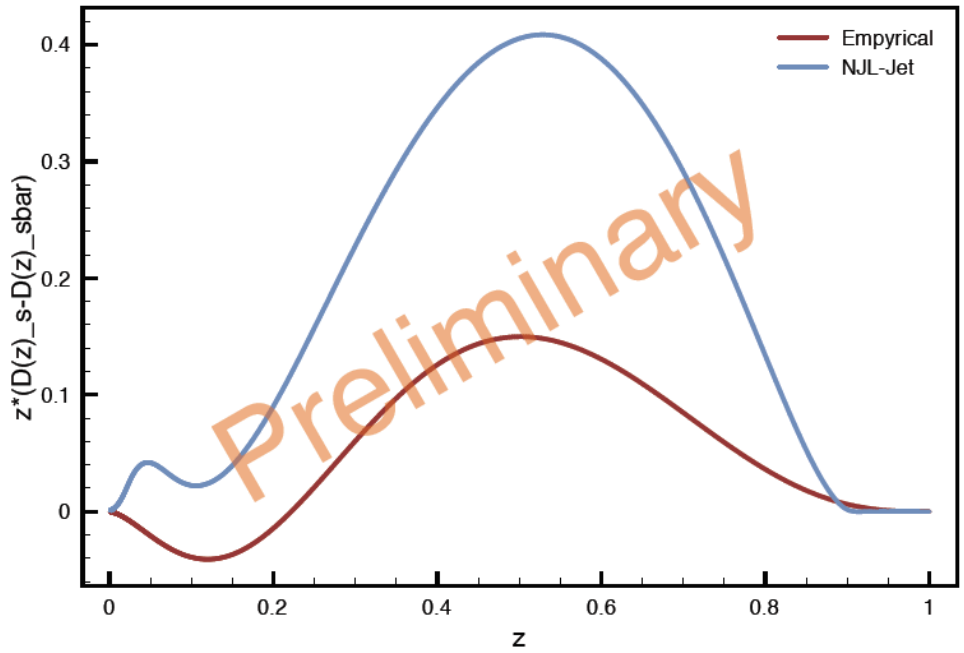
Results for Kaon

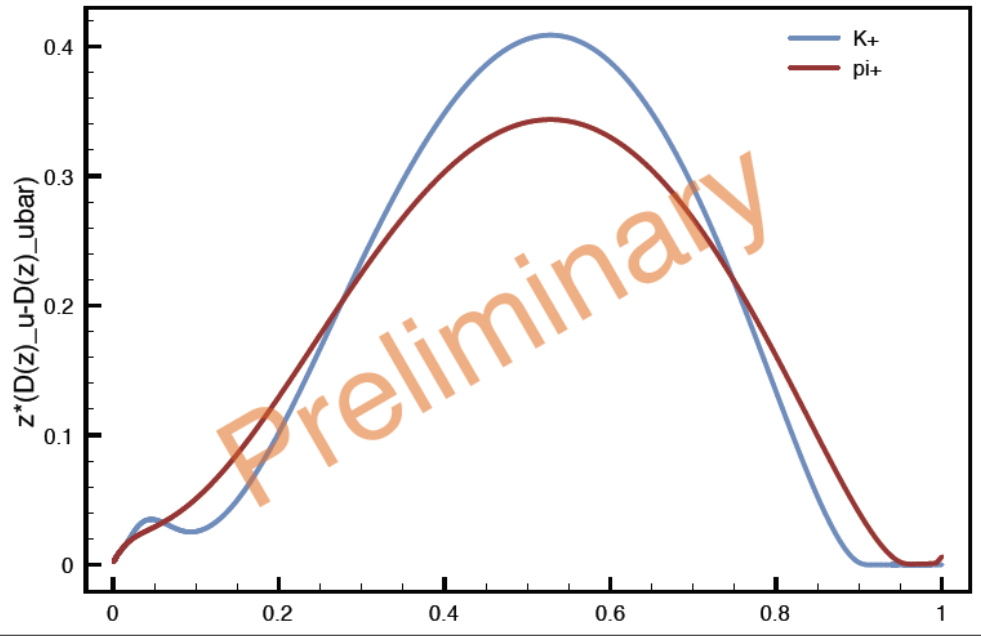




DGLAP Evolved Fragmentations







Outlook

- NJL-Jet model - coupled channel cascade description of fragmentation function.
- Preliminary results: qualitative agreement with empirical parametrizations of experimental data
- Improvements: Include vector mesons and baryons in fragmentation process, NLO DGLAP evolution.
- Fragmentation Ansatz from FT

HAPPY BIRTHDAY TONY!