DRELL-YAN AND PION DISTRIBUTION FUNCTIONS

ECT*
EUROPEAN CENTRE
FOR THEORETICAL STUDIES
IN NUCLEAR PHYSICS AND RELATED AREAS
FONDAZIONE BRUNO KESSLER

DANIELE BINOSI
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Parton Distribution Functions at a Crossroad

ECT* Trento, Italy
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(classical)
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$$\mathcal{L}_{\mathrm{QCD}} = \sum_{j=u,s,d,\ldots} \bar{q}_j \left[\gamma_\mu D_\mu + m_j\right] q_j + \frac{1}{4} G^a_{\mu\nu} G^a_{\mu\nu}$$

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pure-glue QCD displays a **mass gap**

$$m_g \sim 0.5 \text{ GeV}$$

Cornwall, PRD 26 (1982)

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2-point STI can be still satisfied with

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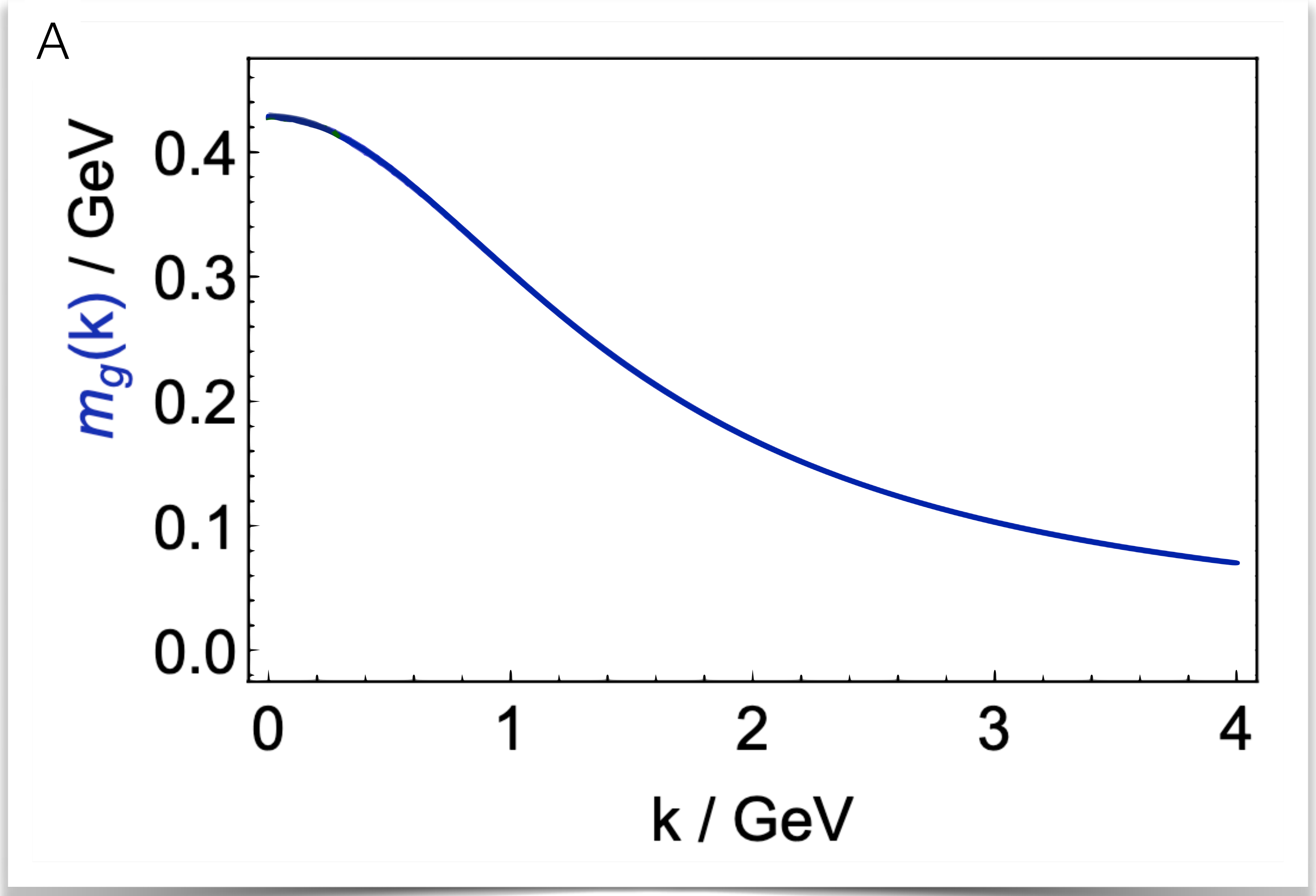

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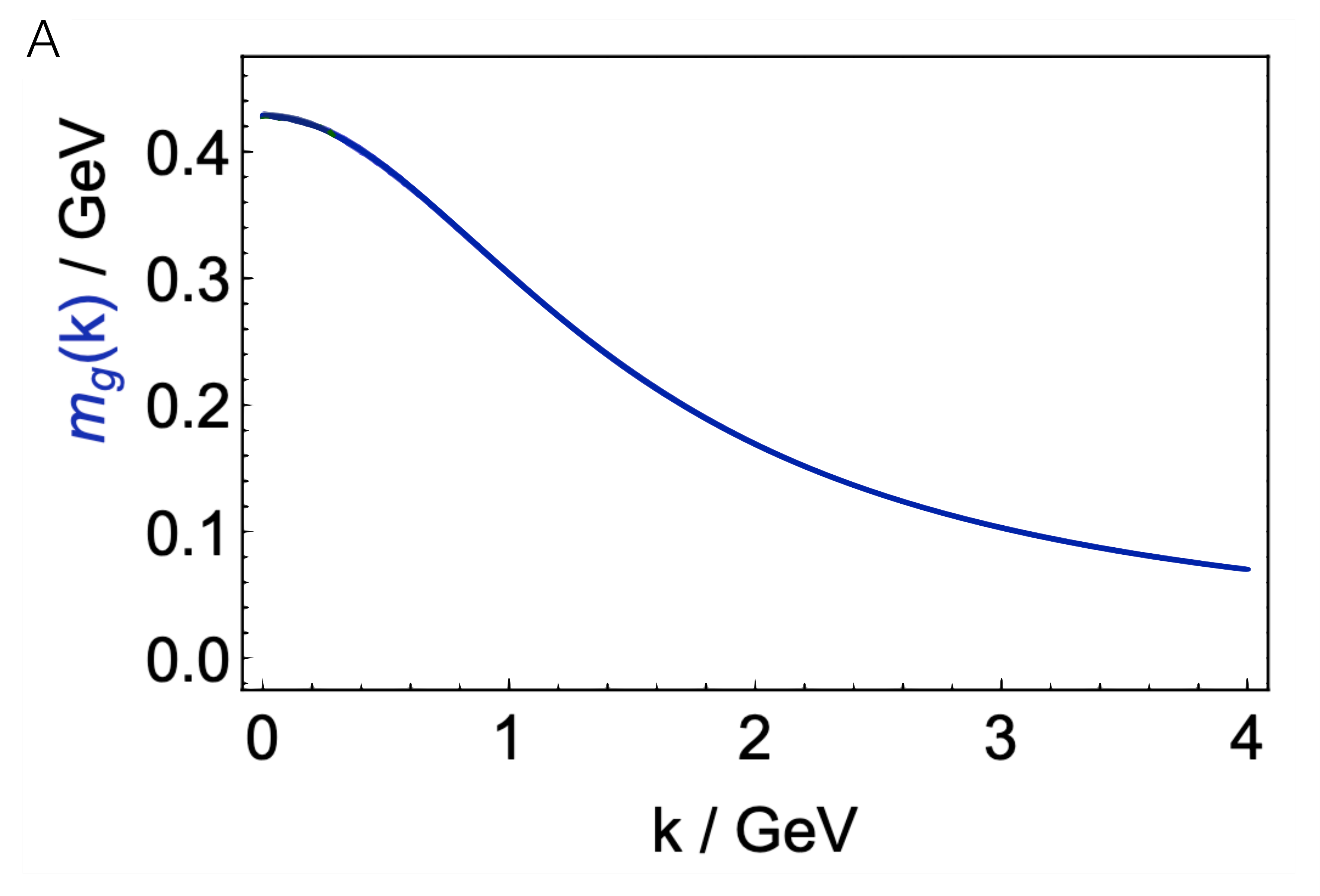

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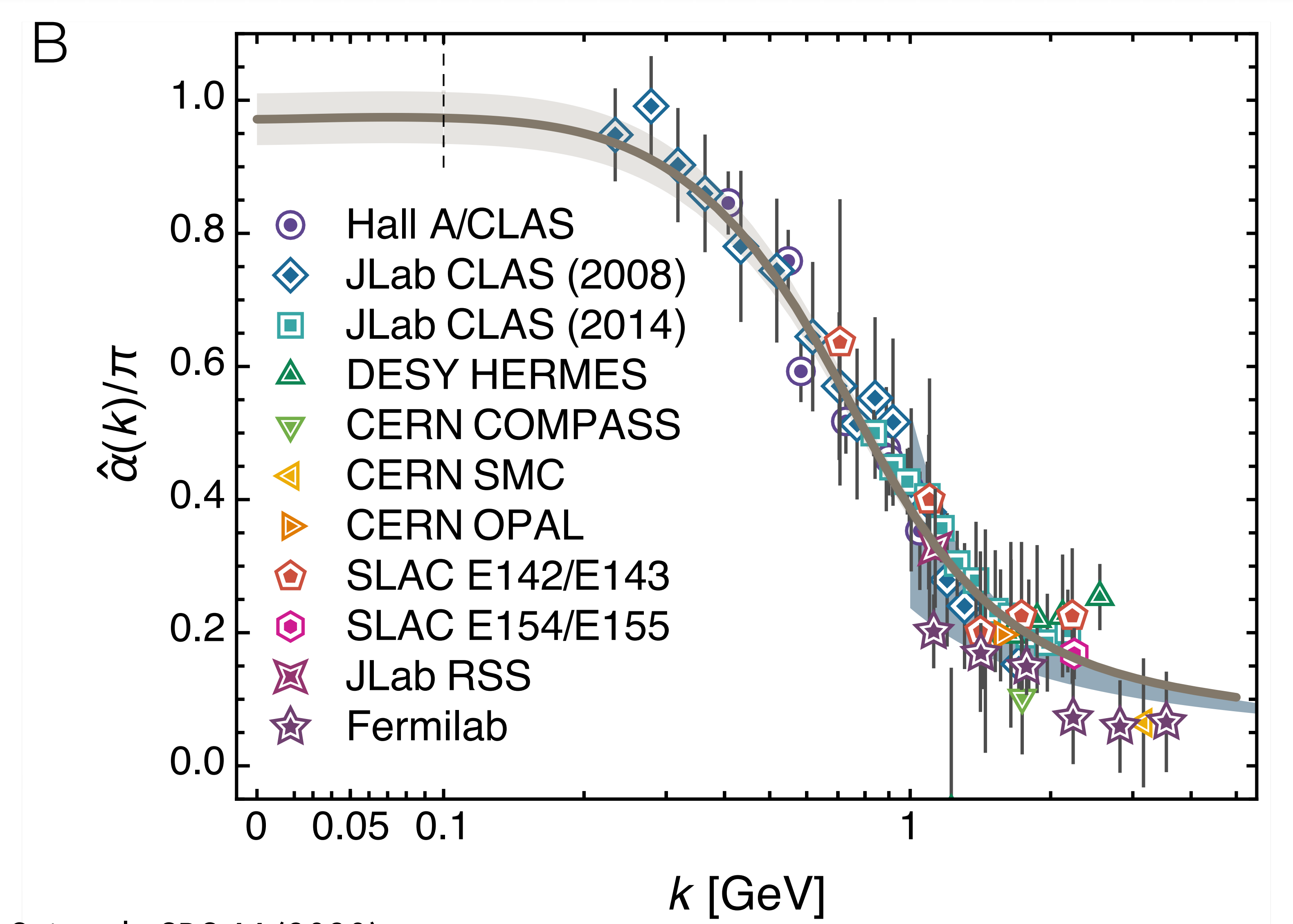

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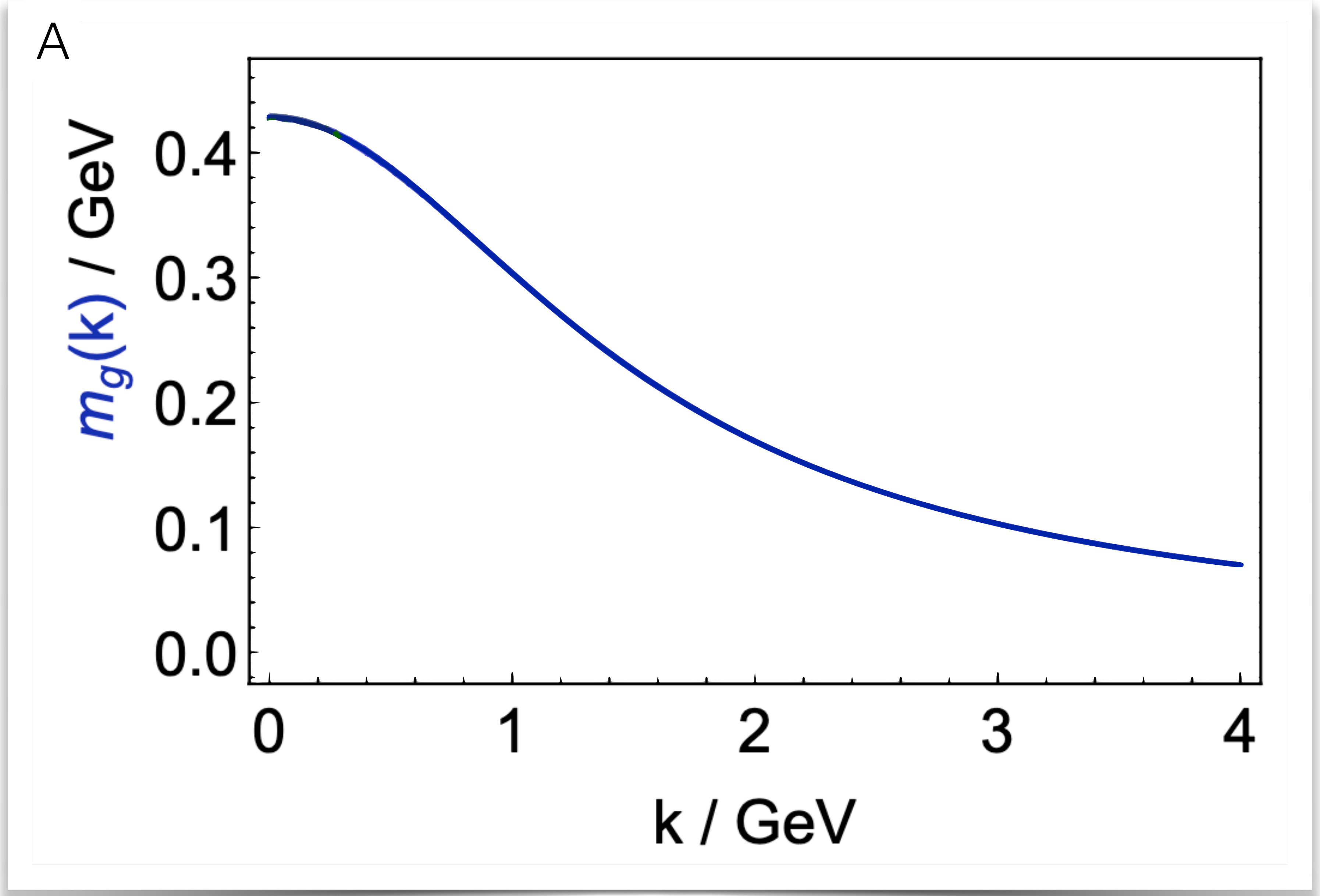

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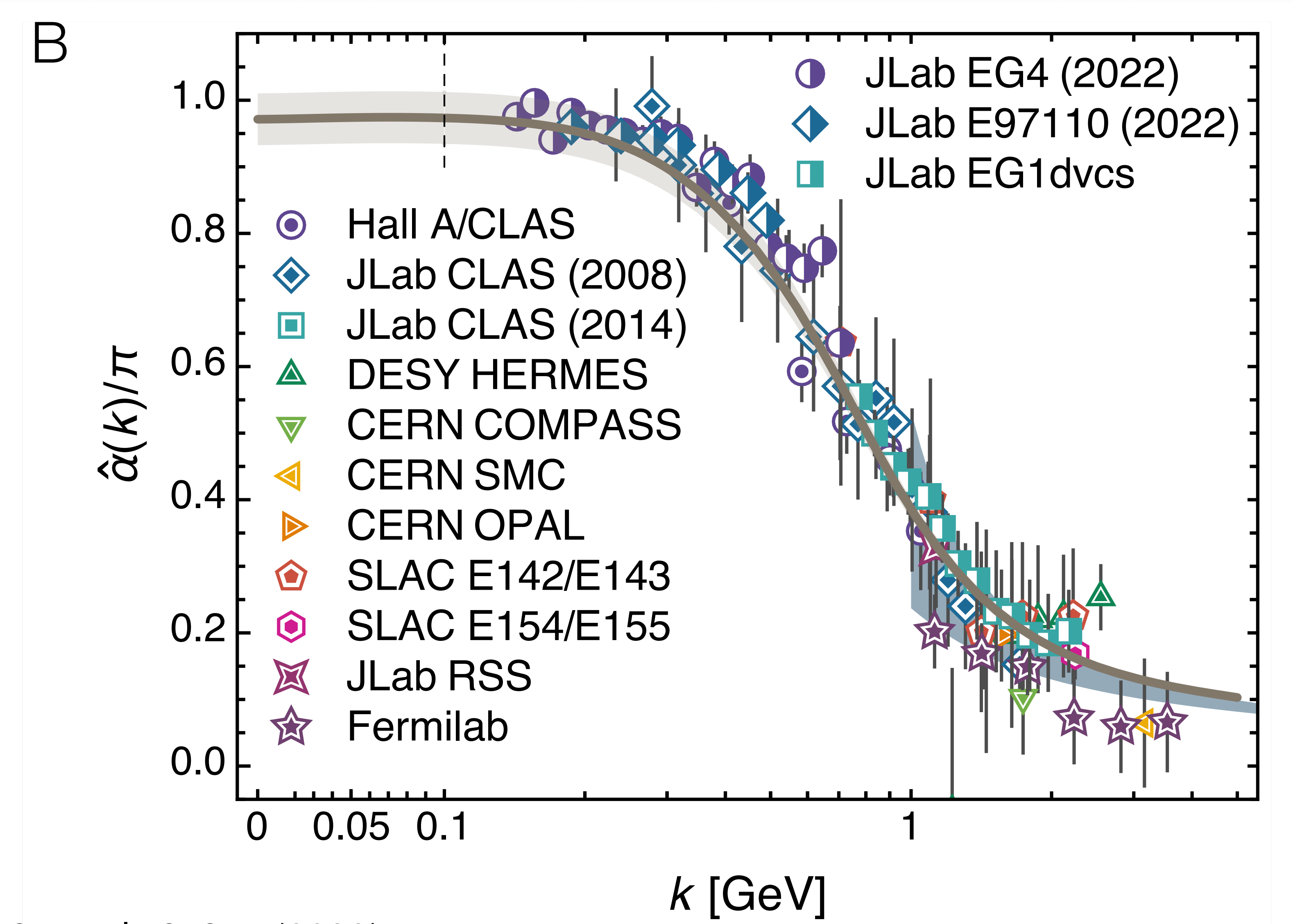

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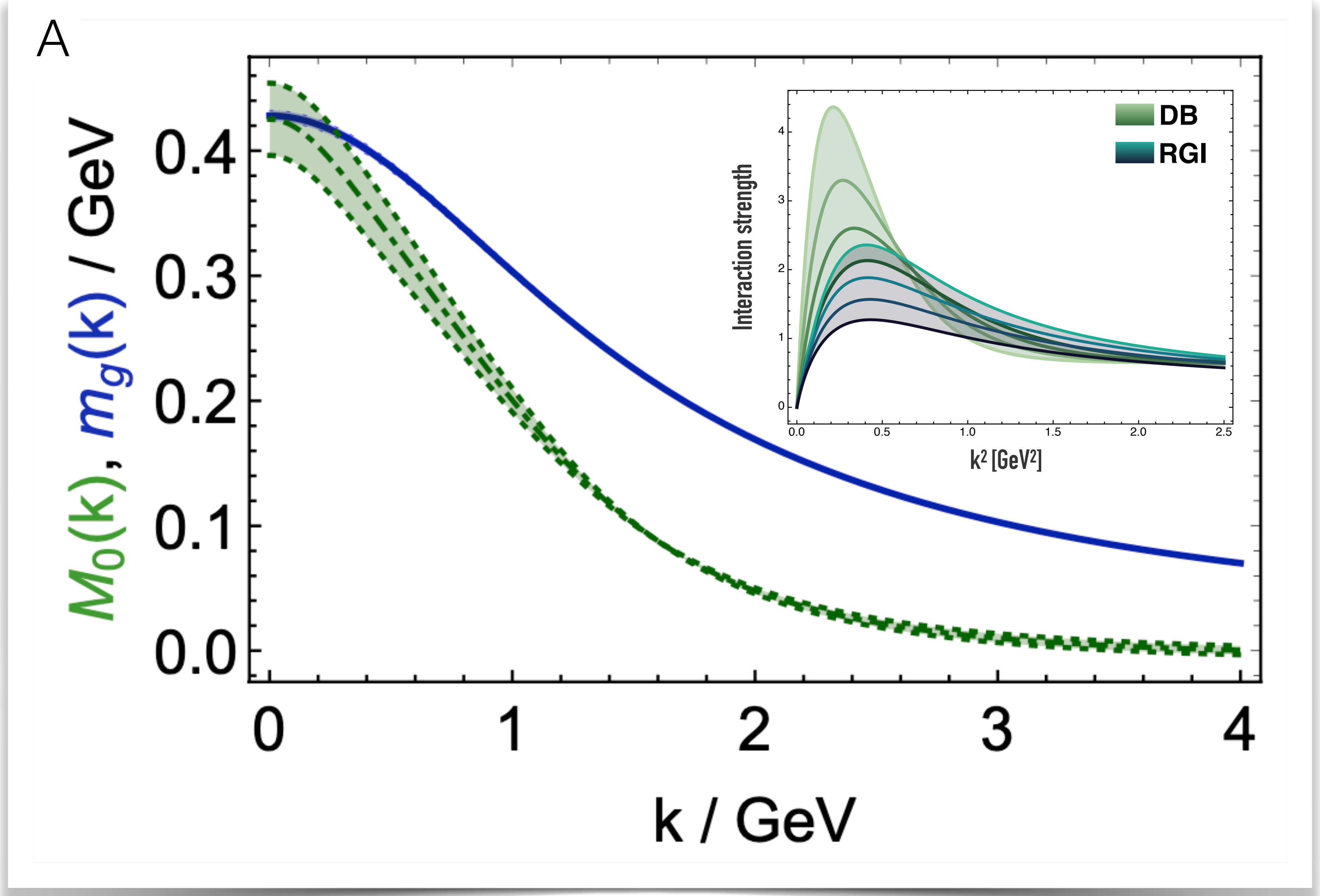

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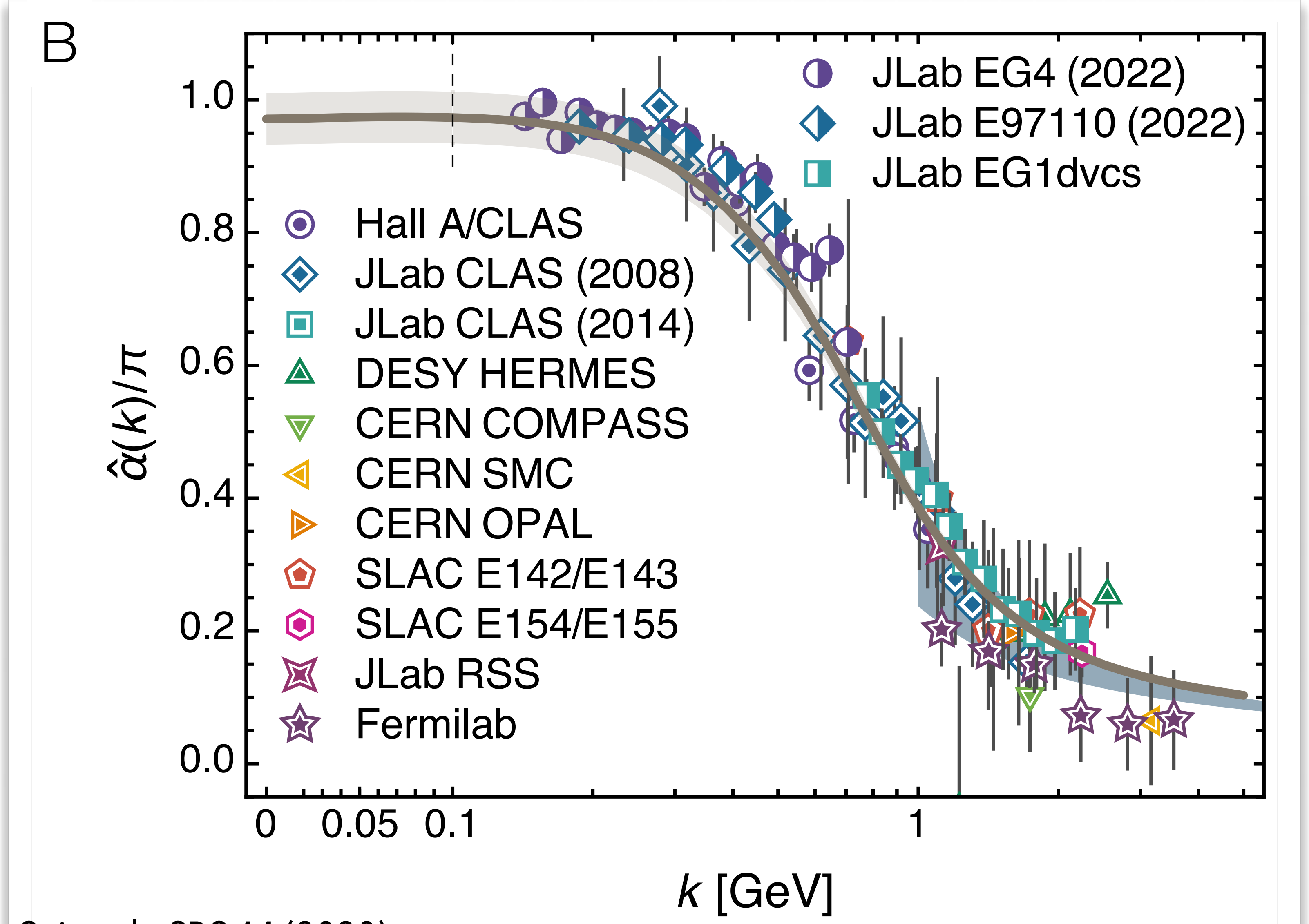

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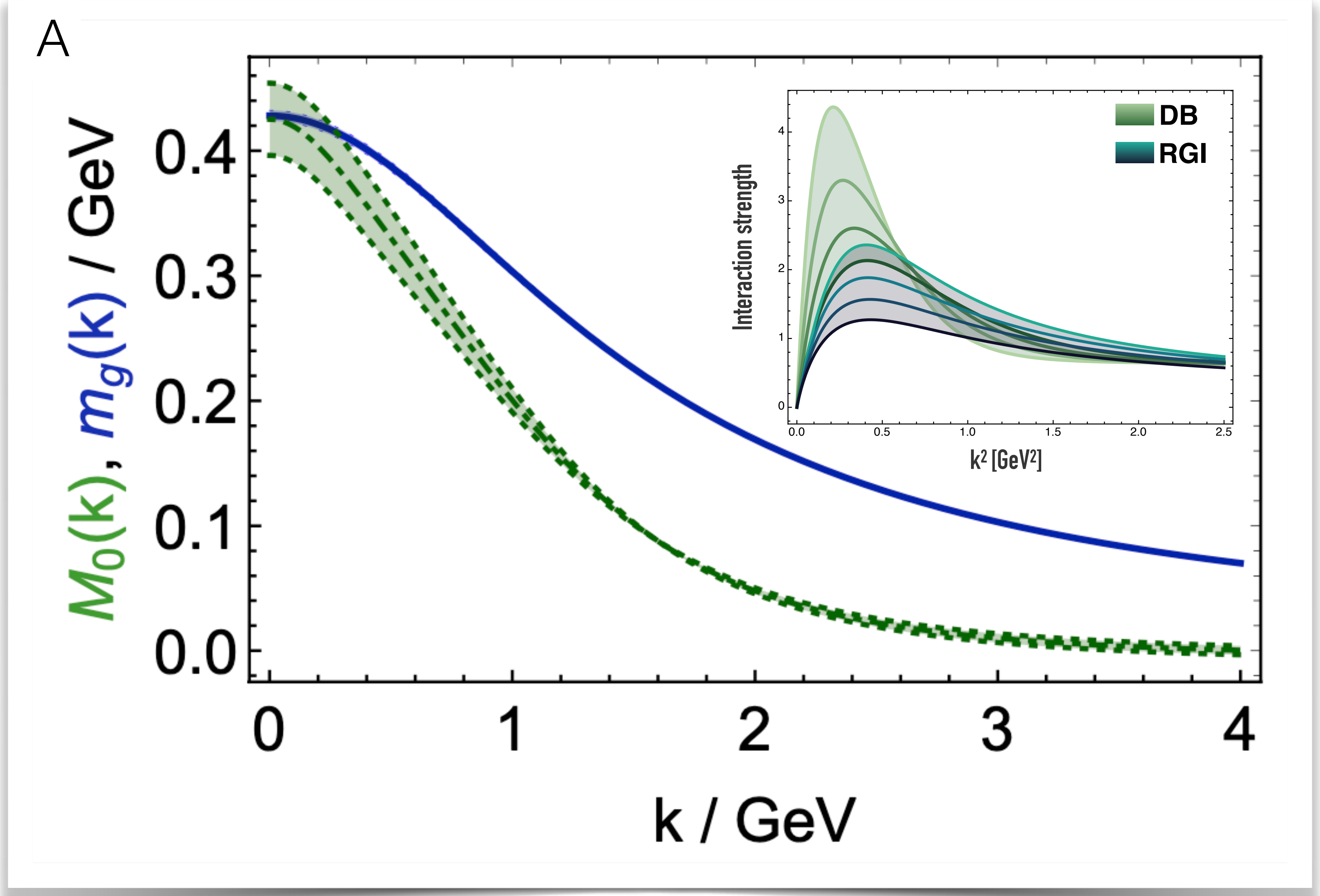

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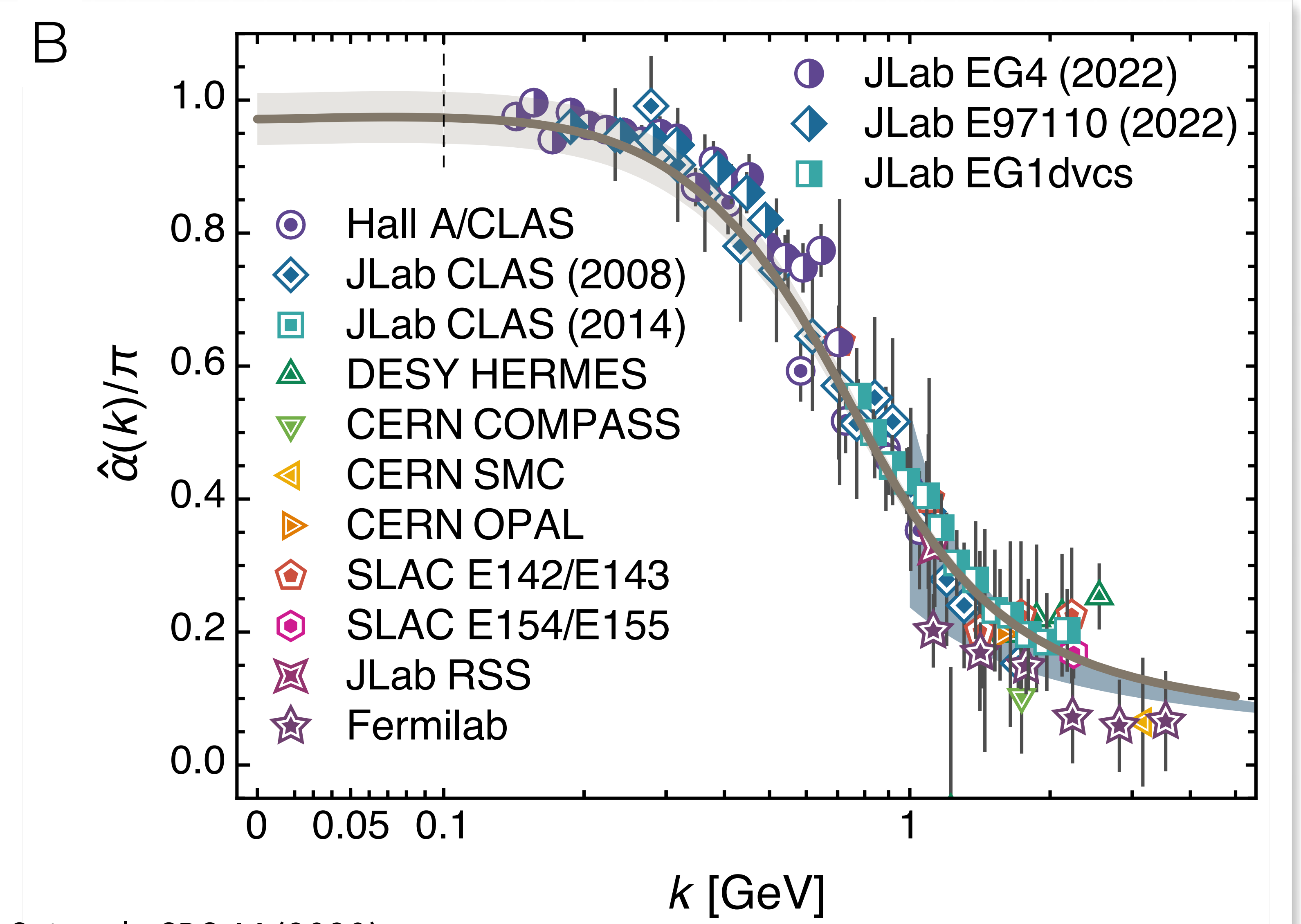

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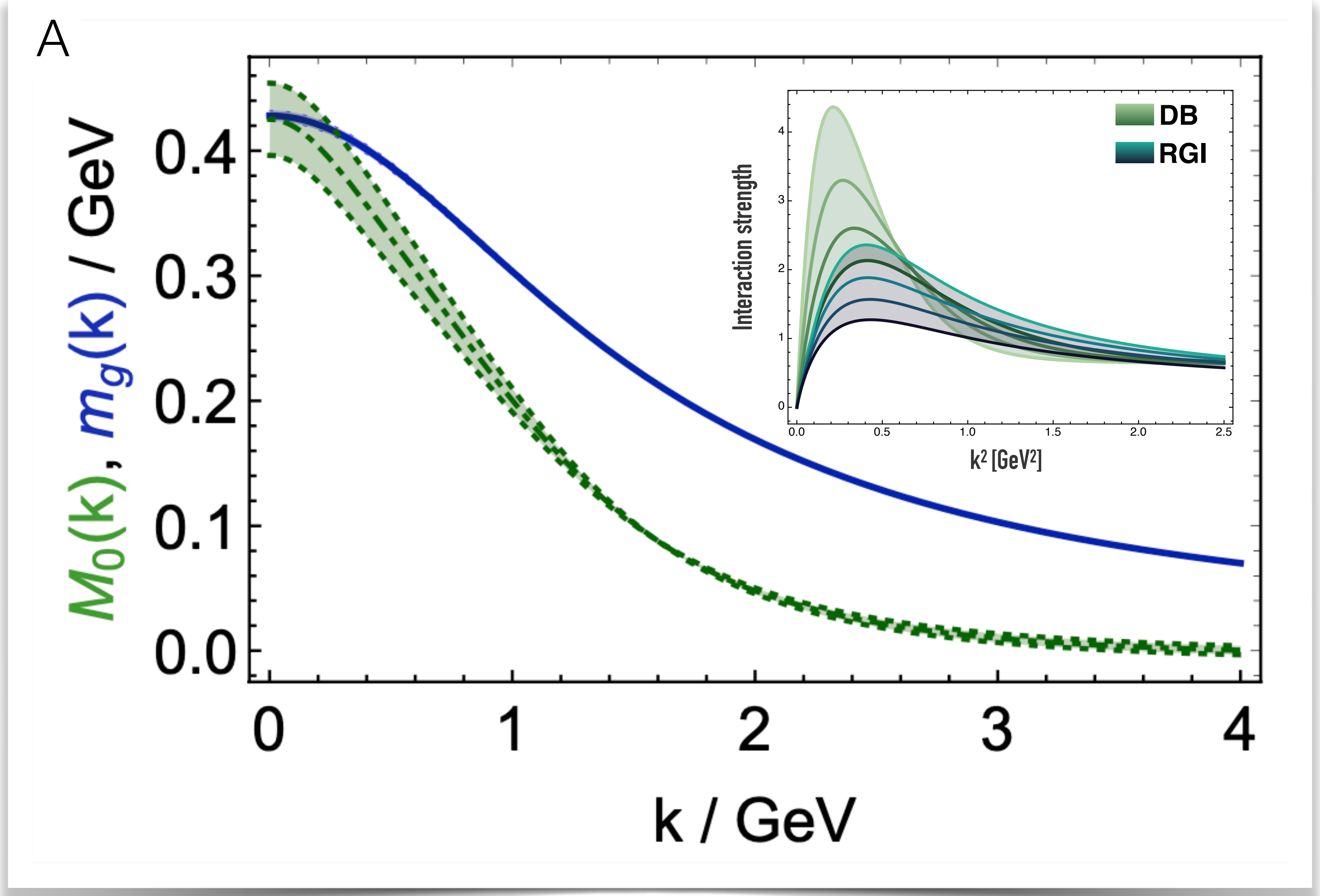

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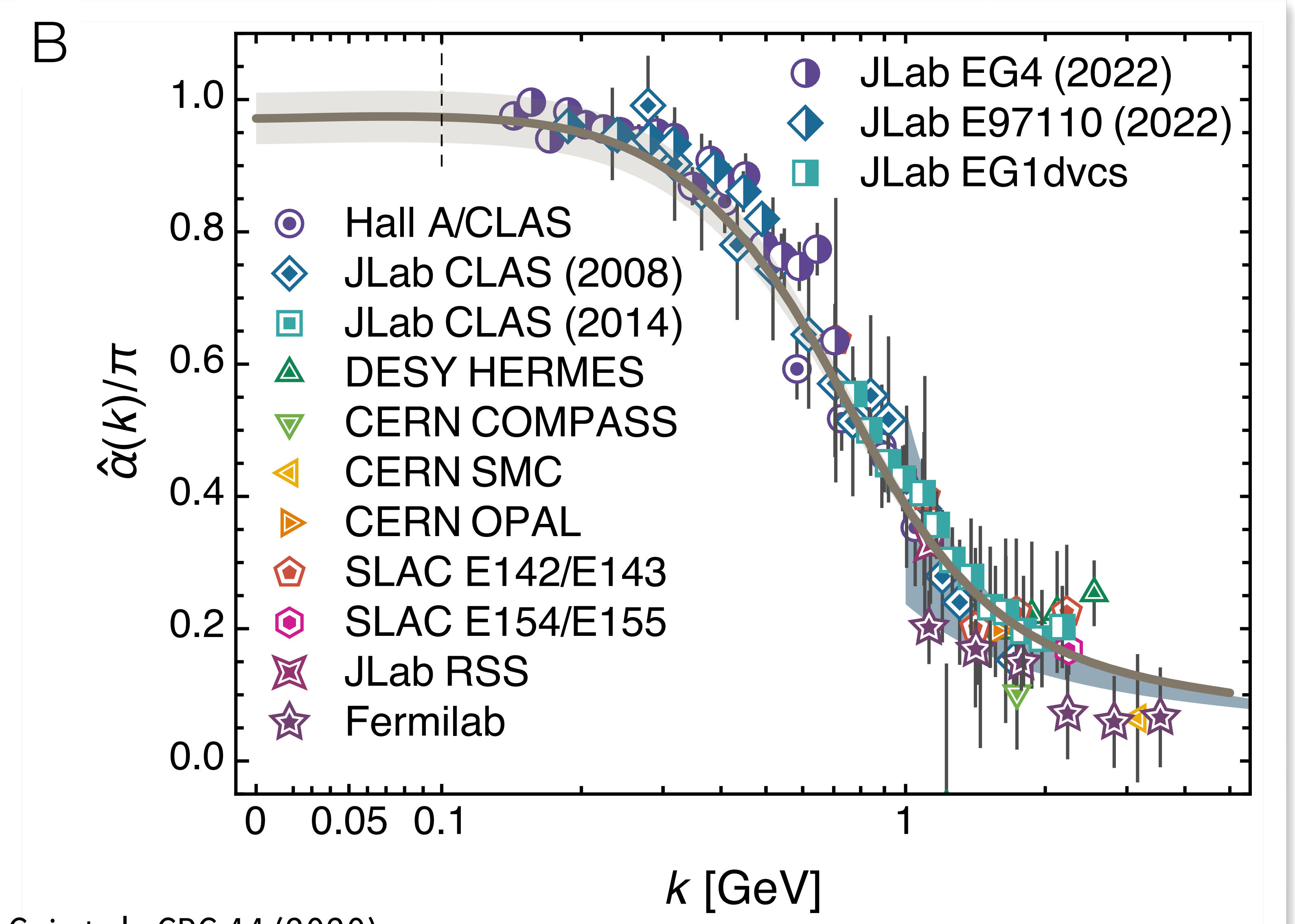

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Instituto de Física de São Carlos, Universidade de São Paulo, Caixa Postal 369, 13560-970 São Carlos, SP, Brazil
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① RGI MASSES

PROCEEDINGS OF SCIENCE

What's up with IR gluon and ghost propagators in Landau gauge? A puzzling answer from huge lattices

Attilio Cucchieri* and Tereza Mendes
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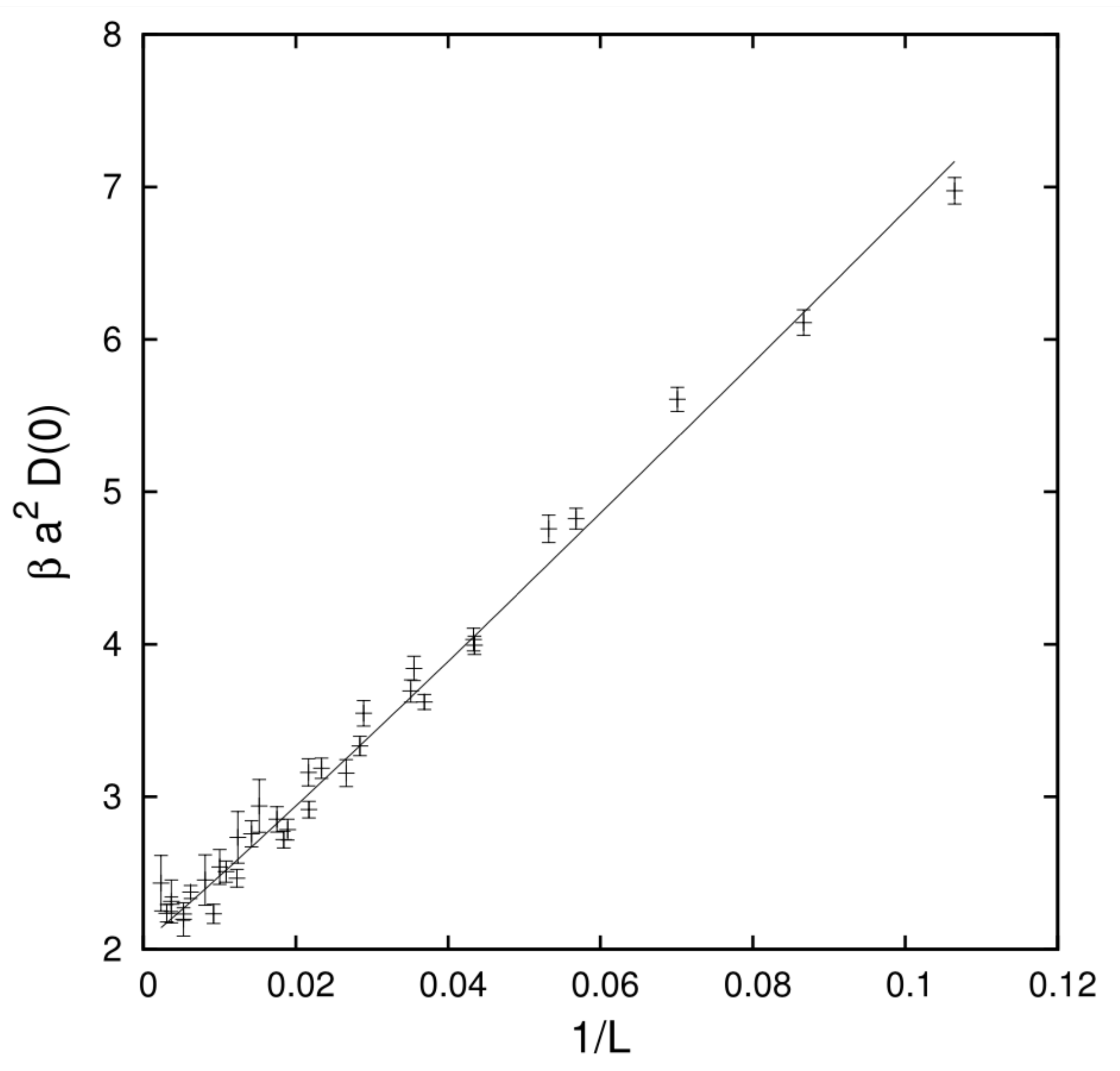
E-mail: attilio@ifsc.usp.br, mendes@ifsc.usp.br



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[A]guilar et al., EPJC 80 (2020)

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DB et al., PLB 742 (2015)

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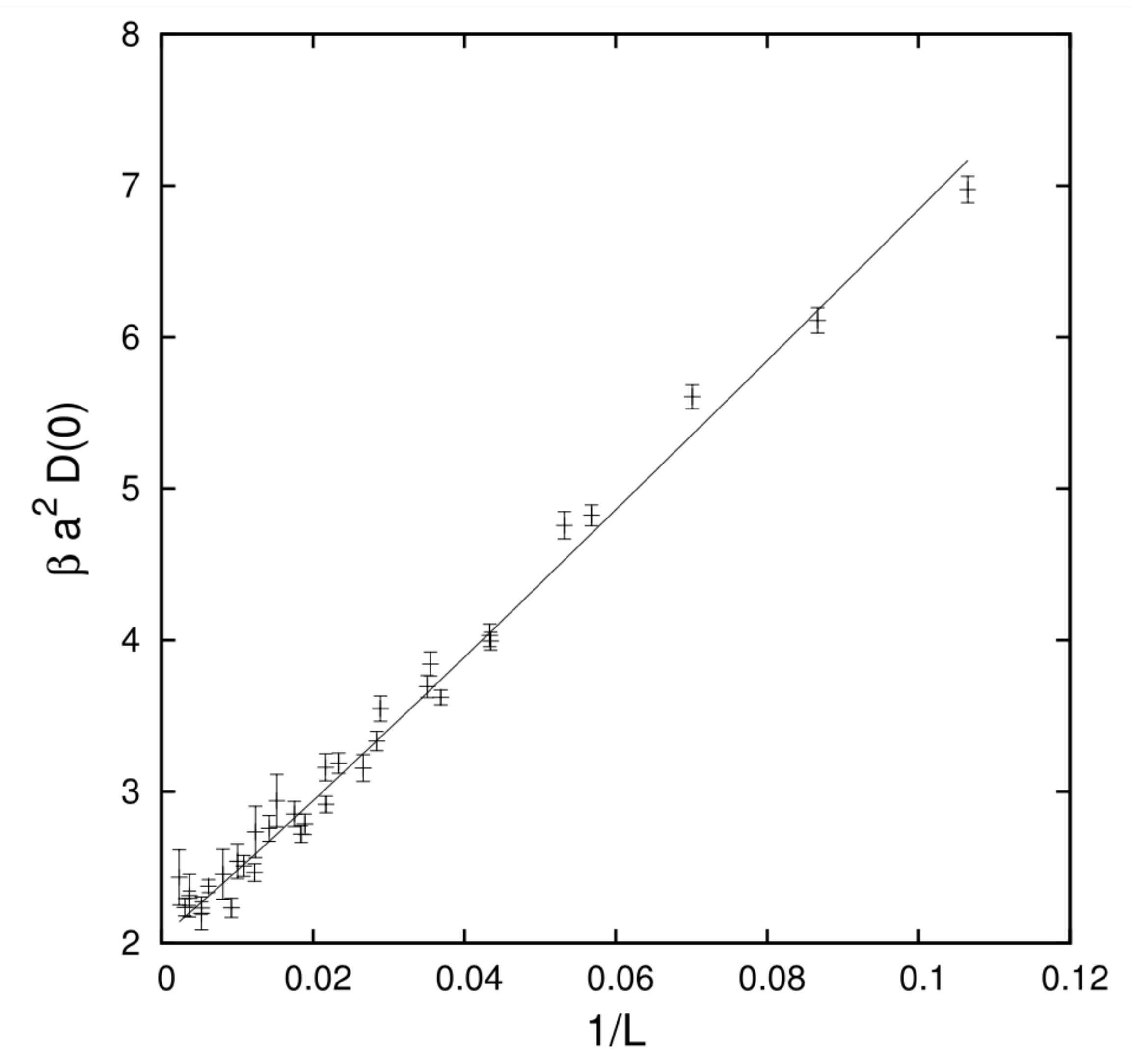

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GAUGE SYMMETRY IS FINE

2-point STI can be still satisfied

$$\Delta_{\mu\nu}(q) = \frac{P_{\mu\nu}(q)}{q^2[1+\Pi(q^2)]}, \quad q^\mu P_{\mu\nu}(q) \dots$$

$$\lim_{q^2\to 0} q^2 \Pi(q^2) = m_g$$

("only" requires the presence of longitudinally coupled massless po...

Schwinger, PR 125 and 128

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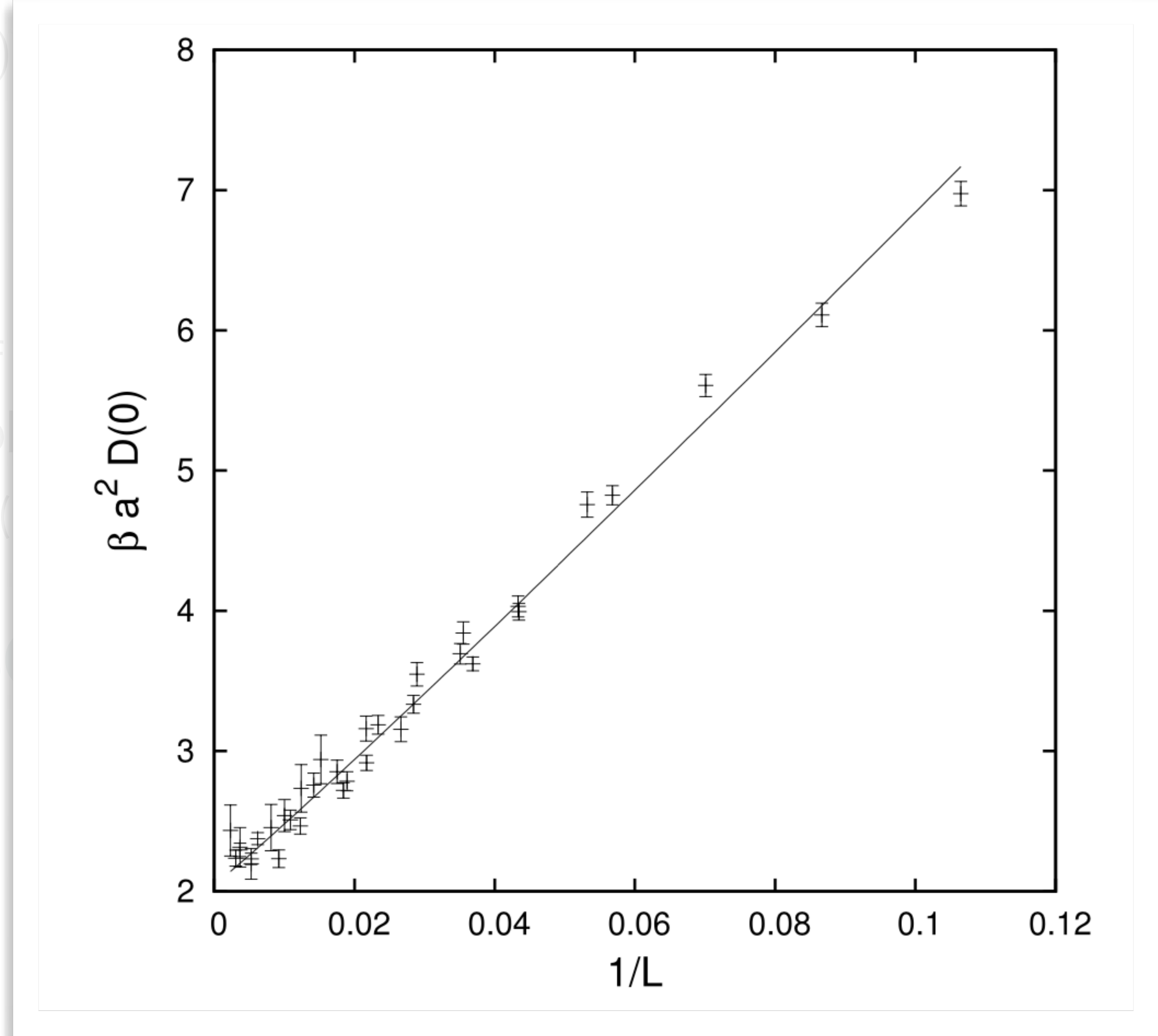

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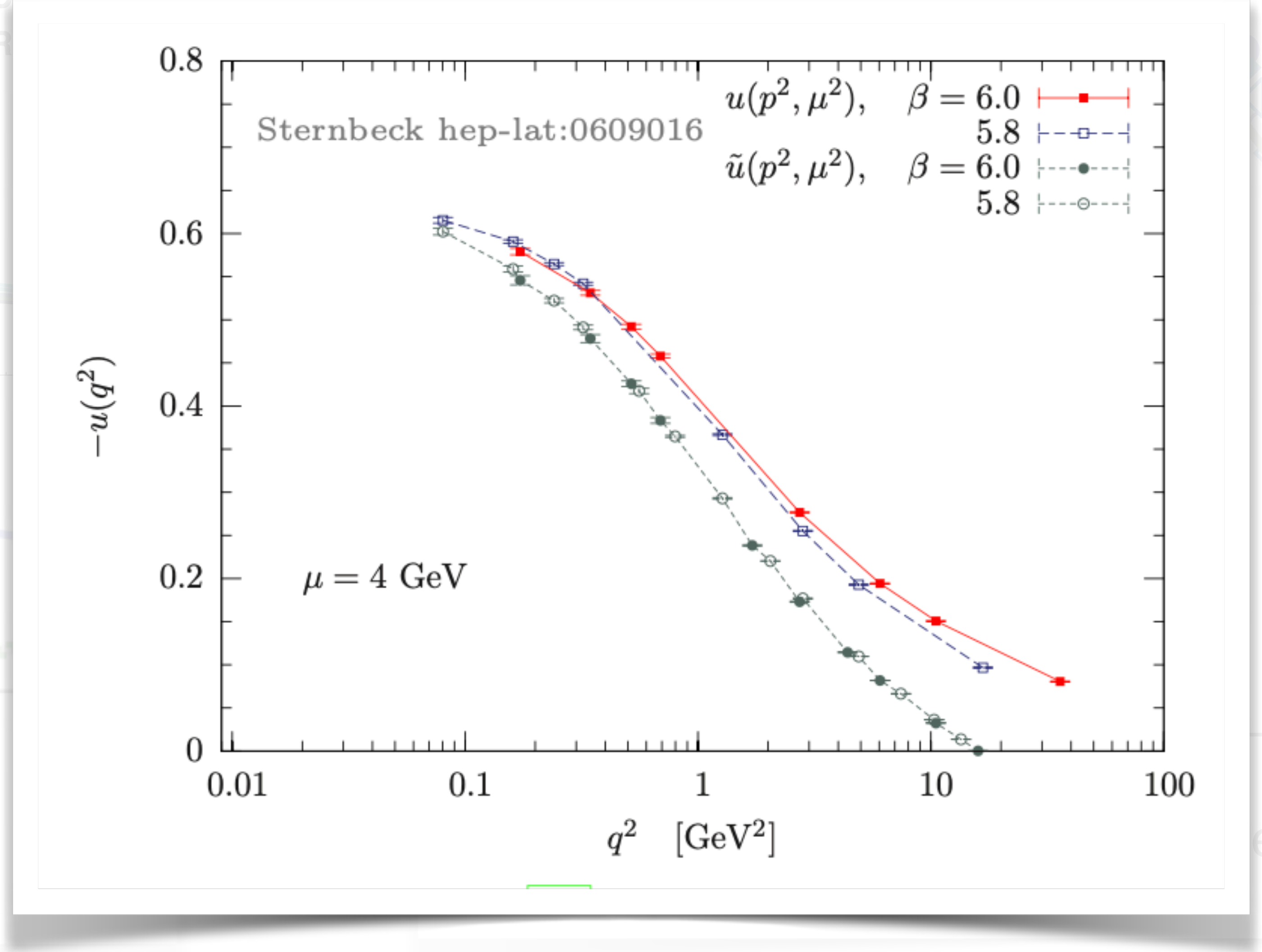
The Infrared behavior of lattice QCD Green's functions
Andre Sternbeck (Humboldt U., Berlin) (Sep, 2006)
e-Print: hep-lat/0609016 [hep-lat]



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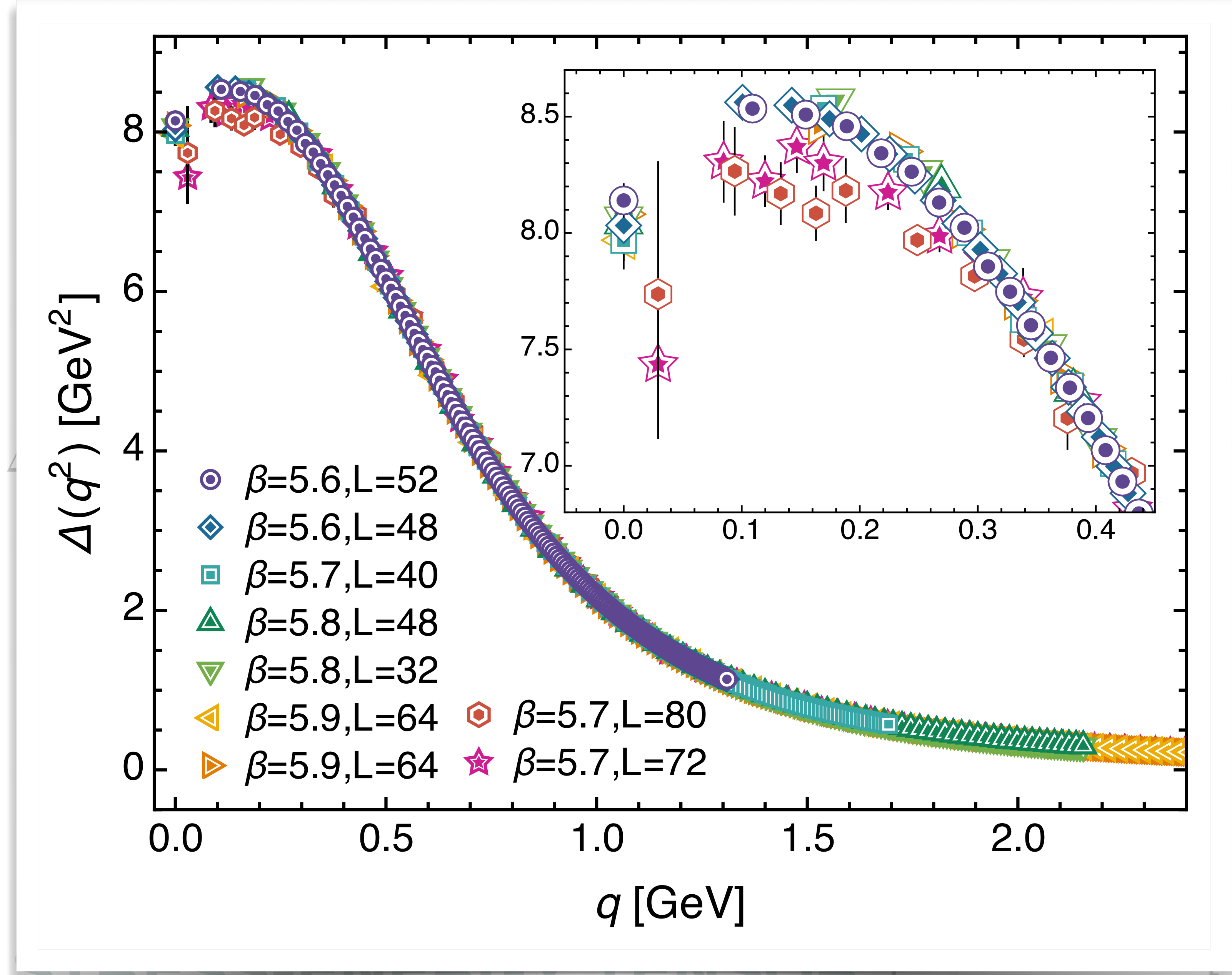

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Aguilar et al., EPJC 80 (2020)

…nd reveal the associated RGI running masses,

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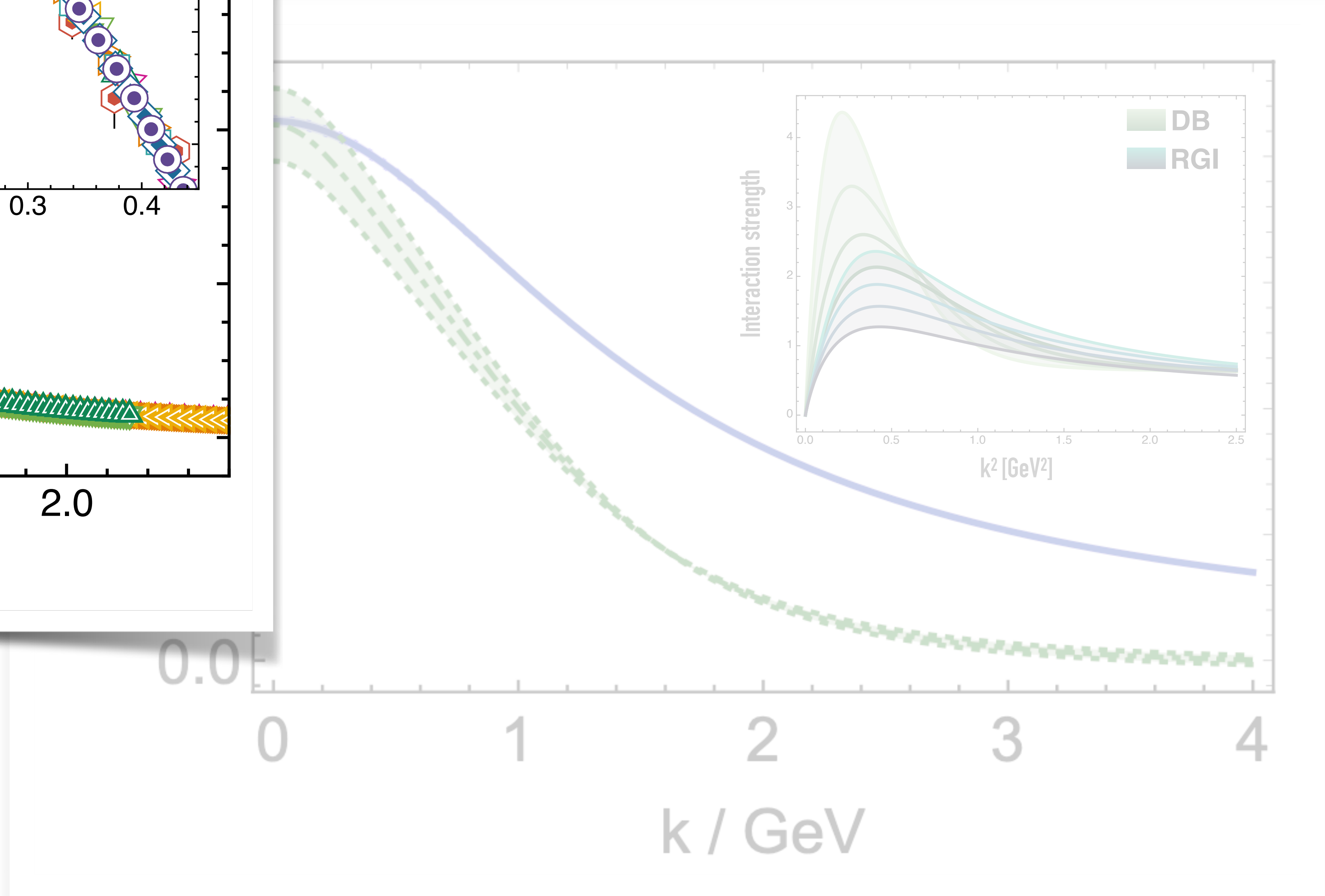

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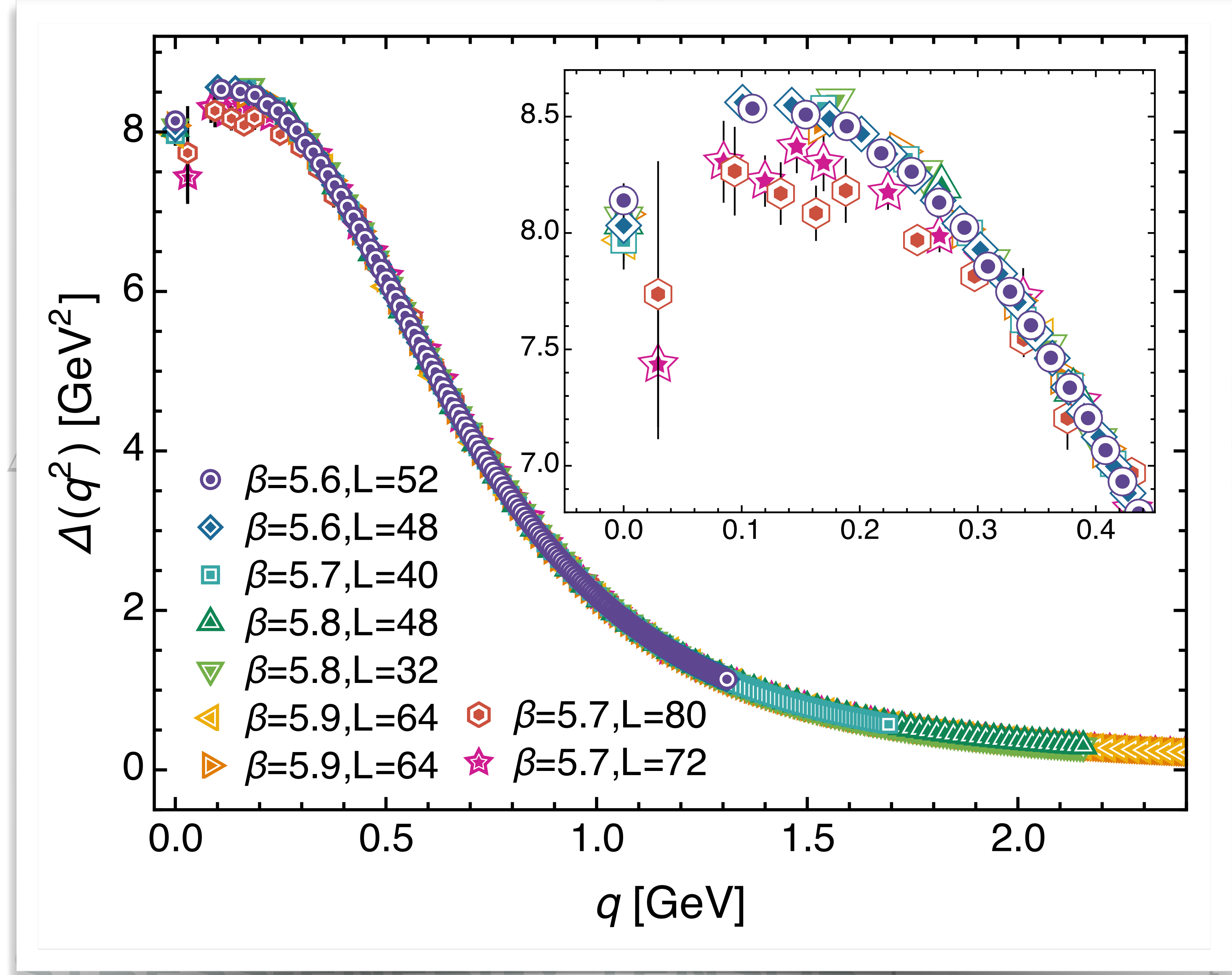

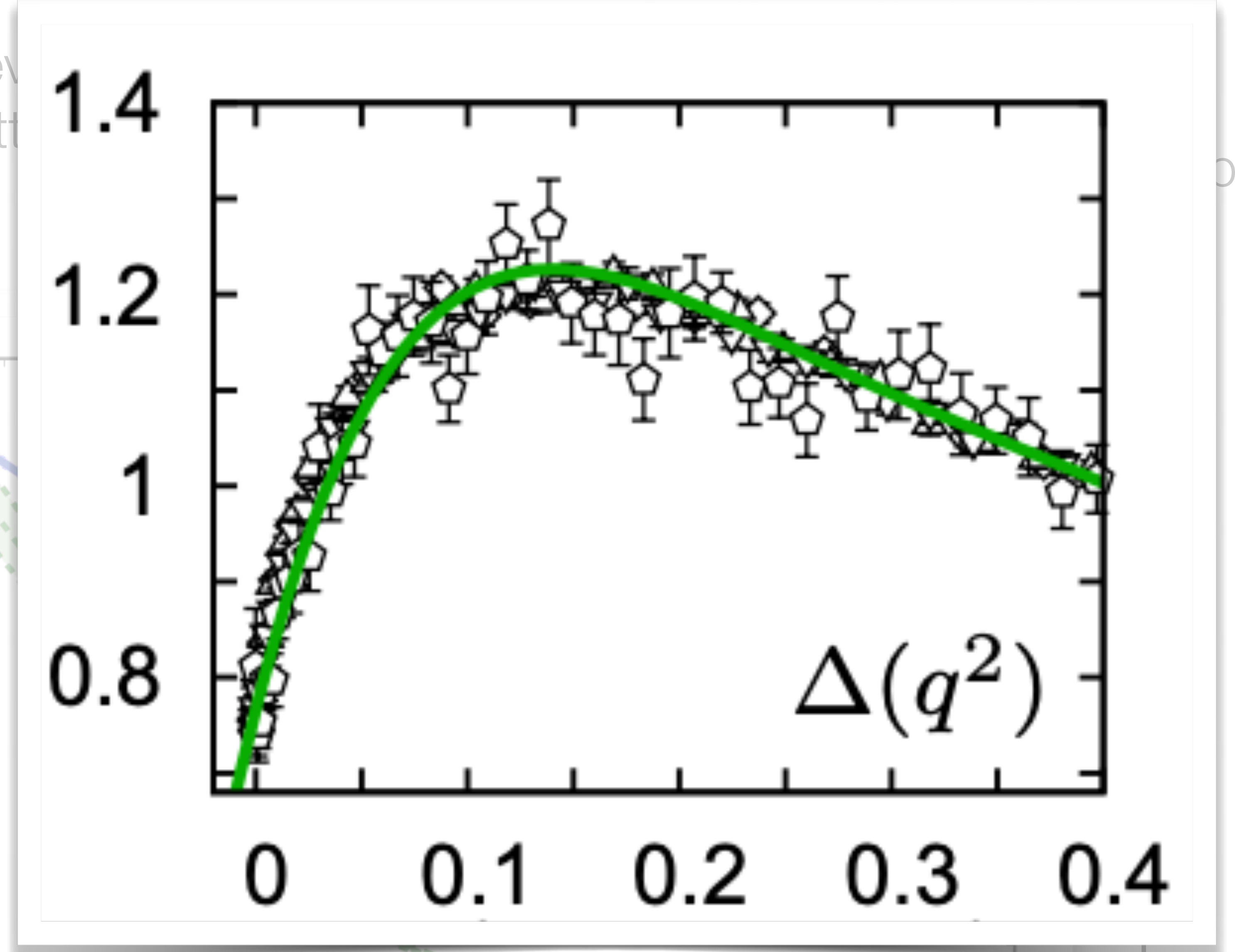

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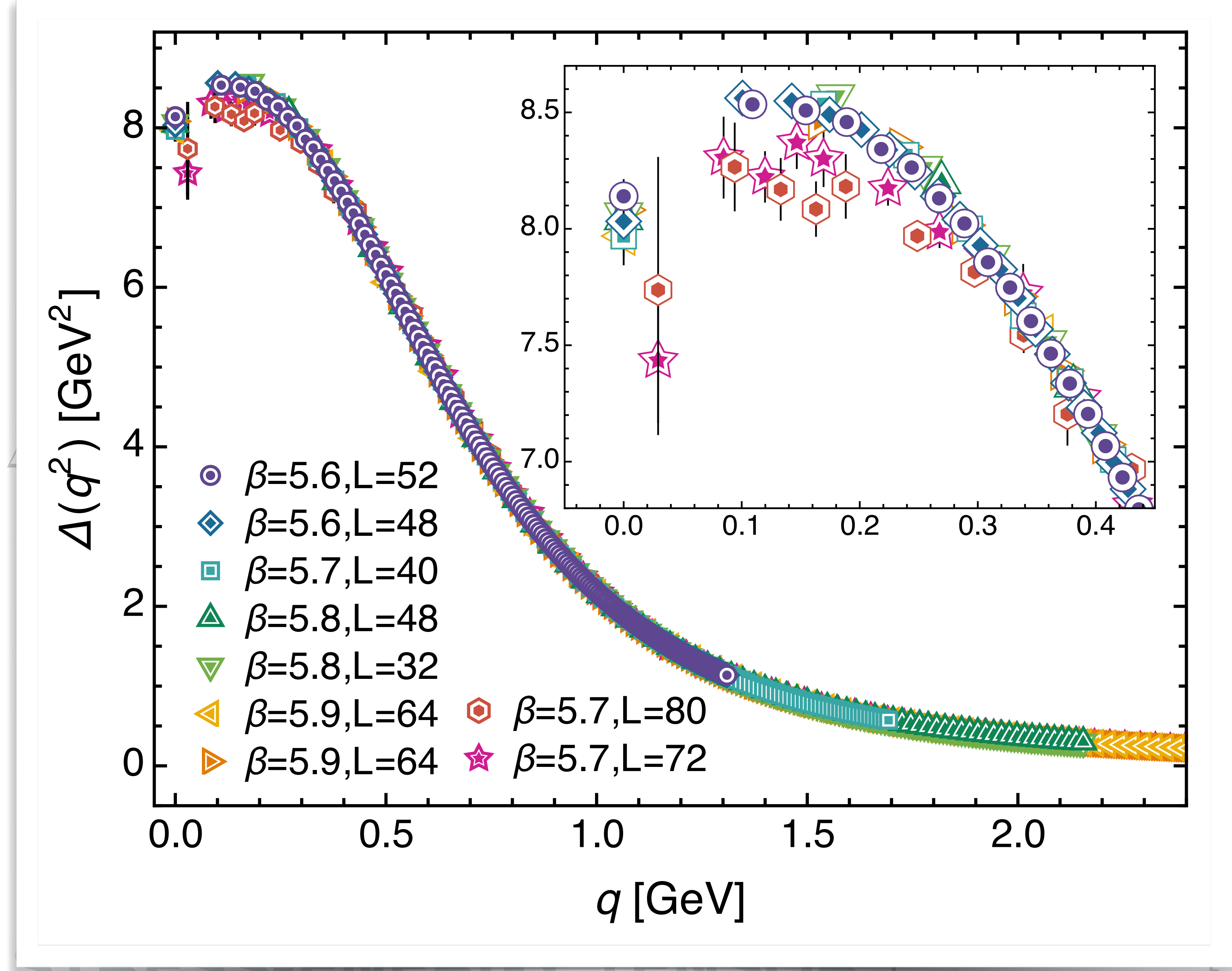

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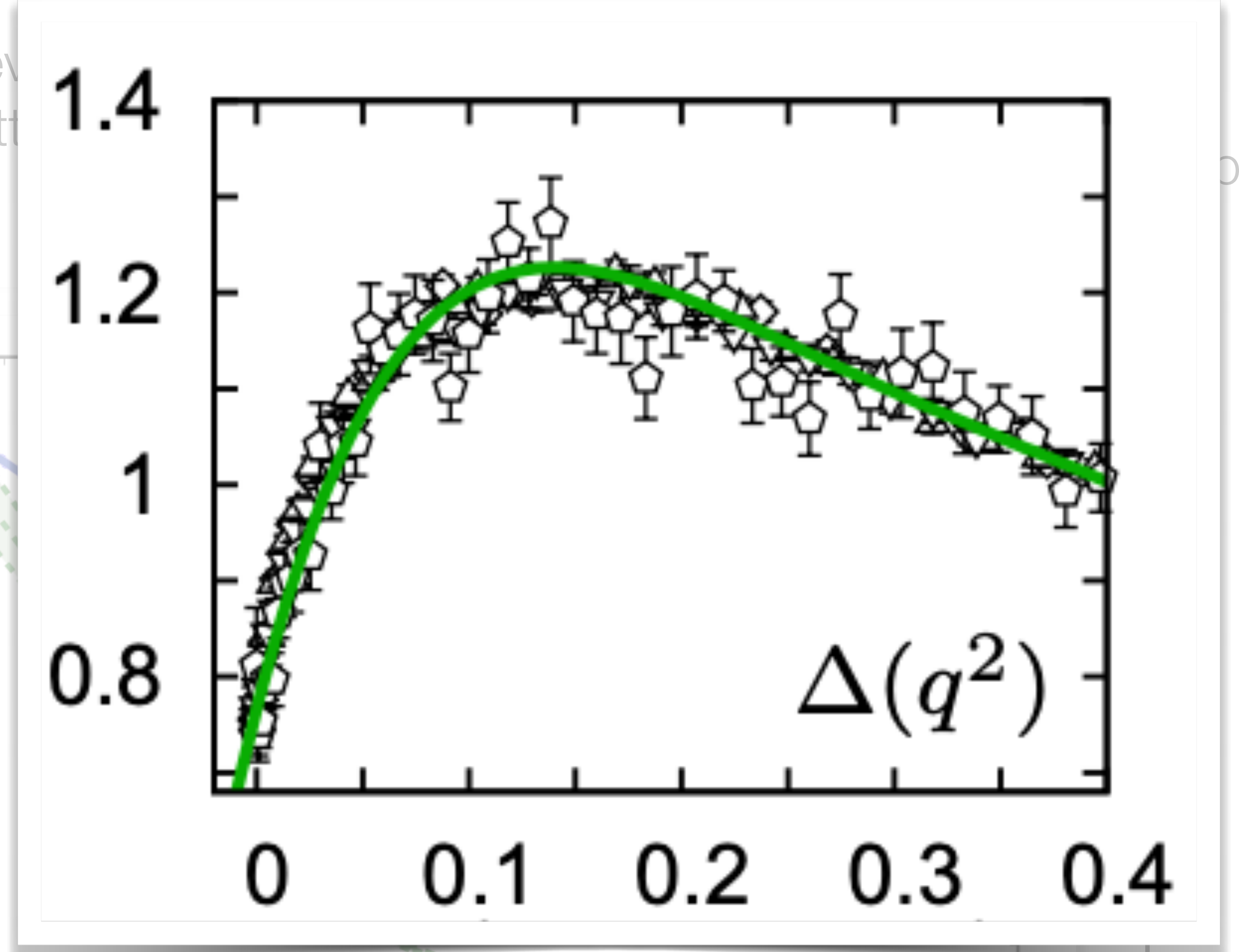

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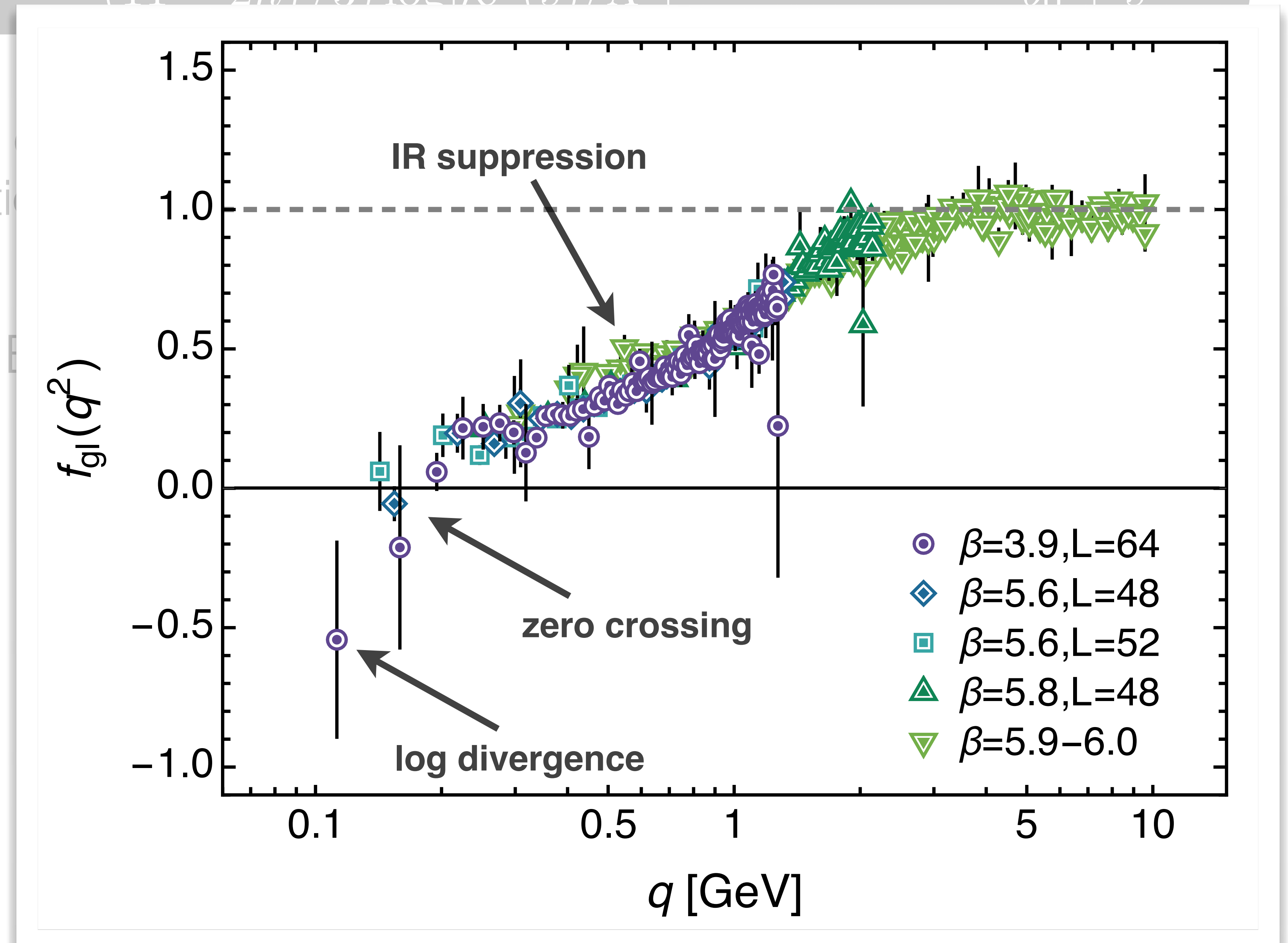

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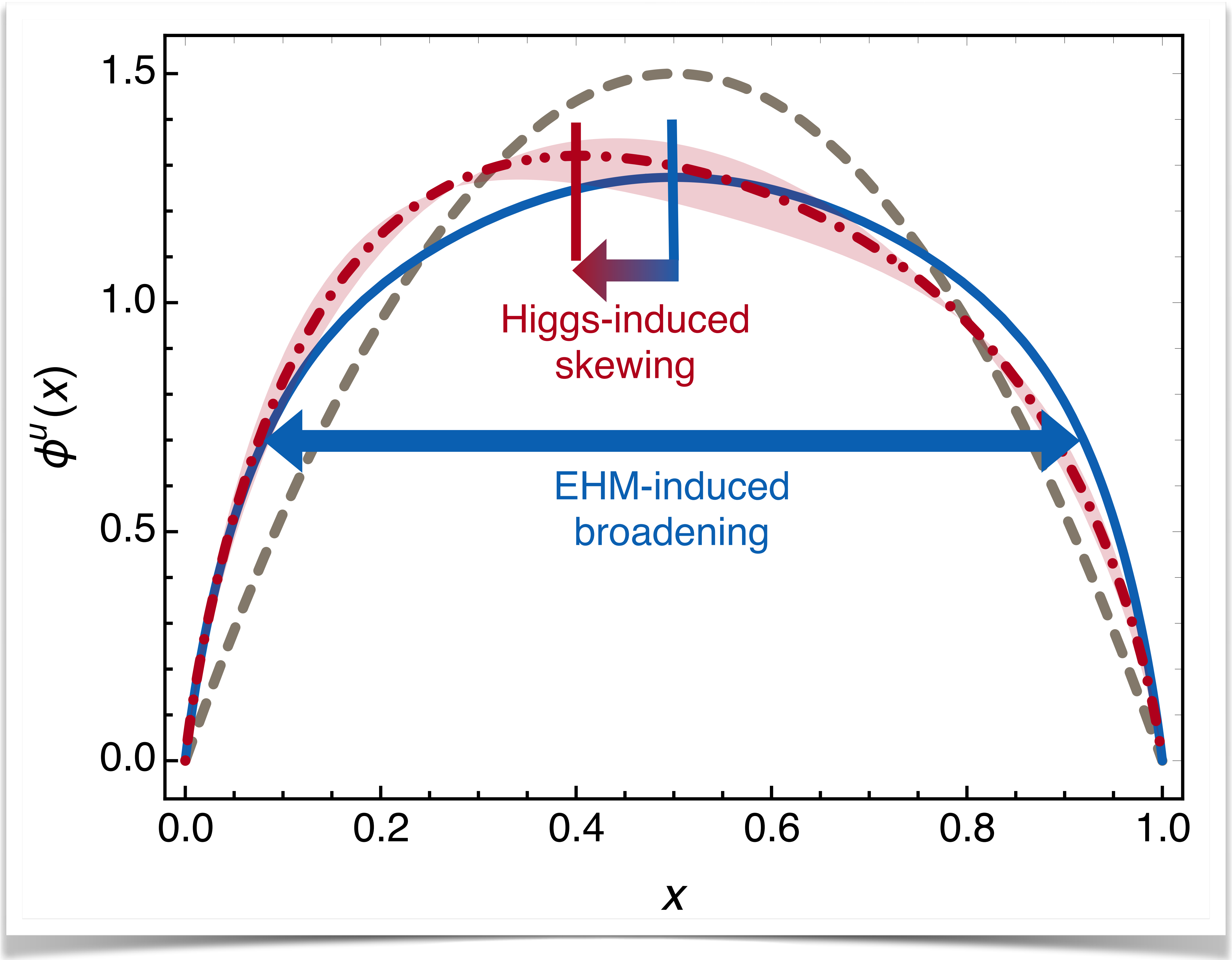

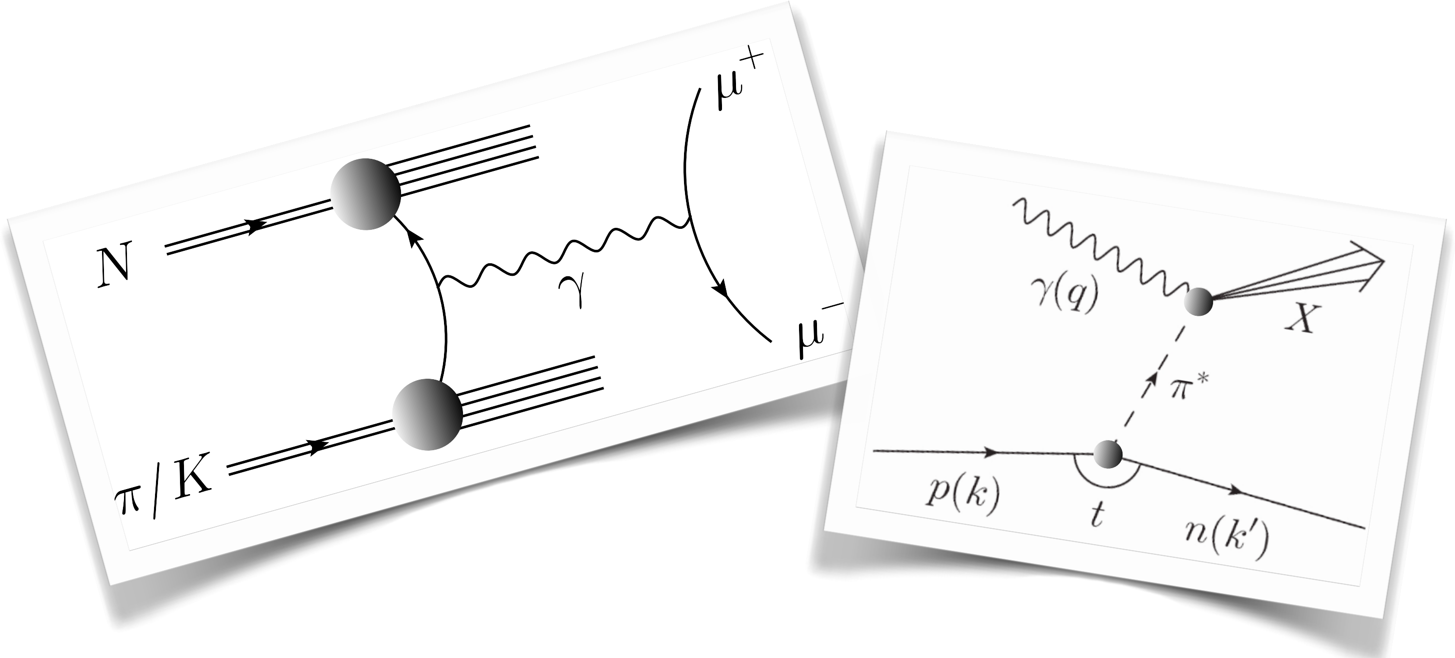

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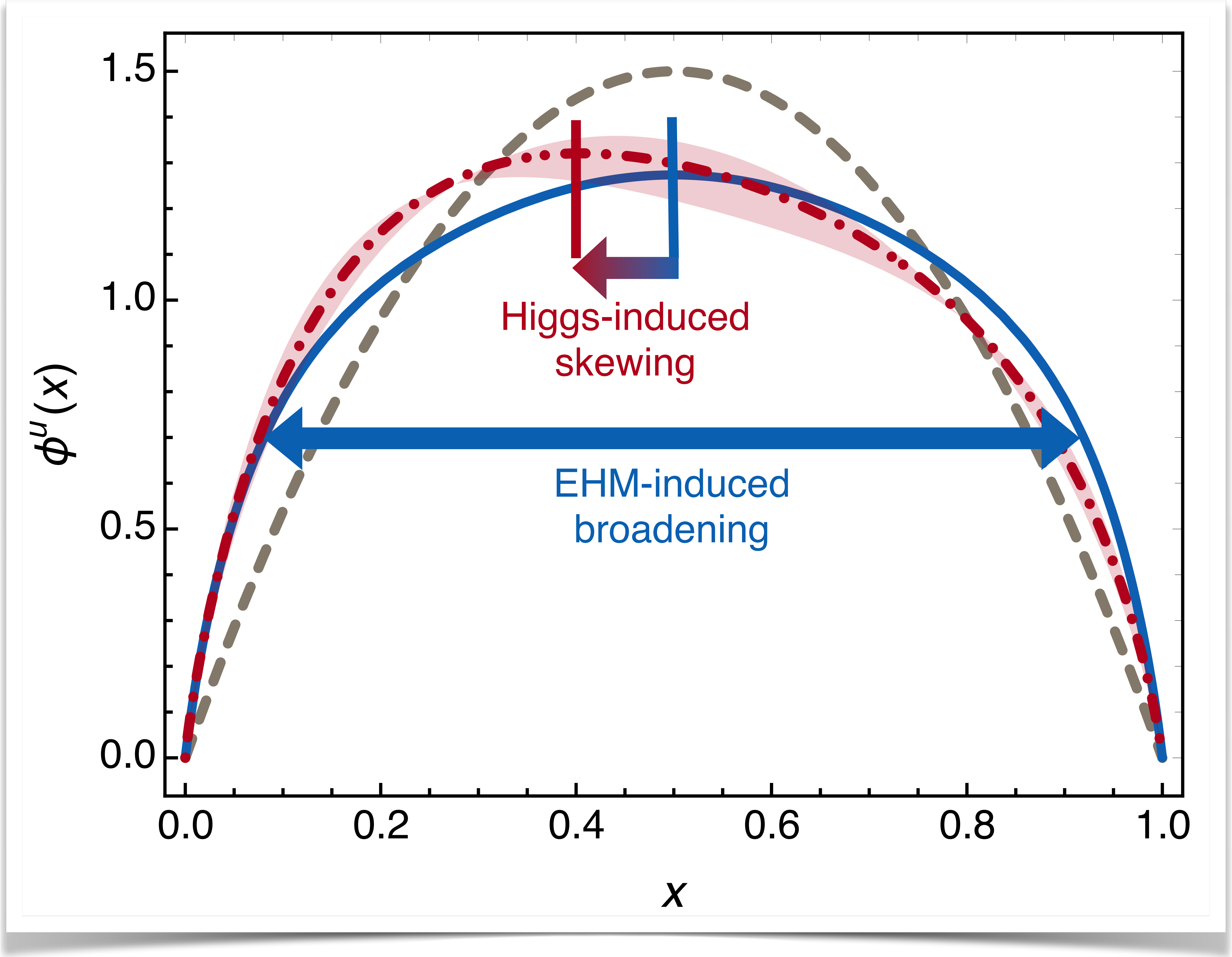

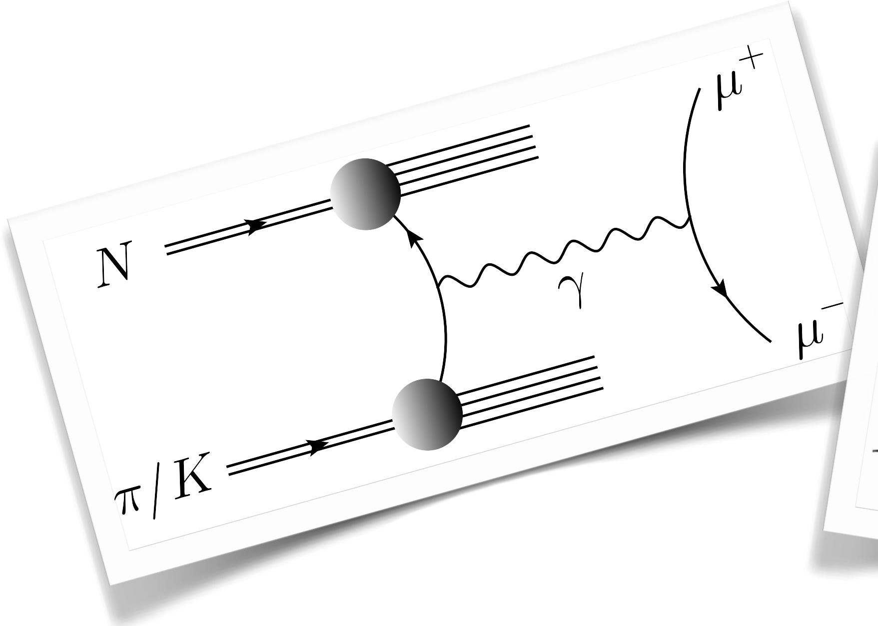

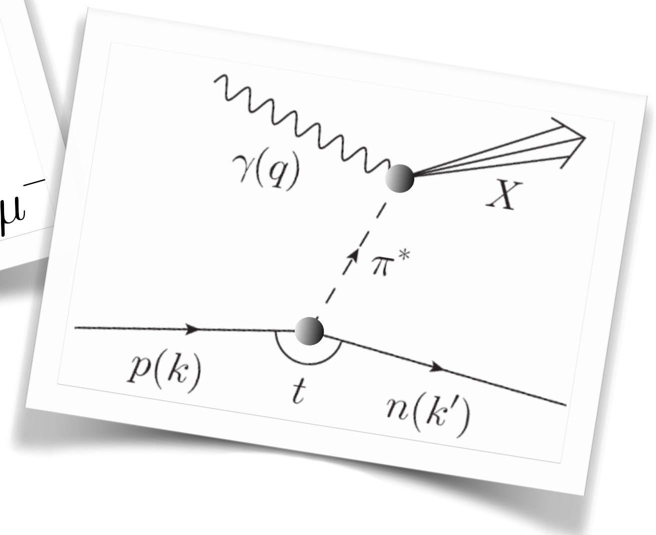

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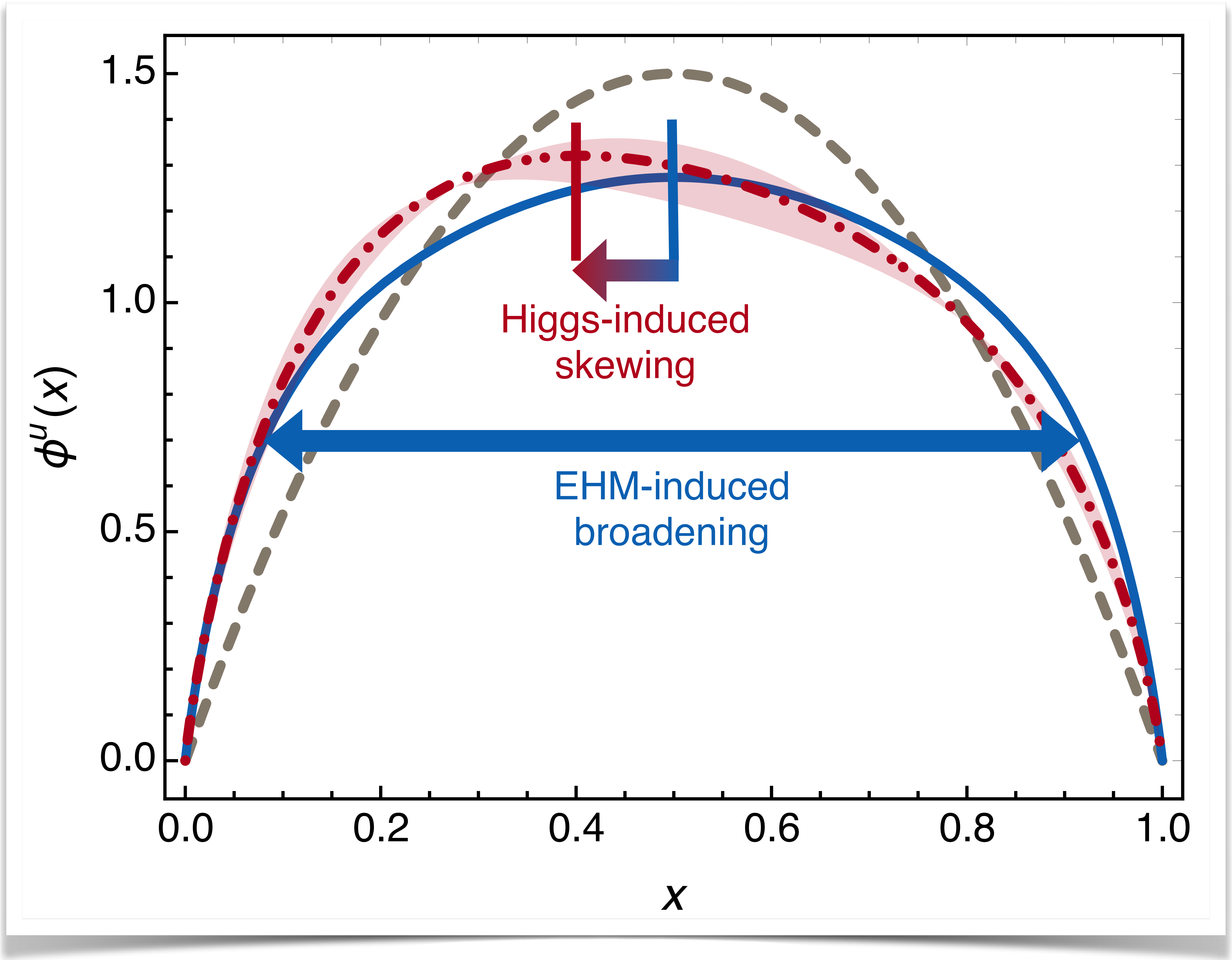

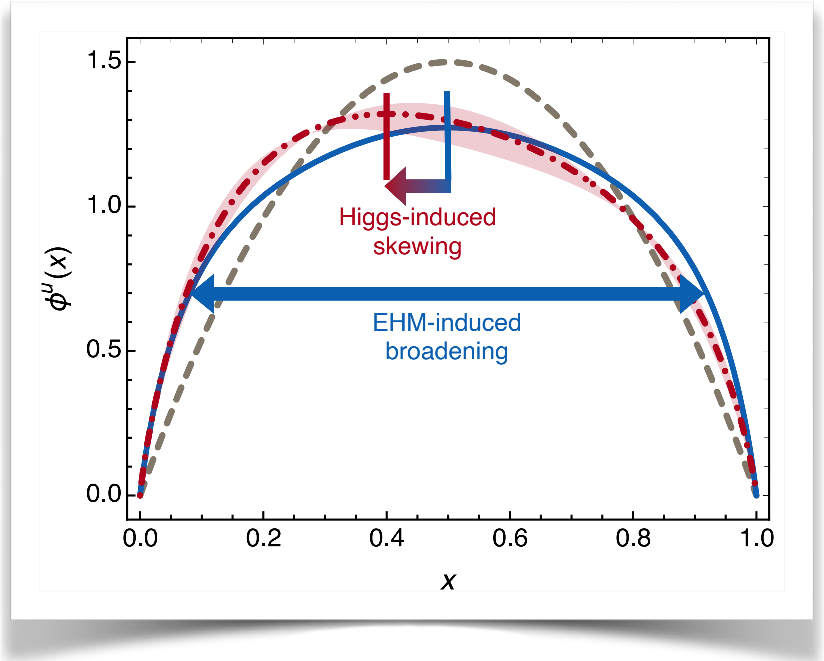

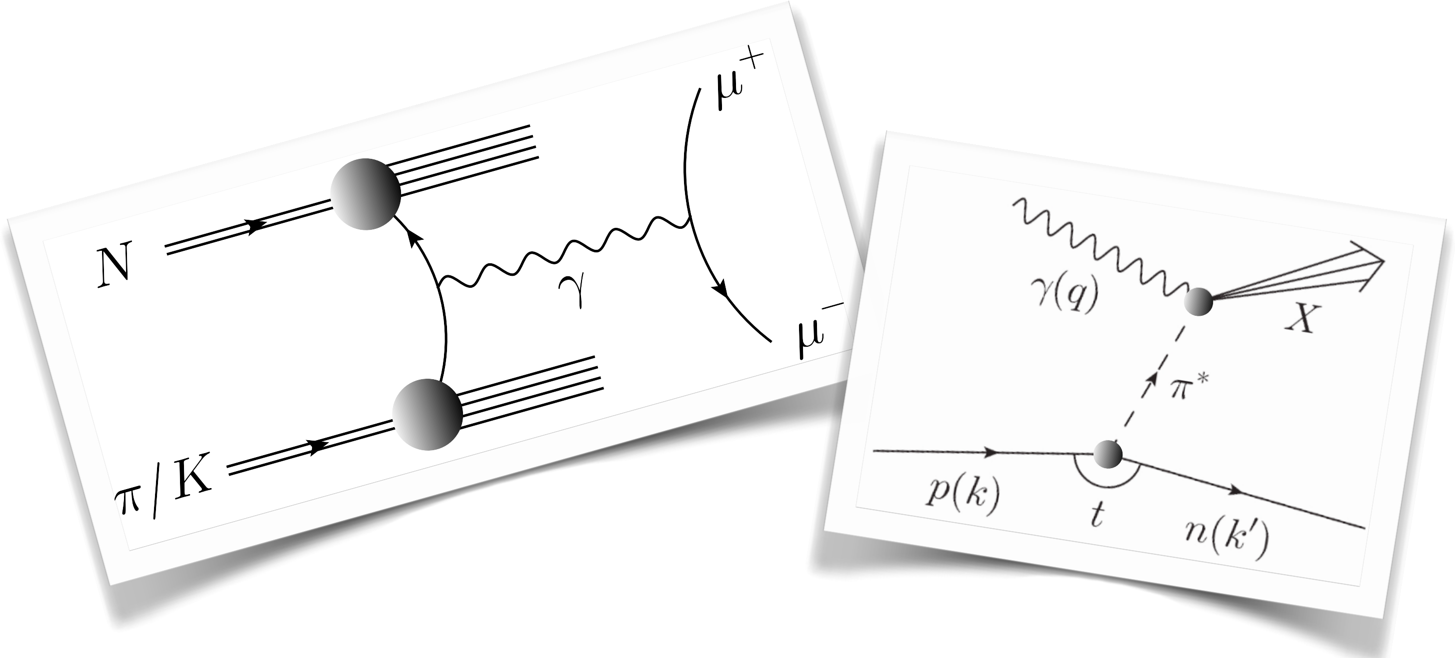

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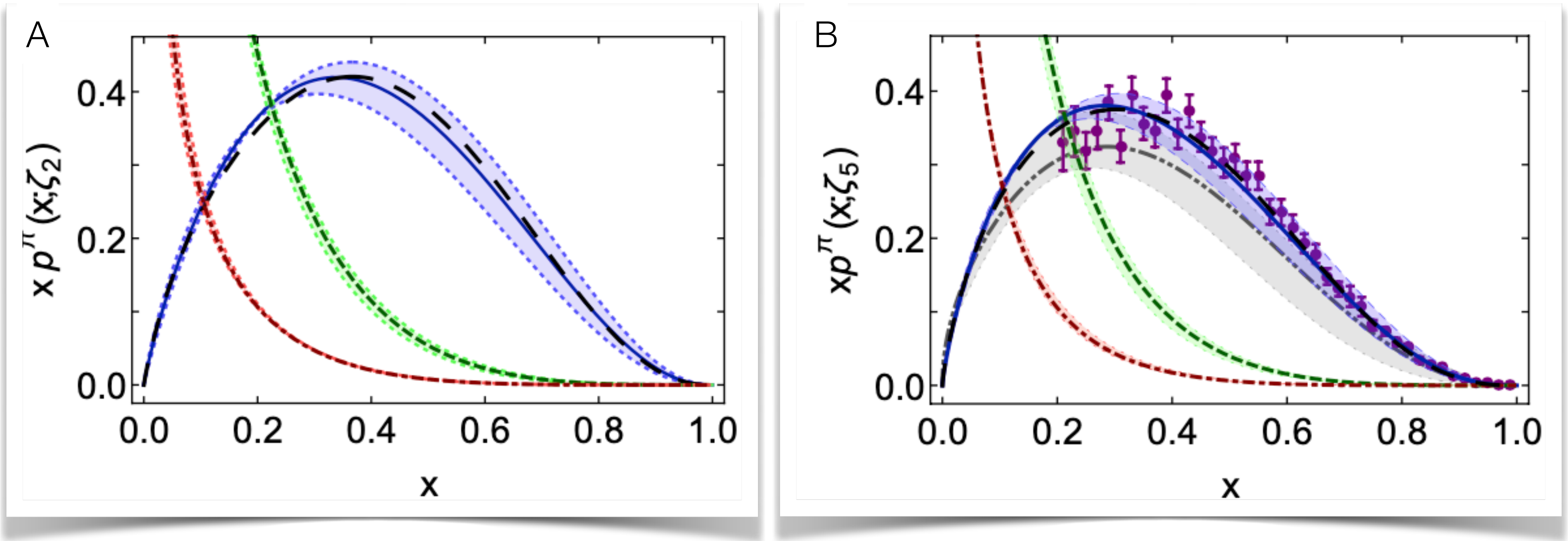

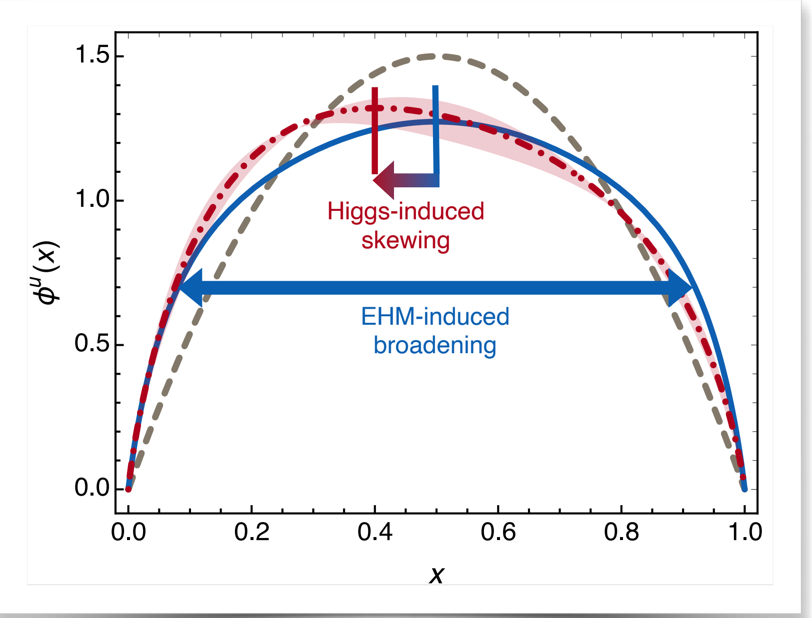

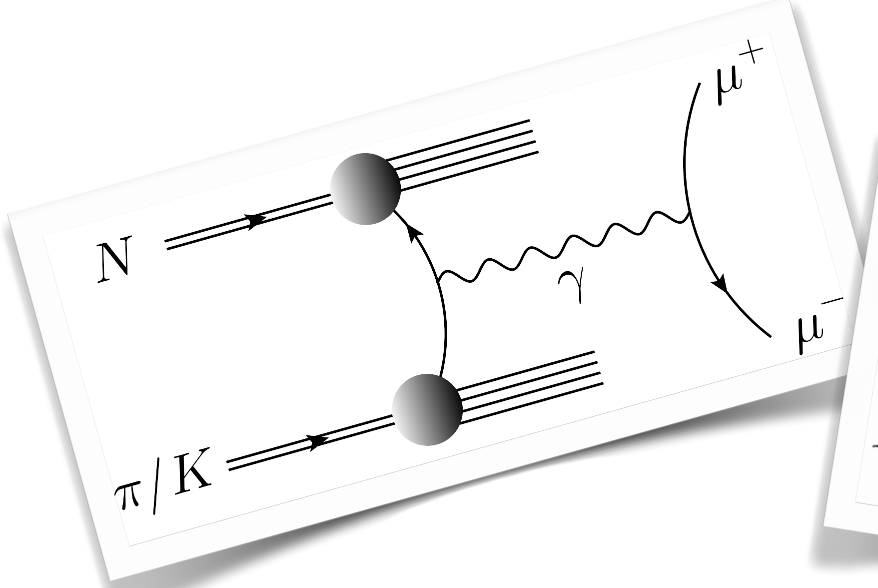

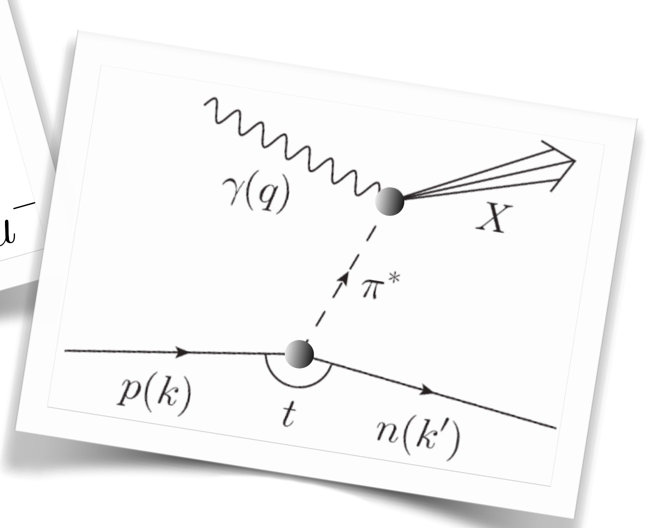

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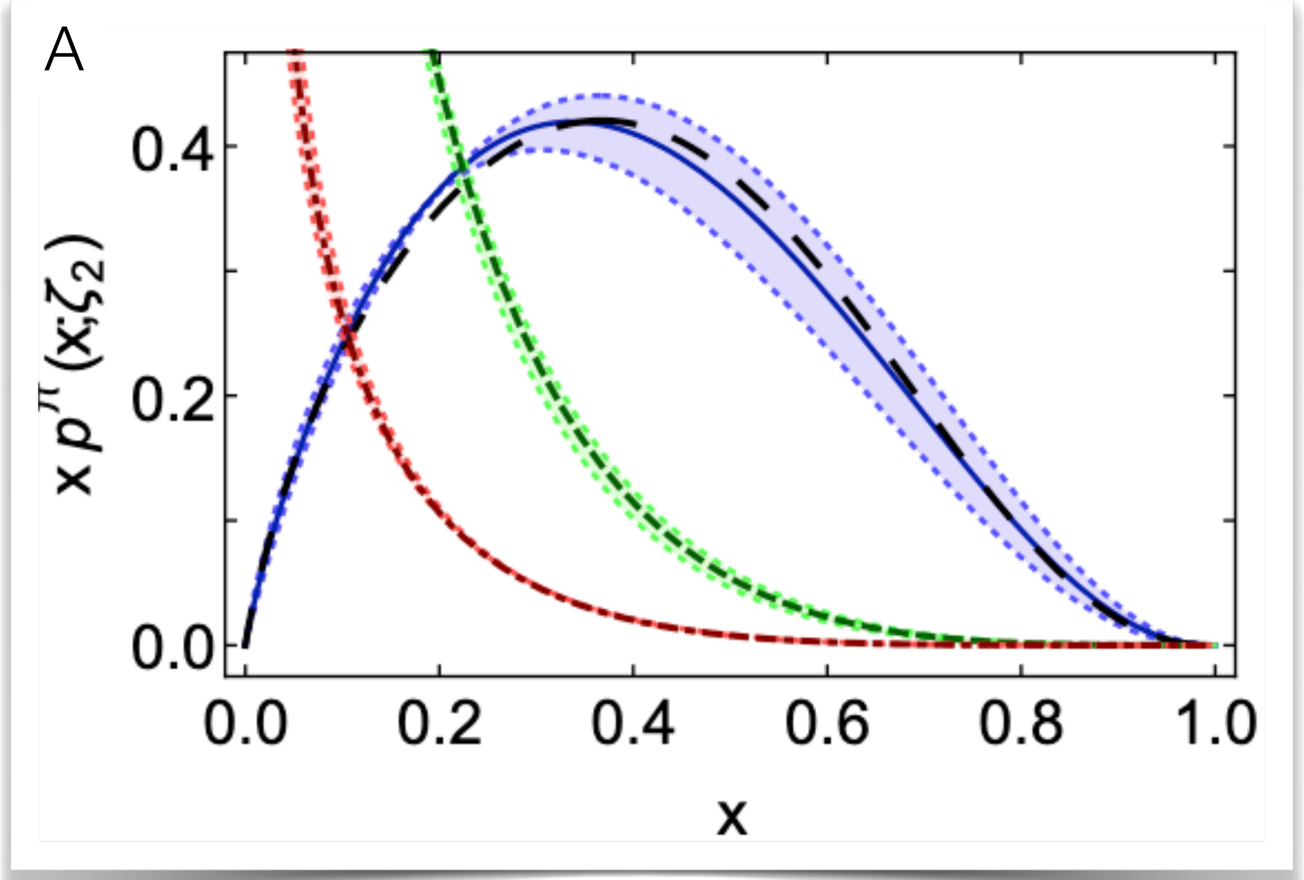

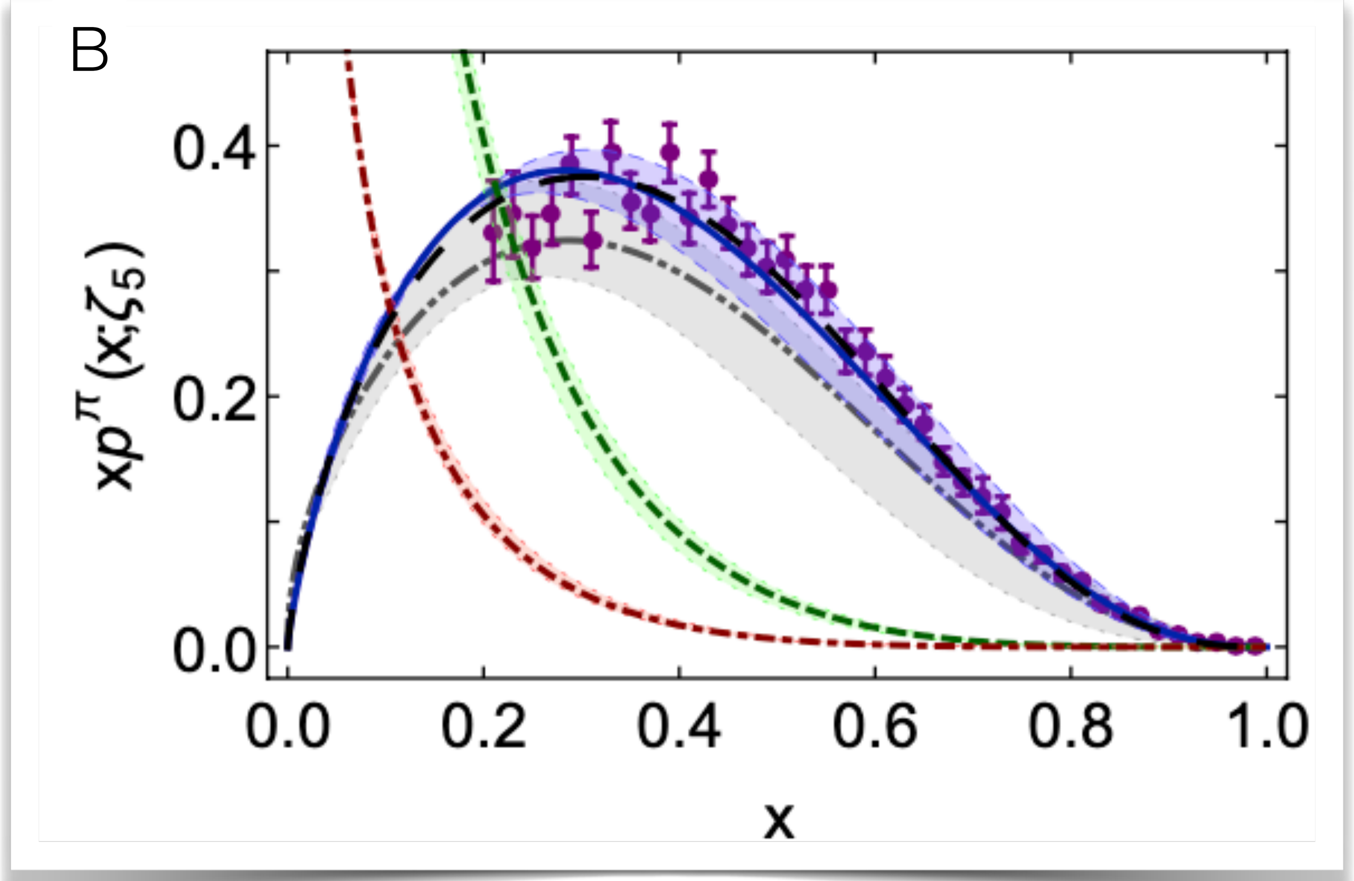

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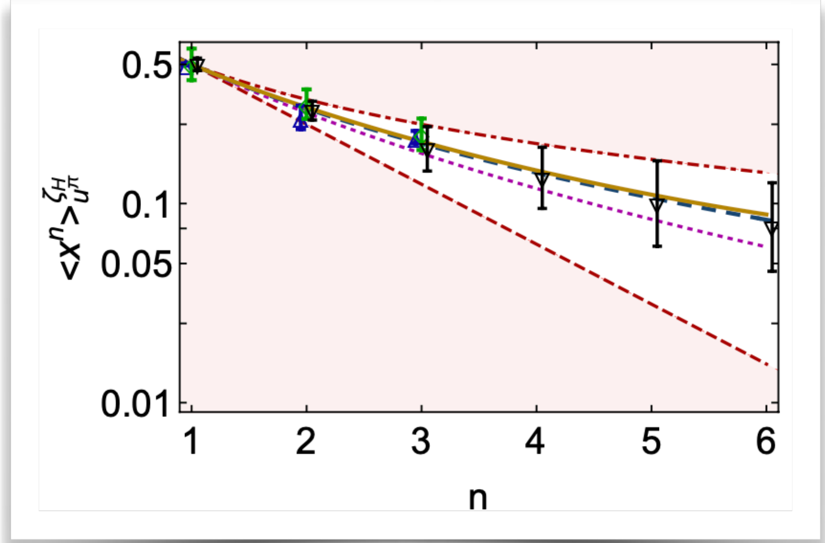

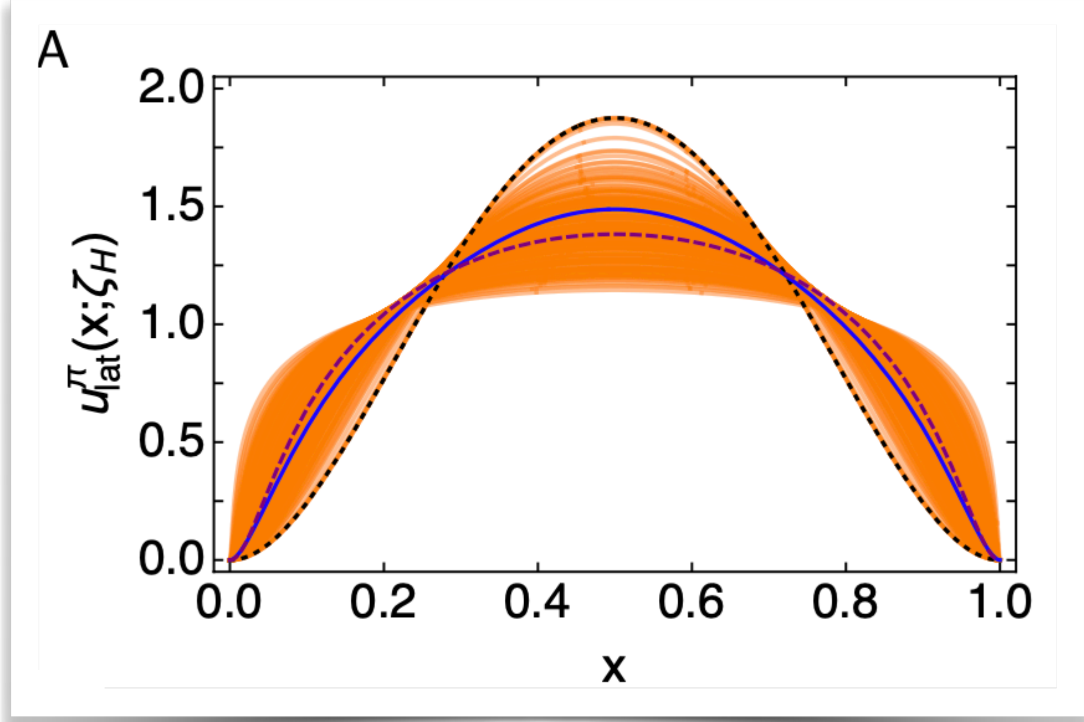

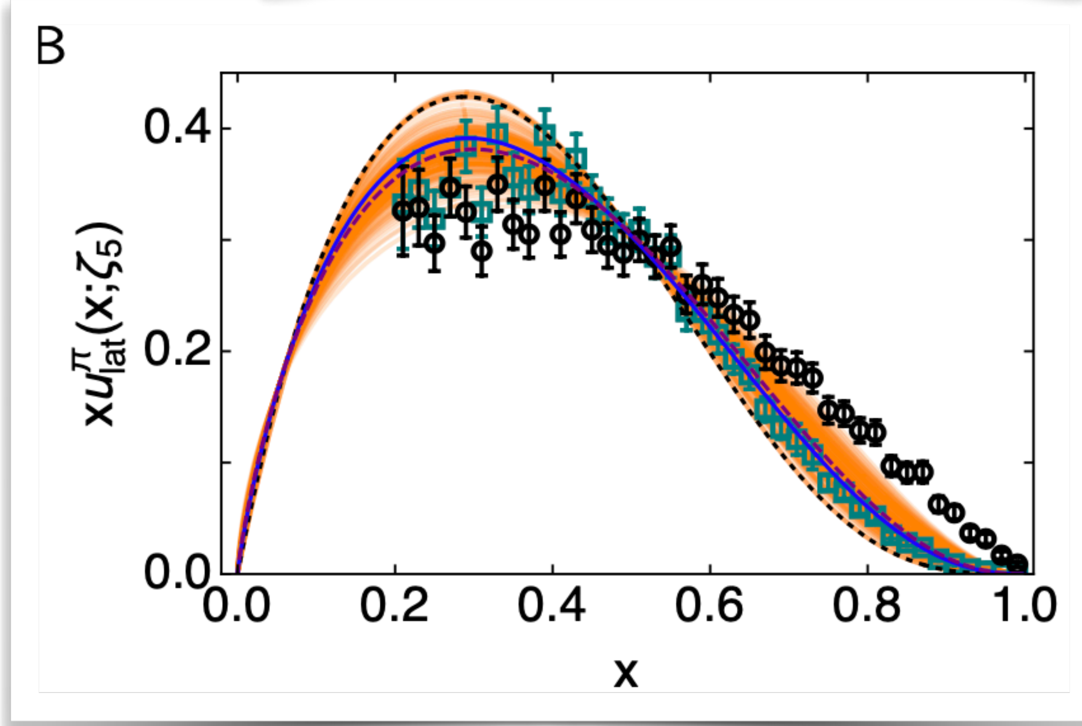

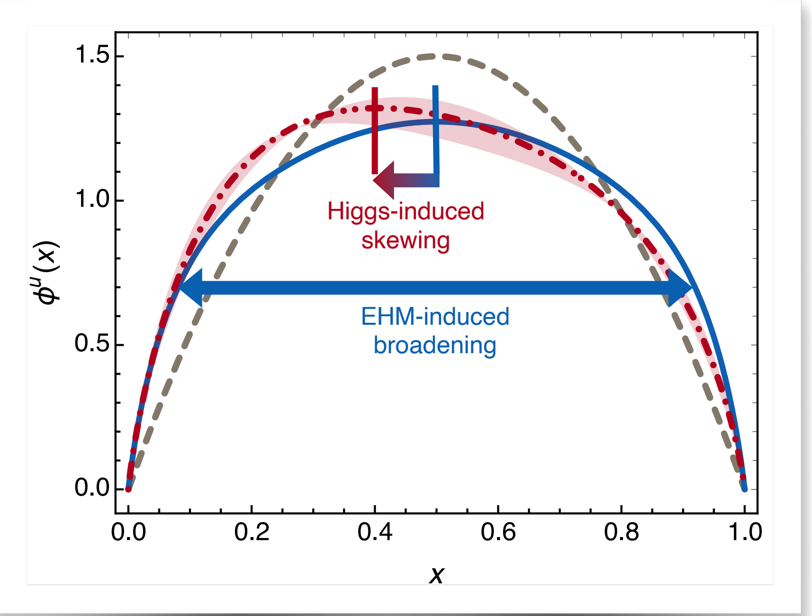

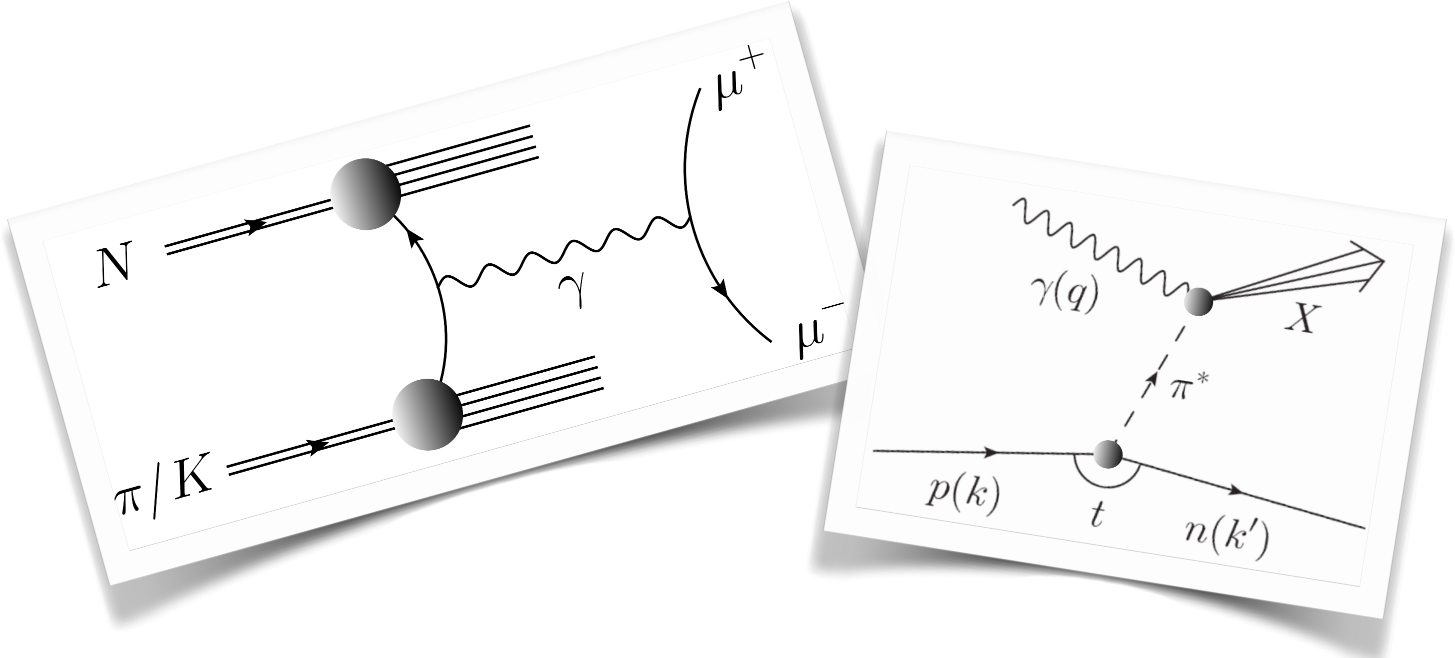

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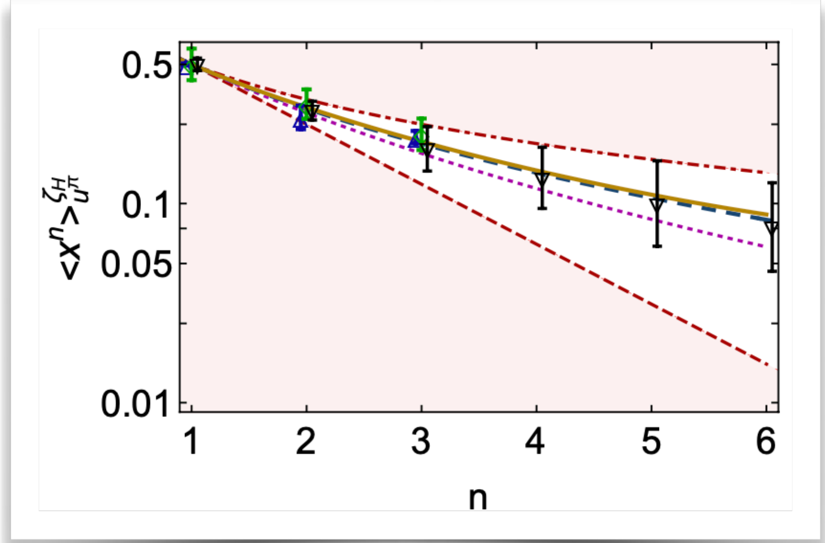

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Xu et al PRD 97 (2018)

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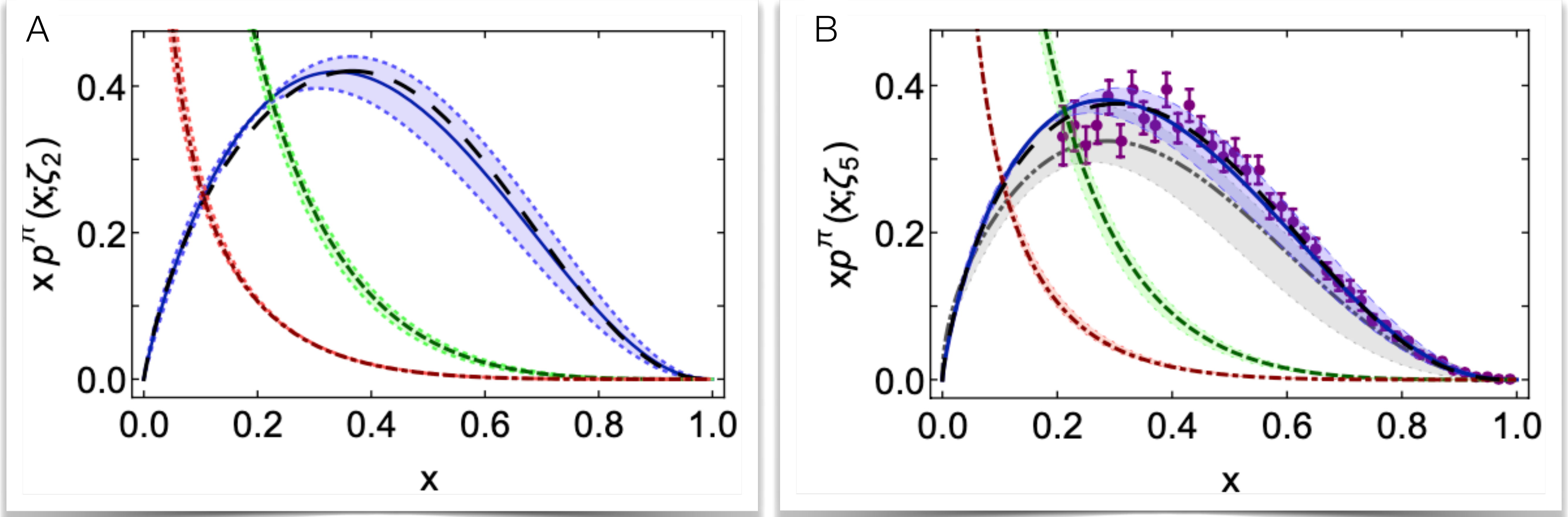

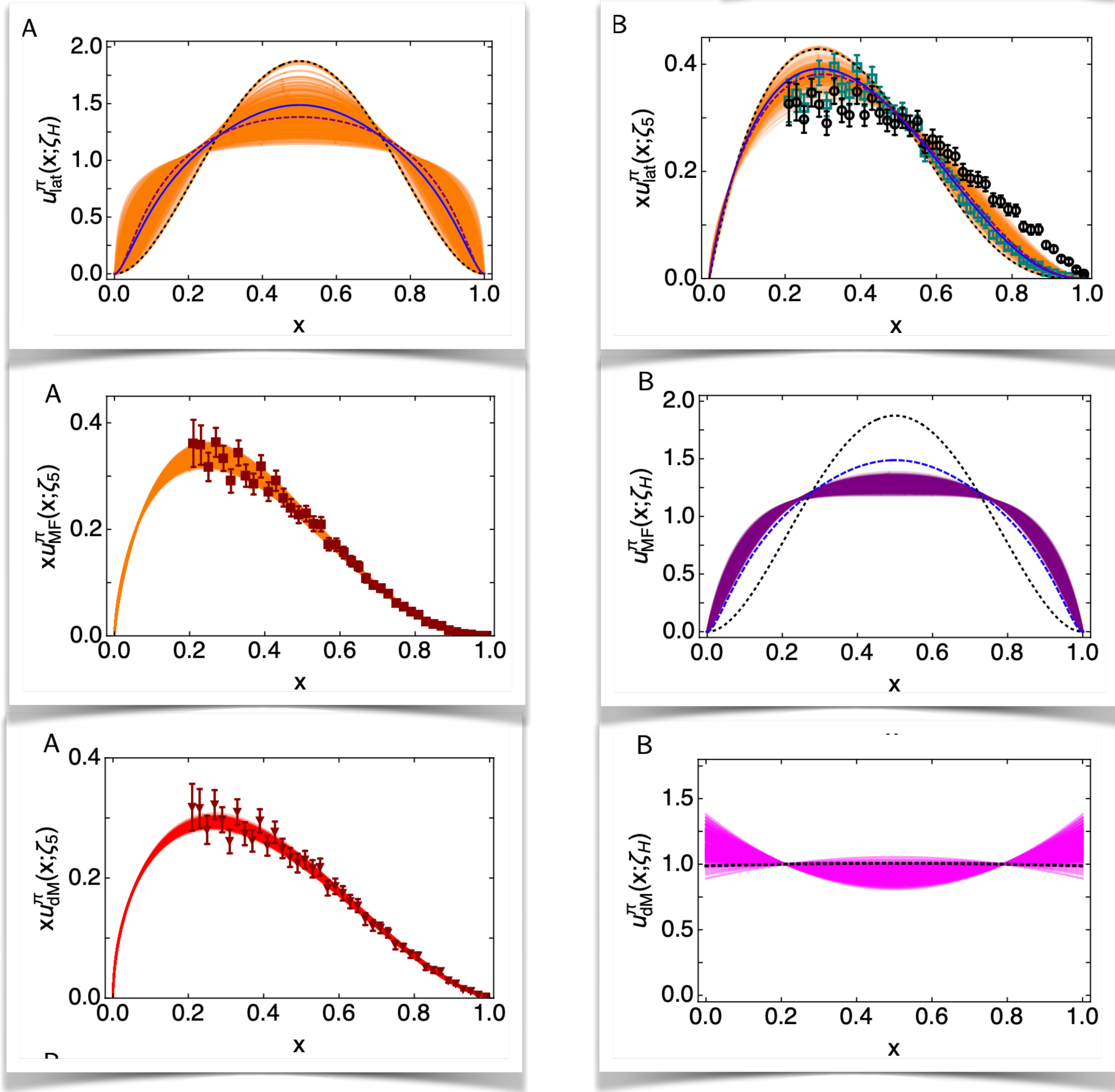

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$$\left.\frac{d\sigma}{dx_F}\right|_{J/\psi} = F \sum_{i,j=q,\bar{q},g} \int_{4m_c^2}^{4m_D^2} \mathrm{d}M_{c\bar{c}}^2 \frac{1}{s\sqrt{x_F^2 + 4\frac{M_{c\bar{c}}^2}{s}}} \,\widehat{\sigma}_{ij}(4m_c^2/M_{c\bar{c}}^2, \mu_R^2/m_c^2)\, f_i^{\pi^\pm}(x_1,\mu_F)\, f_j^N(x_2,\mu_F)$$

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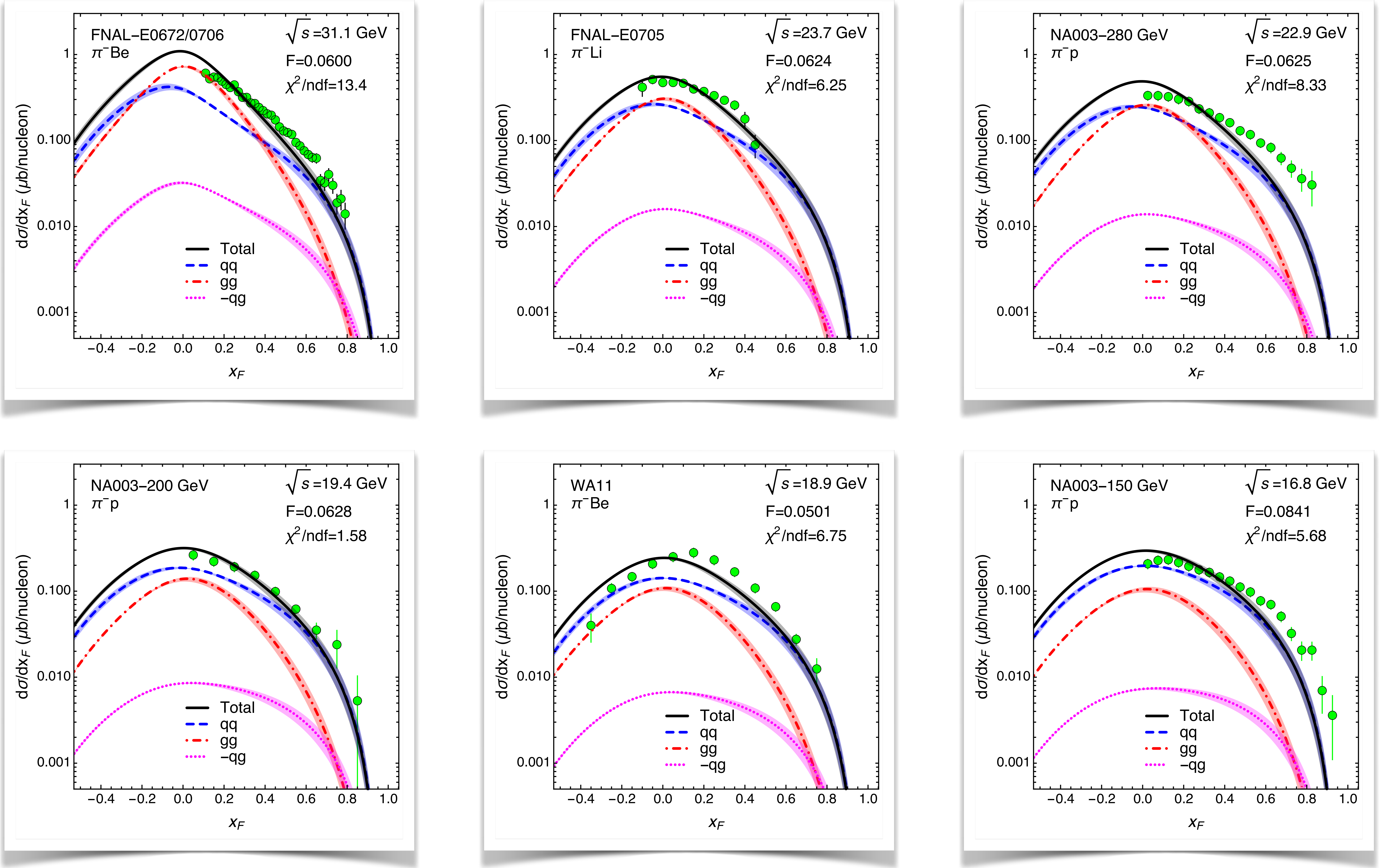

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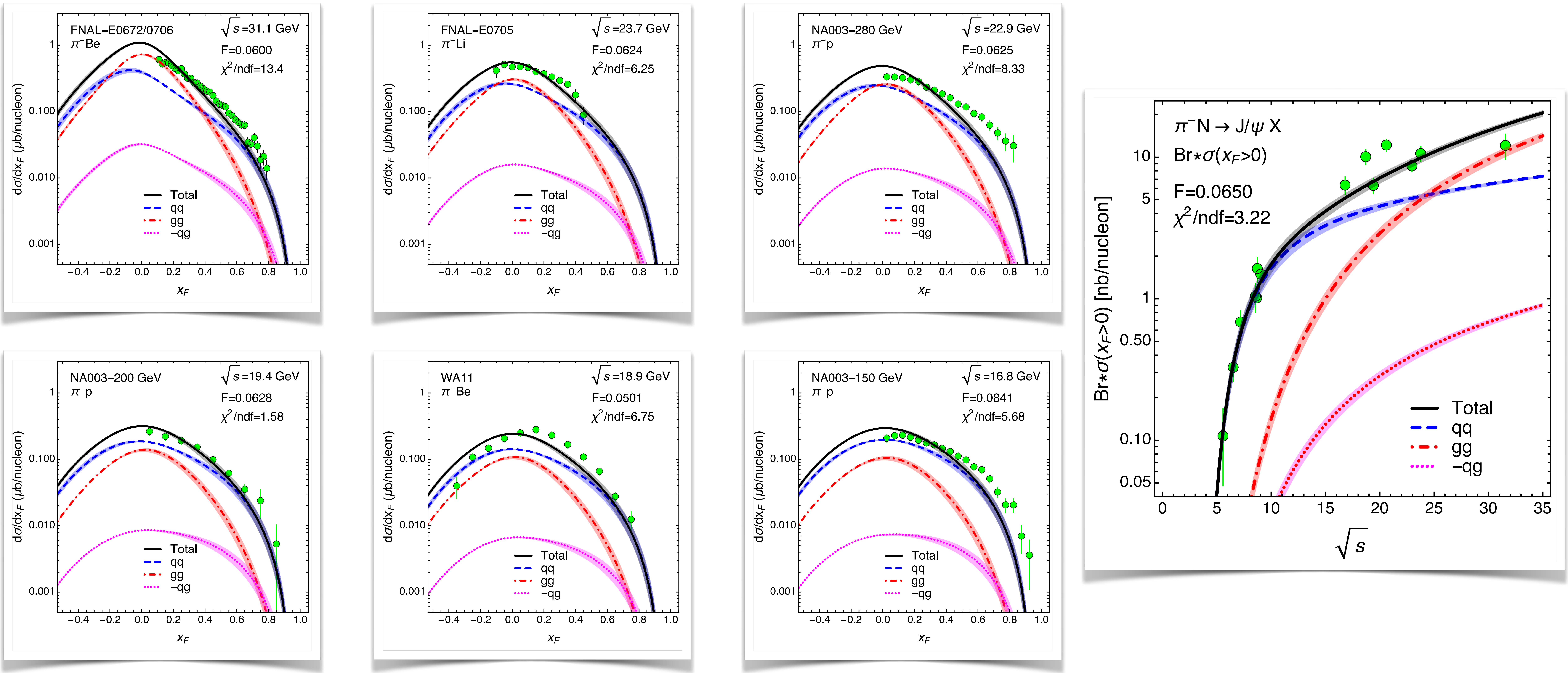

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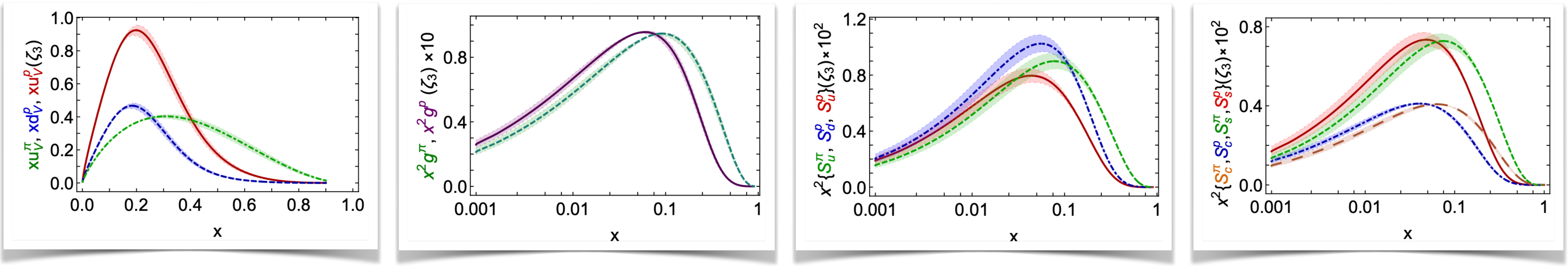
Phys. Lett. B 830 (2022) 137130



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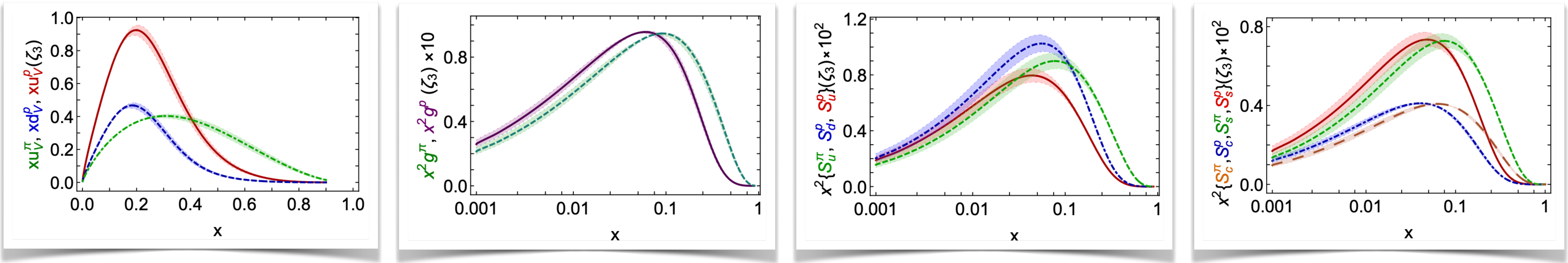

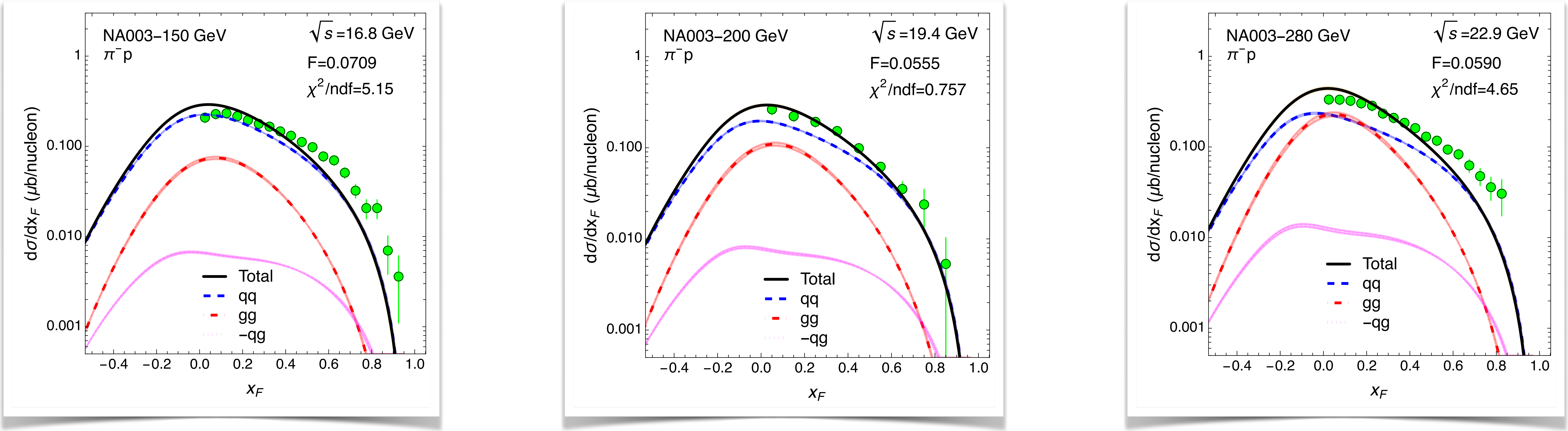

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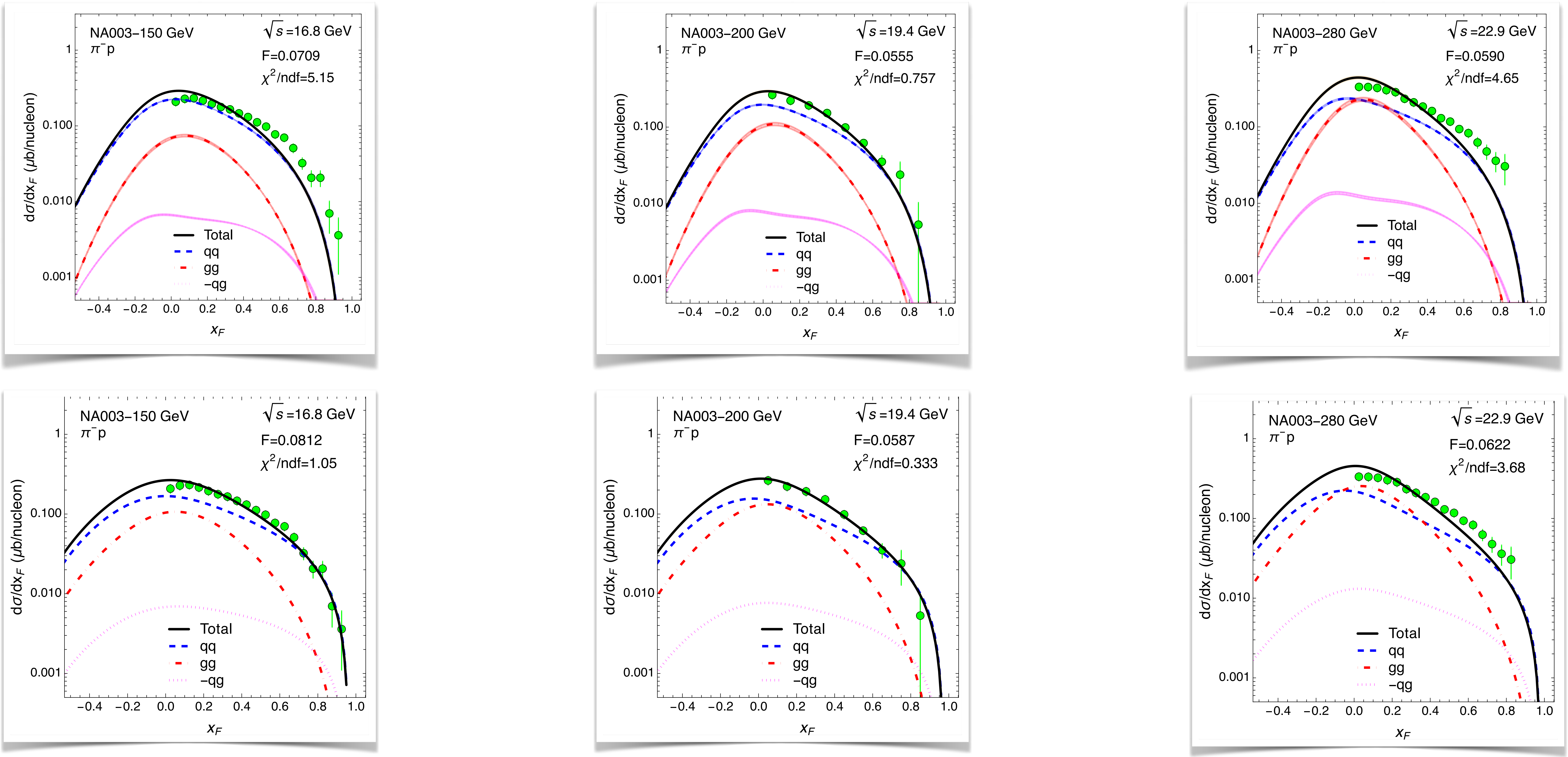

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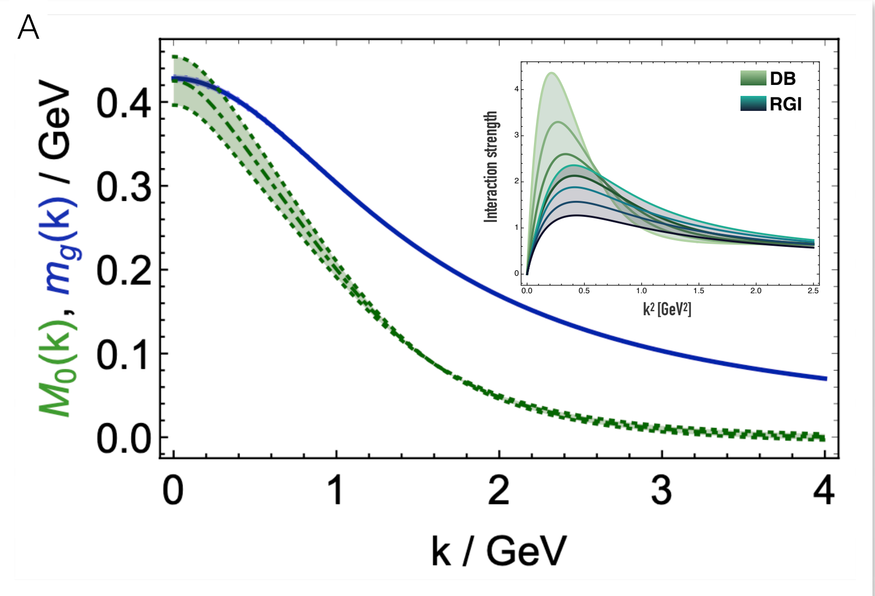

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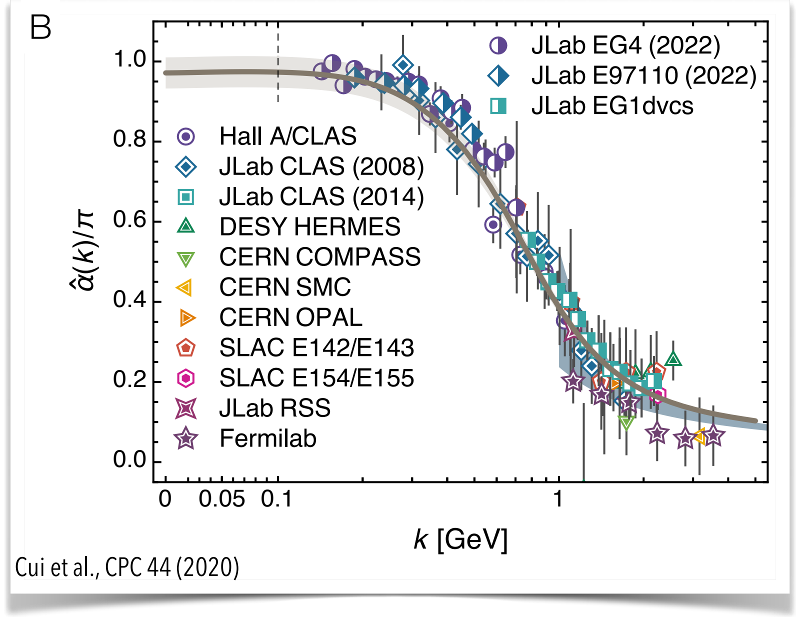

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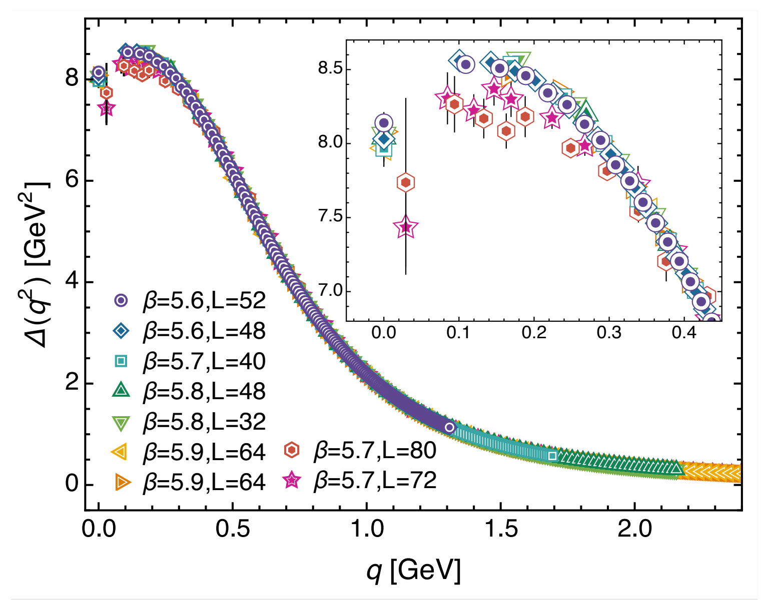
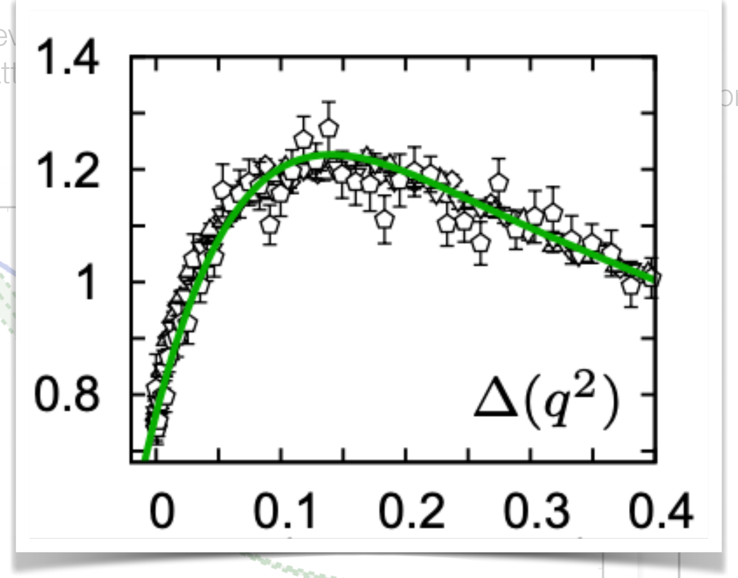
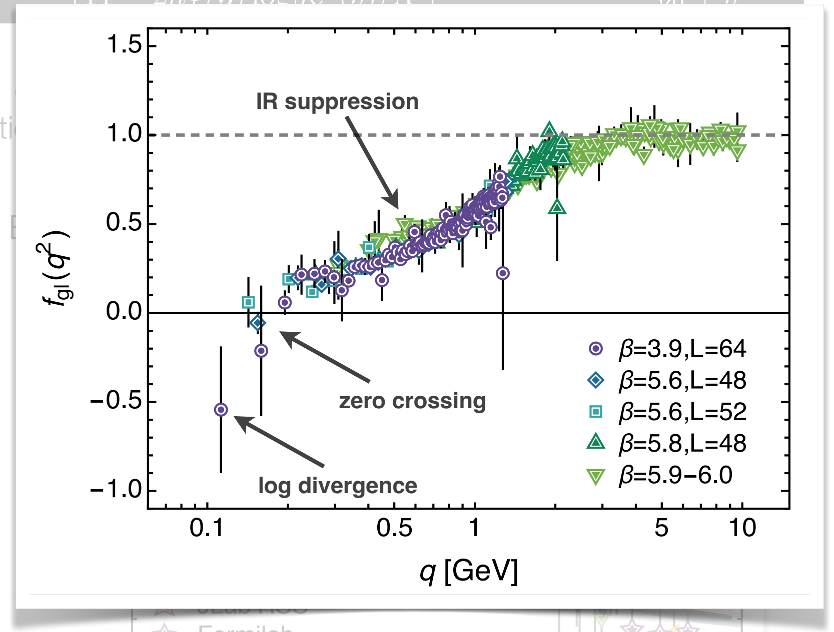
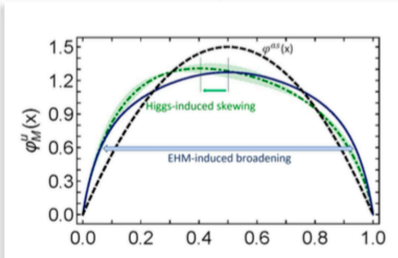
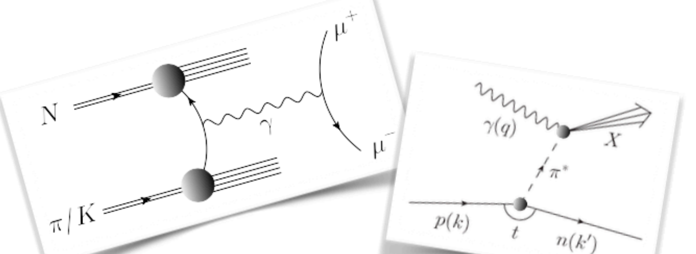




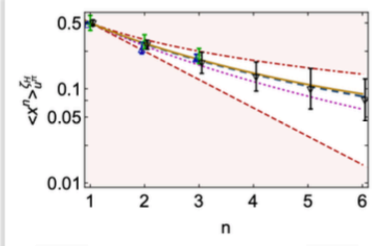






② α + DGLAP

$$\langle x^n\rangle^{\zeta}_{u_\pi} = \langle x^n\rangle^{\zeta_H}_{u_\pi}\left(\langle 2x\rangle^{\zeta}_{u_\pi}\right)^{\gamma_0^n/\gamma_0^1} \qquad \frac{1}{2^n} \le \langle x^n\rangle^{\zeta_H}_{u_\pi} \le \frac{1}{1+n}$$



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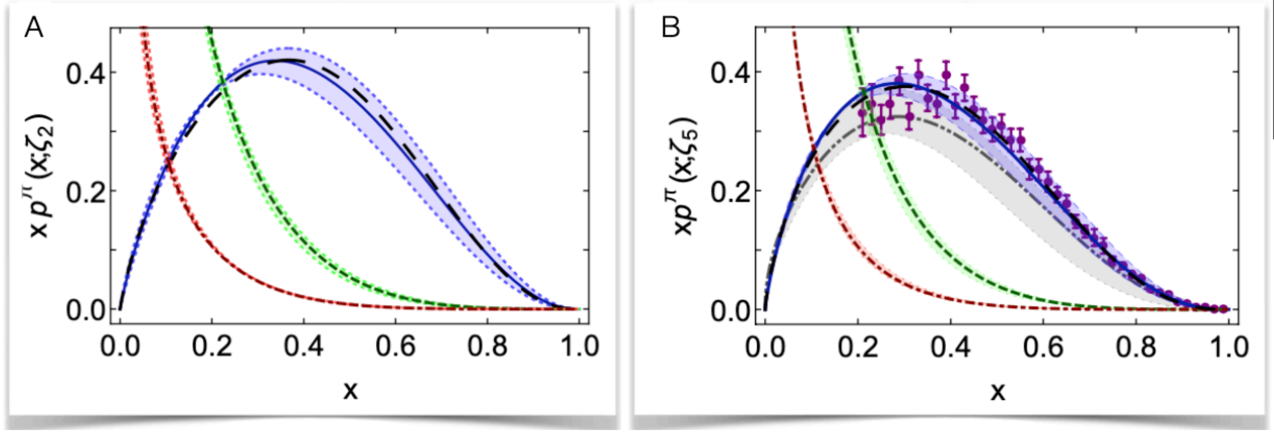

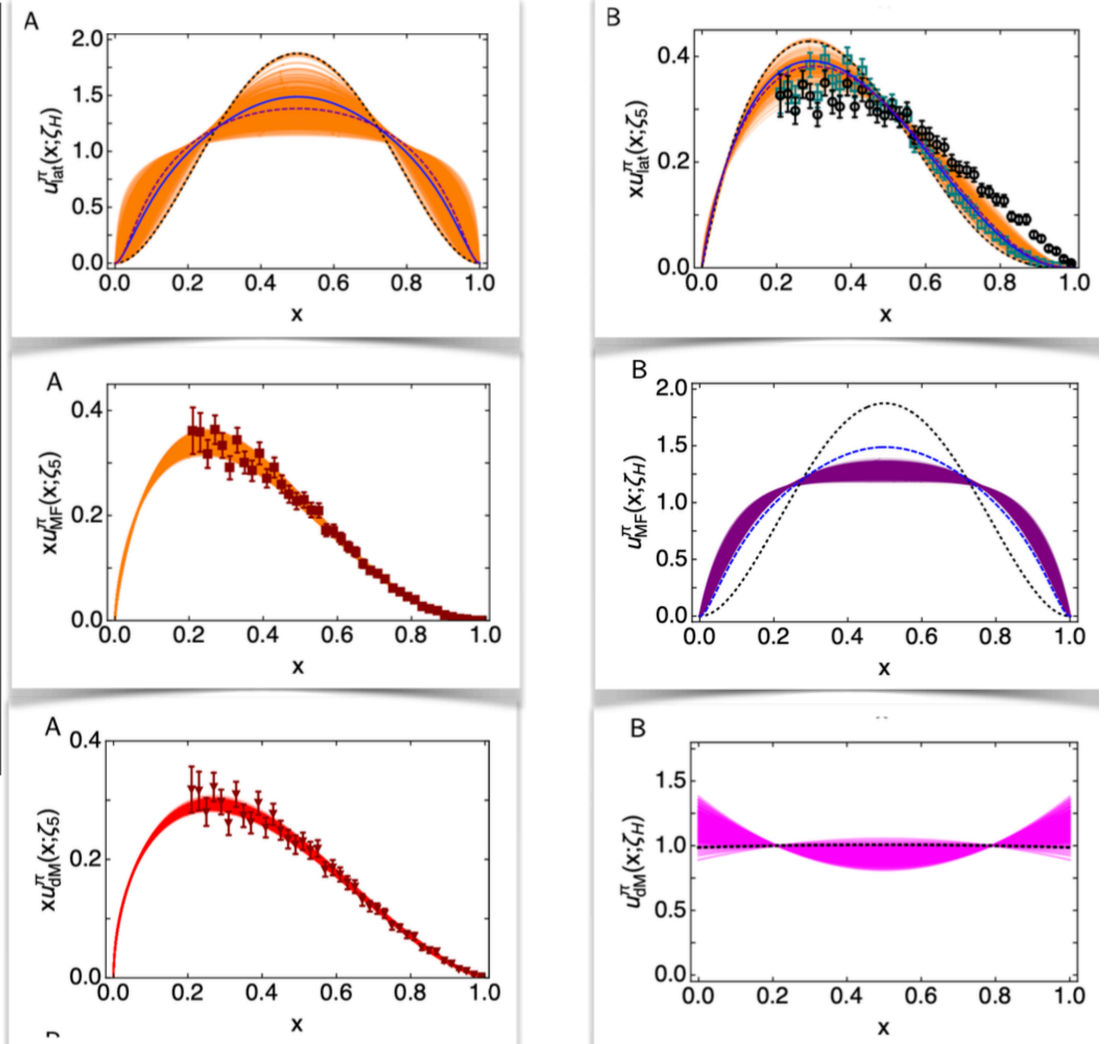

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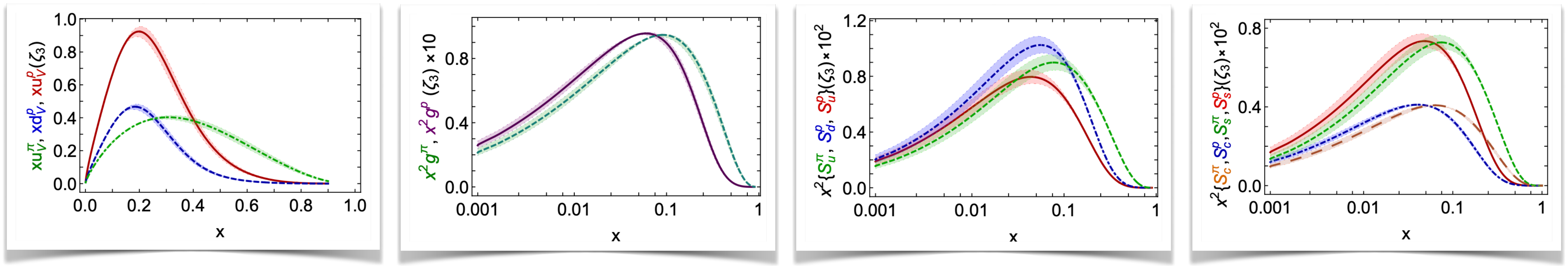

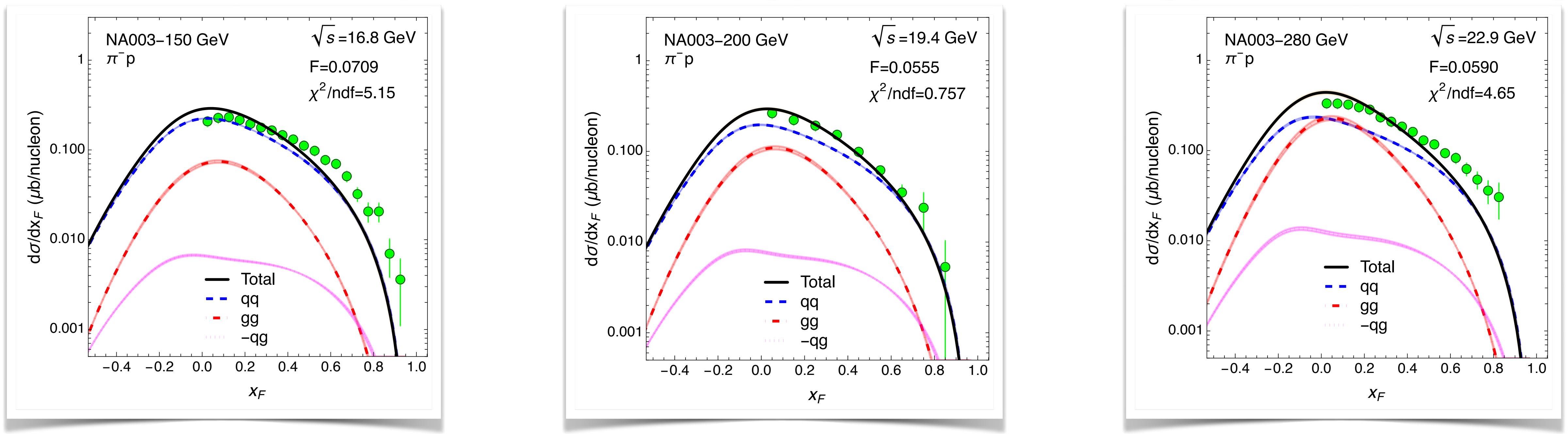

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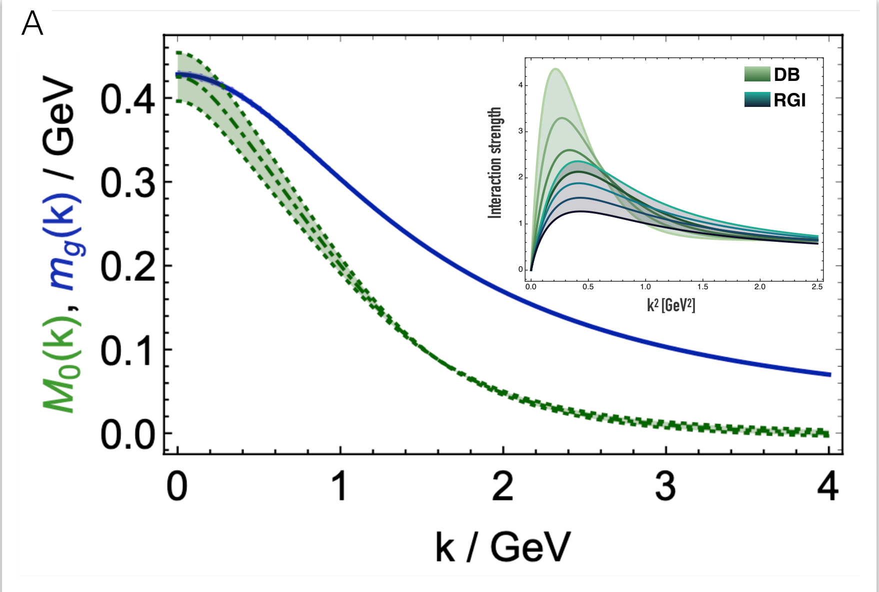

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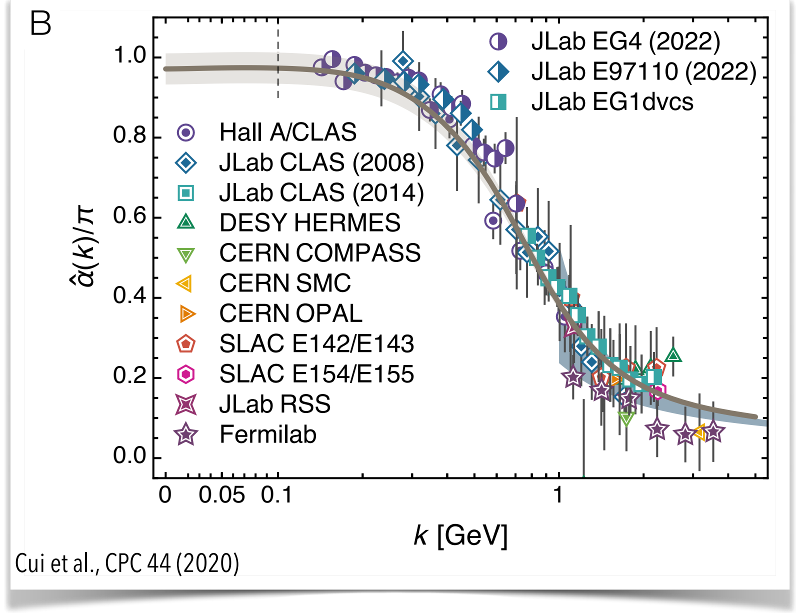

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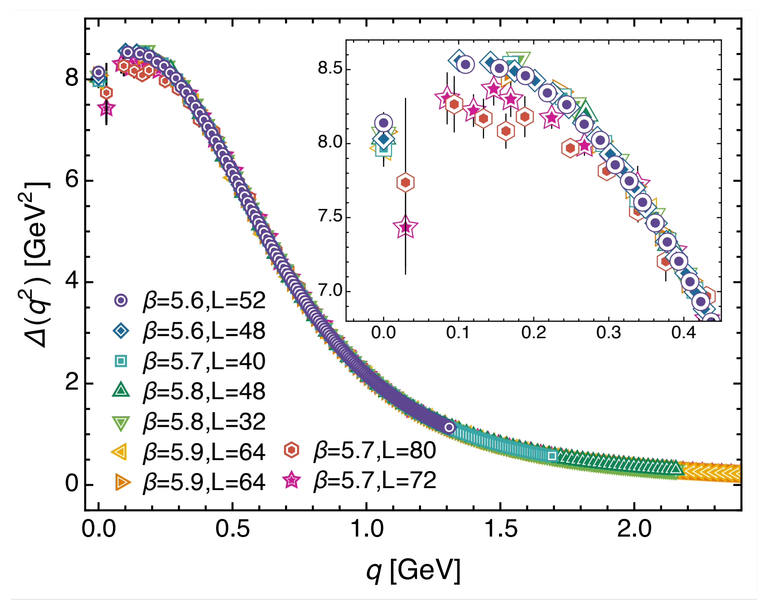

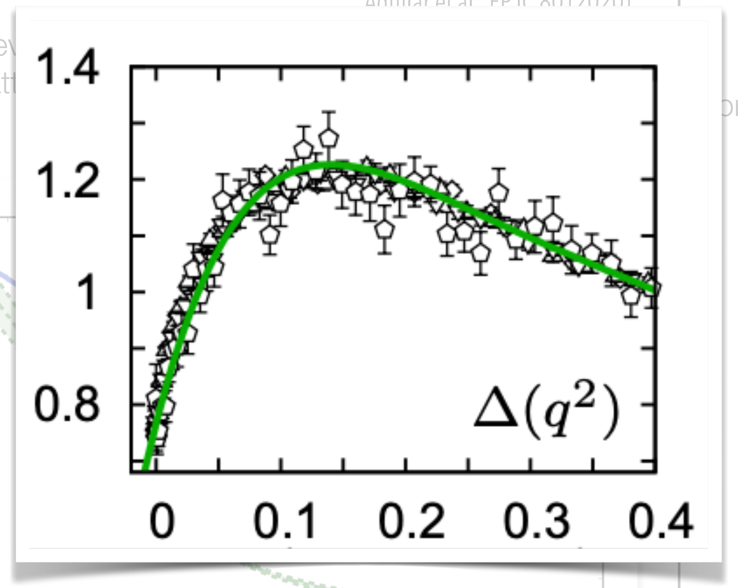

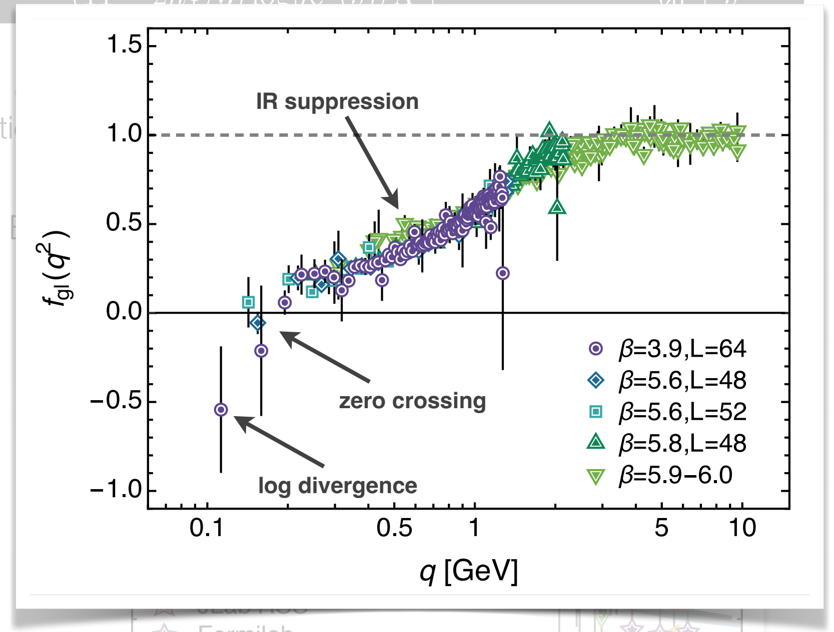

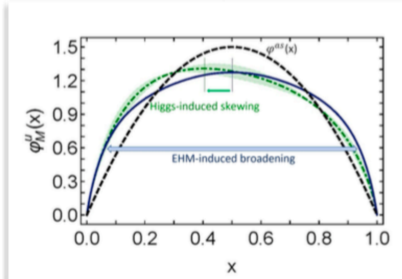

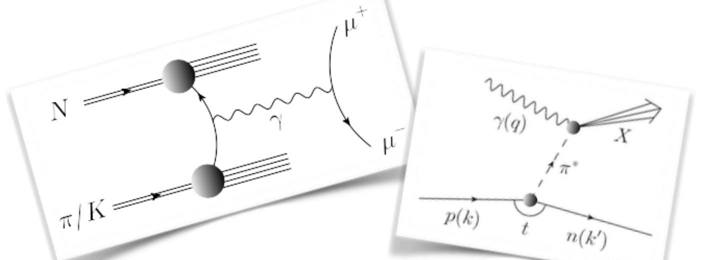

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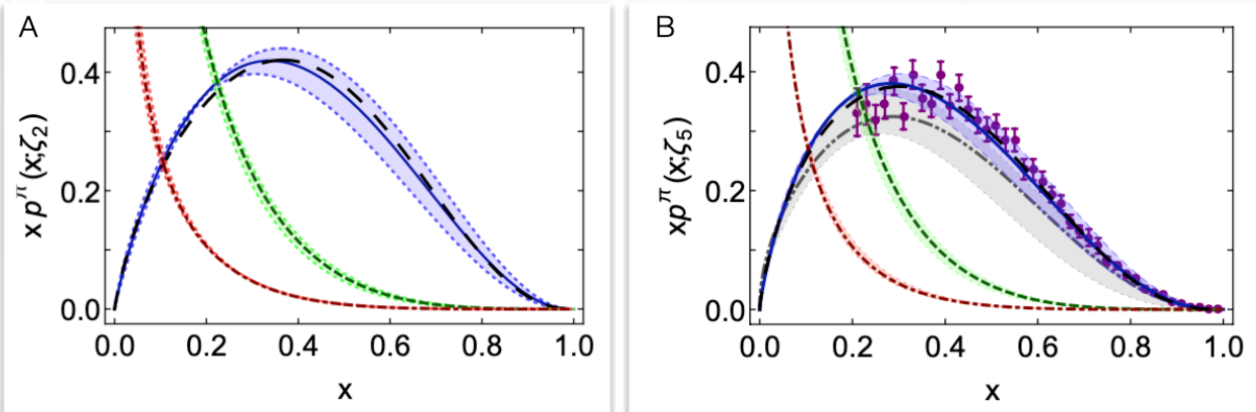
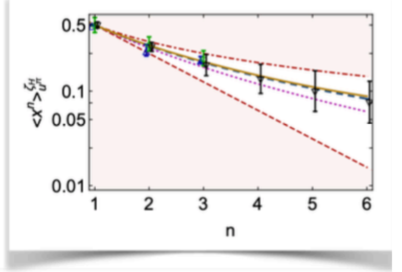
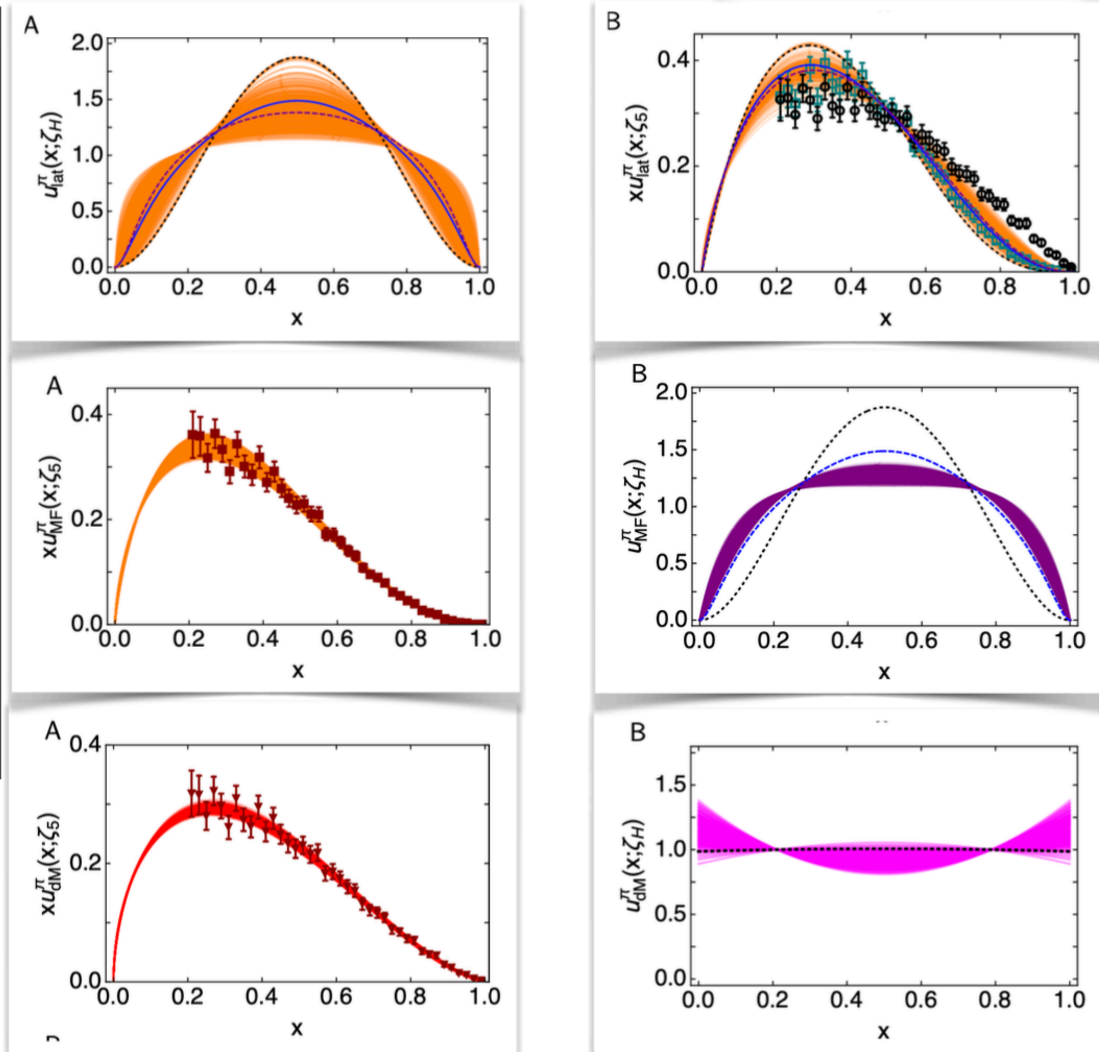
$\langle x\rangle^\pi_g = 0.41(2)$ $\langle x\rangle^\pi_{sea} = 0.11(2)$
$\langle x\rangle^\pi_g = 0.45(2)$ $\langle x\rangle^\pi_{sea} = 0.14(2)$



② α + DGLAP

$$\langle x^n\rangle^{\zeta}_{u_\pi} = \langle x^n\rangle^{\zeta_H}_{u_\pi}\left(\langle 2x\rangle^{\zeta}_{u_\pi}\right)^{\gamma_0^n/\gamma_0^1} \qquad \frac{1}{2^n} \le \langle x^n\rangle^{\zeta_H}_{u_\pi} \le \frac{1}{1+n}$$





J/ψ PRODUCTION

$$\left.\frac{d\sigma}{dx_F}\right|_{J/\psi} = F \sum_{i,j=q,\bar{q},g} \int_{4m_c^2}^{4m_D^2} dM^2_{c\bar{c}} \frac{1}{s\sqrt{x_F^2 + 4\frac{M^2_{c\bar{c}}}{s}}}\,\hat{\sigma}_{ij}(4m_c^2/M^2_{c\bar{c}}, \mu_R^2/m_c^2)\, f_i^{\pi^\pm}(x_1,\mu_F)\, f_j^N(x_2,\mu_F)$$

fit to data — set by the experiment — known at LO and NLO — EHM Phys. Lett. B 830 (2022) 137130