Parton Distributions from simultaneous global QCD analyses

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Jefferson Lab Angular Momentum Collaboration

Jefferson Lab EXPLORING THE NATURE OF MATTER

Motivation

- Traditionally different types of collinear distributions (PDFs, FFs) are obtained from independent analyses.

- Performing **simultaneous** fits of different collinear distributions allows us to:

  - Study the limits in x and Q^2 of collinear factorization

  - Test the universality of PDFs, FFs…

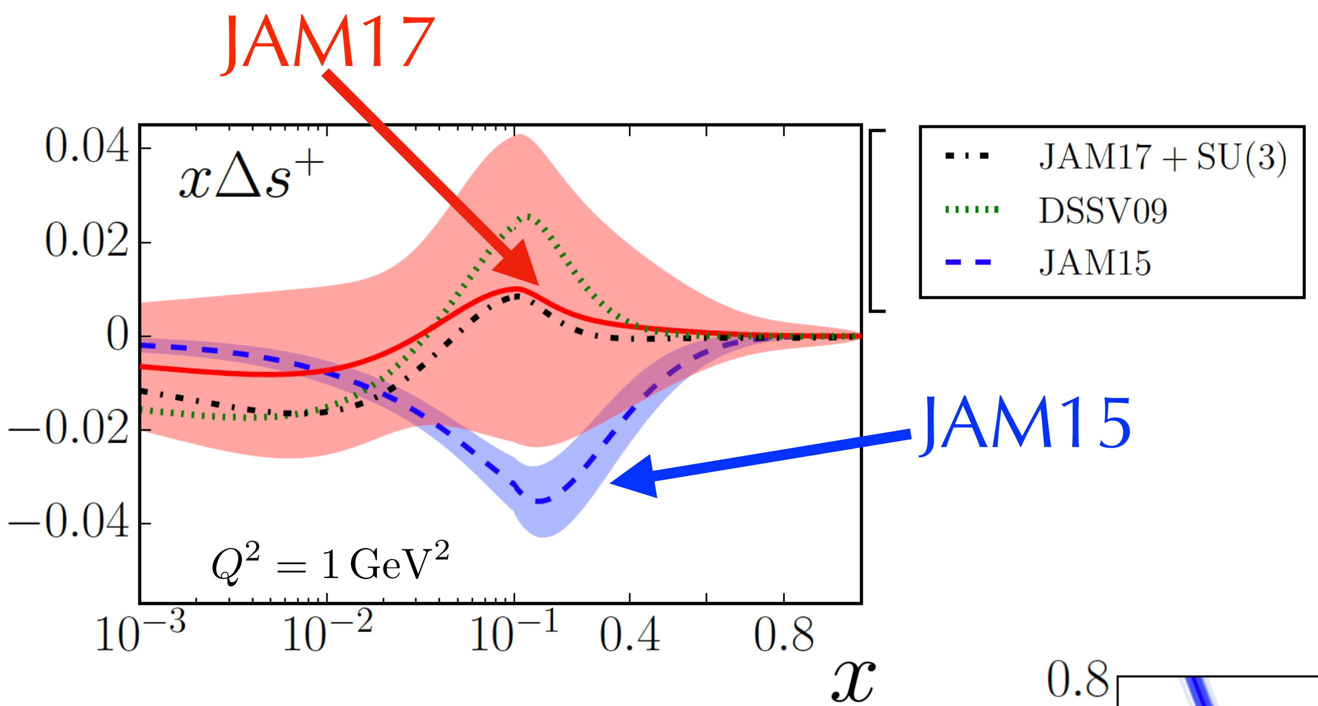
  - Extract the distributions in a rigorous way where all the data are studied using the **same** theoretical framework

- In this talk: (first) **simultaneous** analysis of **unpolarized** PDFs and FFs ⟶ **Strange** quark distribution

JAM17

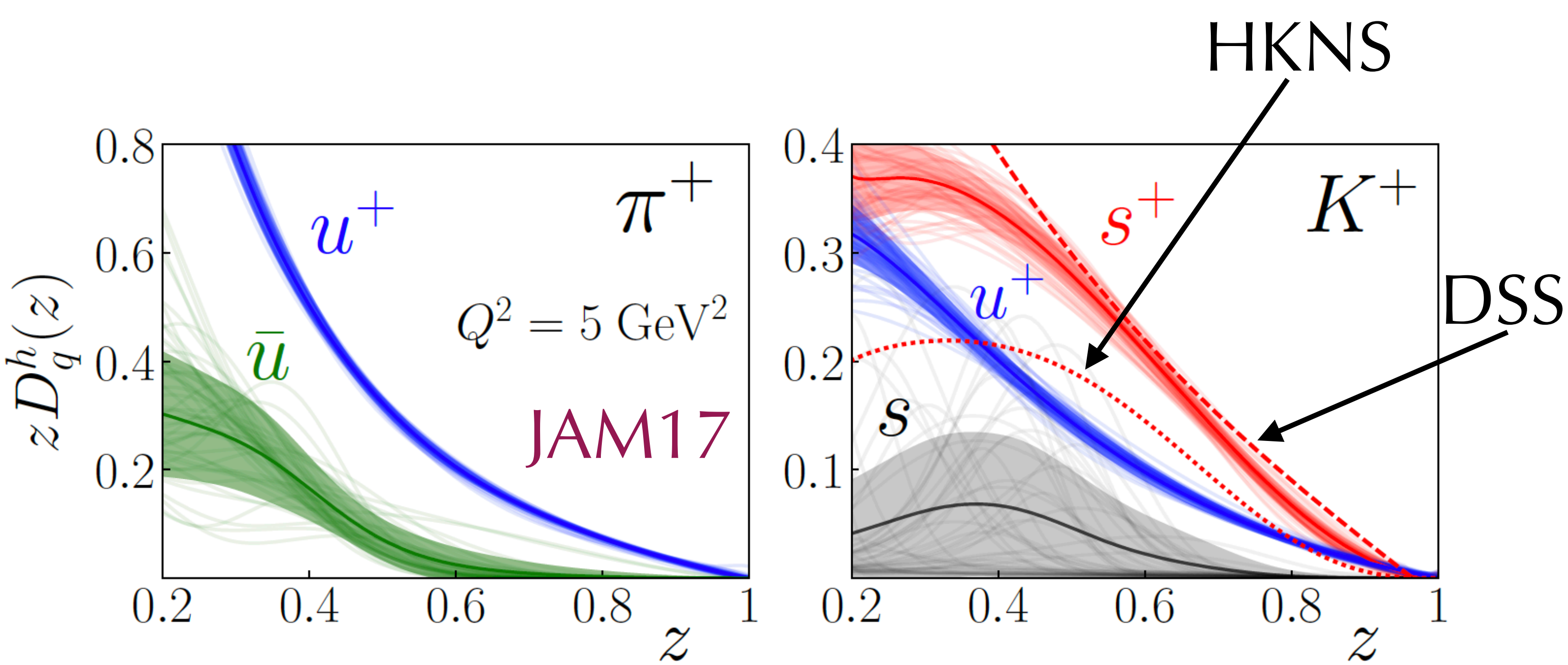
Ethier, Sato, Melnitchouk: Phys. Rev. Lett. 119, 132001 (2017)

- First (simultaneous) MC analysis of polarized PDFs and FFs
- Polarized SIDIS, polarized DIS, and SIA data included



Δs^+ consistent with zero

Primarily influenced by HERMES K data on deuterium



Evolution of JAM

		JAM15	JAM16	JAM17	JAM19	JAM20?
Process	DIS	✓	✗	✓	✓	✓
	DY	✗	✗	✗	✓	✓
	SIA	✗	✓	✓	✓	✓
	SIDIS	✗	✗	✓	✓	✓
						+ More processes
Function	f	✗	✗	✗	✓	✓
	Δf	✓	✗	✓	✗	✓
	D_f^h	✗	✓	✓	✓	✓

Evolution of JAM

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	SIA	✗	✓	✓	✓	✓
	SIDIS	✗	✗	✓	✓	✓
						+ More processes
Function	f	✗	✗	✗	✓	✓
	Δf	✓	✗	✓	✗	✓
	D_f^h	✗	✓	✓	✓	✓

First **simultaneous** analysis of **unpolarized** PDFs and FFs

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	Δf	✓	✗	✓	✗	✓
	D_f^h	✗	✓	✓	✓	✓

First **simultaneous** analysis of **unpolarized** PDFs and FFs

Why JAM19?

To study the **strange** quark distribution

Motivation II

- The strange PDF is less known than the non-strange light flavors

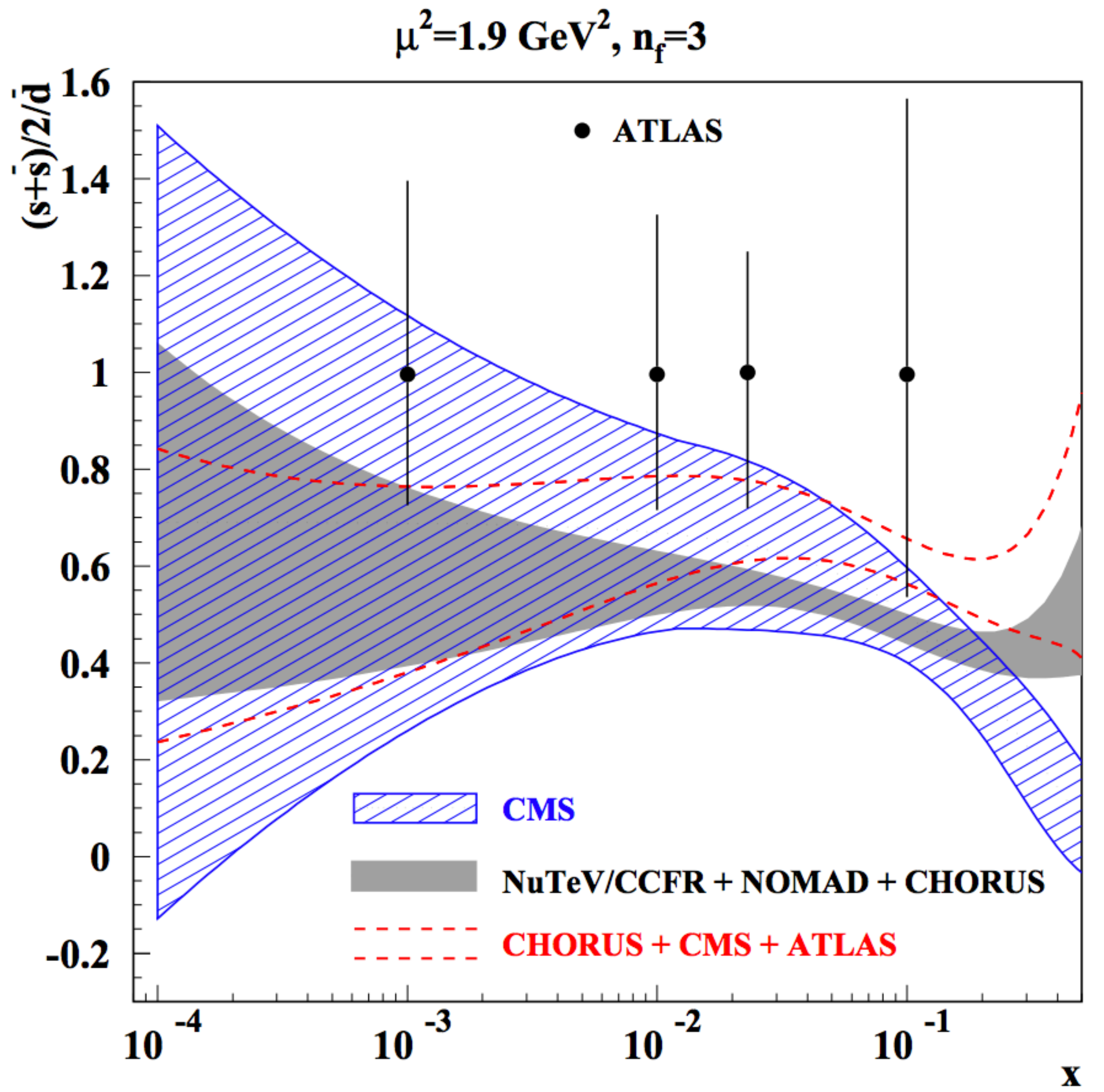
- Traditionally: neutrino-(heavy) nucleus DIS data used to extract the strange PDF.
    - Drawbacks: nuclear effects on PDFs.

- W and Z inclusive production in p-p collisions also sensitive to flavor separation
    - Drawbacks: tension between CMS and ATLAS results?

Motivation II

Alekhin et al. arXiv:1404.6469 [hep-ph]

$r_s =$



Setup: data

$$W^2 > 10\,\mathrm{GeV}^2$$

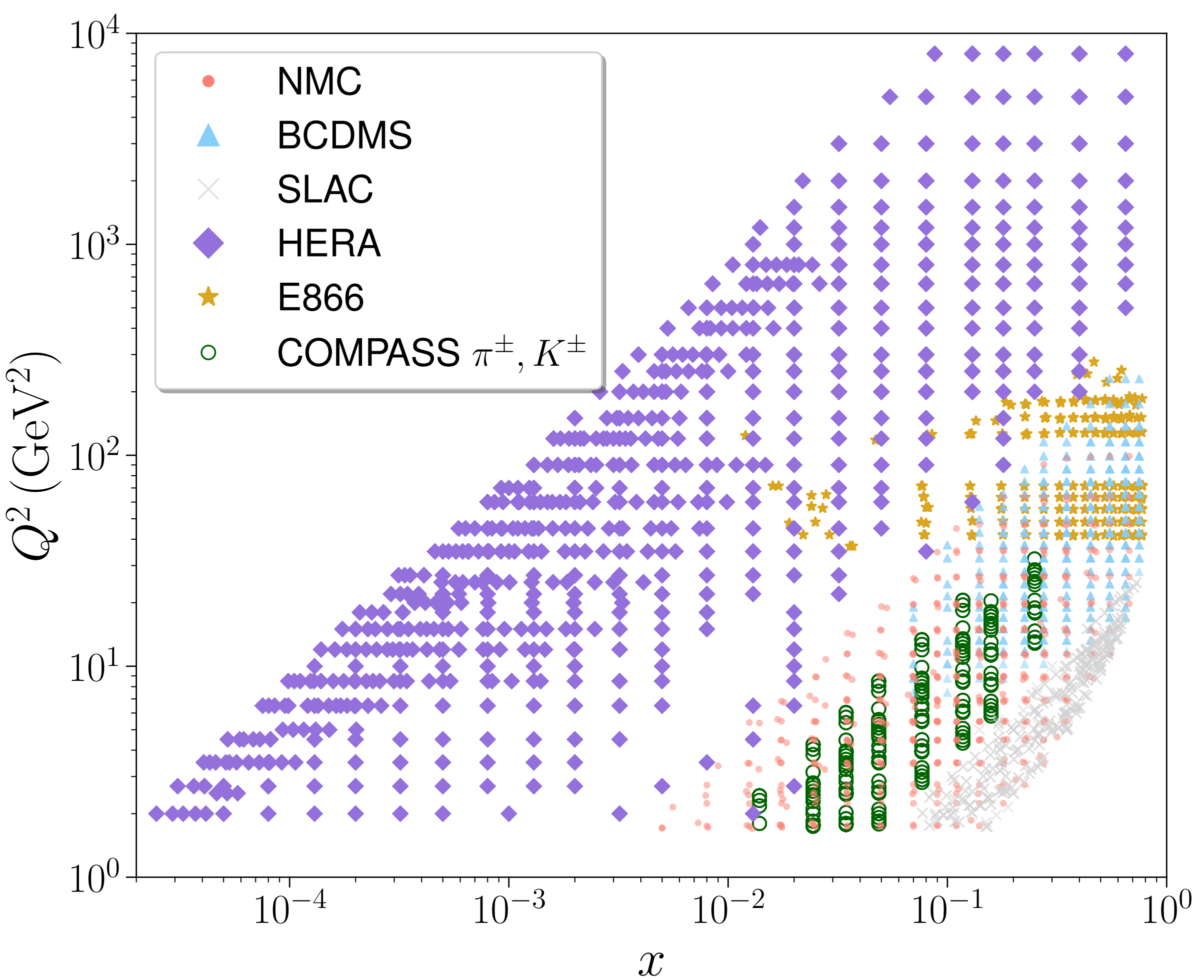
$$Q^2 > \mathrm{m}_c^2$$

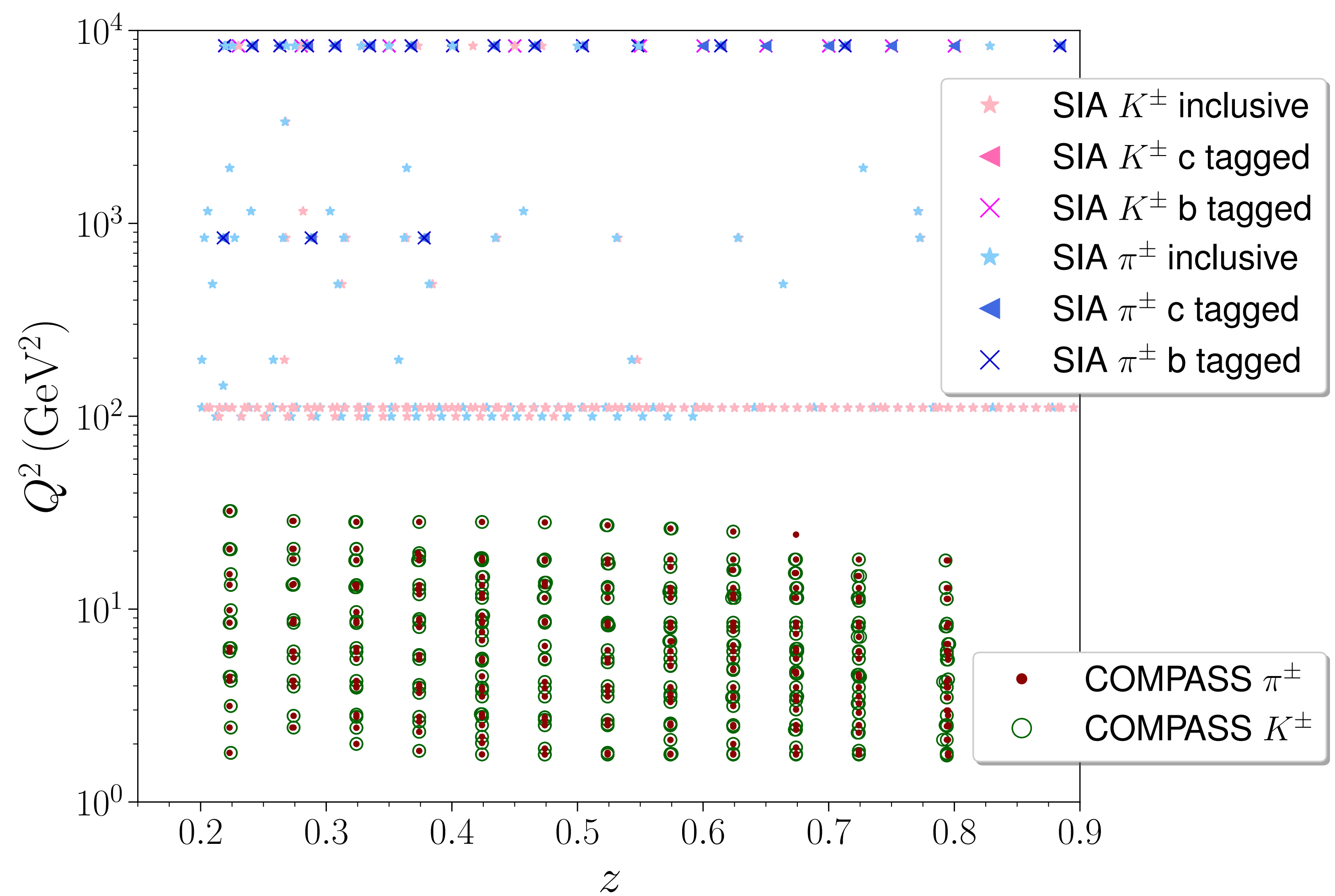
$$\mathrm{DIS} : l + (p,d) \rightarrow l' + X$$

$$\mathrm{DY} : l + (p,d) \rightarrow l\bar{l} + X$$

$$\mathrm{SIDIS} : l + d \rightarrow l' + h + X$$

$$\mathrm{SIA} : e^+ + e^- \rightarrow h + X$$





Setup: theory

- All observables computed at NLO in pQCD
- DGLAP truncated evolution at order α_s in Mellin space
- DIS/SIDIS/SIA cross sections computed at leading twist
- Nuclear smearing for deuterium DIS
- Heavy quark treatment : ZM-VFN
- Fitting methodology:
    - MC (multi-steps), k-means clustering, extended reduced χ^2

Why MC?

$$\chi^2 = \sum_e^{N_{exp}} \sum_i^{N_{data}} \frac{(D_i^e - T_i)^2}{(\sigma_i^e)^2}$$

- Typical PDF parametrization:

$$x\Delta f(x) = N x^a (1-x)^b (1 + c\sqrt{x} + dx)$$

- Perform single χ^2-fit: → Multiple local minima!

Parameters difficult to constrain

Hessian method for uncertainties → Introduces tolerance criteria

Unsuitable for simultaneous analysis of collinear distributions

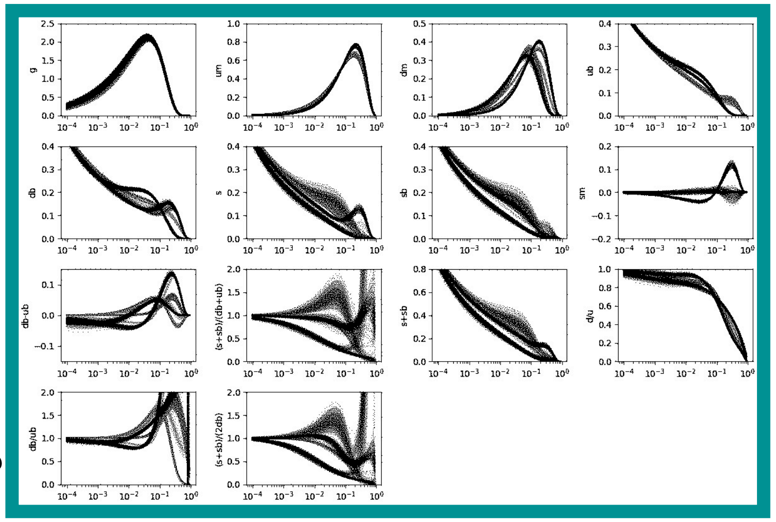
- Monte Carlo methods:
  - Allow efficient exploration of the parameter space
  - Uncertainties directly obtained from MC replicas

JAM19 methodology

JAM19: multi-step fitting

PDFs

$x\,f(x)$



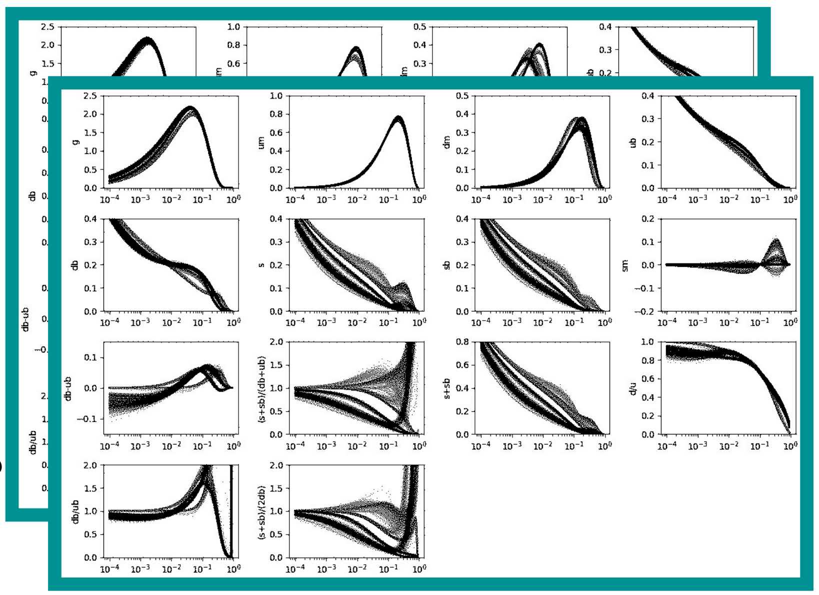
x

+ DIS data

JAM19: multi-step fitting

PDFs

$x\,f(x)$



x

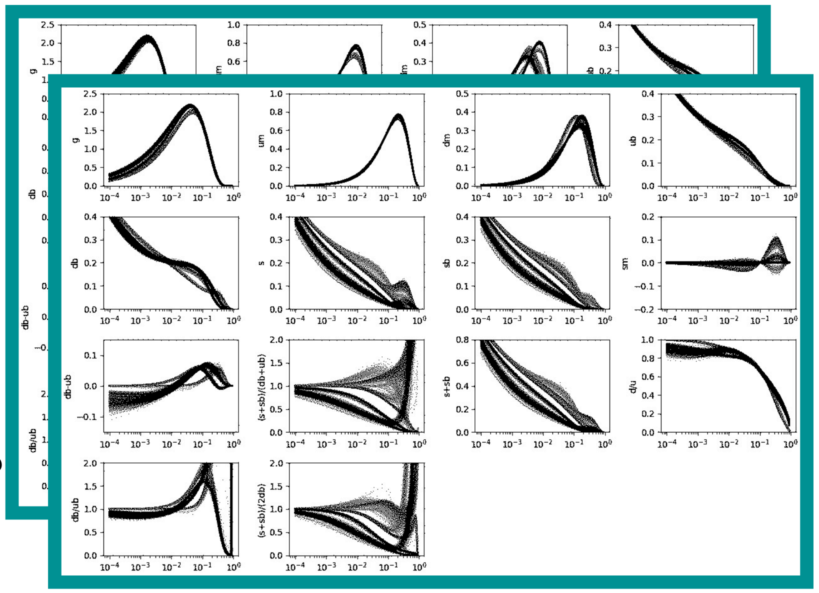
+ DIS data

+ DIS + DY data

JAM19: multi-step fitting

PDFs

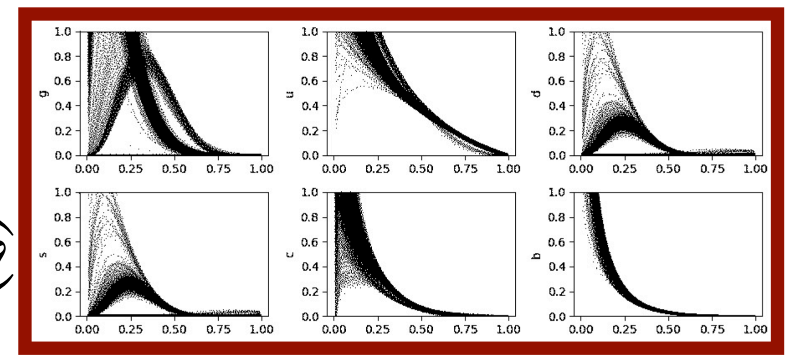
$x\,f(x)$



x

PION FF

$z\,D(z)$



z

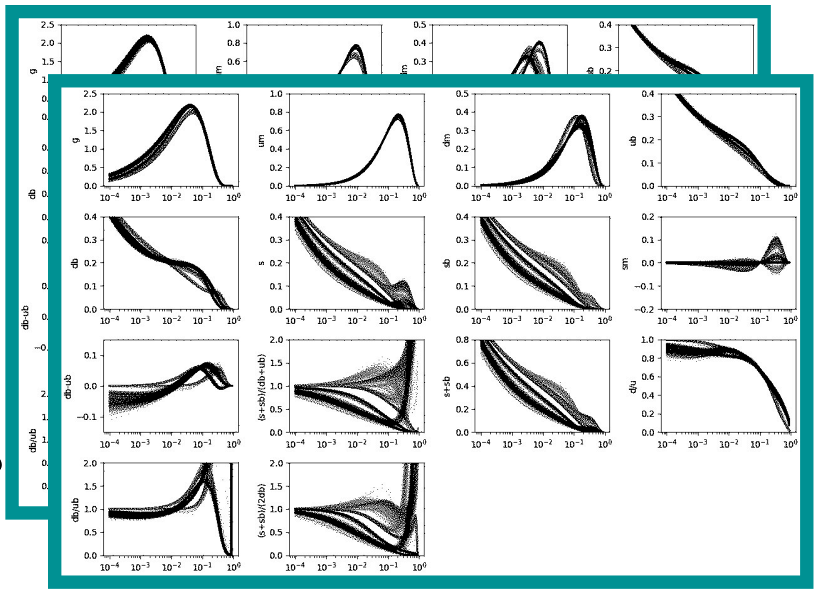
+ DIS data

+ DIS + DY data

+ SIA pion data

JAM19: multi-step fitting

PDFs



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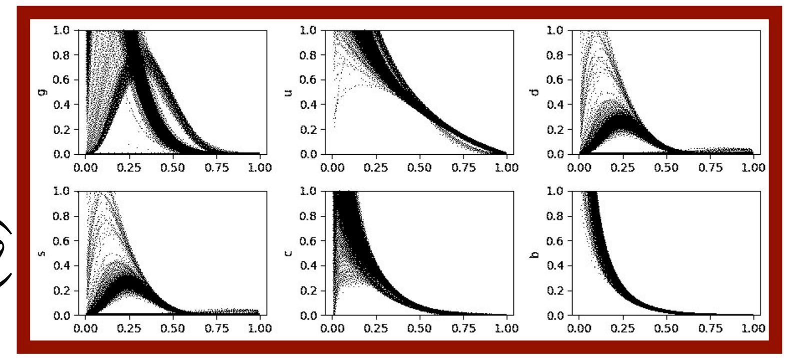
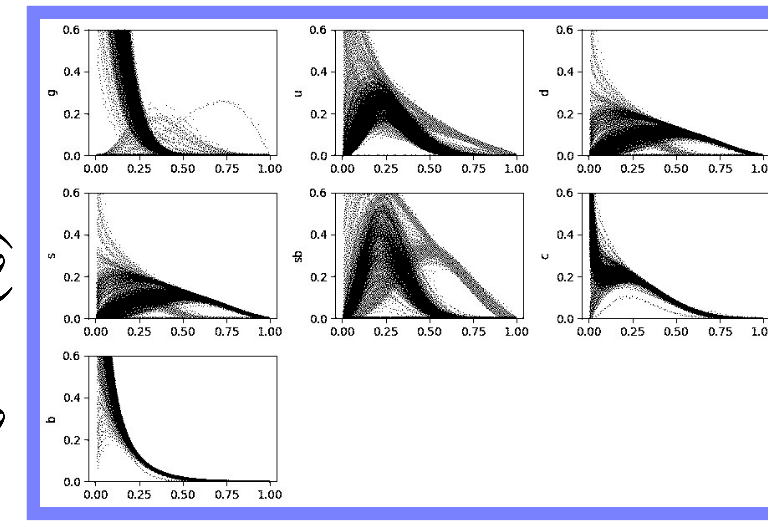


KAON FF



+ DIS data

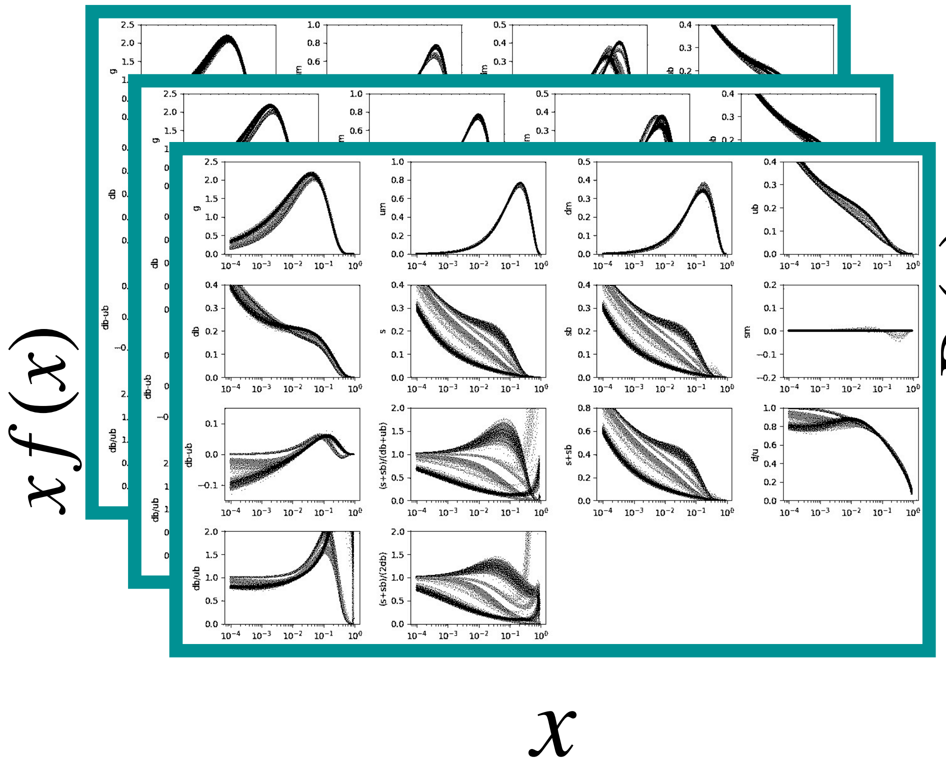
+ DIS + DY data

+ SIA pion data

+ SIA kaon data

JAM19: multi-step fitting

PDFs

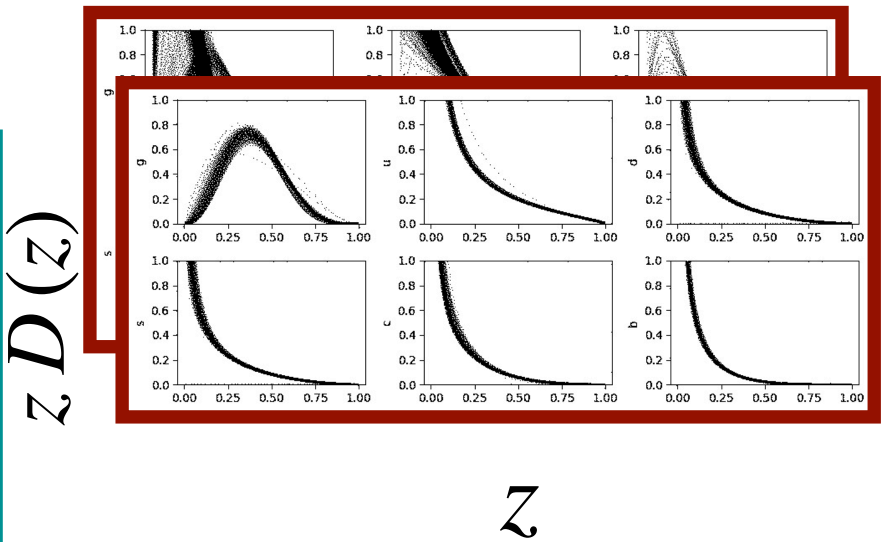


+ DIS data

+ DIS + DY data

+ SIDIS data

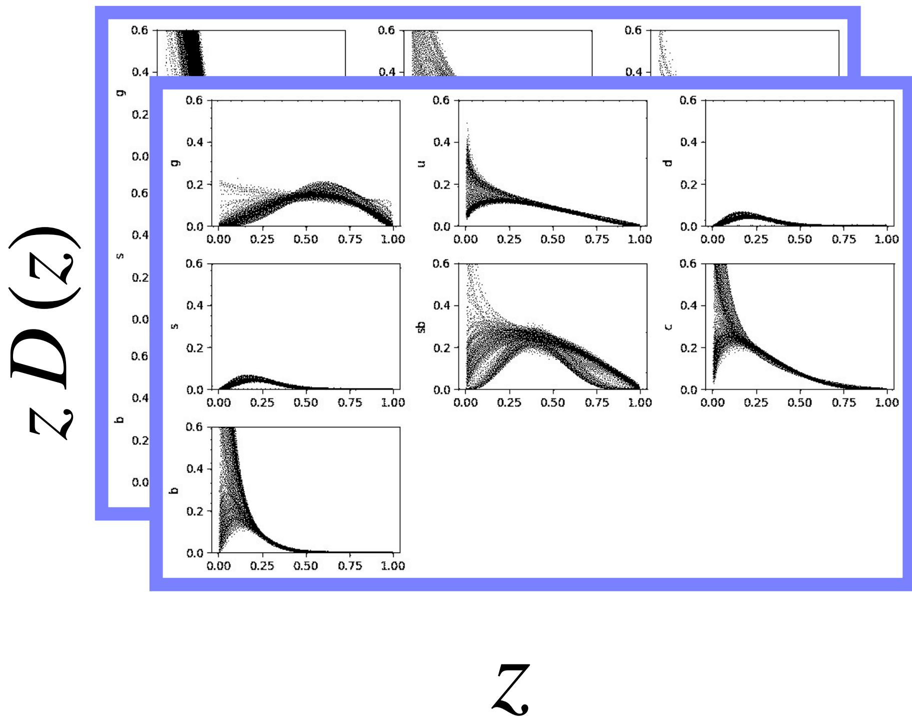
PION FF



+ SIA pion data

+ SIDIS pion data

KAON FF

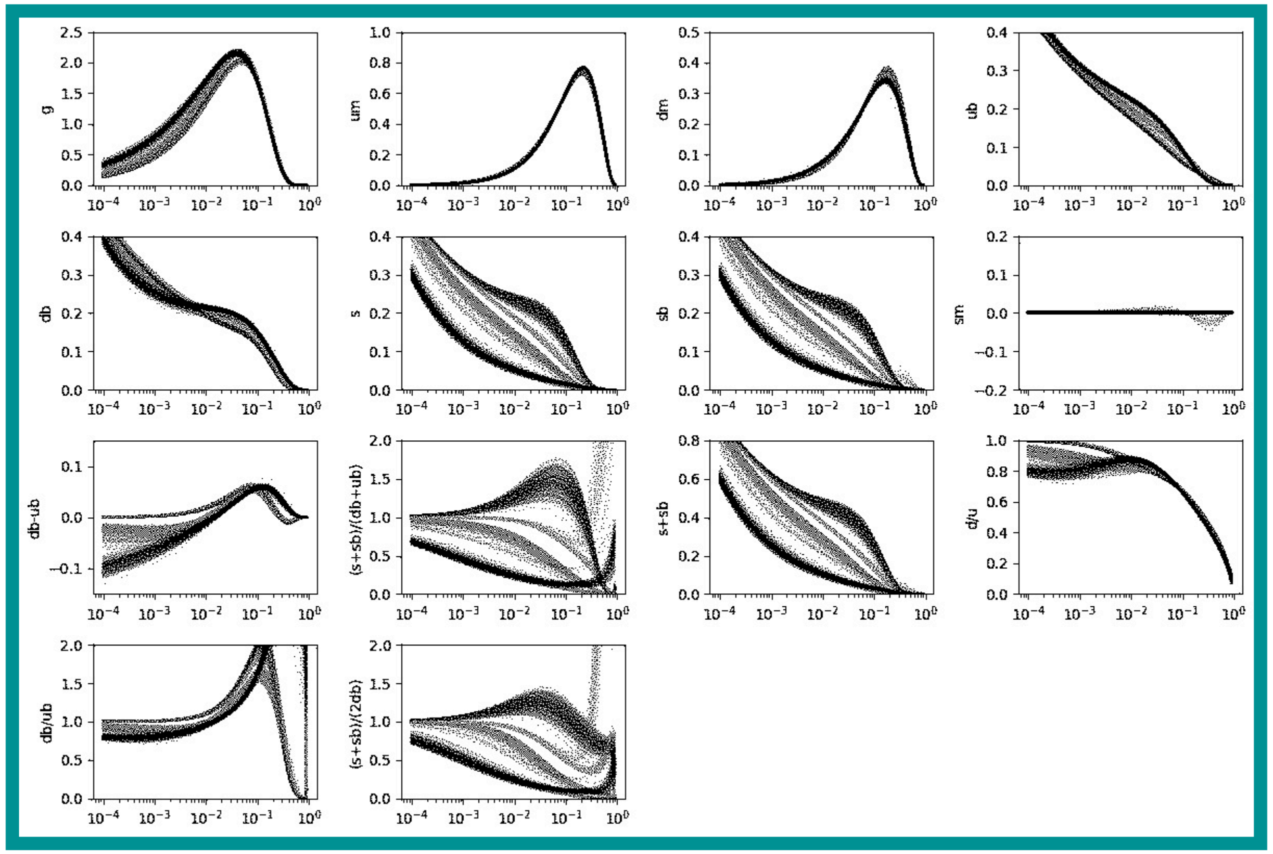


+ SIA kaon data

+ SIDIS kaon data

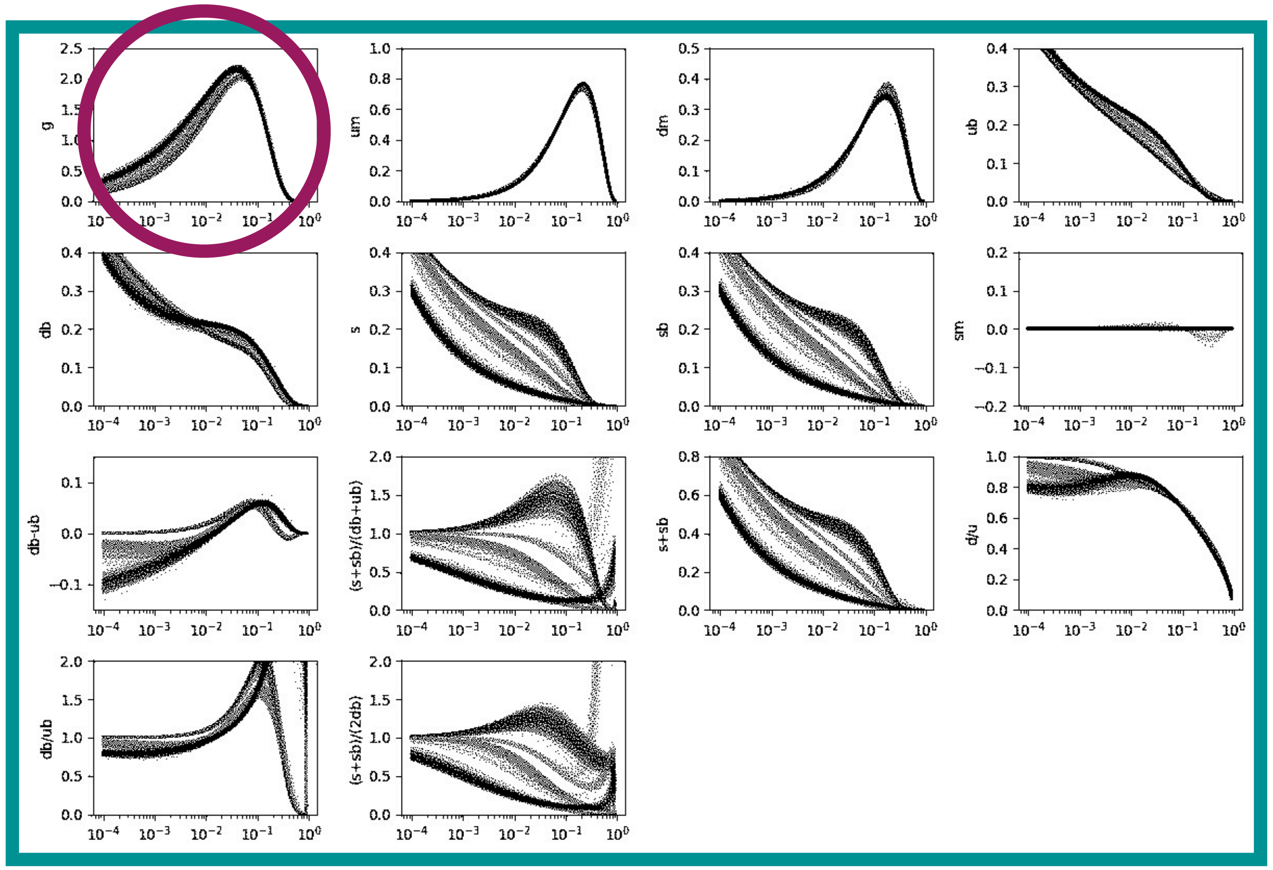
Discrminating multiple solutions

$x\,f(x)$



x

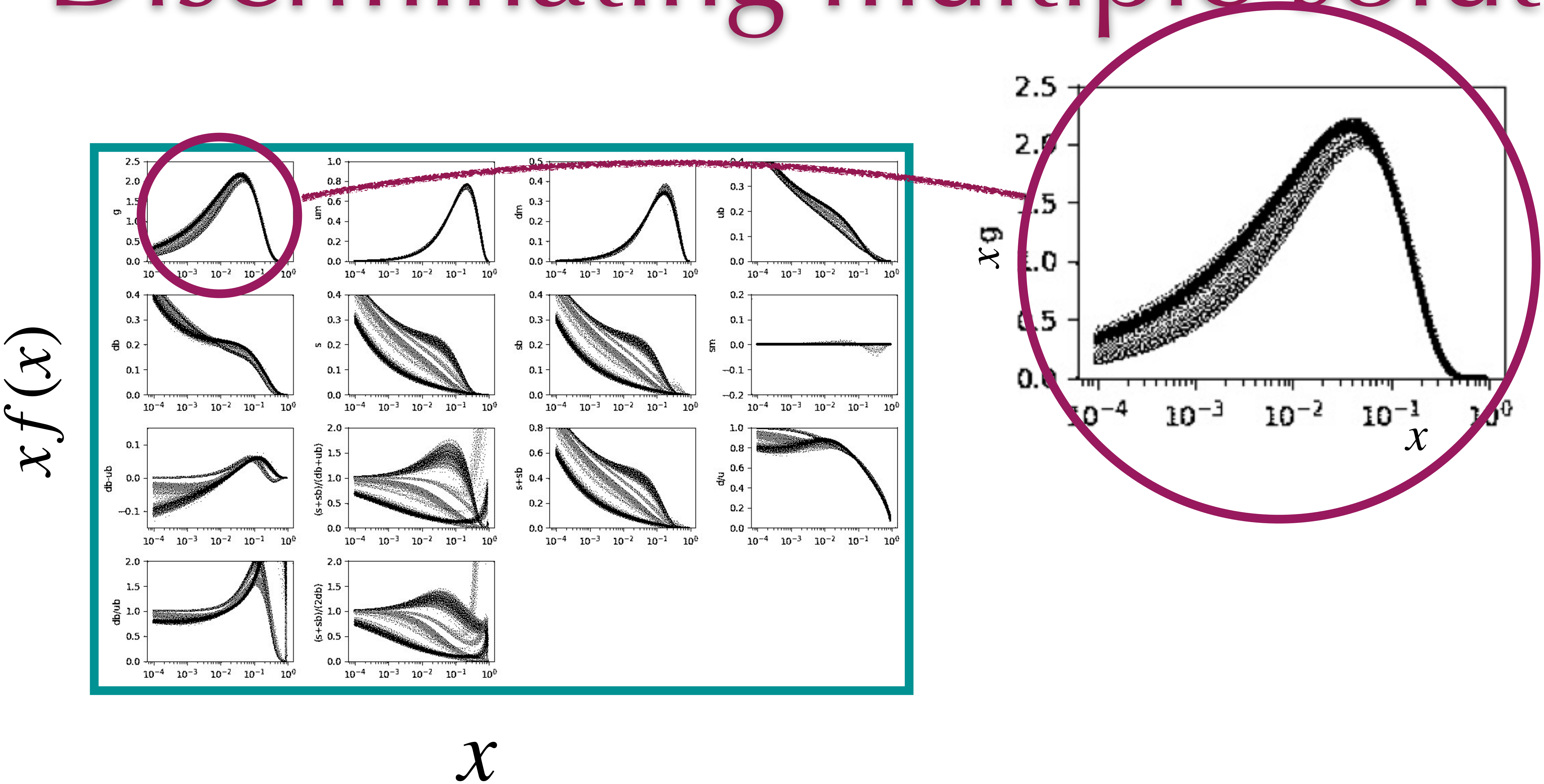
Discrminating multiple solutions



$x\,f(x)$

x

Discrminating multiple solutions



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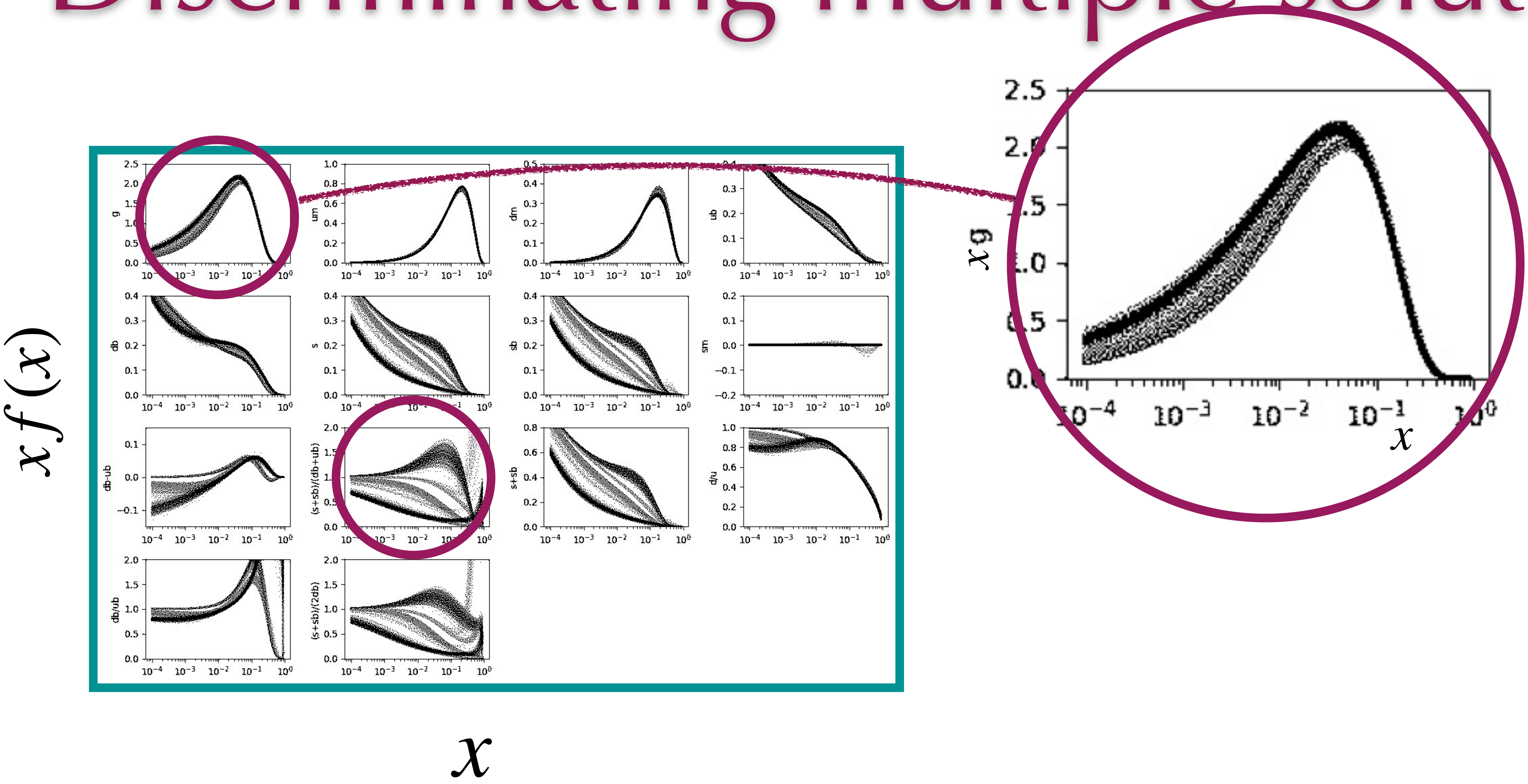
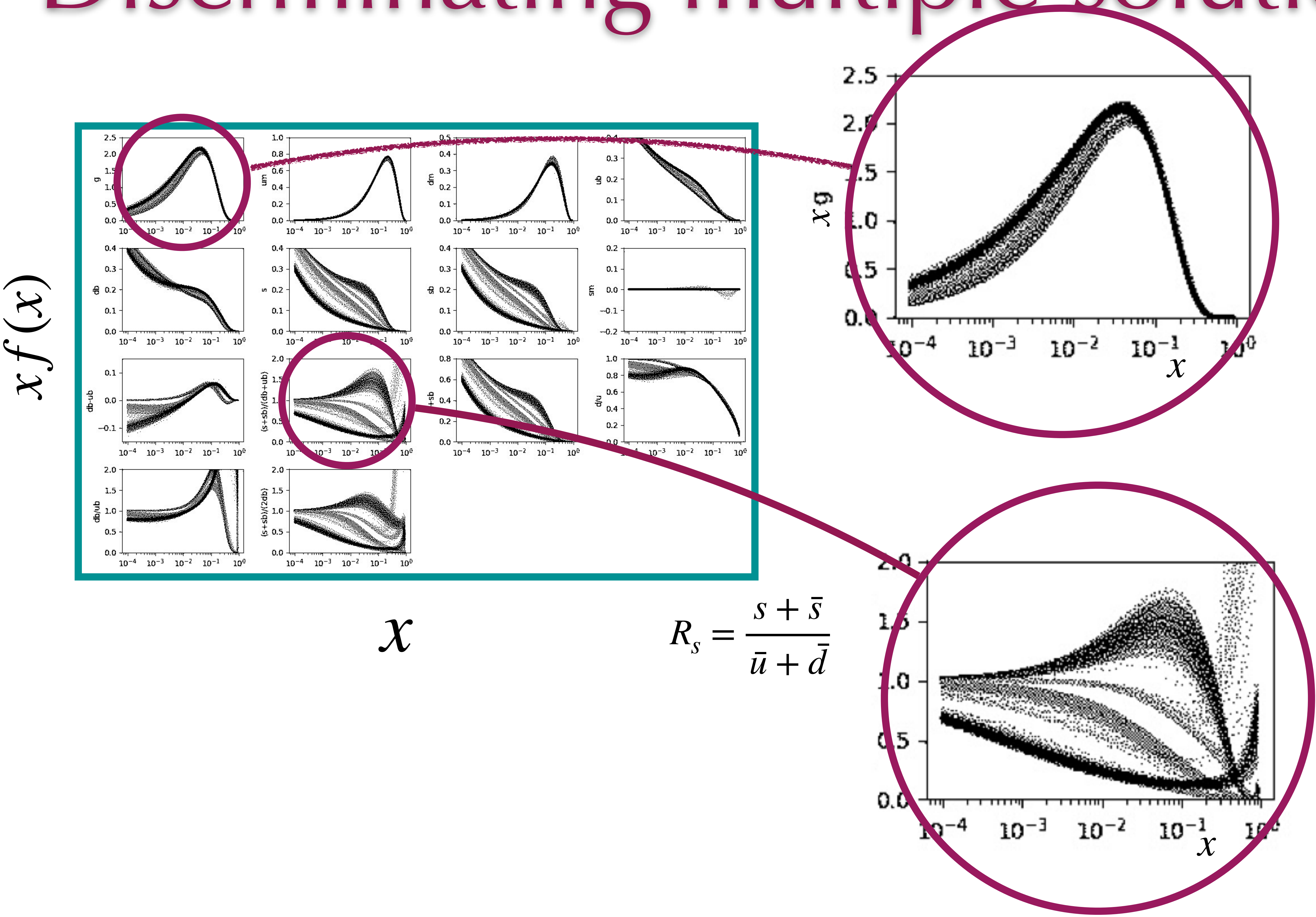


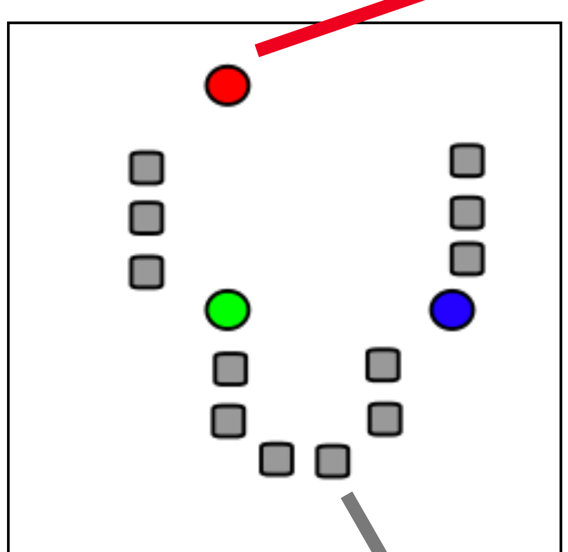
Discrminating multiple solutions



k-means clustering

E.g. $f(x) = x^{\alpha}(1-x)^{\beta}$

(α^*, β^*) : centroid



Initialization

(α_i, β_i) : replica

k-means clustering

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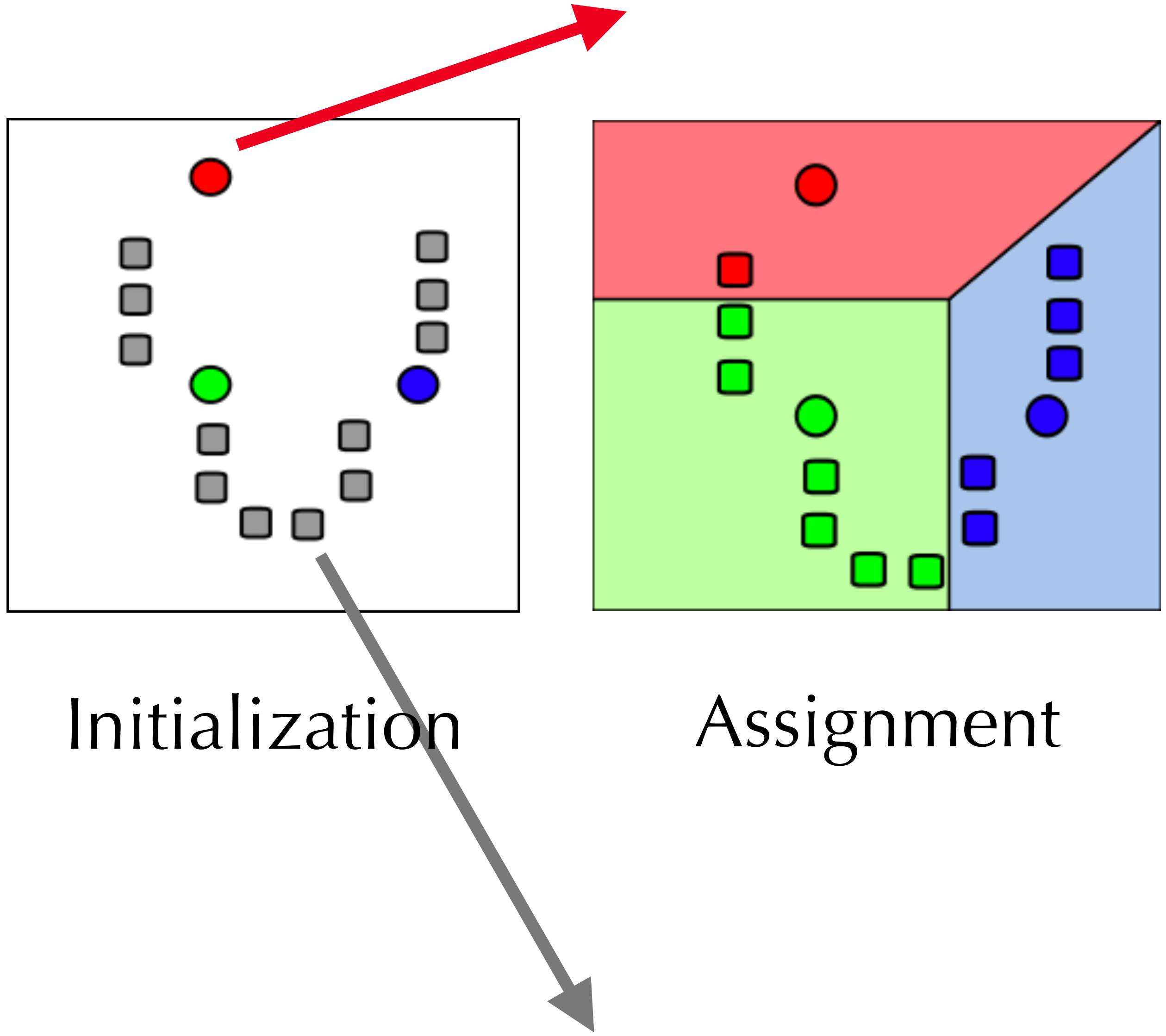

Initialization Assignment

(α_i, β_i) : replica

k-means clustering

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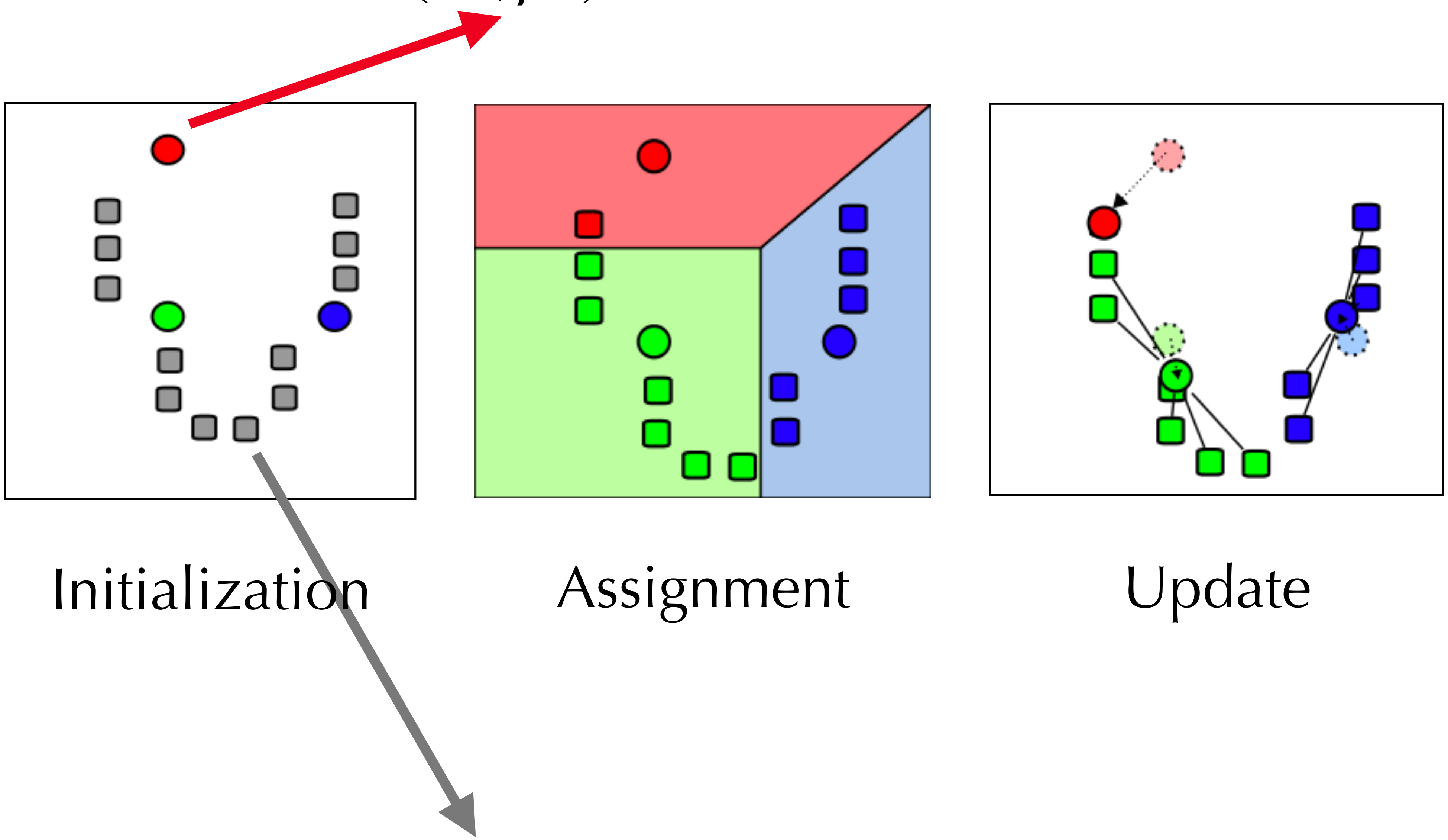

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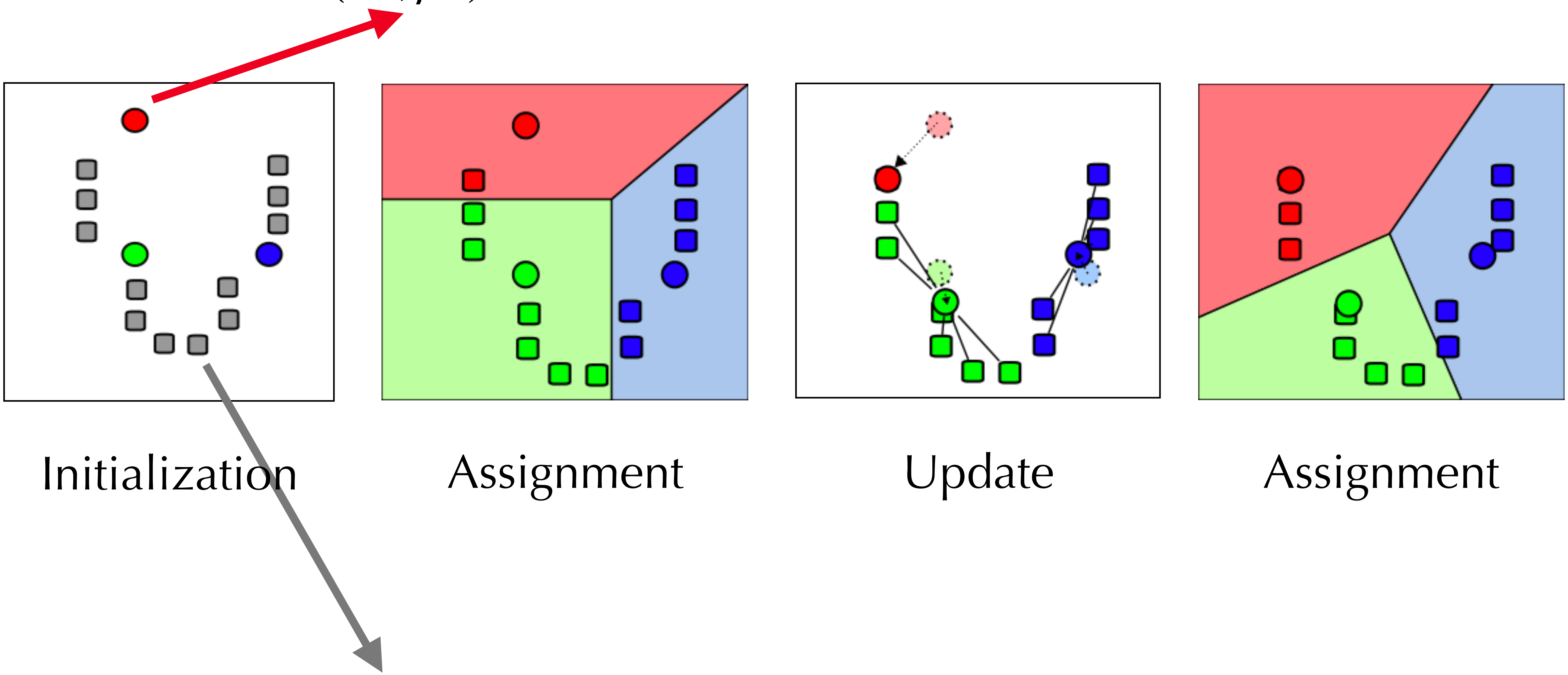

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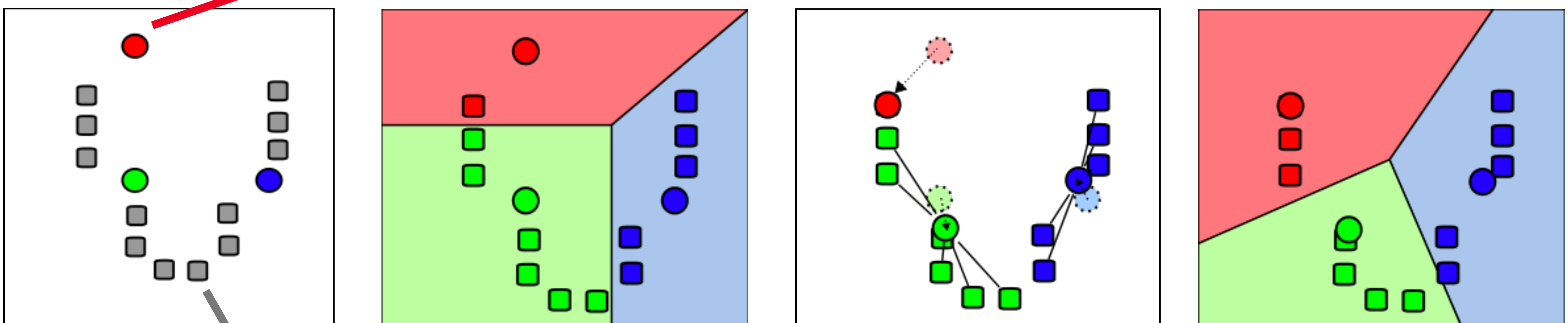
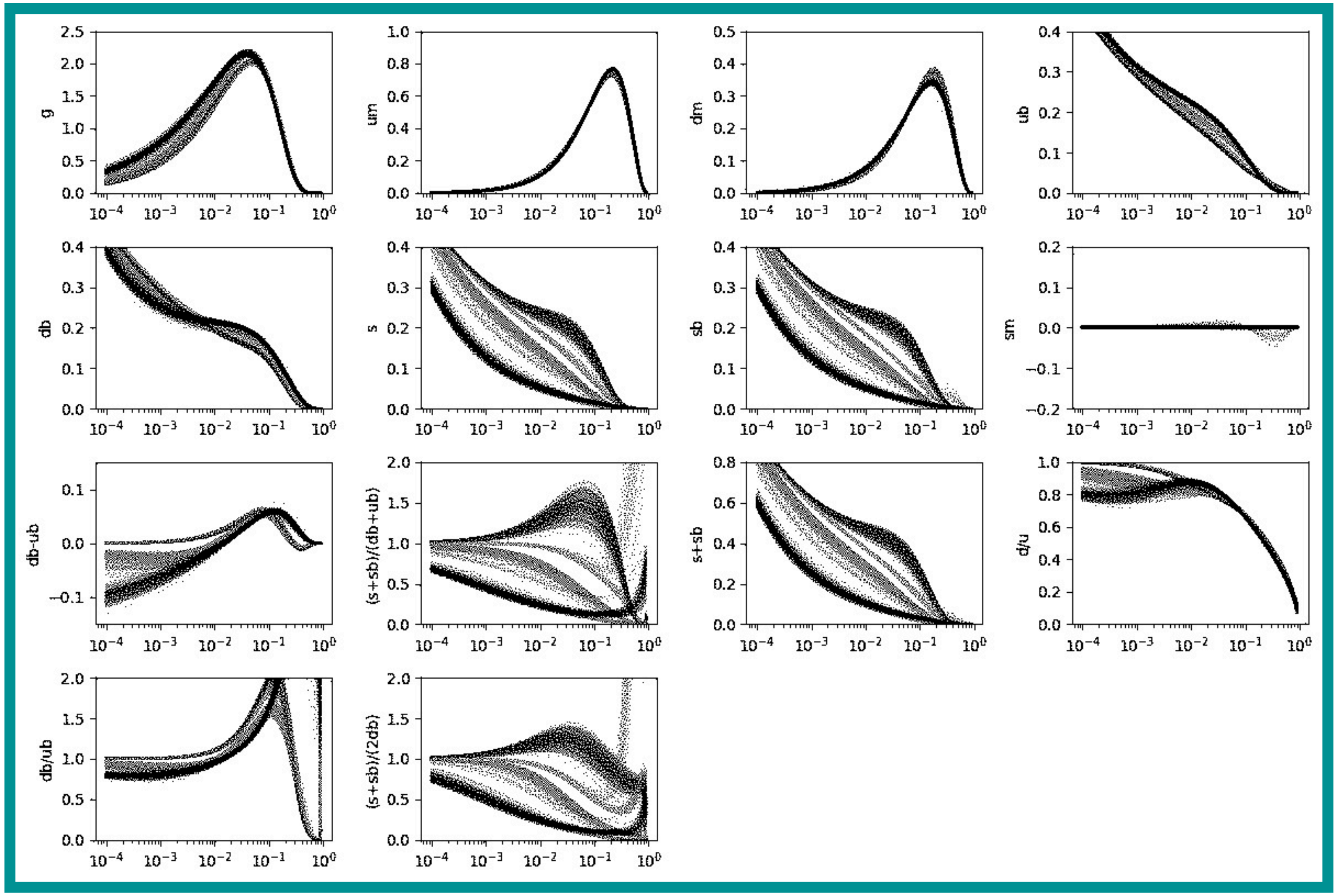


Initialization | Assignment | Update | Assignment

Repeat until convergence

(α_i, β_i) : replica

Discriminating multiple solutions

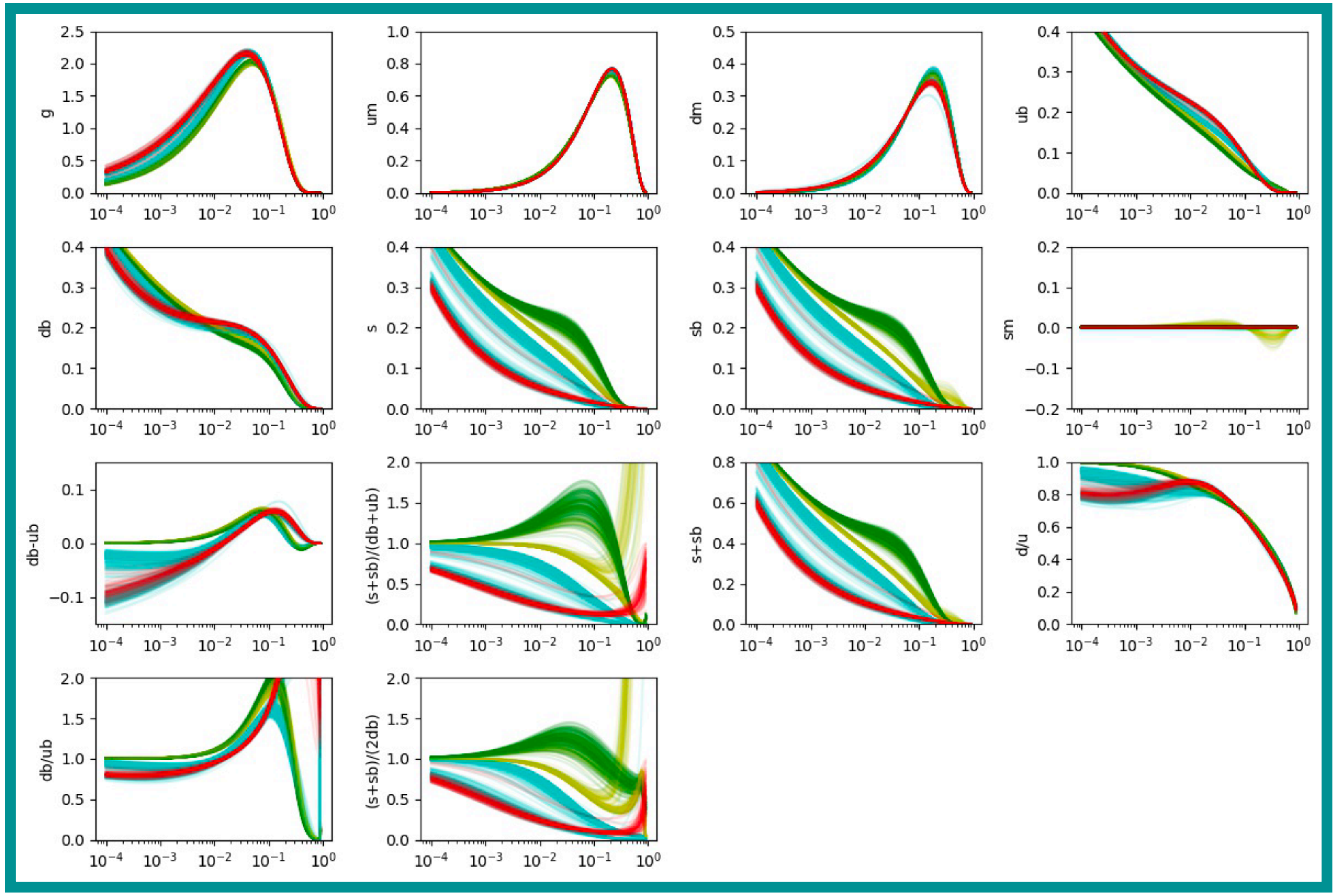


+ DIS data

+ DIS + DY data

+ SIDIS data

Discriminating multiple solutions



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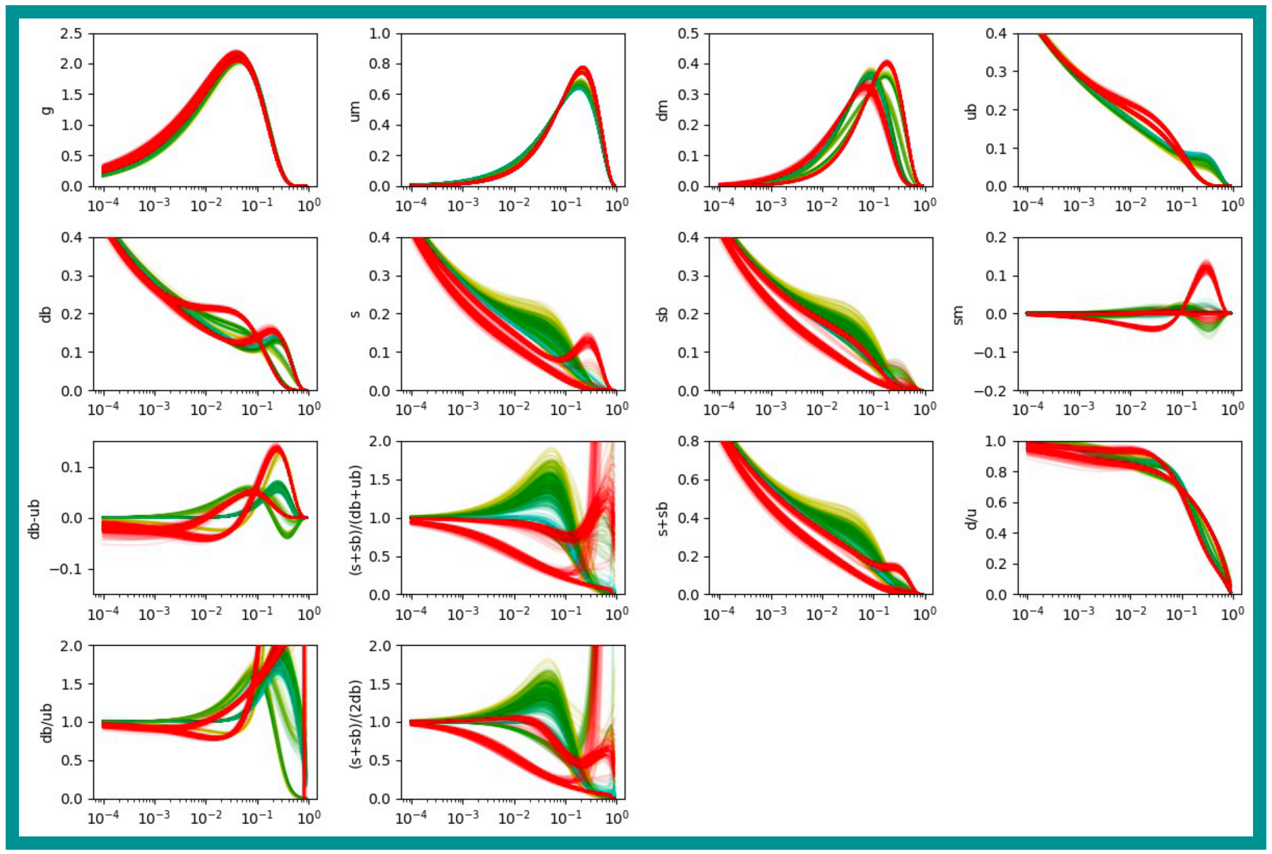
+ SIDIS data

Constraints on Rs

$$R_s = \frac{s + \bar{s}}{\bar{u} + \bar{d}}$$

PDFs

$x\,f(x)$



x

+ DIS data

Constraints on Rs

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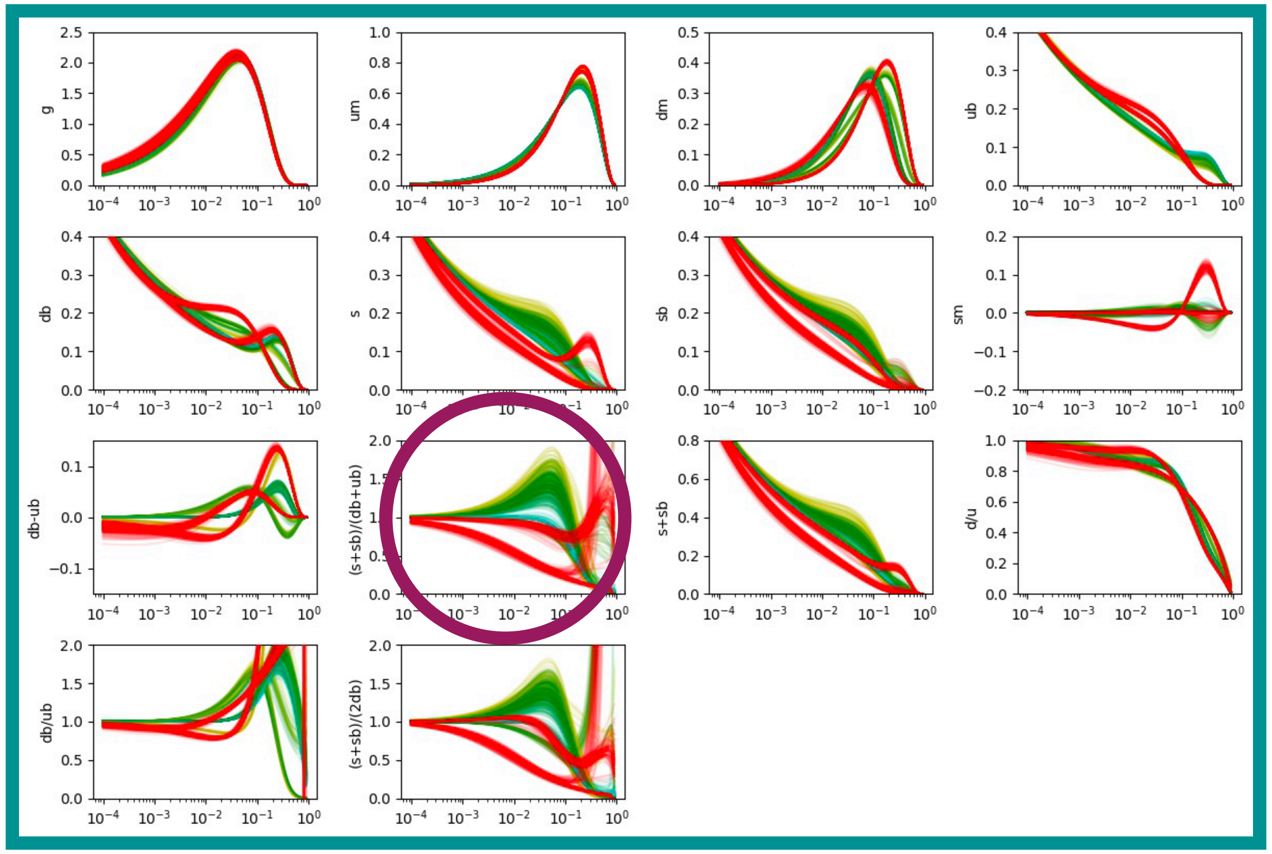
$x\,f(x)$



x

+ DIS data

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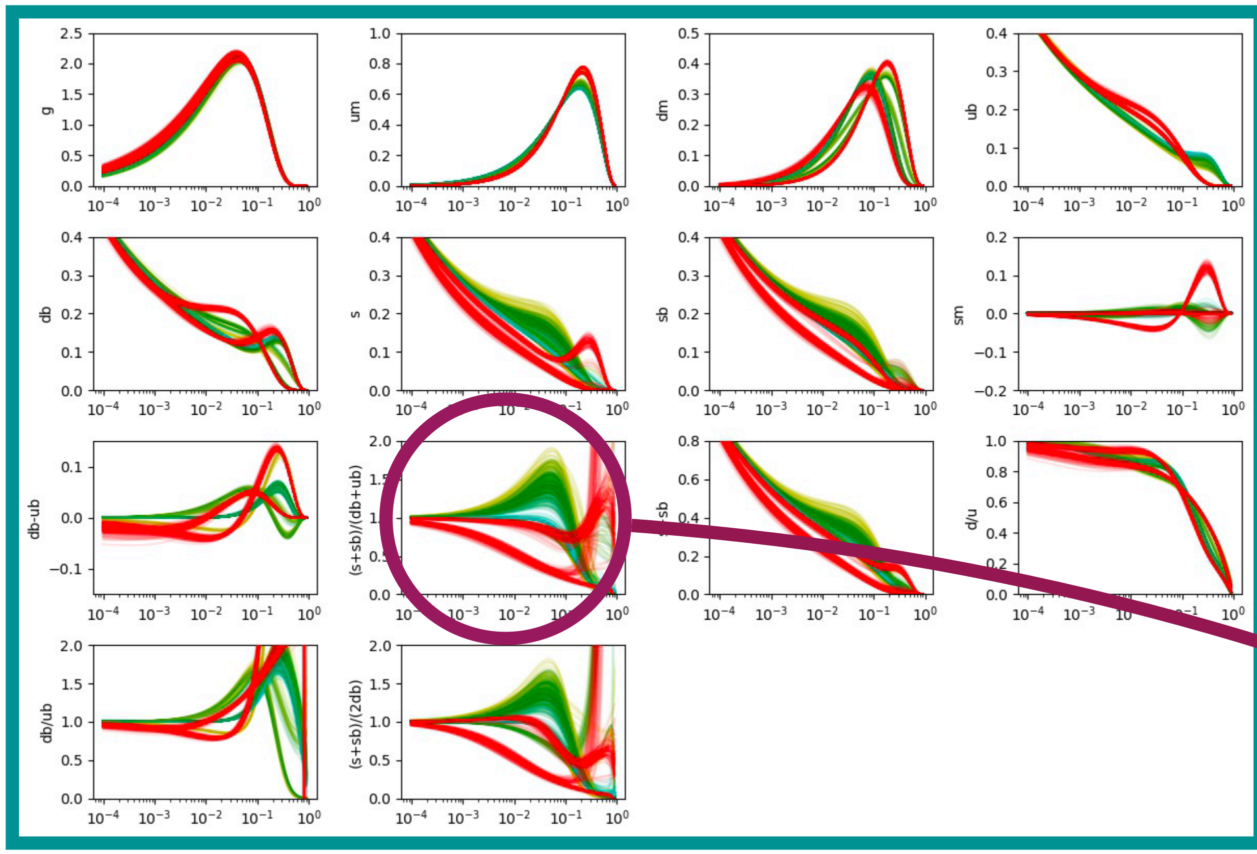
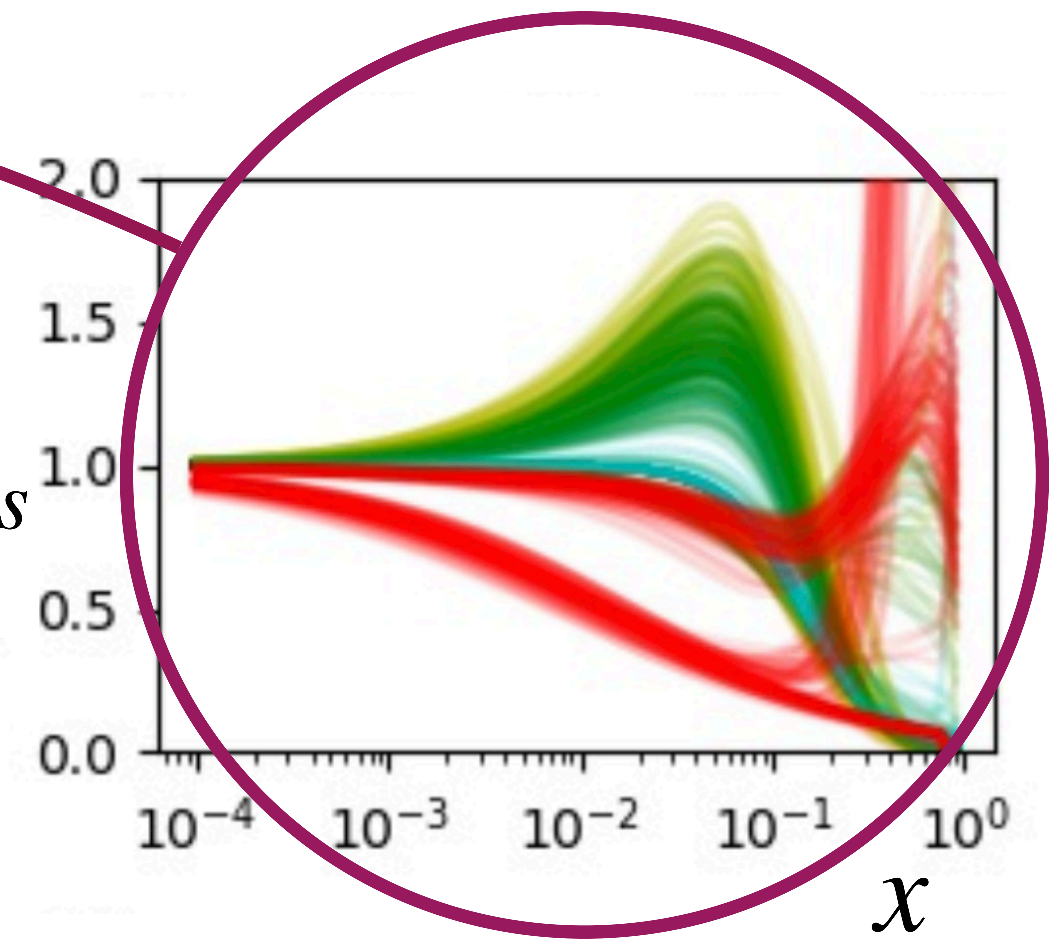


x

+ DIS data



Constraints on Rs

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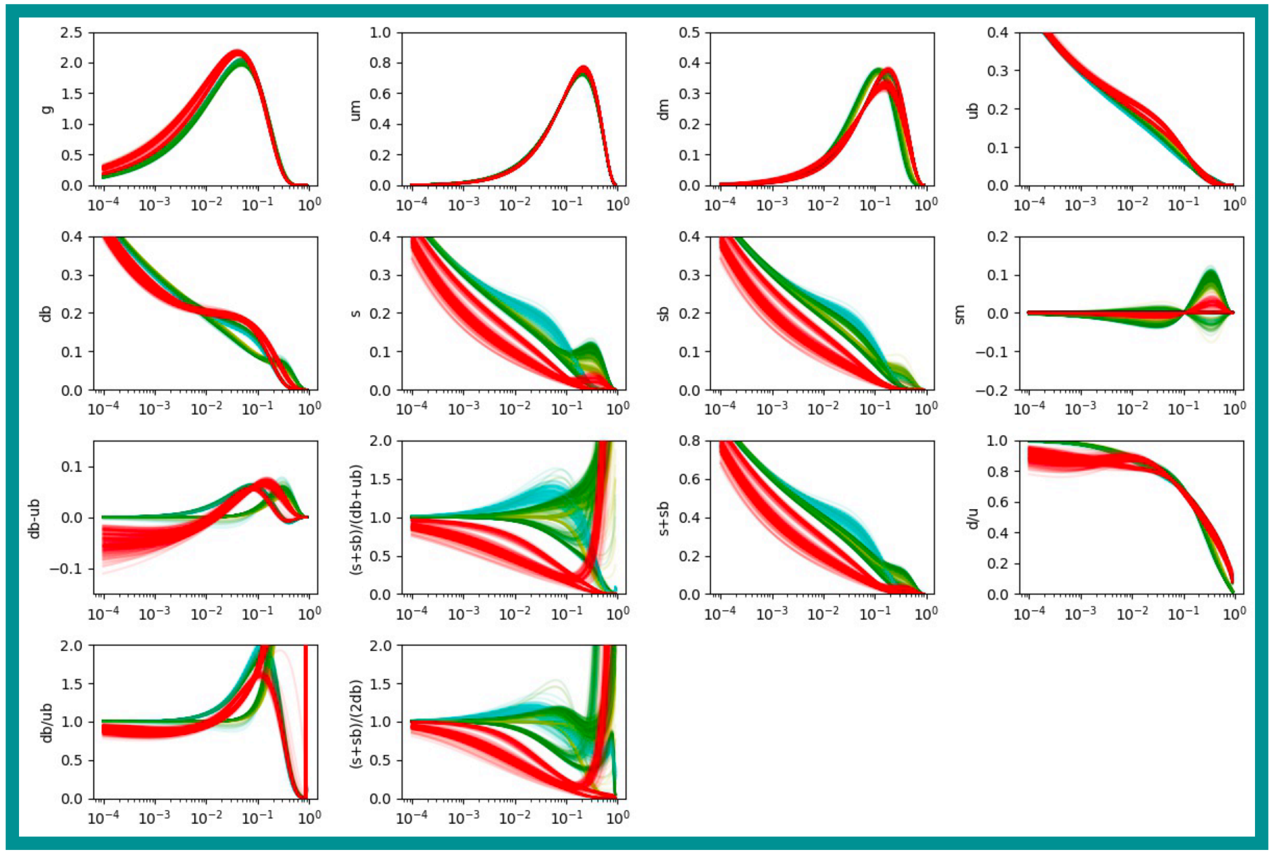
PDFs

$x\,f(x)$



x

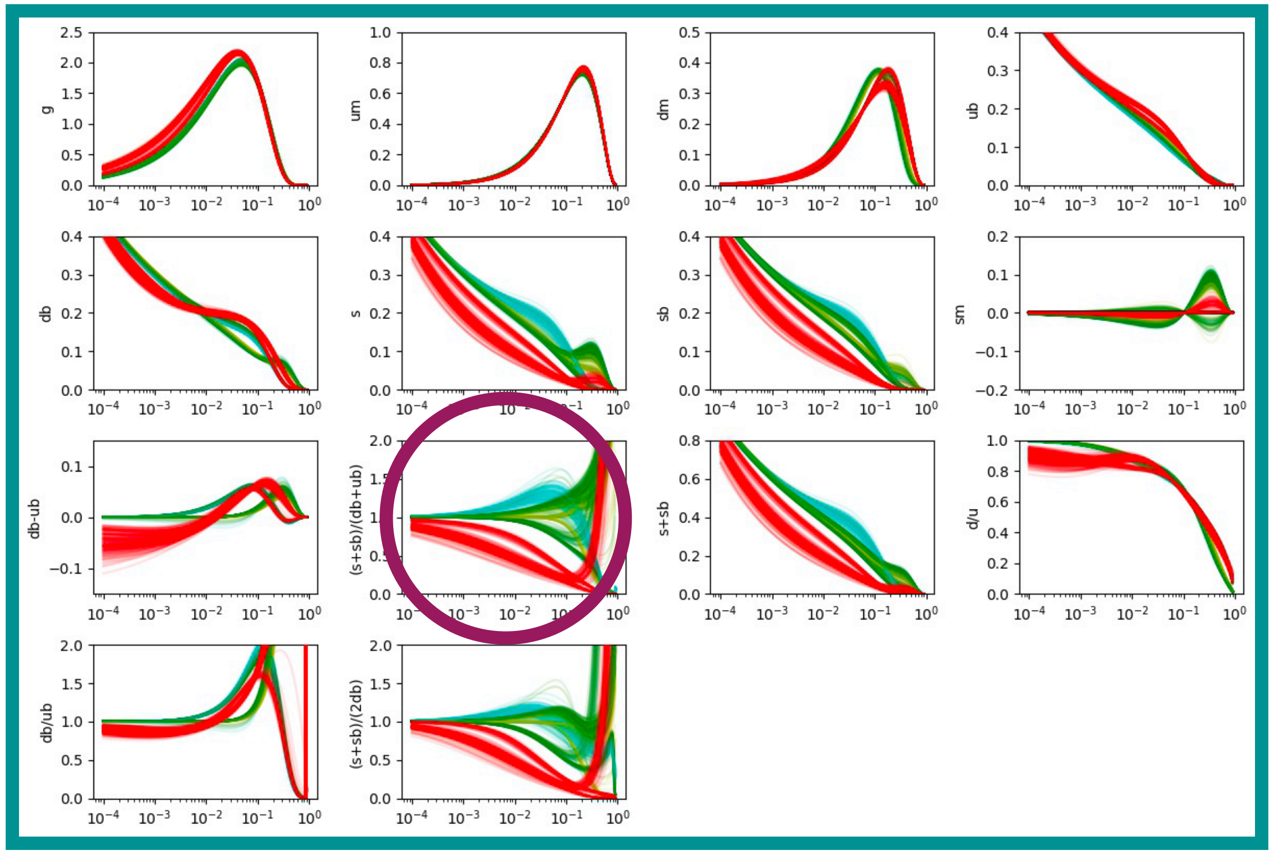
+ DIS data
+ DY data

Constraints on Rs

$$R_s = \frac{s + \bar{s}}{\bar{u} + \bar{d}}$$

PDFs

$x\, f(x)$



x

\+ DIS data

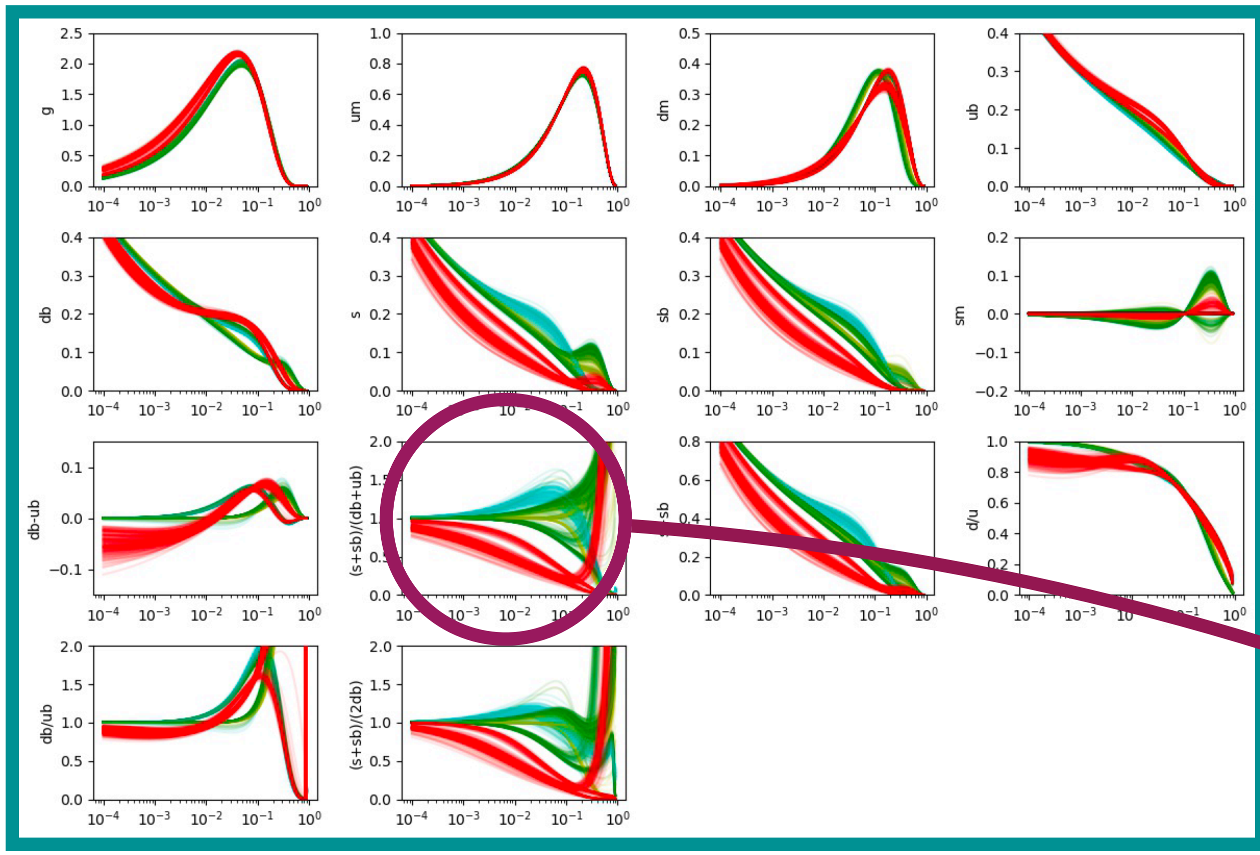
\+ DY data

Constraints on Rs

$$R_s = \frac{s + \bar{s}}{\bar{u} + \bar{d}}$$

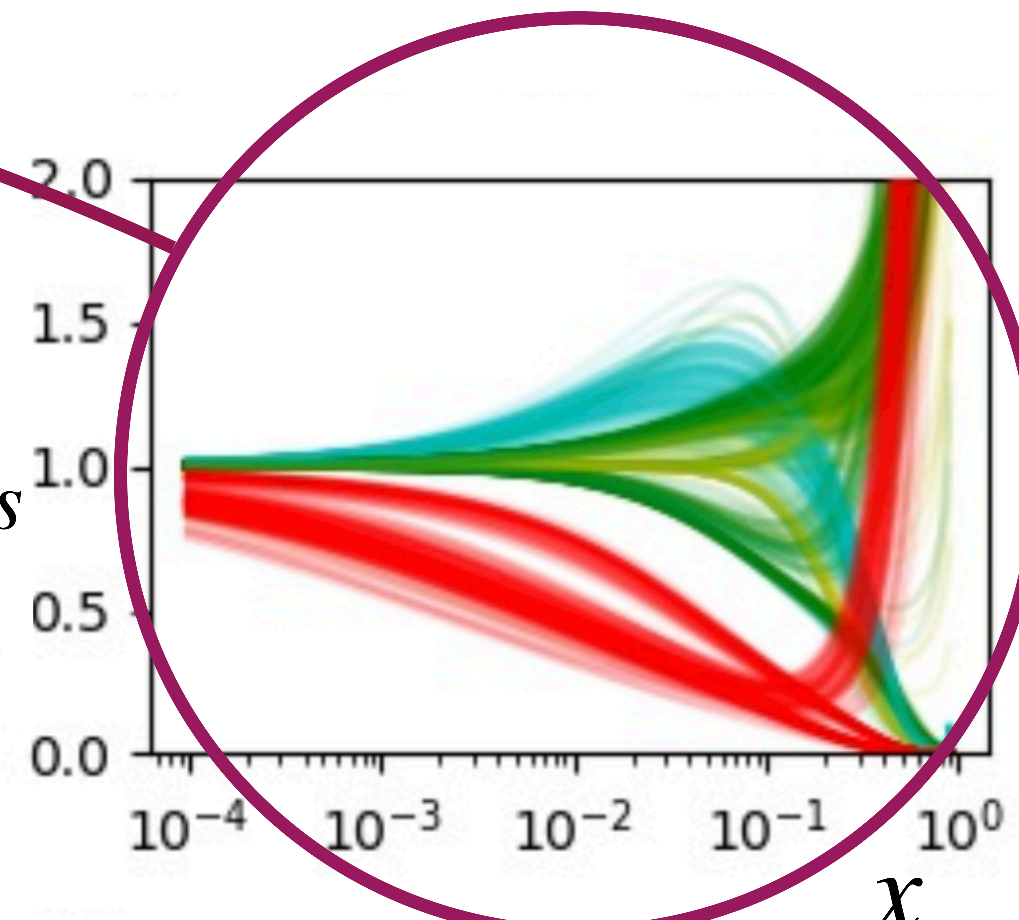
PDFs

$x\,f(x)$



x

+ DIS data
+ DY data



R_s

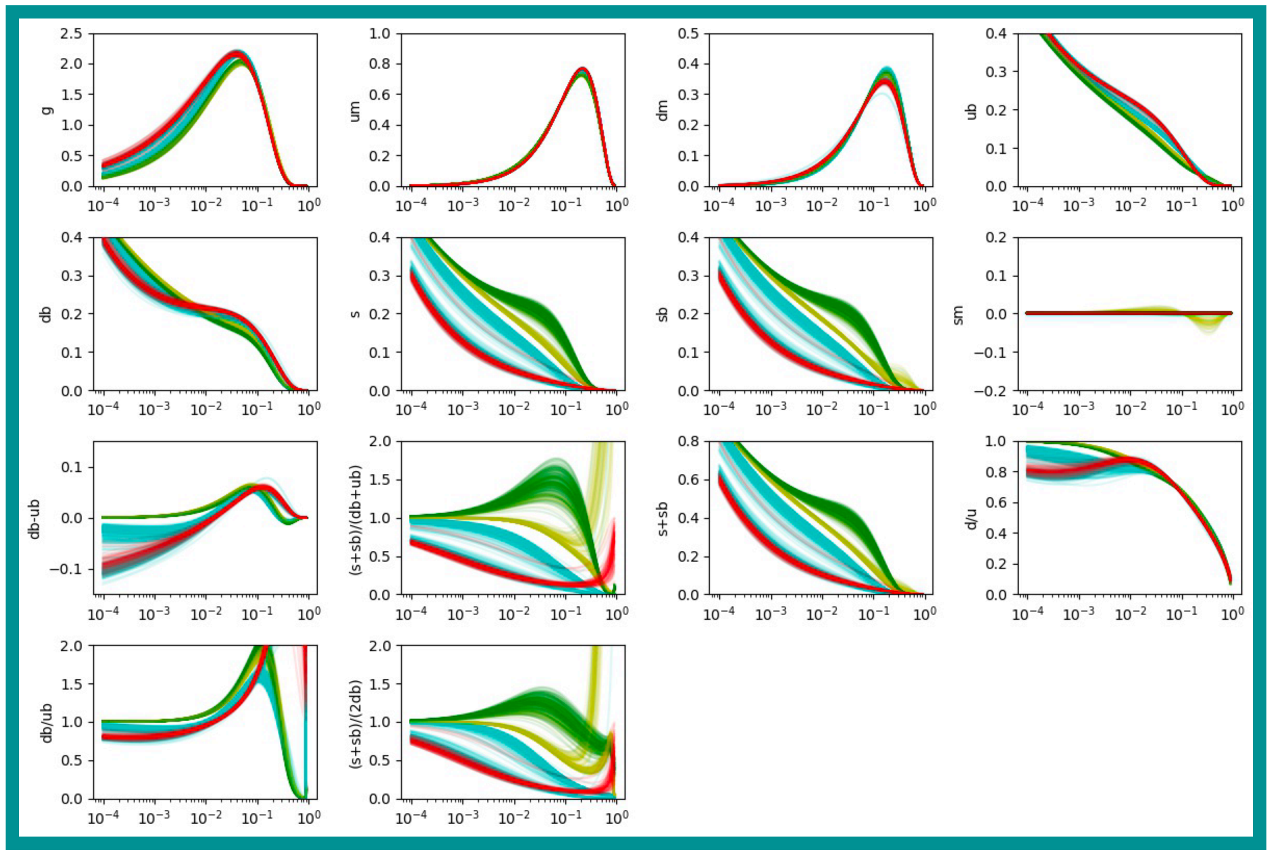
x

Constraints on R_s

$$R_s = \frac{s + \bar{s}}{\bar{u} + \bar{d}}$$

PDFs

$x\,f(x)$



x

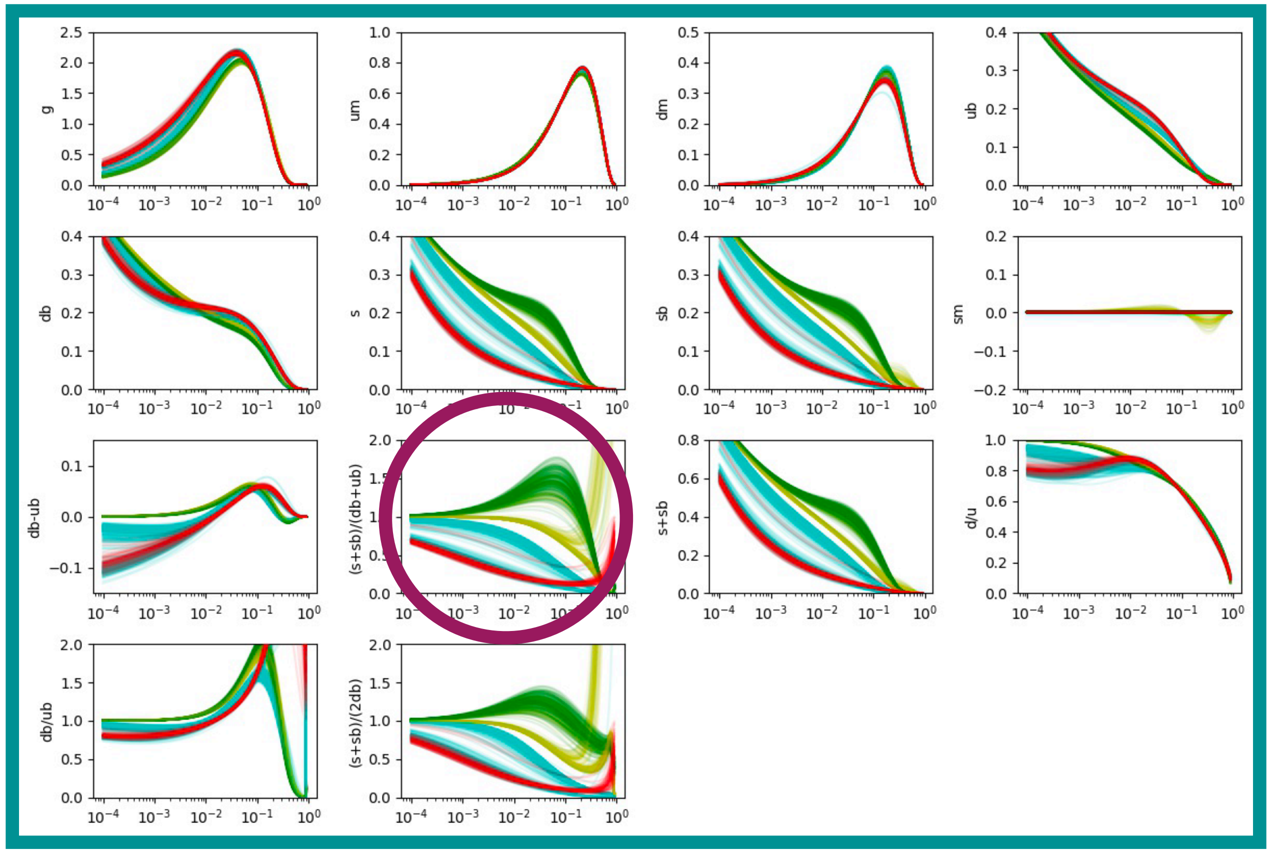
+ DIS data
+ DY data
+ SIA + SIDIS data

Constraints on R_s

$$R_s = \frac{s + \bar{s}}{\bar{u} + \bar{d}}$$

PDFs

$x\,f(x)$



x

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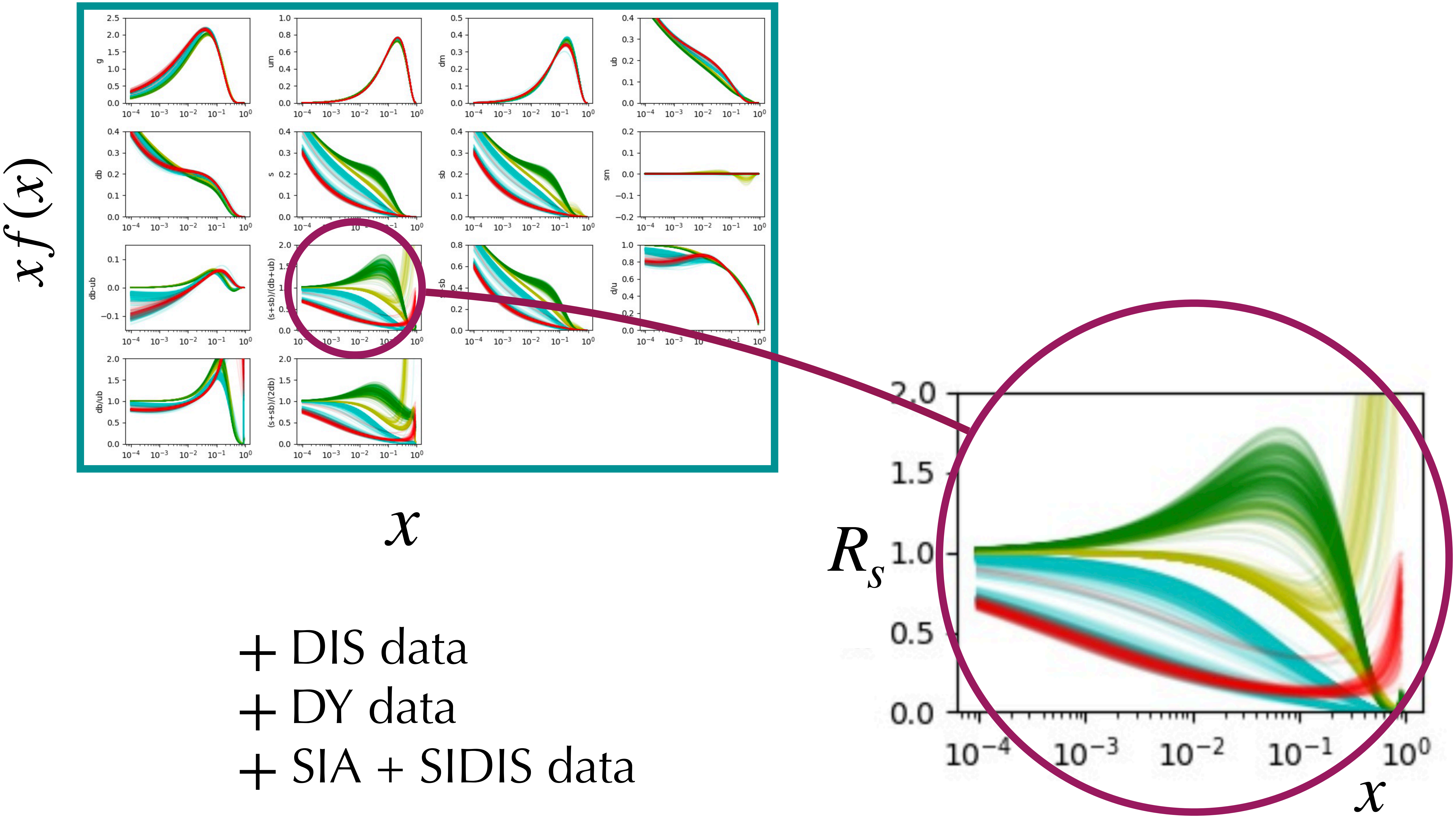
Constraints on R_s

$$R_s = \frac{s + \bar{s}}{\bar{u} + \bar{d}}$$

PDFs



+ DIS data
+ DY data
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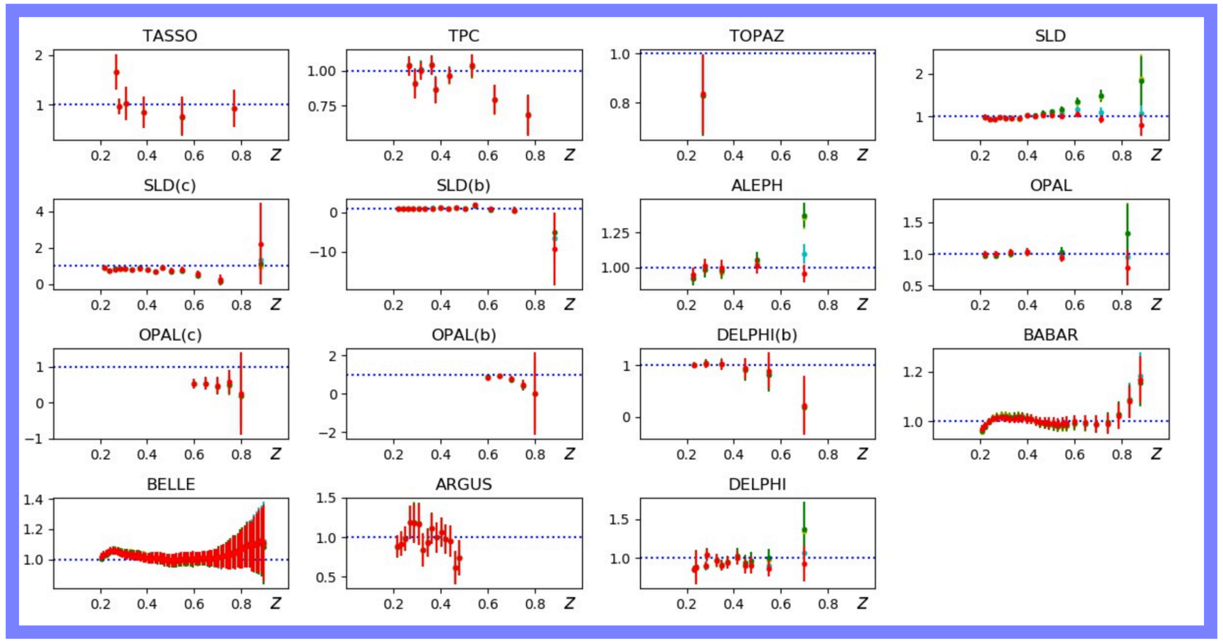
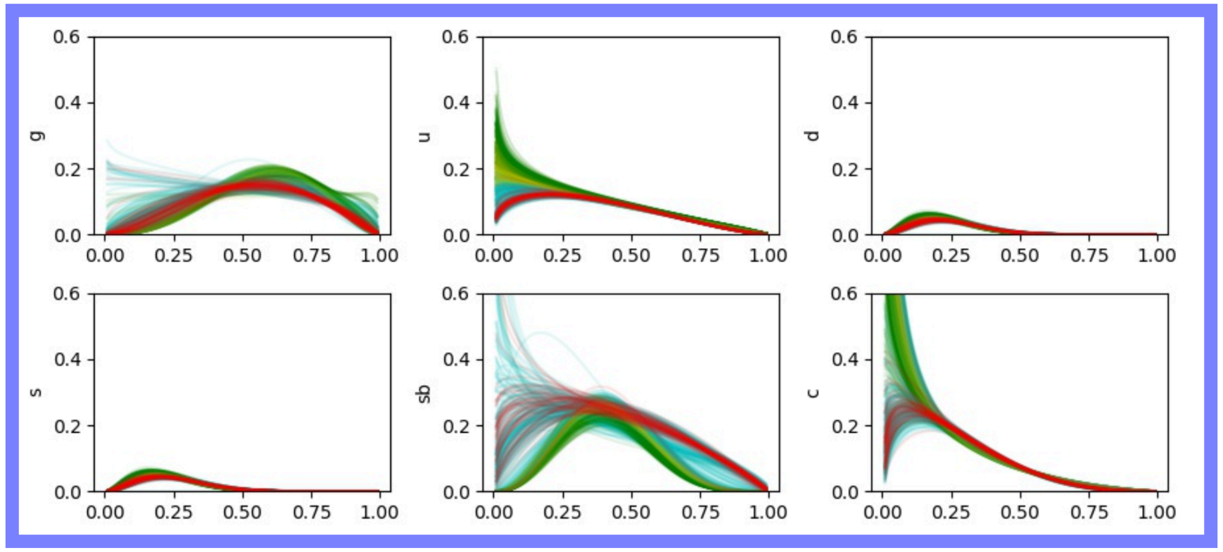
SIA K+/K- data

Data/Theory



z

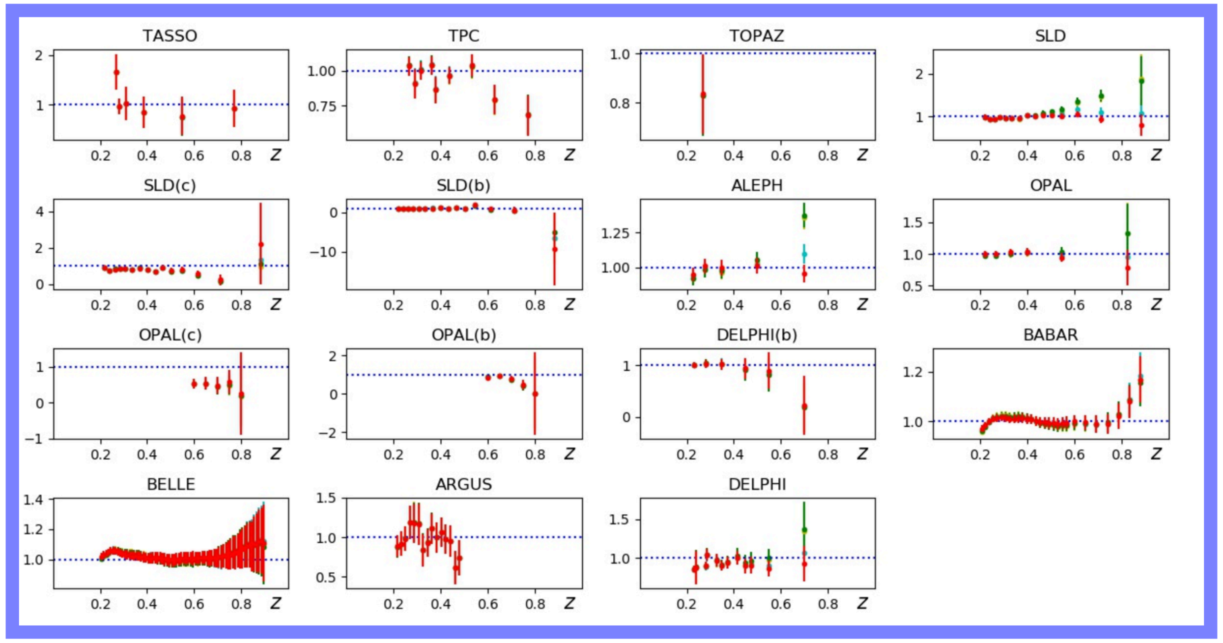
$zD_q^{K^+}$



z

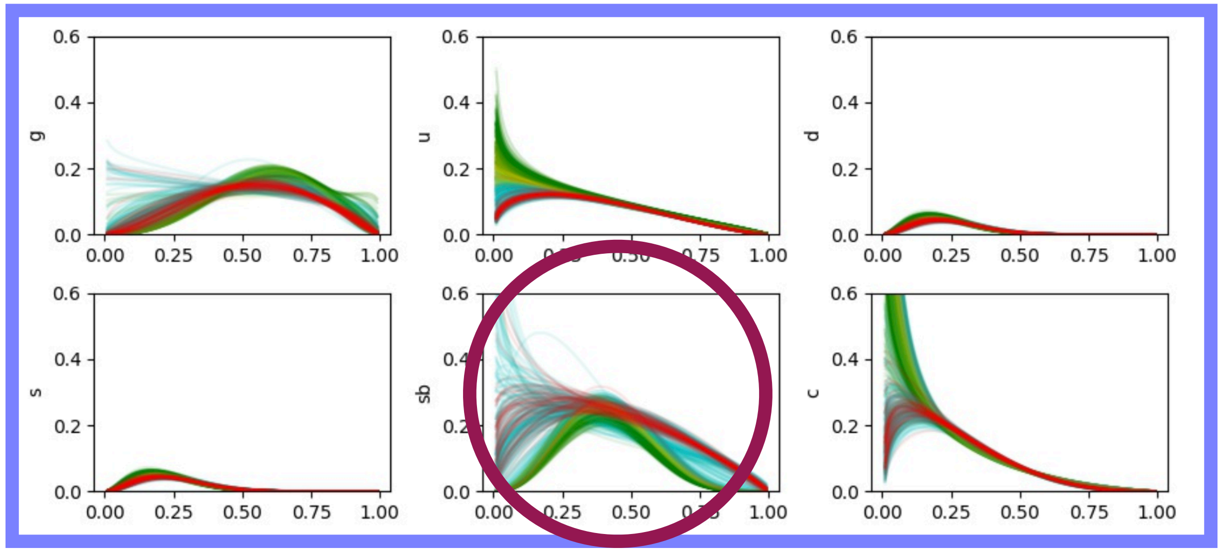
SIA K+/K- data

Data/Theory



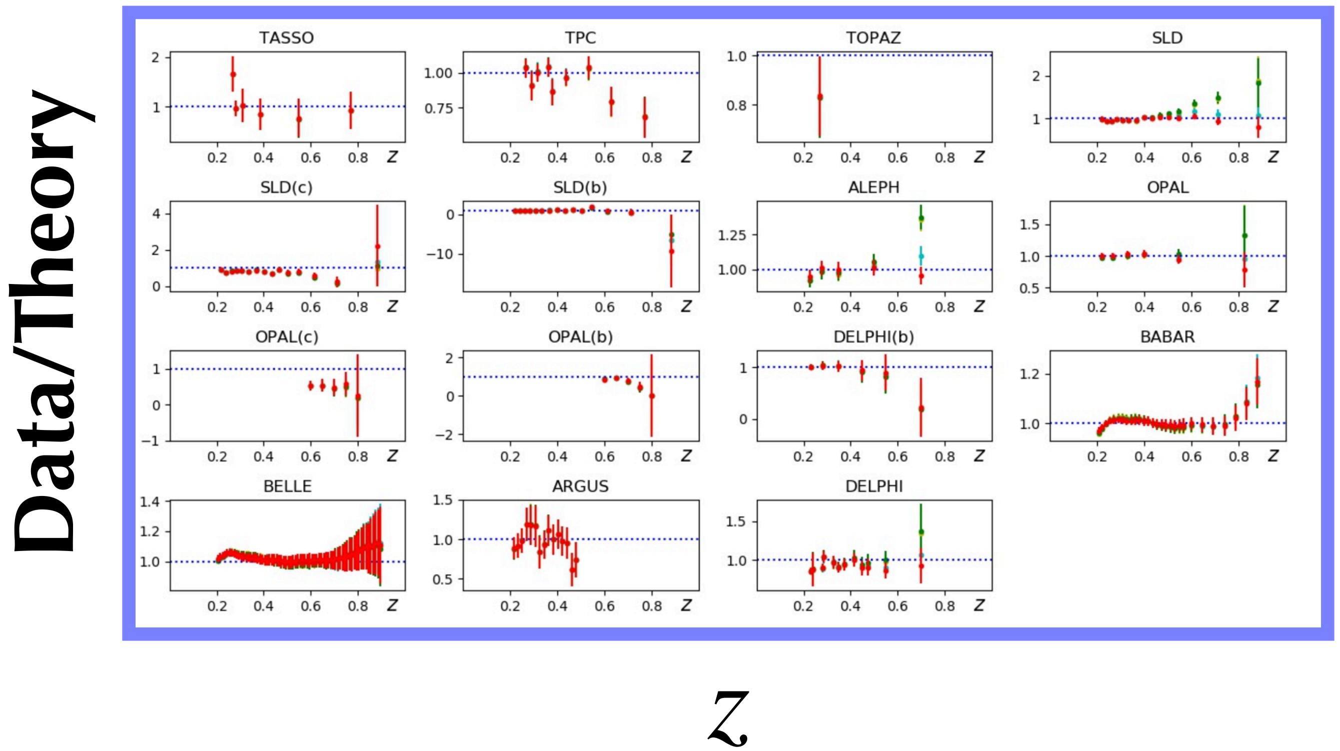
z

$zD_q^{K^+}$

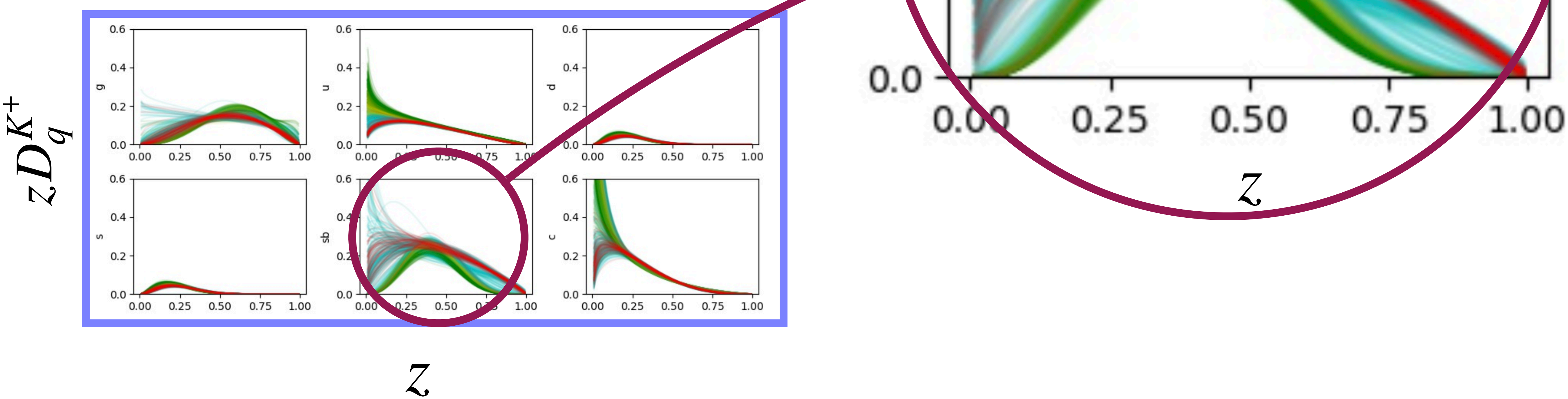


z

SIA K+/K- data



Data/Theory
TASSO
TPC
TOPAZ
SLD
SLD(c)
SLD(b)
ALEPH
OPAL
OPAL(c)
OPAL(b)
DELPHI(b)
BABAR
BELLE
ARGUS
DELPHI
z



$zD_q^{K^+}$
g
u
d
s
sb
c
z
$\bar{s} \to K^+$

SIDIS K-

Unfavored solutions

Large $s(x)$

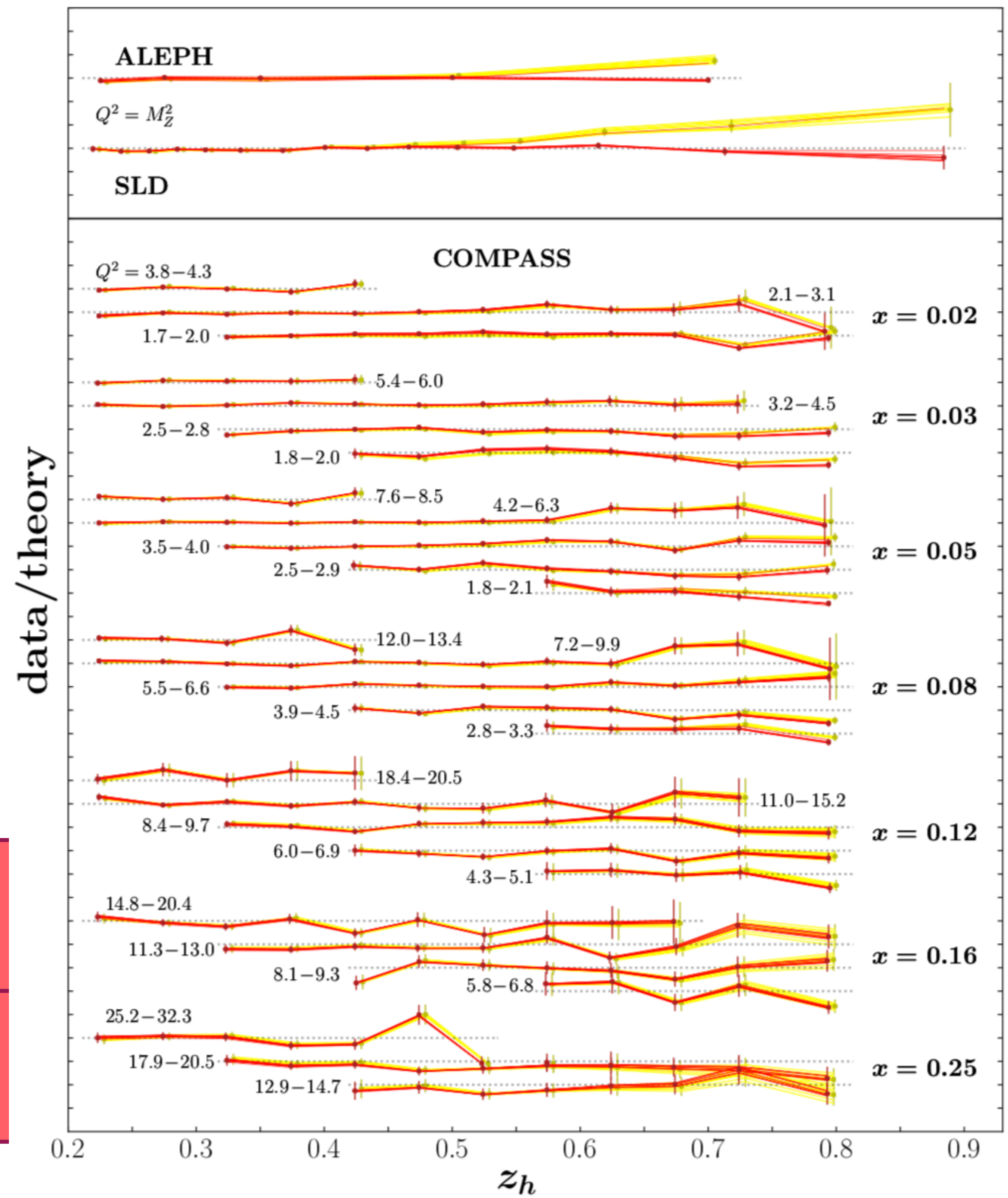
Small $D_{s^\pm}^{K^\pm}(z)$

Favored solutions

Large $D_{s^\pm}^{K^\pm}(z)$

Small $s(x)$

$\chi^2_{\text{SLD}} = 4.10$	$\chi^2_{\text{SLD}} = 1.38$
$\chi^2_{\text{ALEPH}} = 4.62$	$\chi^2_{\text{ALEPH}} = 0.34$



SIA

SIDIS

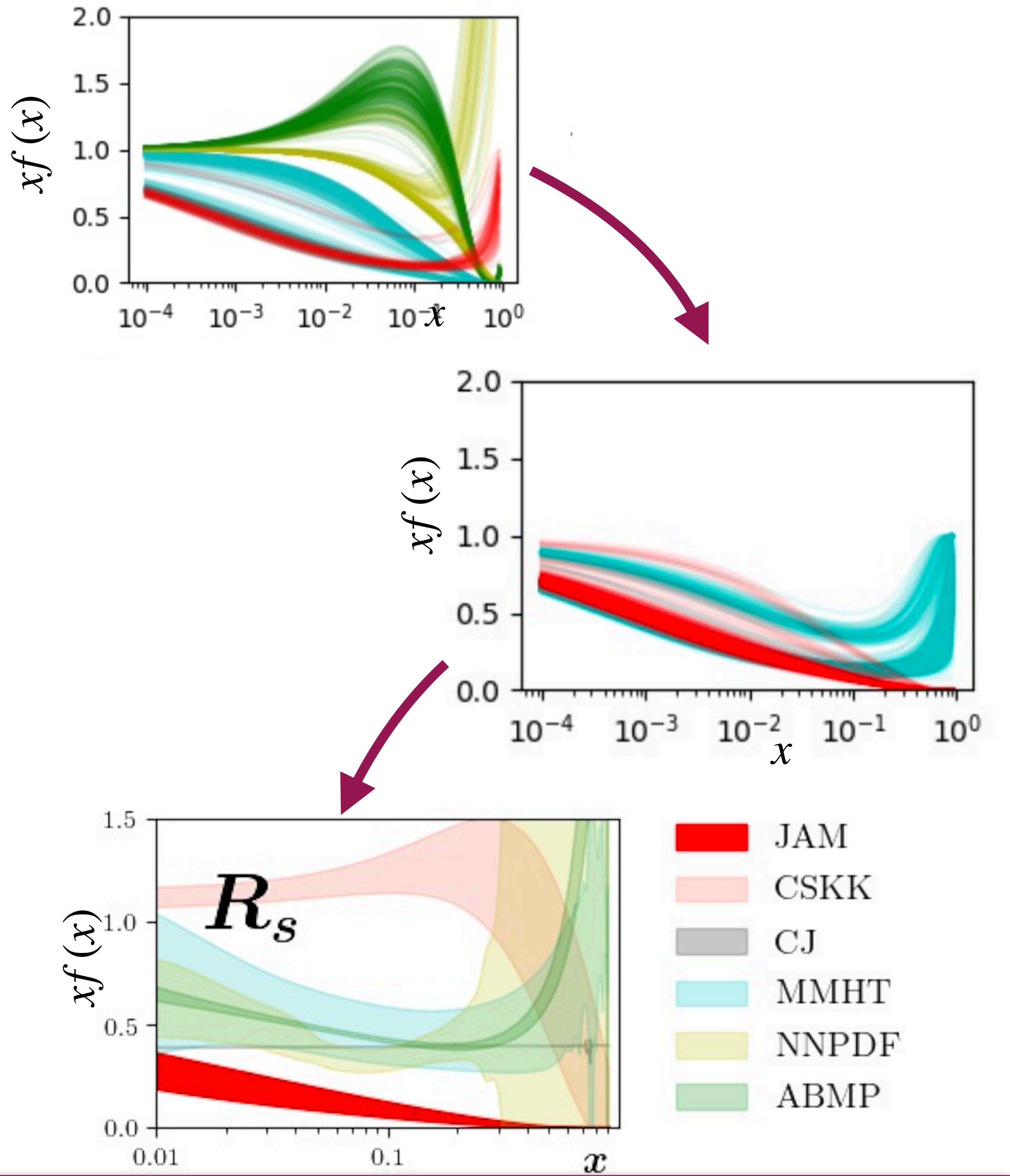
JAM19: Selection criteria

- Apply k-means clustering

- Classify clusters by increasing order in 'extended' reduced χ^2

$$\frac{\chi^2}{N_{\rm tot}} + \sum_{exp} \frac{\chi^2_{\rm exp}}{N_{\rm exp}}$$

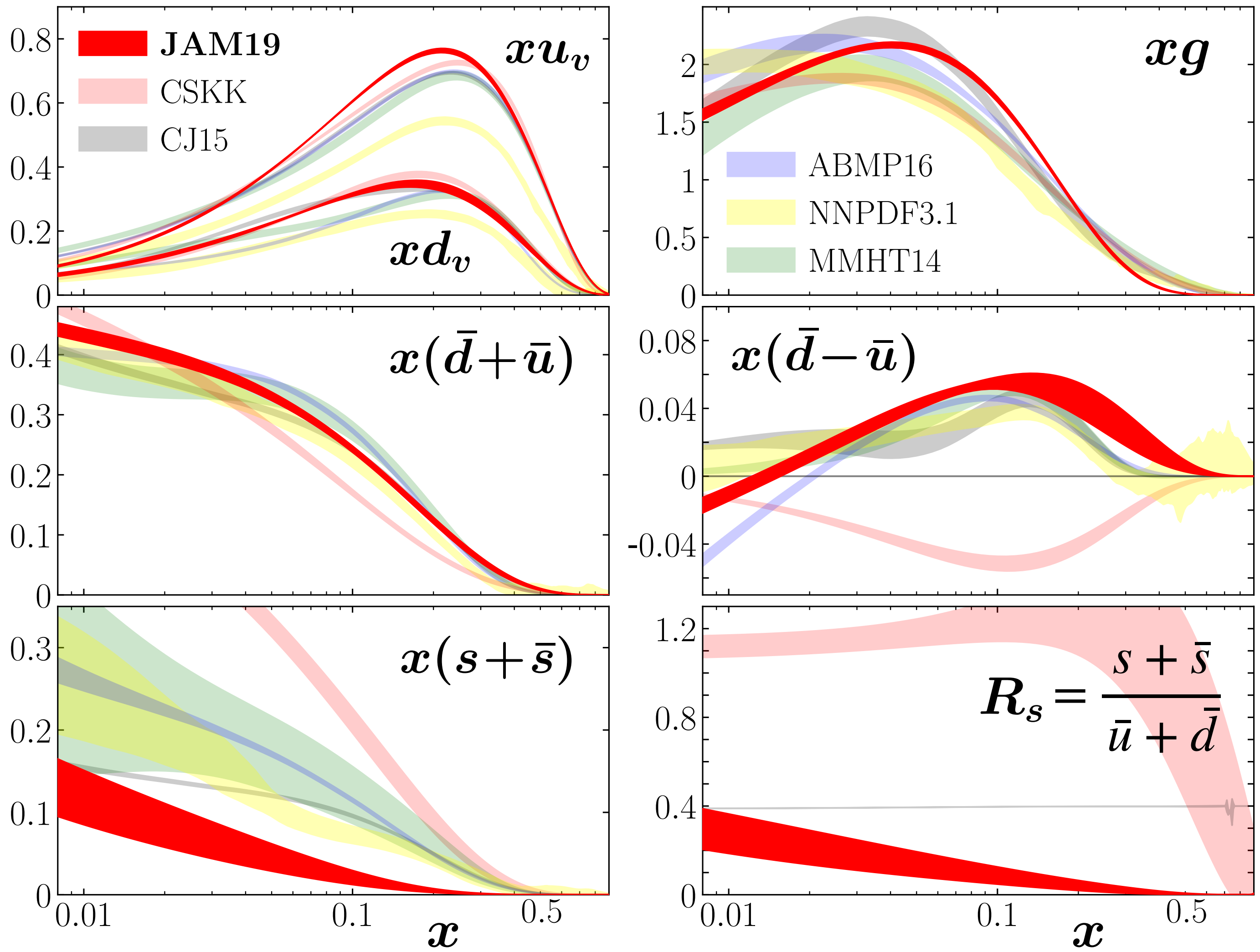
- Perform a new sampling with flat priors around the best cluster



PDF results

JAM19 PDFs

arXiv:1905.03788 [hep-ph]

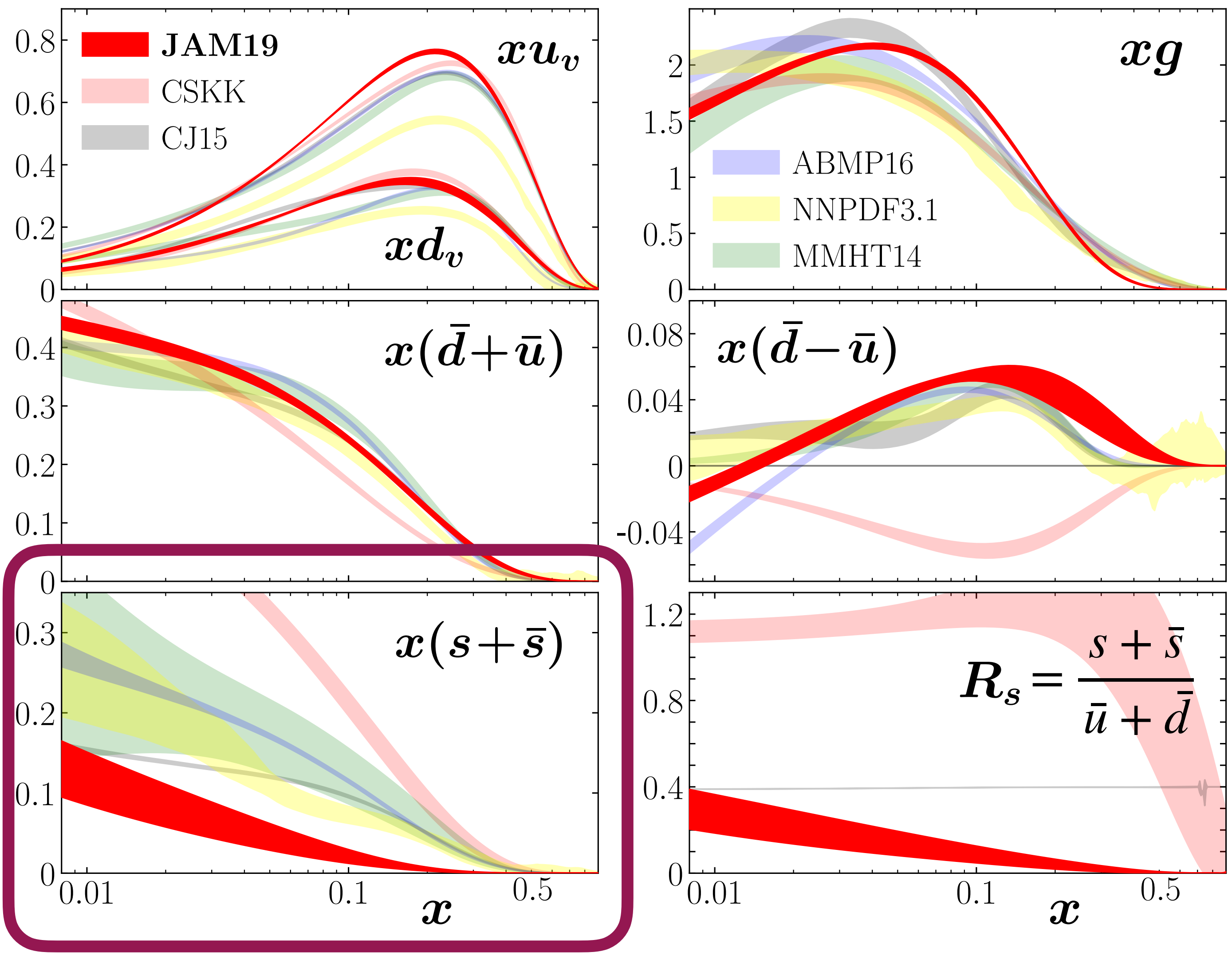


$\mathbf{Q = m_c}$

DIS(p, d)
DY(pp, pd)
SIA$(\pi^\pm, K^\pm)$
SIDIS$(\pi^\pm, K^\pm)$

JAM19 PDFs

arXiv:1905.03788 [hep-ph]

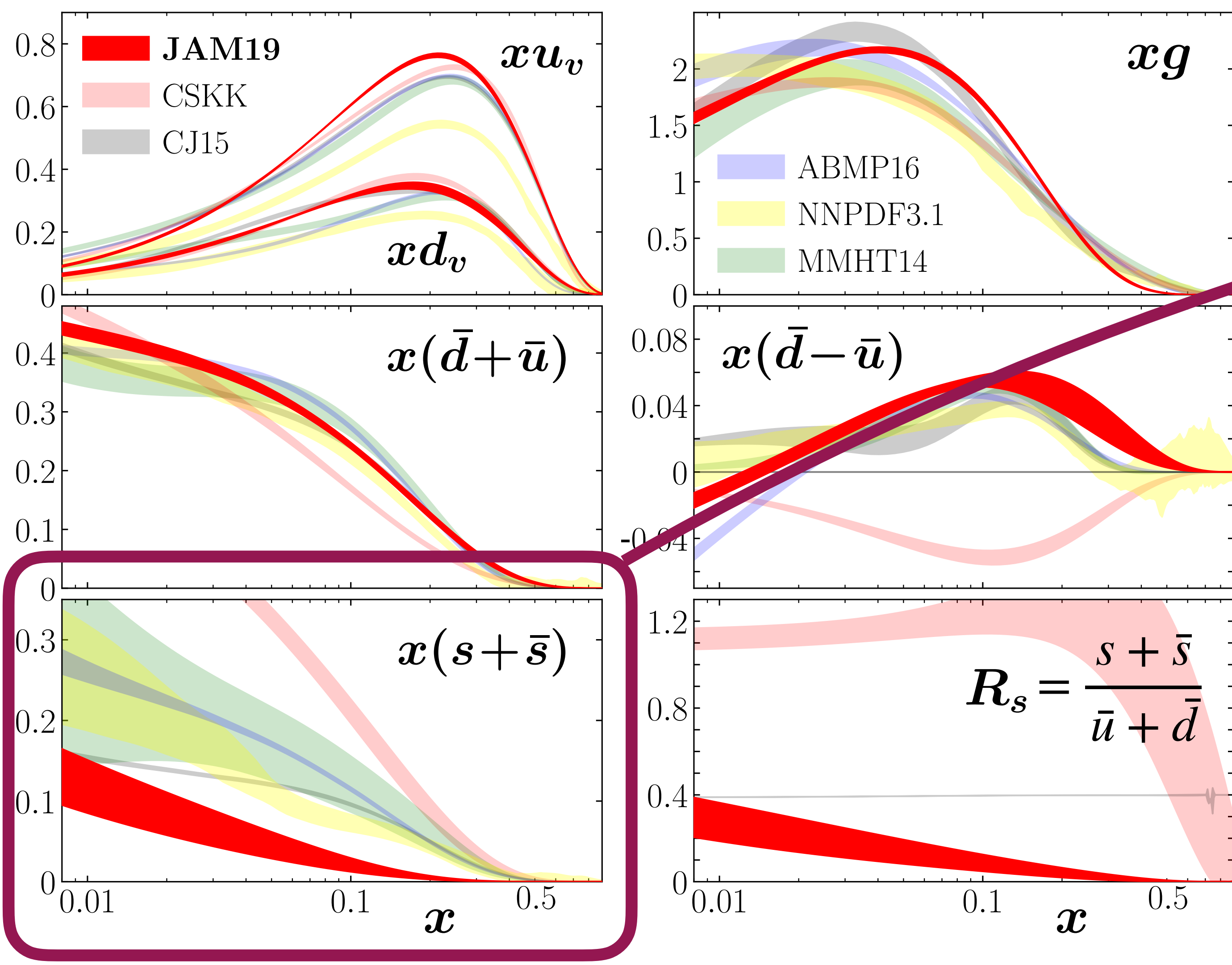


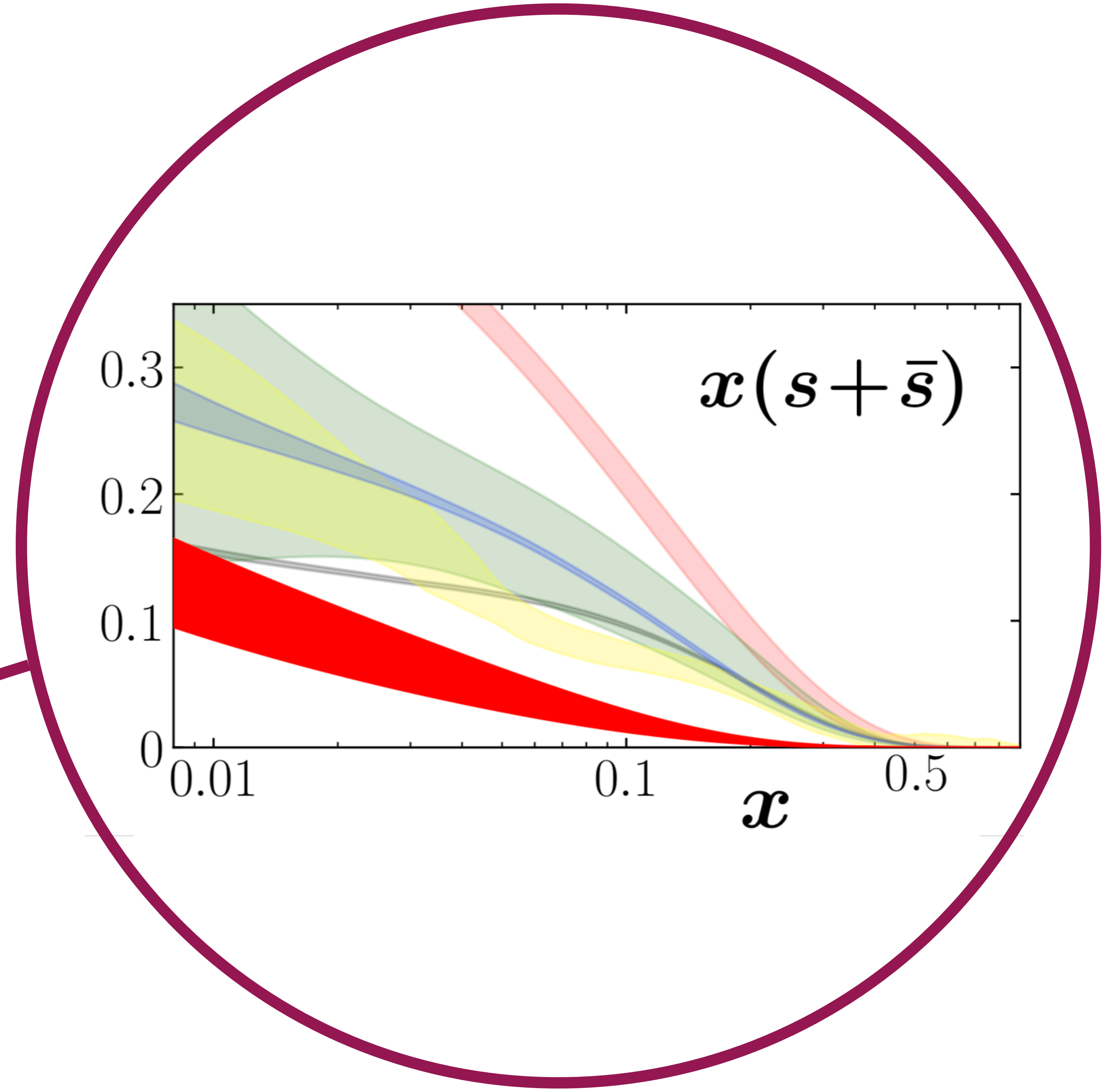
$DIS(p, d)$
$DY(pp, pd)$
$SIA(\pi^{\pm}, K^{\pm})$
$SIDIS(\pi^{\pm}, K^{\pm})$

Q = m$_c$

JAM19 PDFs

arXiv:1905.03788 [hep-ph]





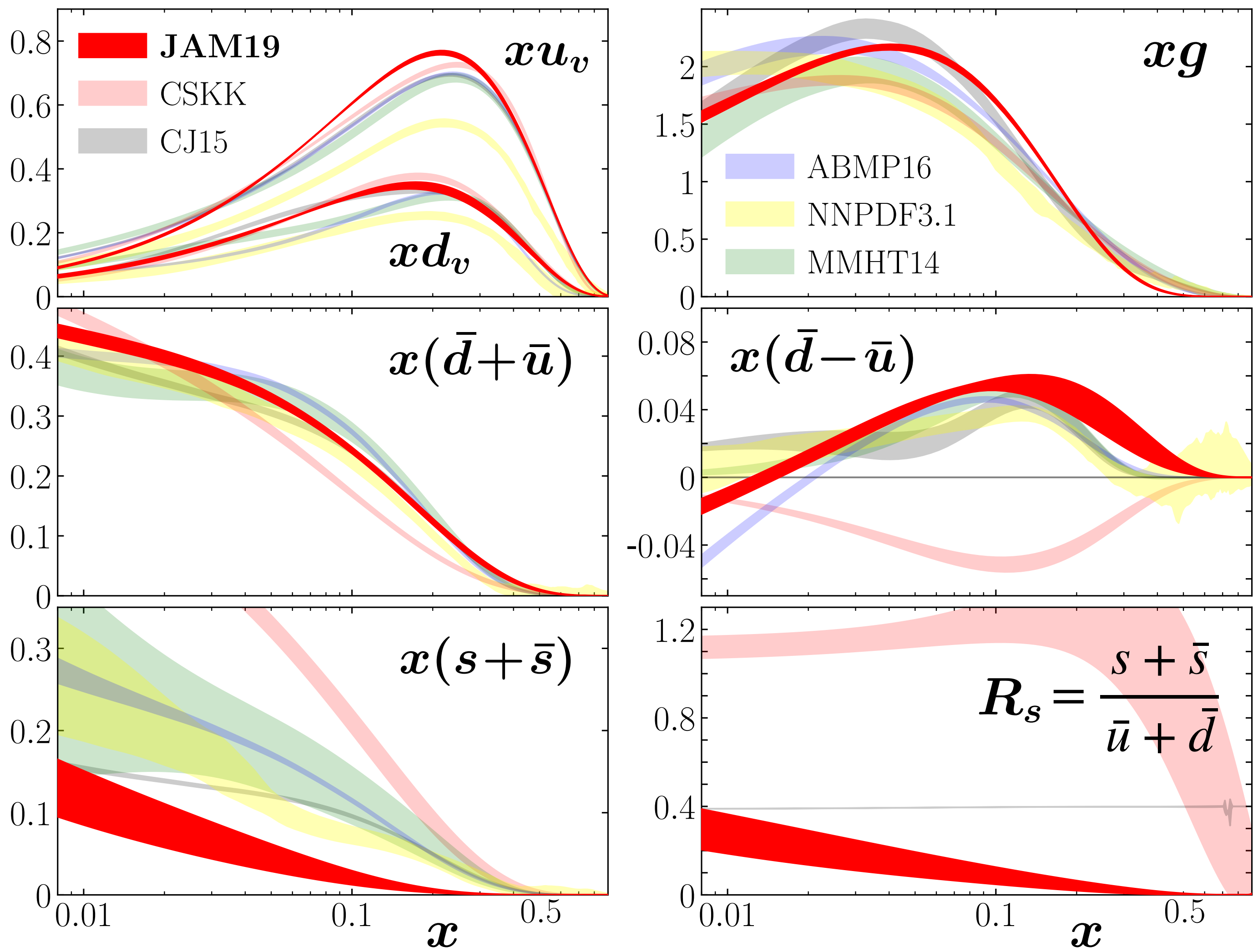
Strong strange suppression

$\mathbf{Q = m_c}$

DIS(p, d)
DY(pp, pd)
SIA$(\pi^{\pm}, K^{\pm})$
SIDIS$(\pi^{\pm}, K^{\pm})$

JAM19 PDFs

arXiv:1905.03788 [hep-ph]

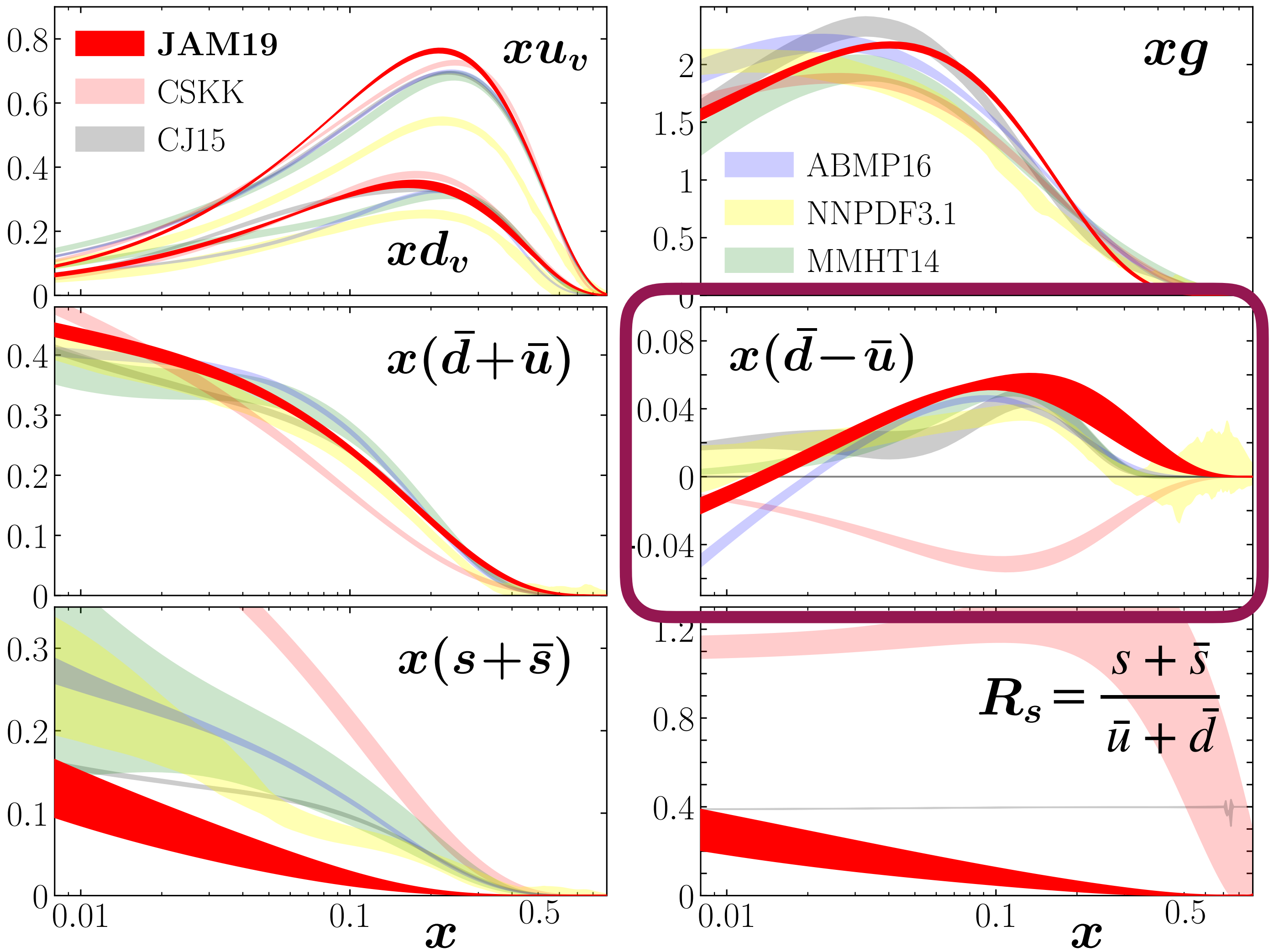


$\mathbf{Q = m_c}$

DIS(p, d)
DY(pp, pd)
SIA$(\pi^{\pm}, K^{\pm})$
SIDIS$(\pi^{\pm}, K^{\pm})$

JAM19 PDFs

arXiv:1905.03788 [hep-ph]

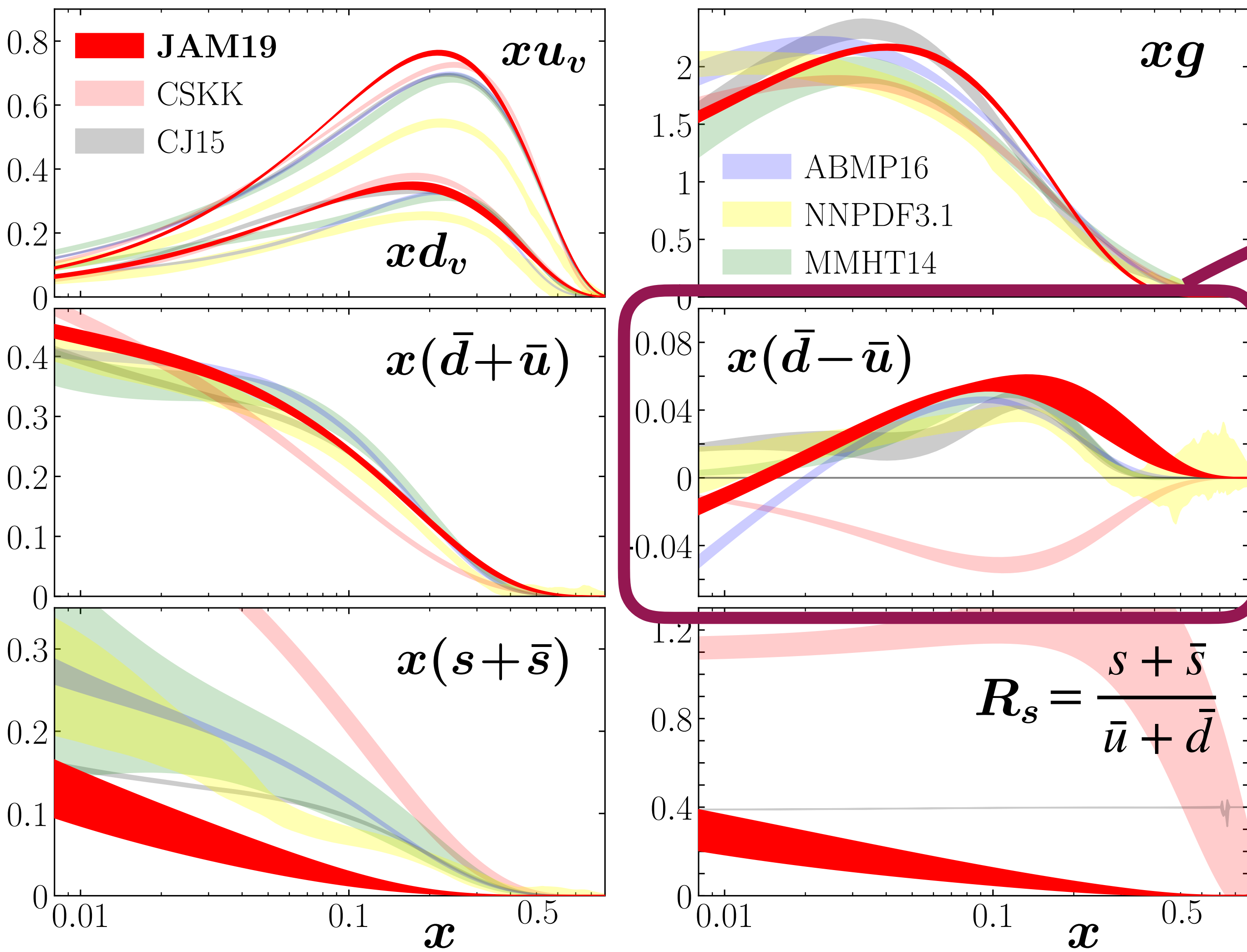


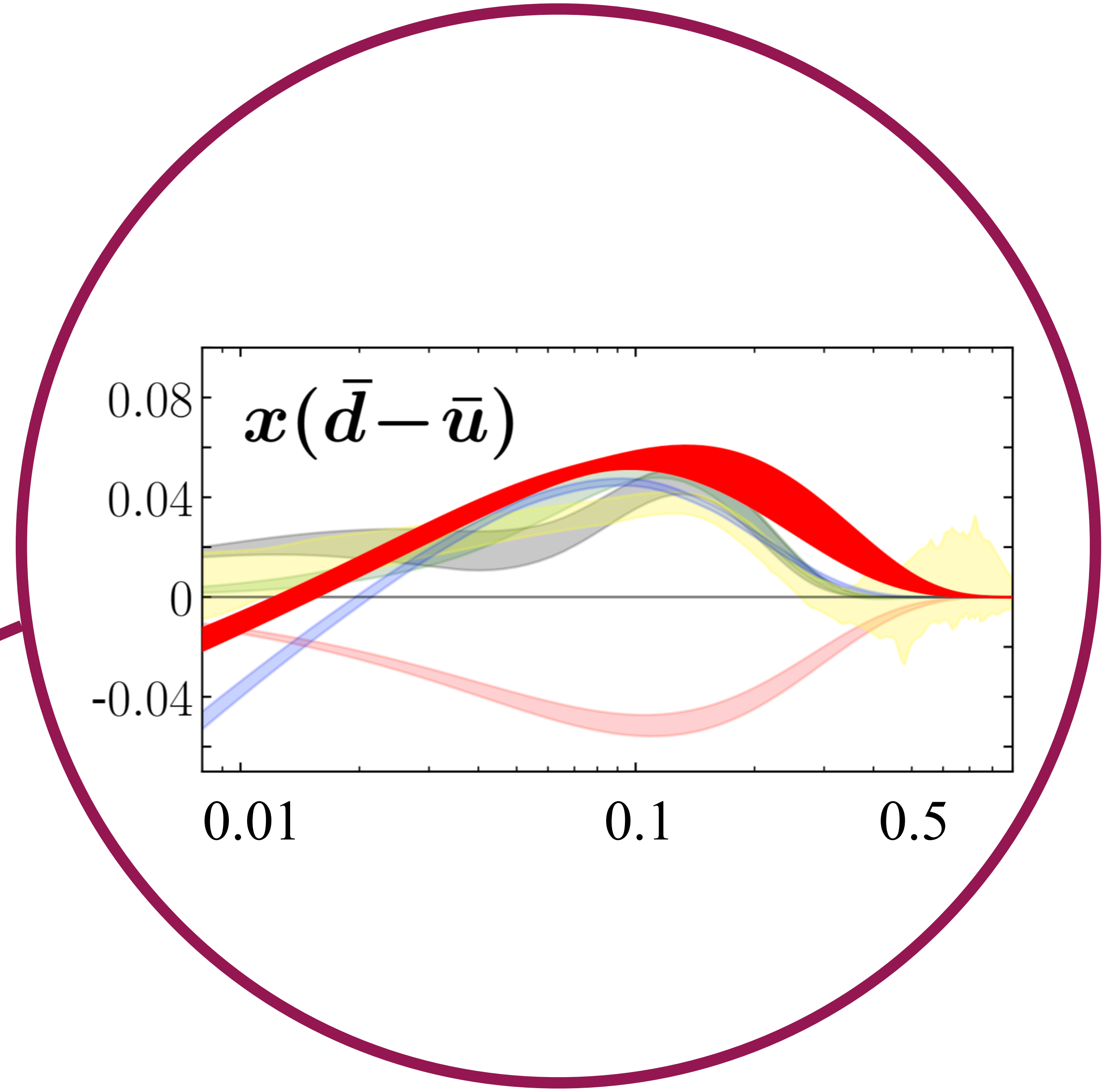
$\mathbf{Q = m_c}$

DIS(p, d)
DY(pp, pd)
SIA$(\pi^\pm, K^\pm)$
SIDIS$(\pi^\pm, K^\pm)$

JAM19 PDFs

arXiv:1905.03788 [hep-ph]





$\bar{d} - \bar{u} > 0$ at x ~ 0.1 – 0.2

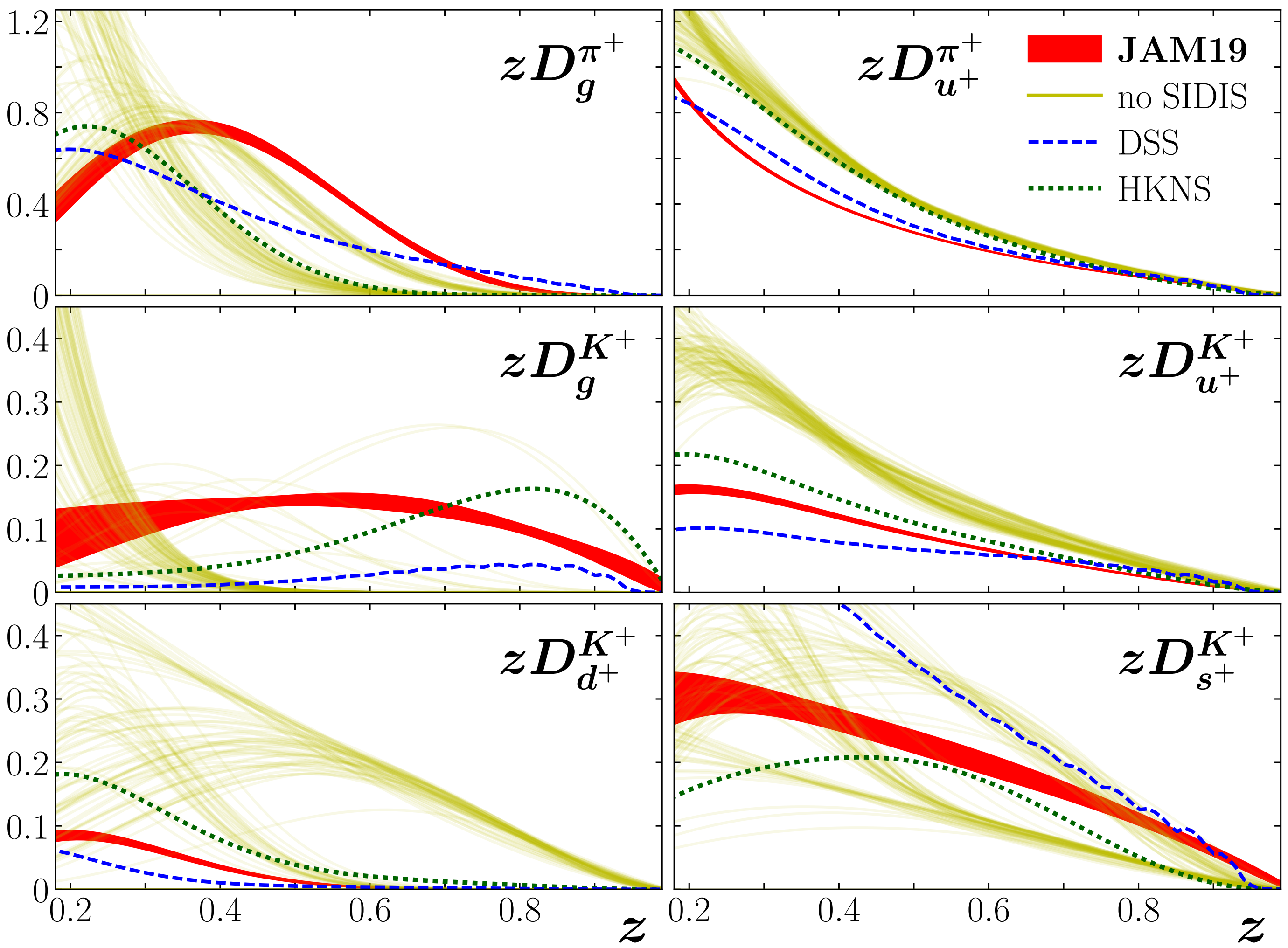
Q = m$_c$

DIS(p, d)
DY(pp, pd)
SIA$(\pi^\pm, K^\pm)$
SIDIS$(\pi^\pm, K^\pm)$

FF results

JAM19: FF

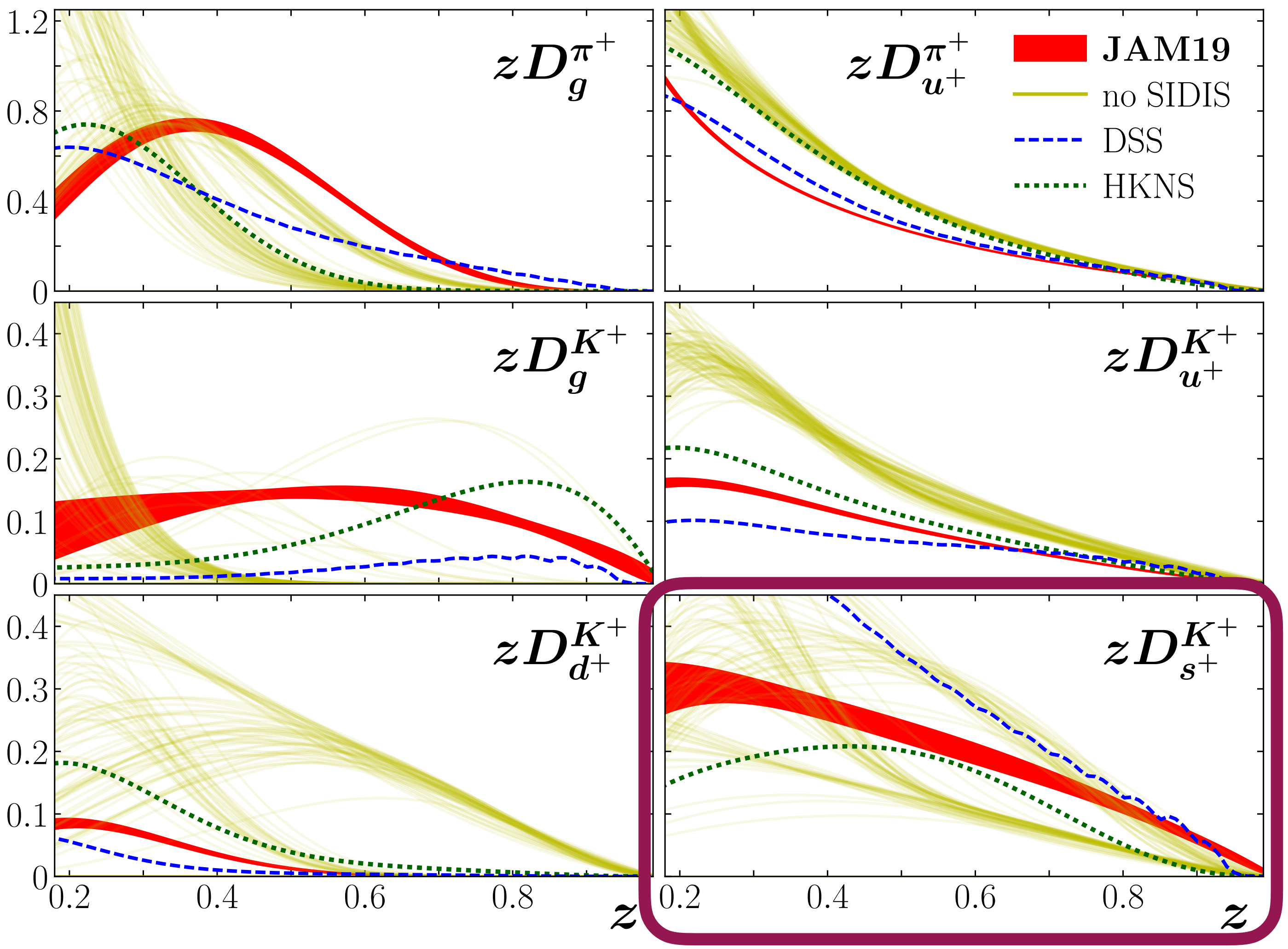
arXiv:1905.03788 [hep-ph]



$Q = m_c$

JAM19: FF

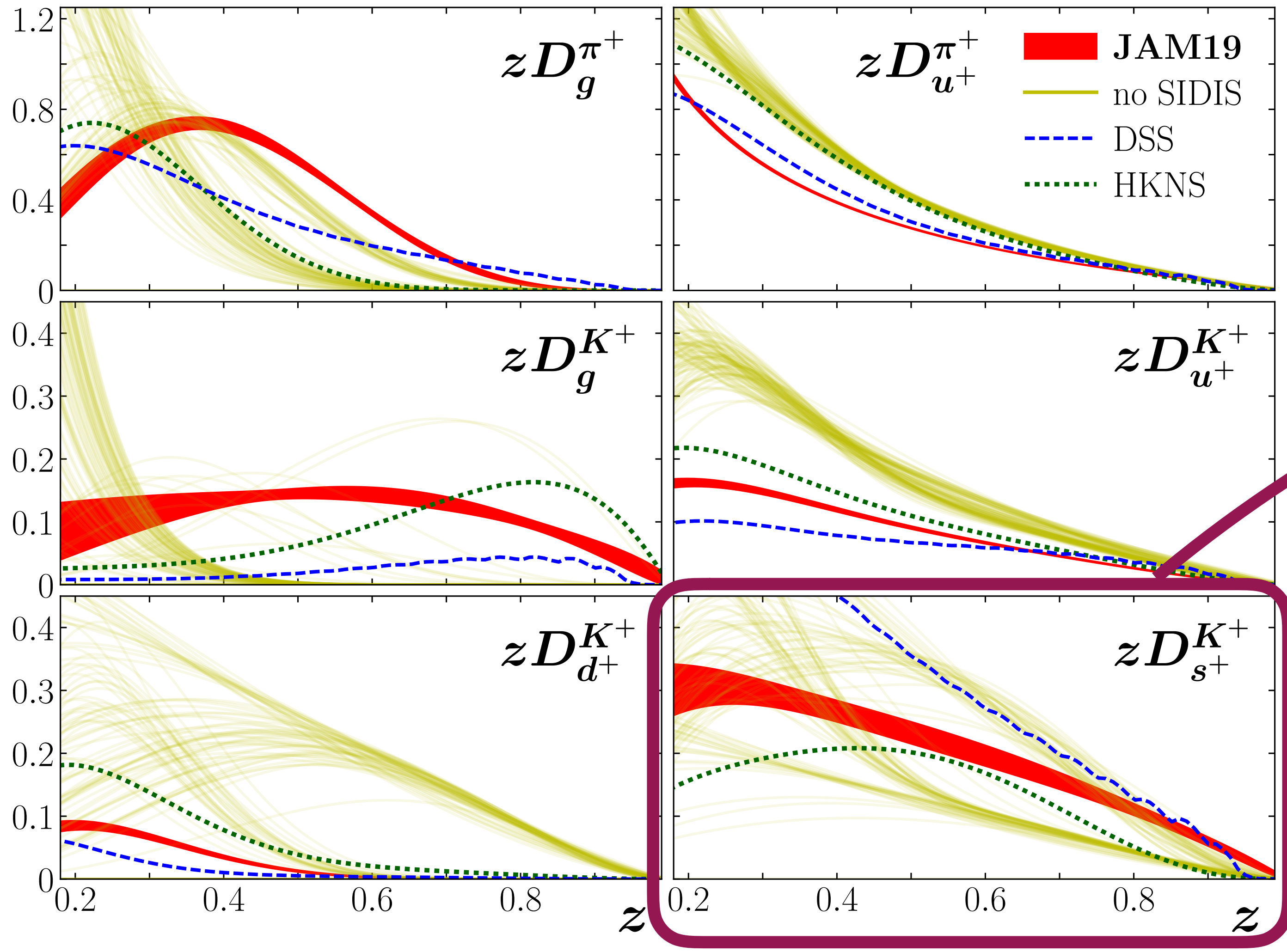
arXiv:1905.03788 [hep-ph]

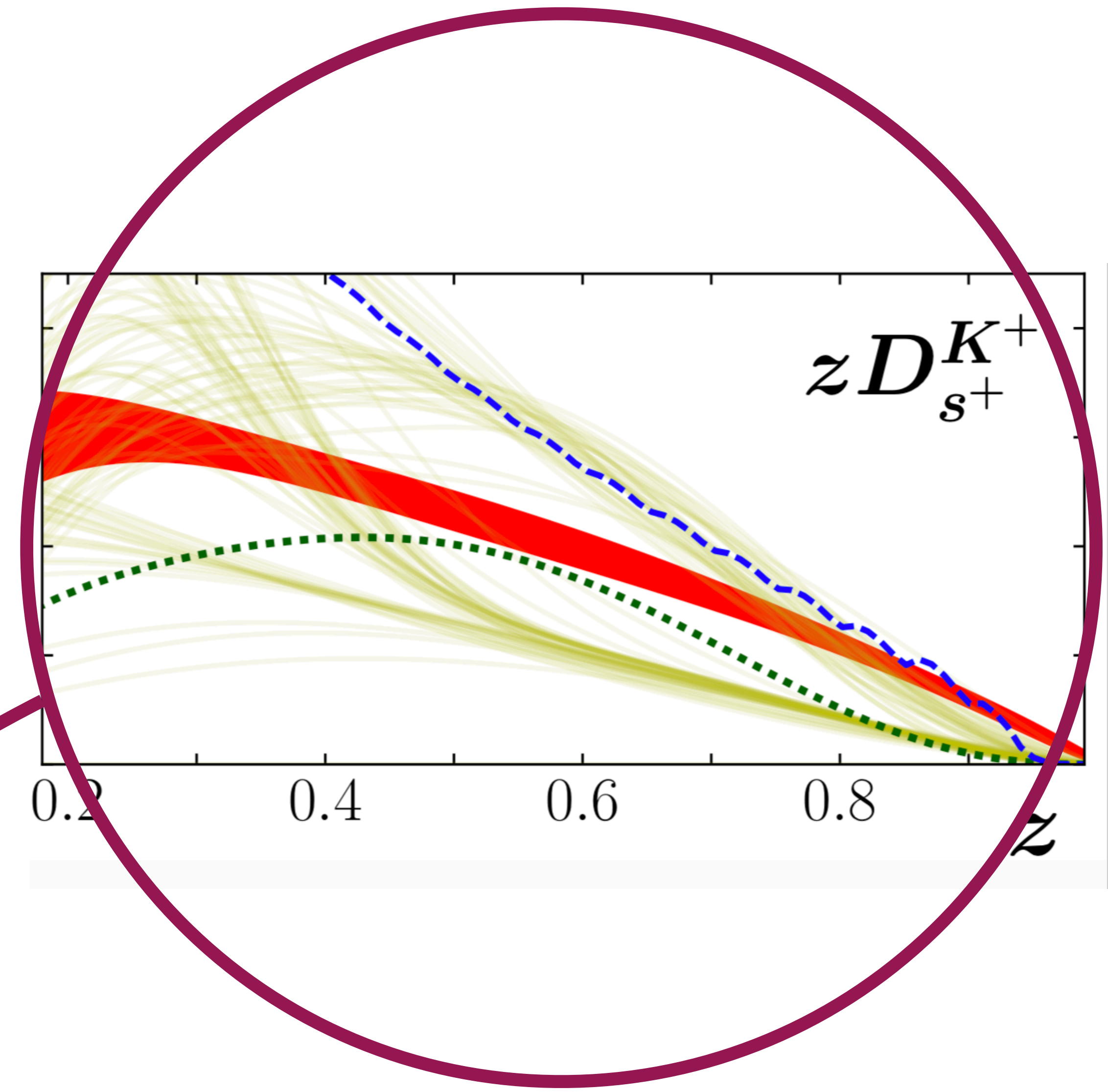


Q = m_c

JAM19: FF

arXiv:1905.03788 [hep-ph]



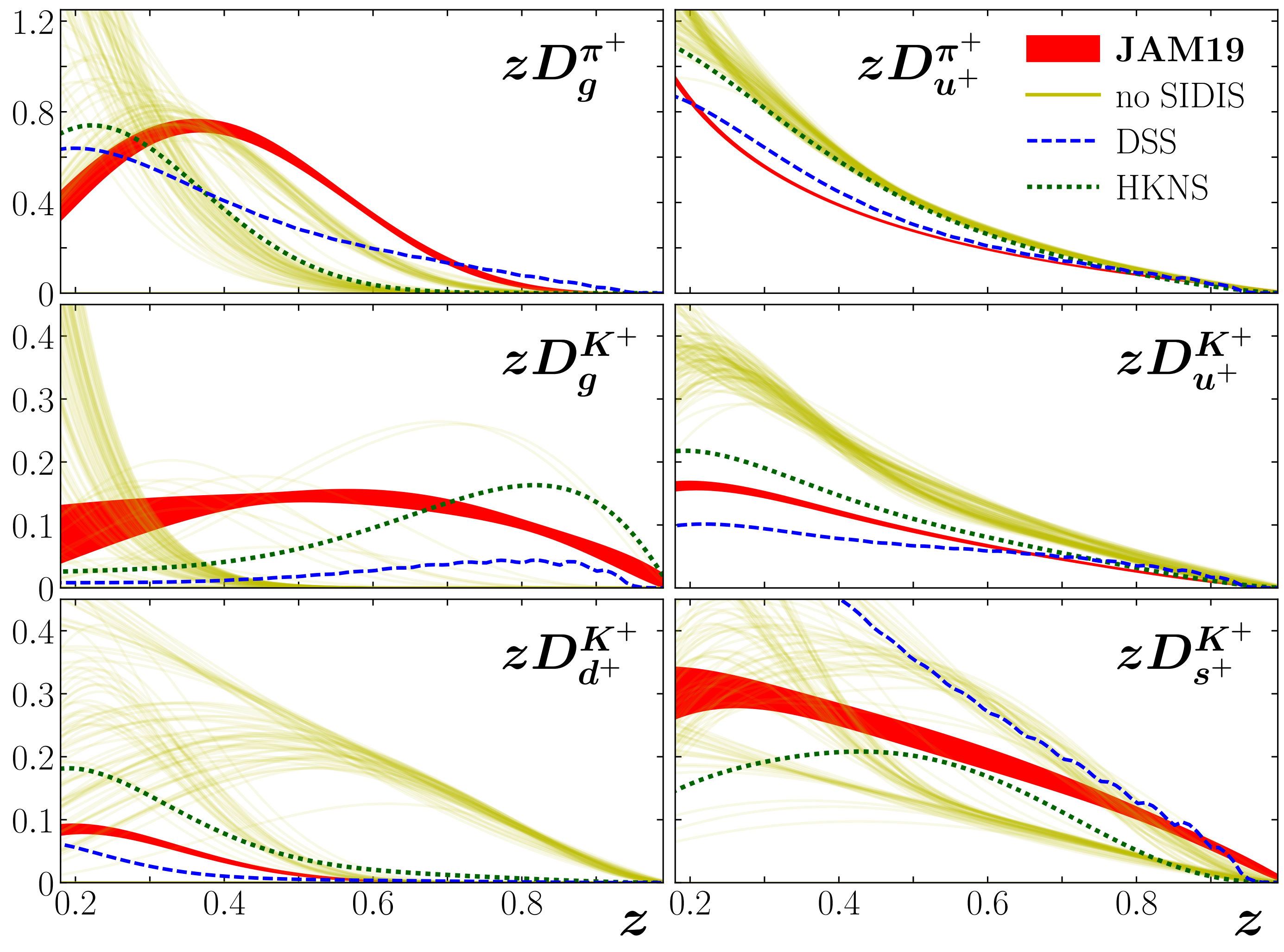


Large $\bar{s} \rightarrow K^+$

$Q = m_c$

JAM19: FF

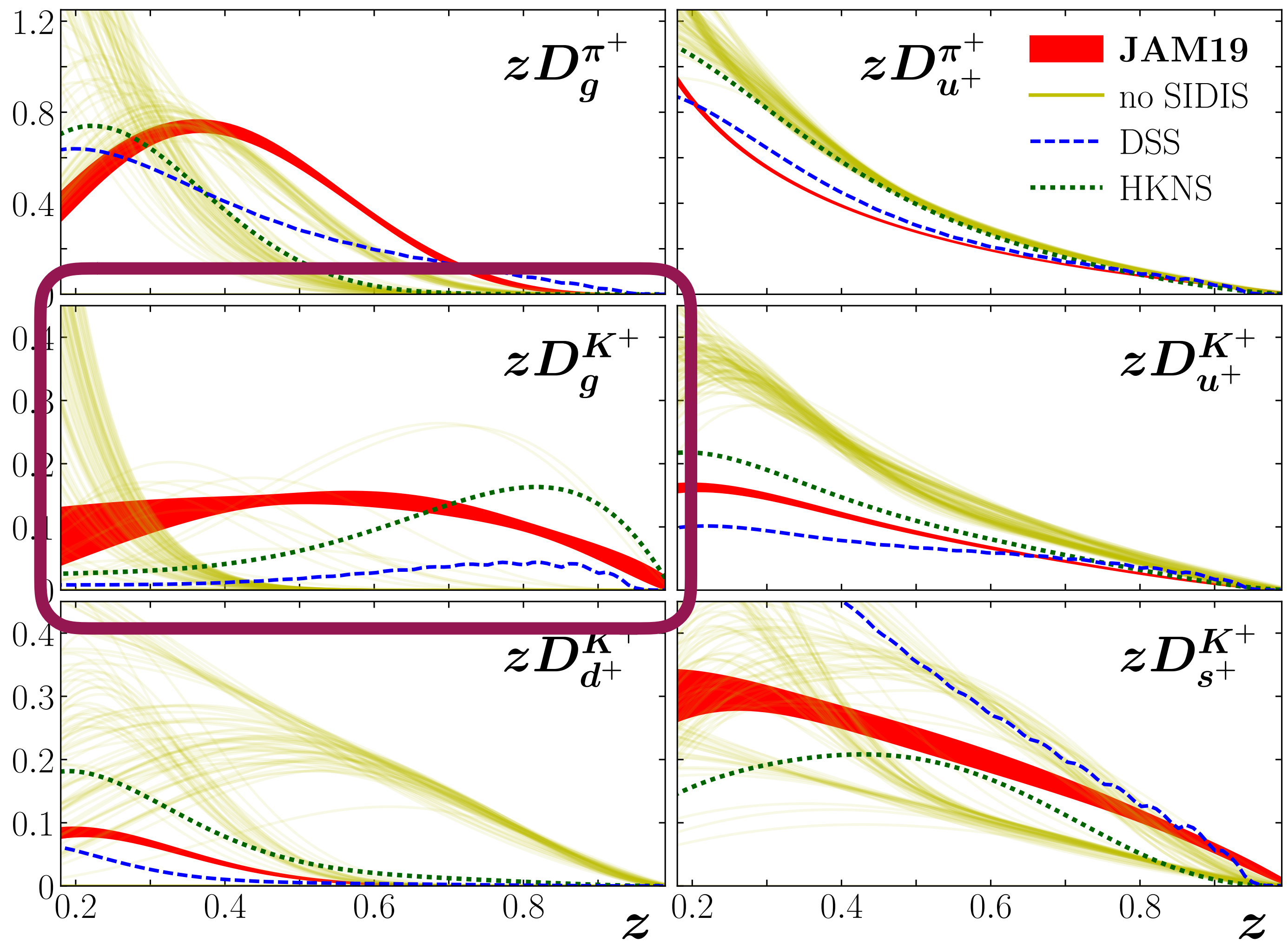
arXiv:1905.03788 [hep-ph]



Q = m$_c$

JAM19: FF

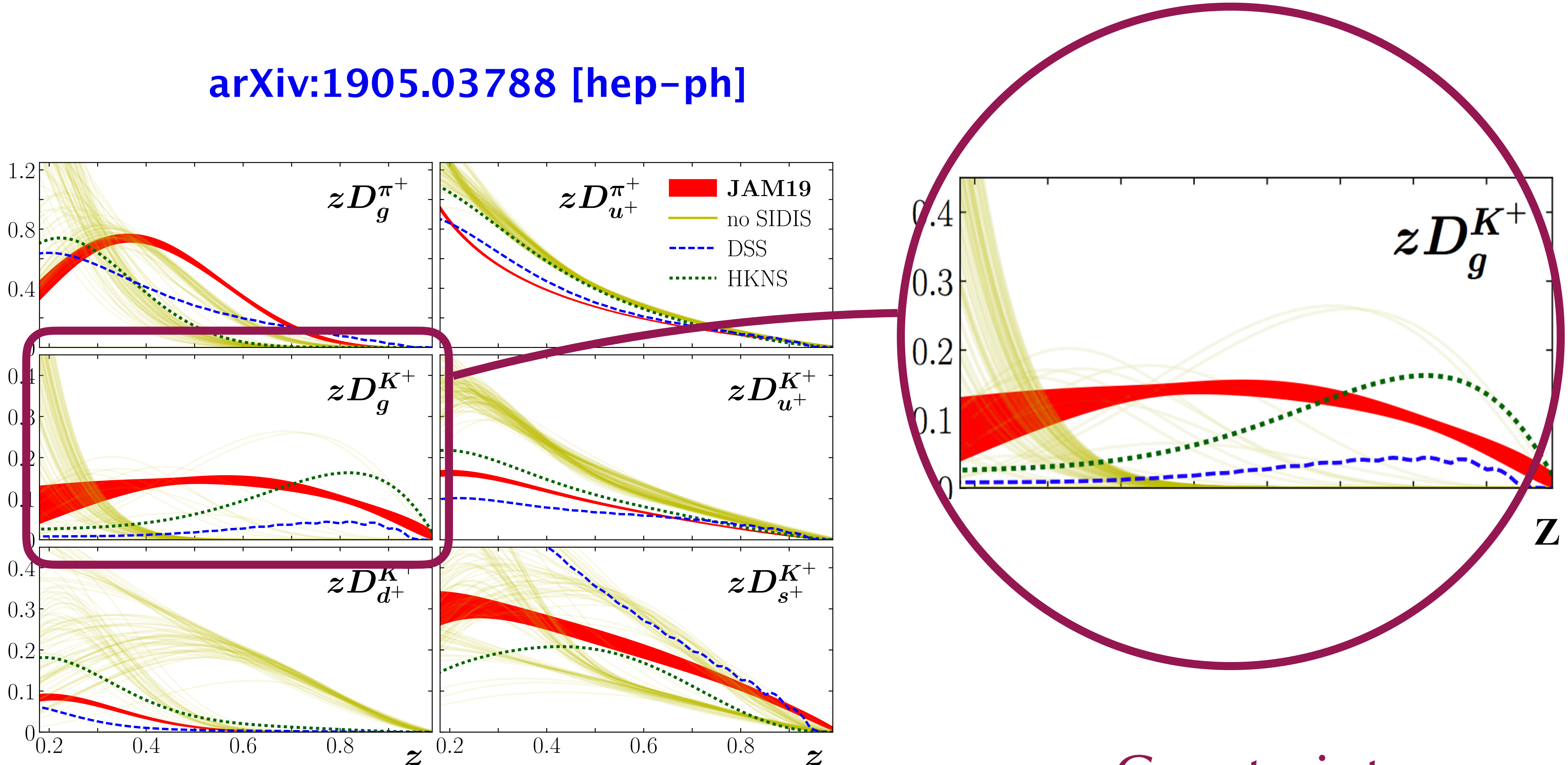
arXiv:1905.03788 [hep-ph]



Q = m$_c$

JAM19: FF

arXiv:1905.03788 [hep-ph]



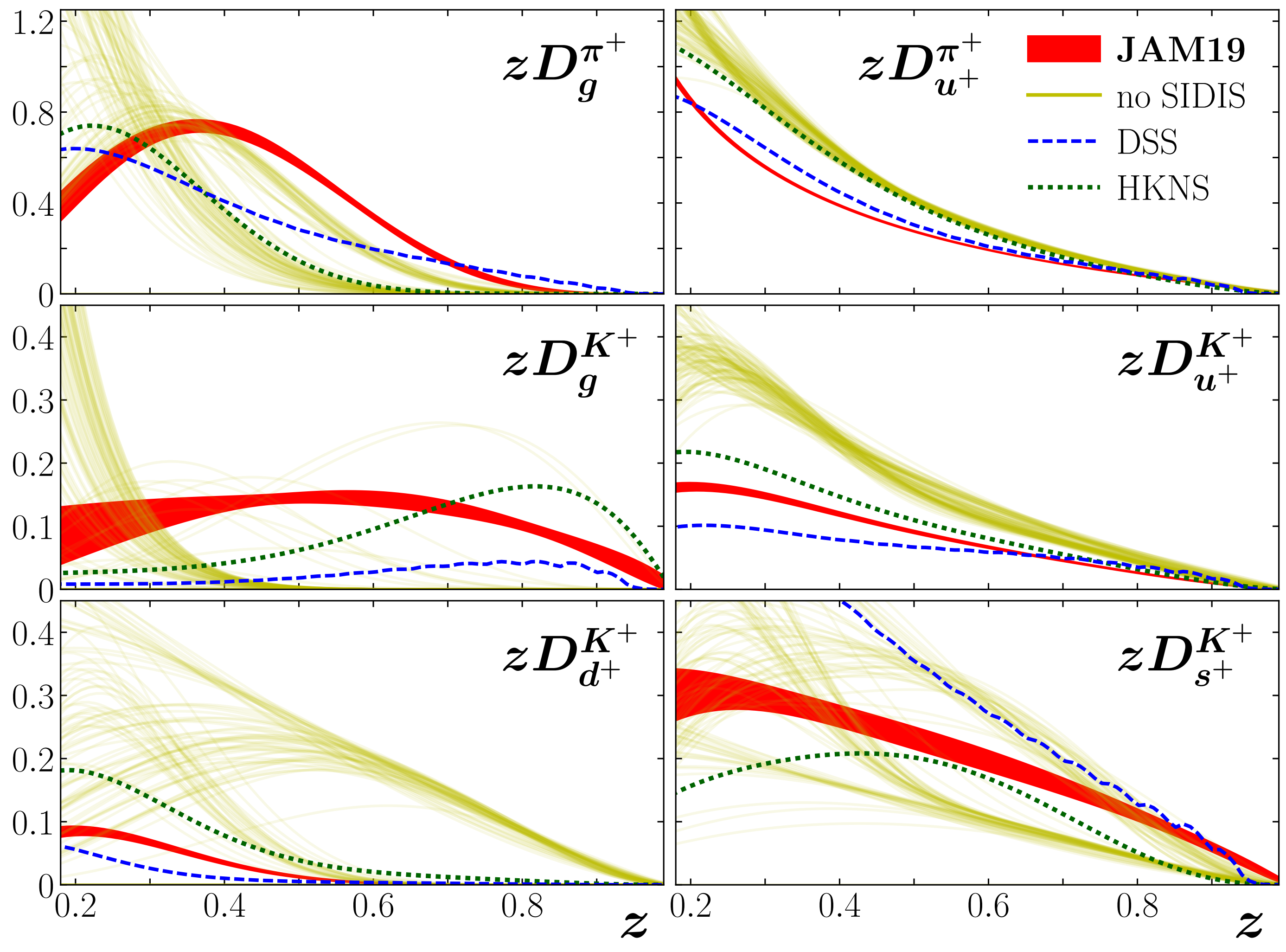
Q = m$_c$

Constraints on

$g \to K^+$

JAM19: FF

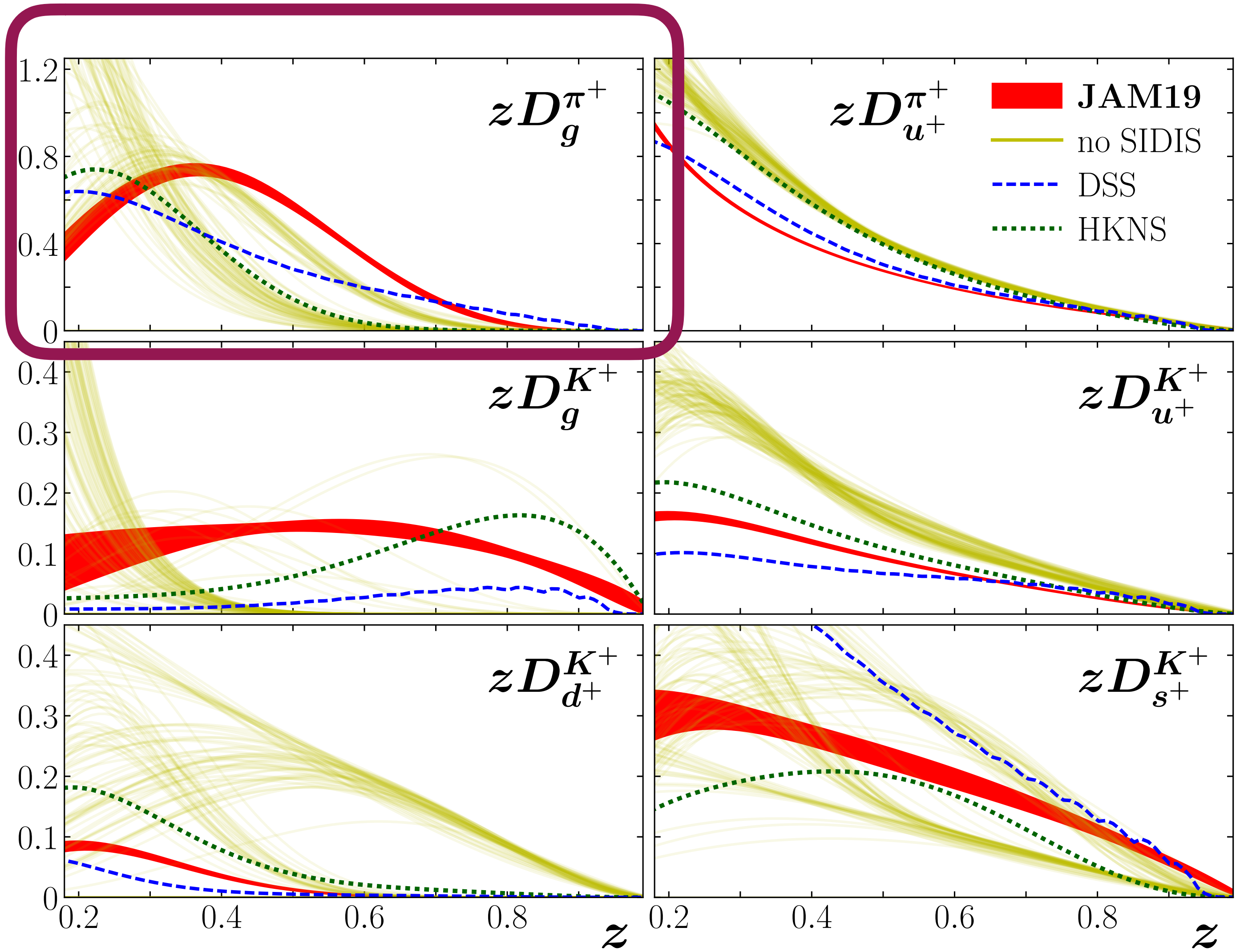
arXiv:1905.03788 [hep-ph]



Q = m$_c$

JAM19: FF

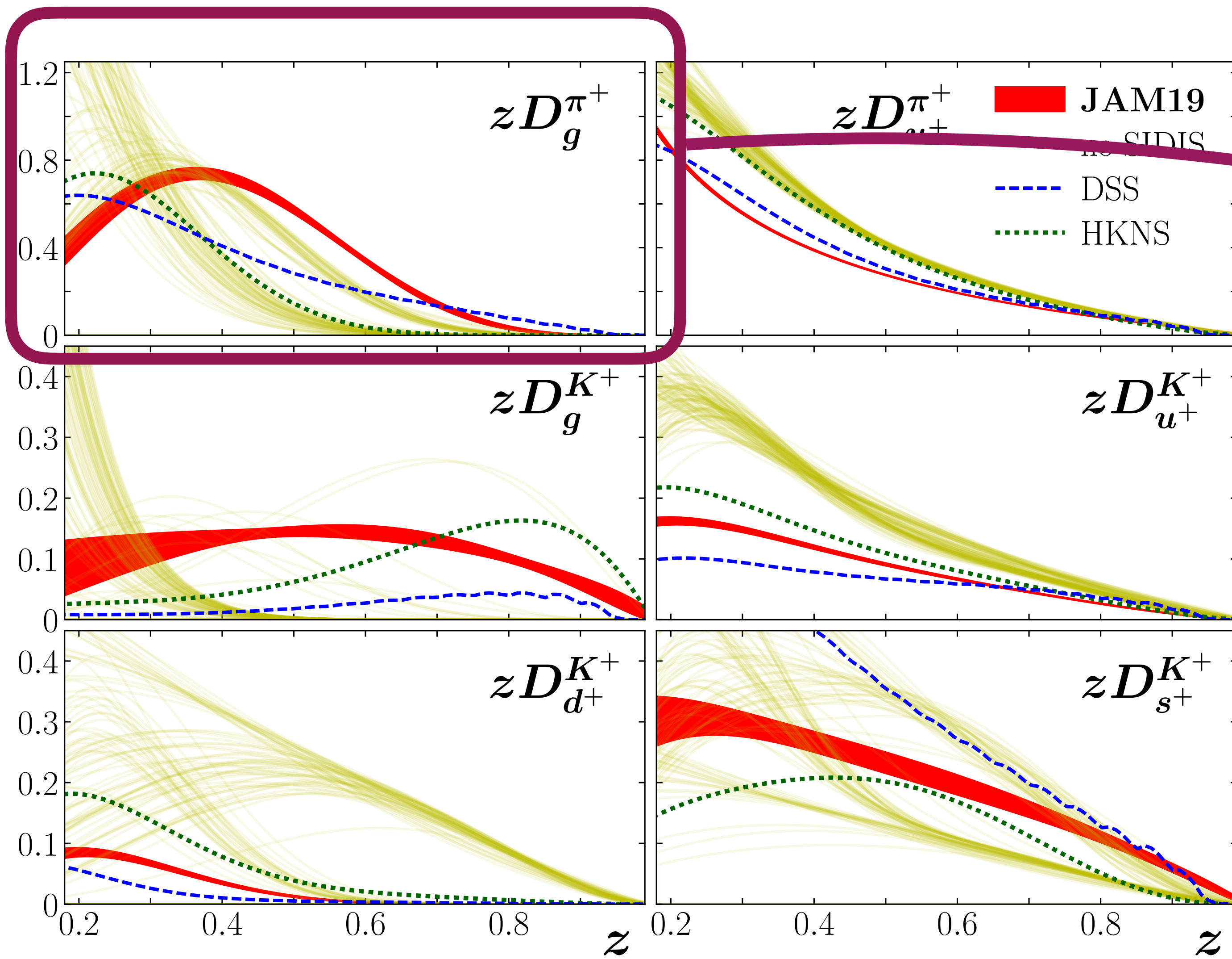
arXiv:1905.03788 [hep-ph]

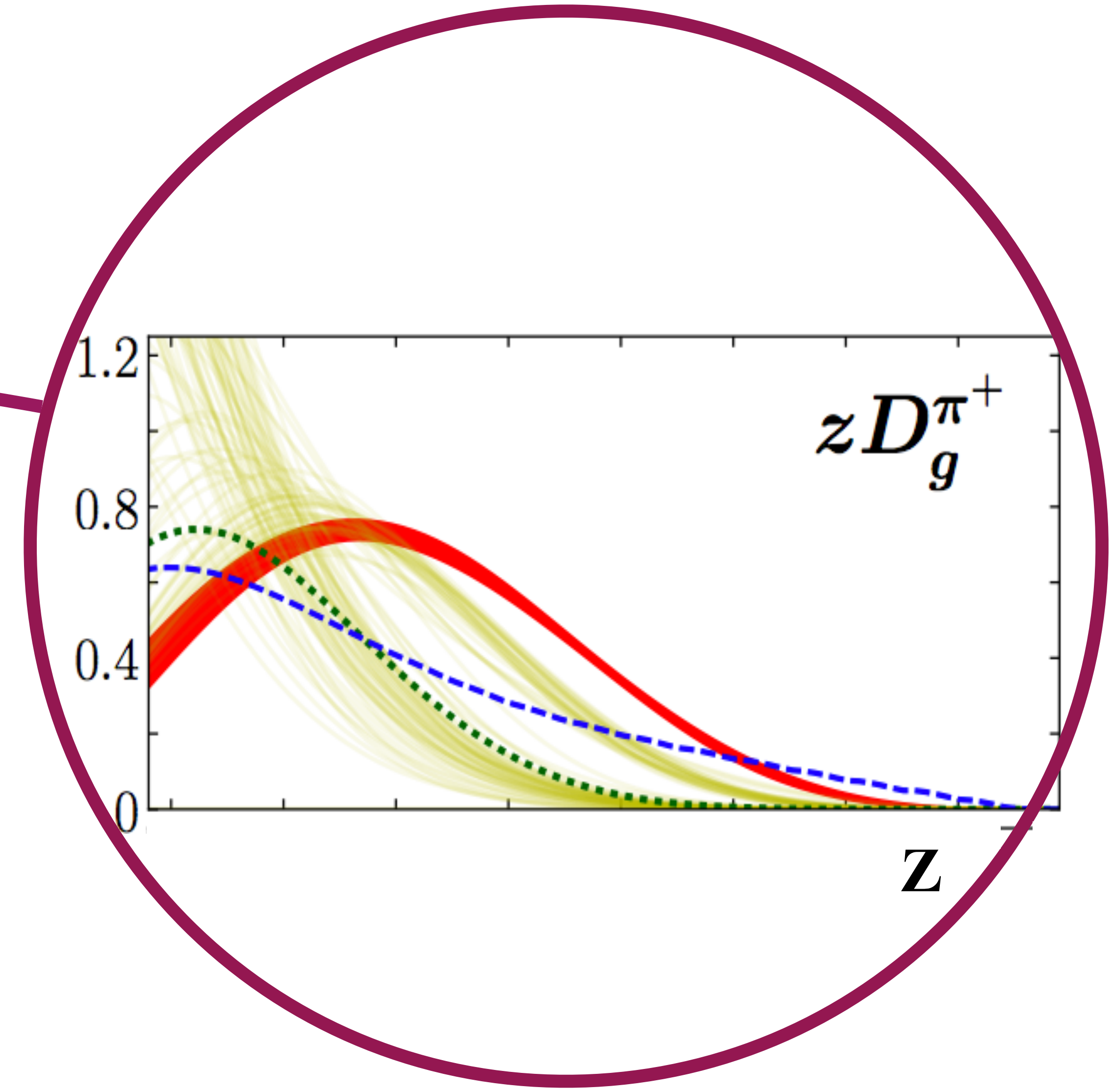


Q = m$_c$

JAM19: FF

arXiv:1905.03788 [hep-ph]





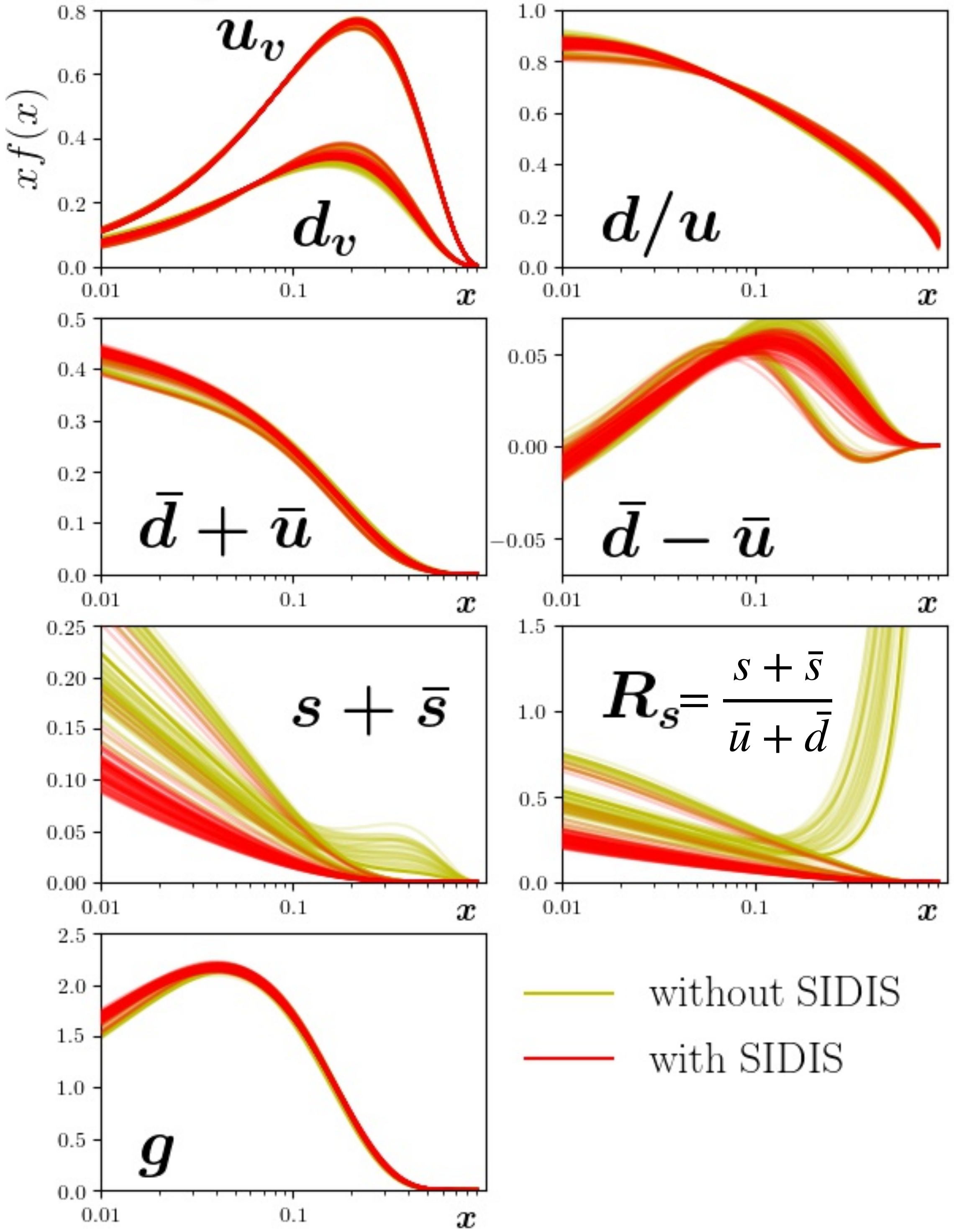
$Q = m_c$

Constraints on

$g \rightarrow \pi^+$

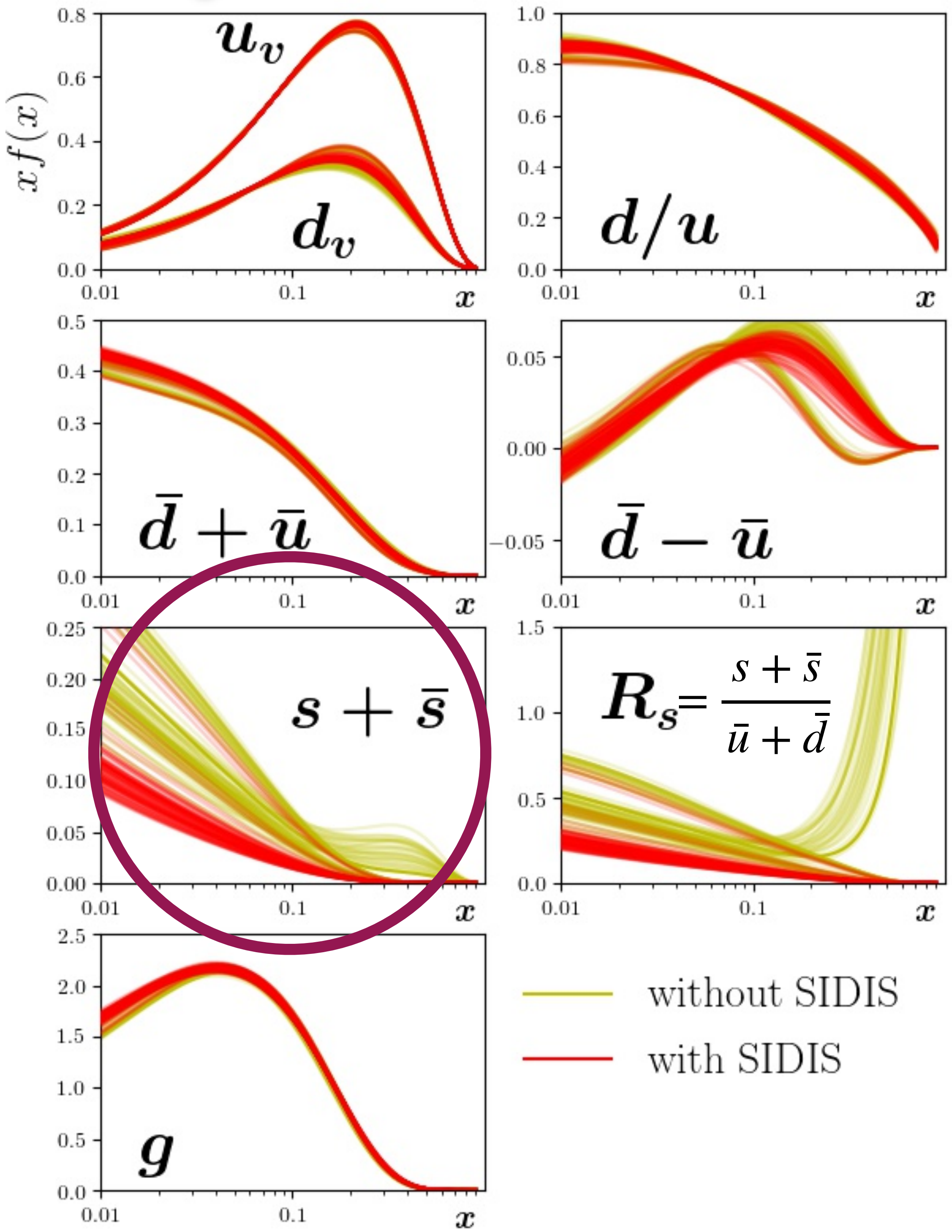
Impact of SIDIS data

Impact of SIDIS data on PDFs



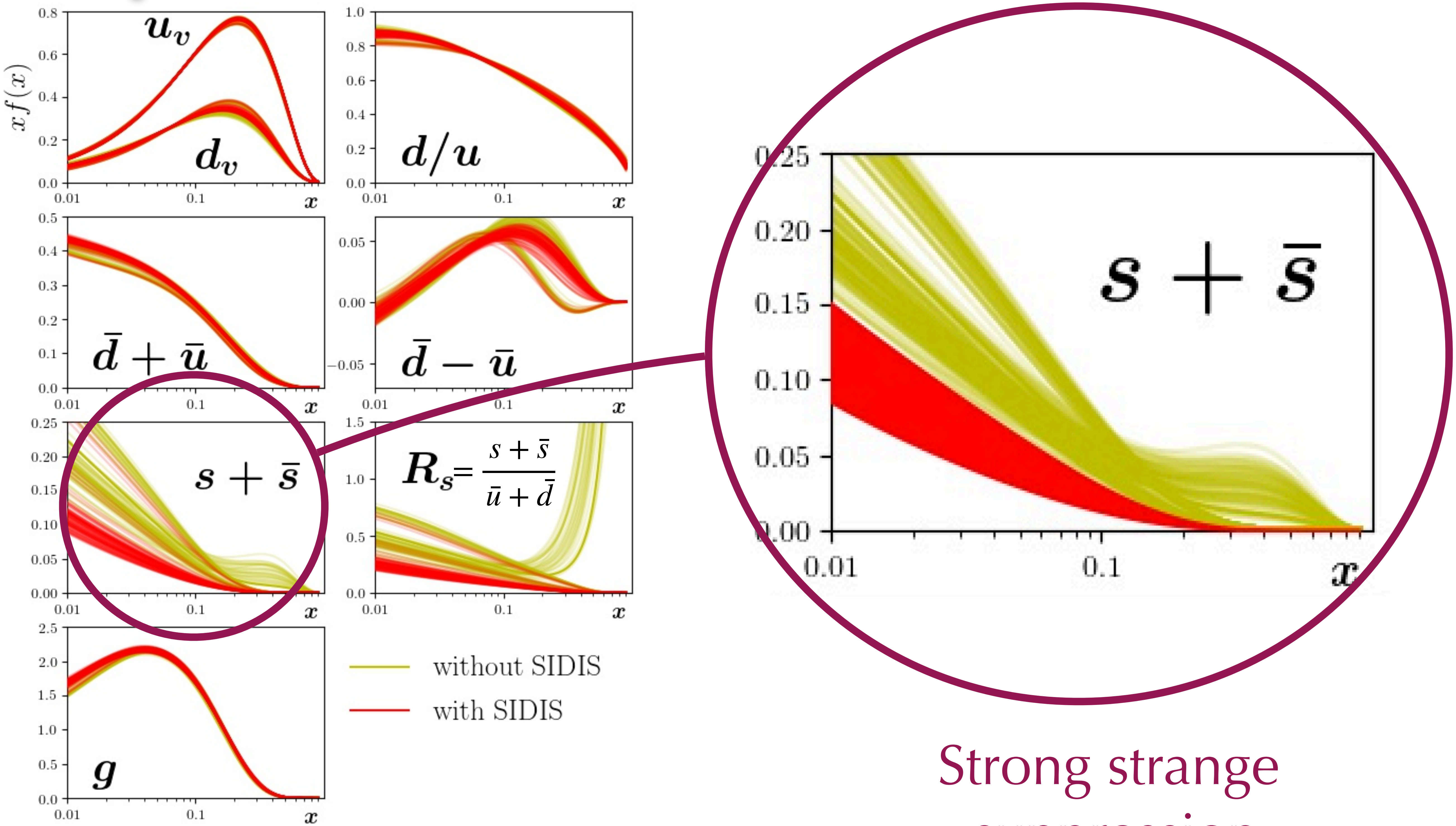
Q = m$_c$

Impact of SIDIS data on PDFs



Q = m$_c$

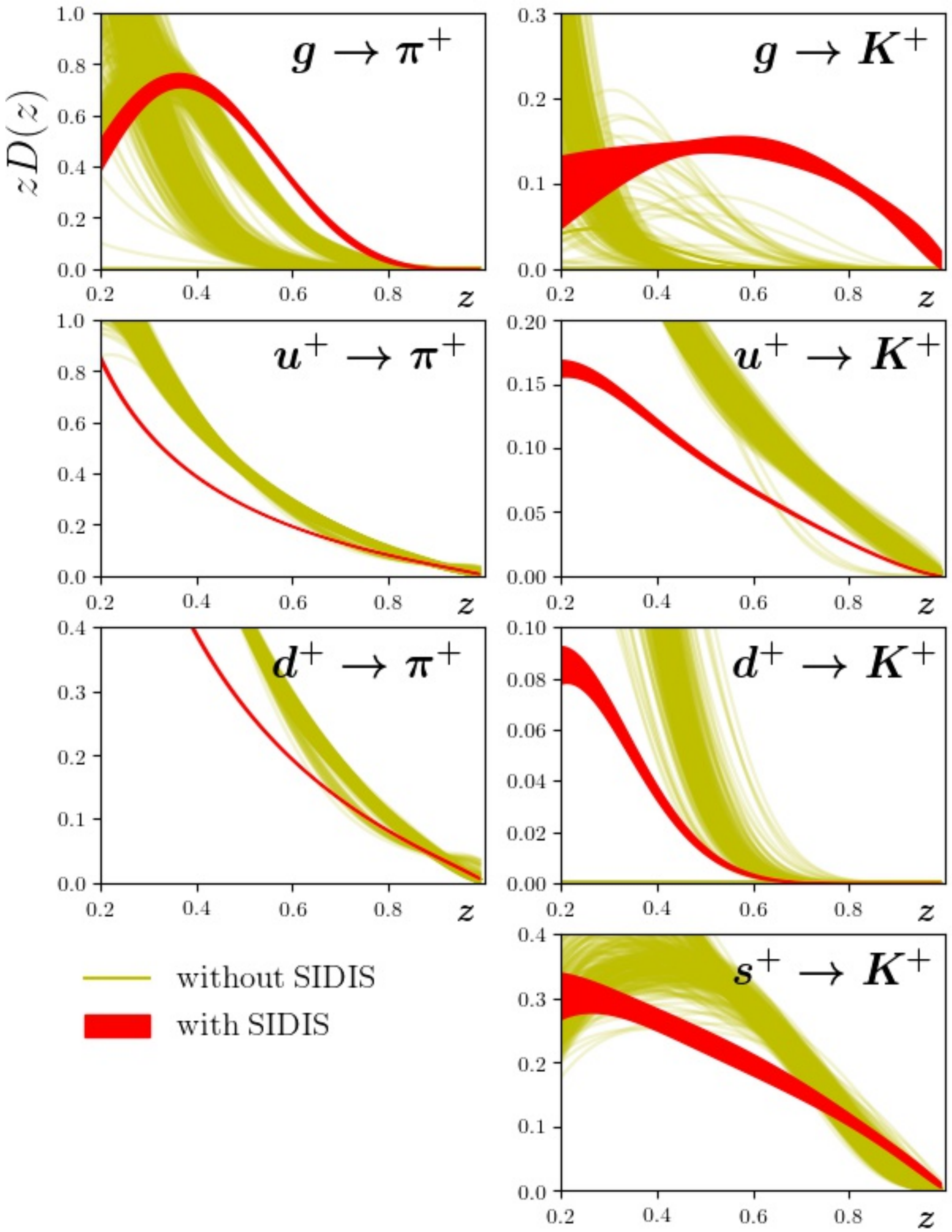
Impact of SIDIS data on PDFs



Q = m$_c$

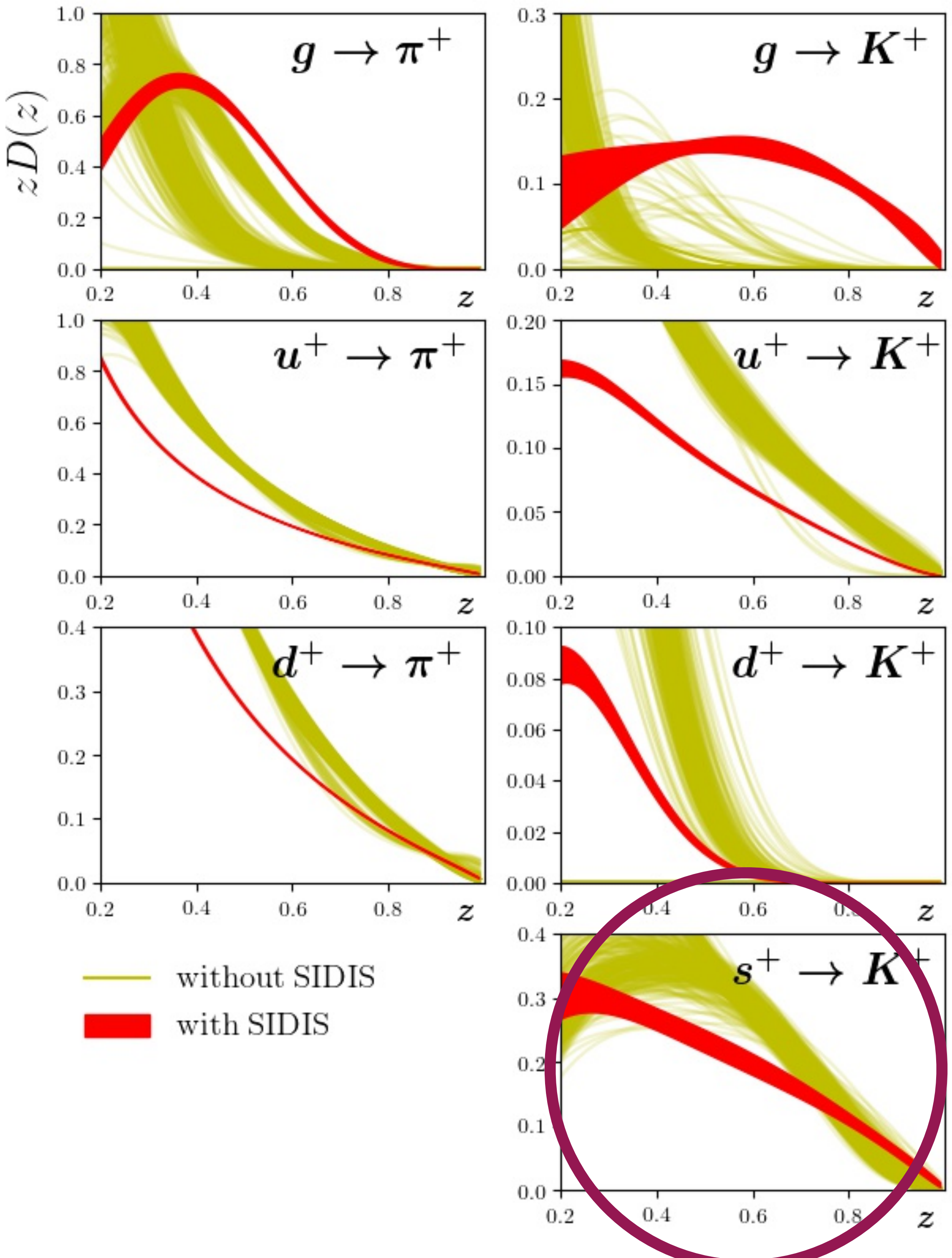
Strong strange suppression

Impact of SIDIS data on FFs



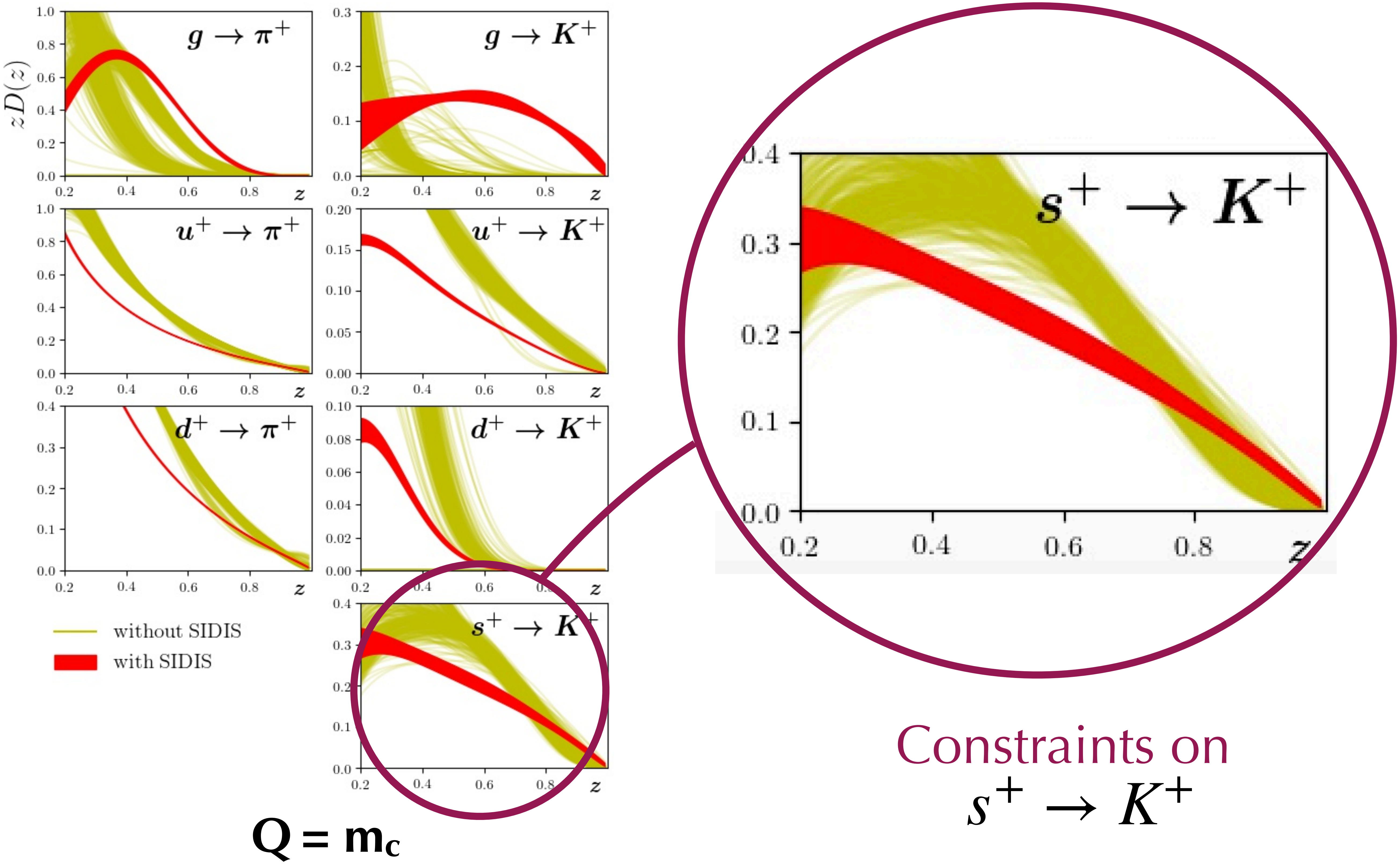
Q = m_c

Impact of SIDIS data on FFs



Q = m$_c$

Impact of SIDIS data on FFs



Constraints on
$s^+ \to K^+$

Summary

- MC statistical methods are important for a robust extraction of non-perturbative collinear distributions

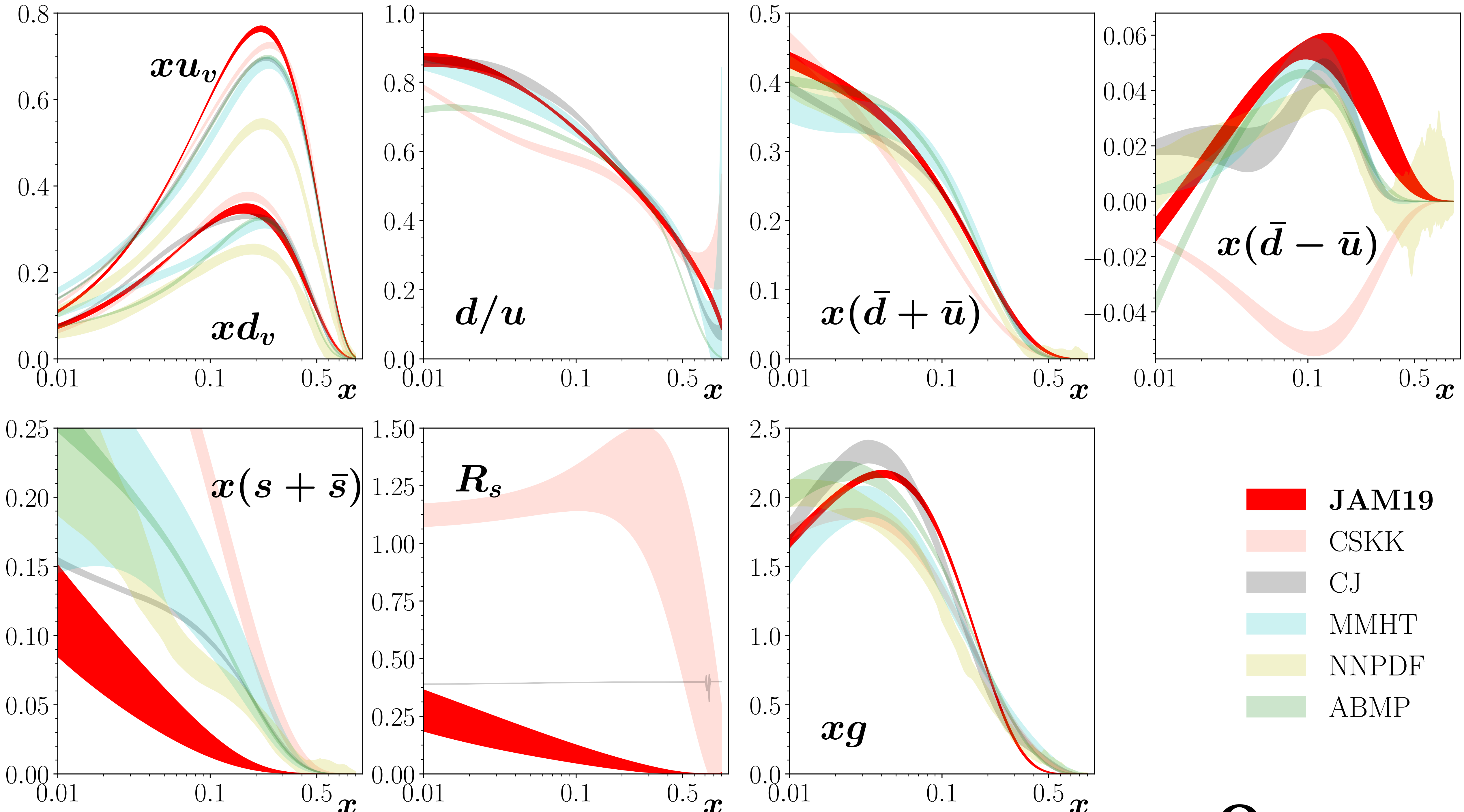
→ Crucial for future global TMDs, GPDs analysis

- First MC fit of PDFs and FFs using DIS, DY, SIDIS and SIA data

- JAM19 methodology: MC (multi-steps), k-means clustering, 'extended' reduced χ^2

- Strange PDF strongly suppressed

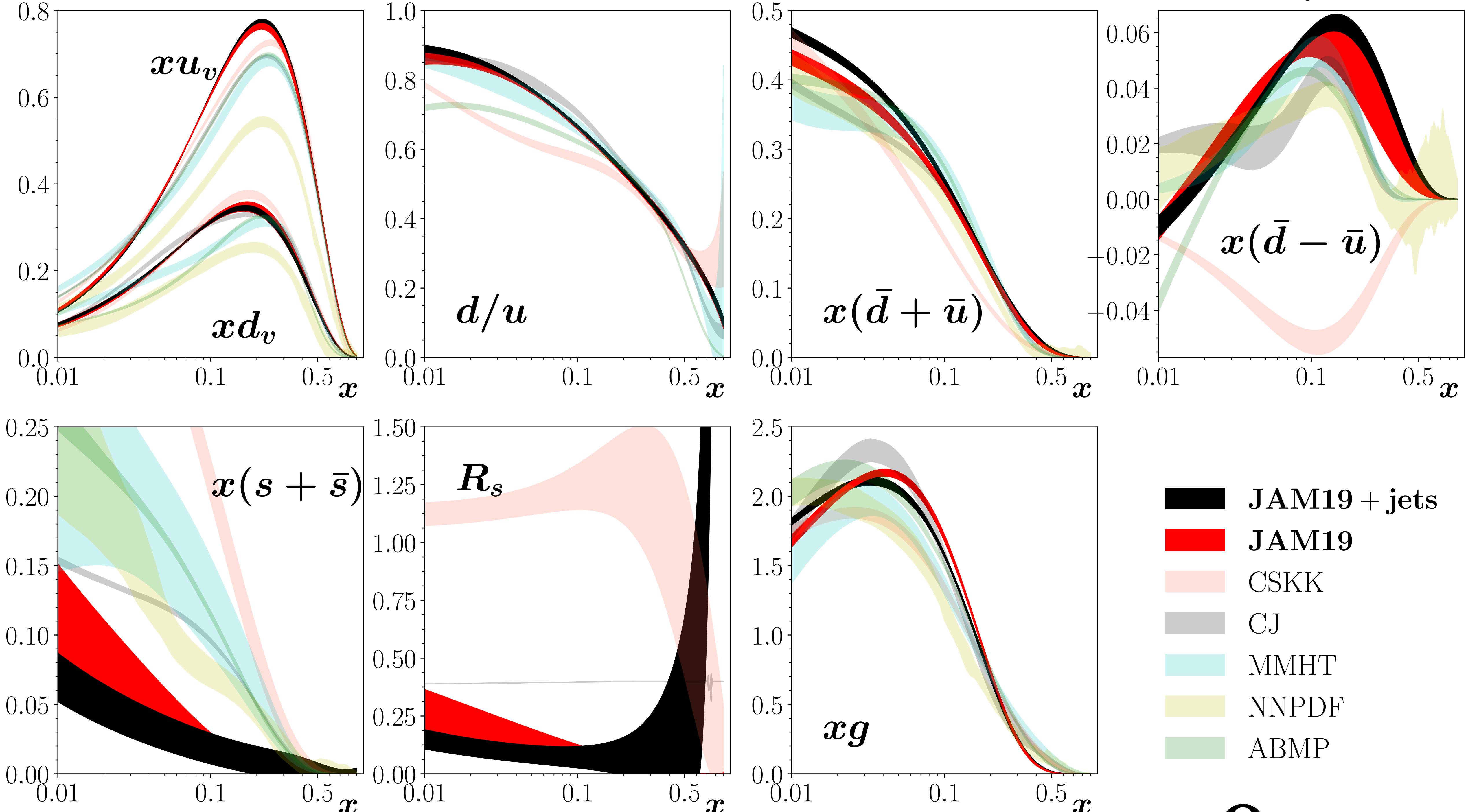
The way forward



Q = m$_c$

The way forward

Yiyu Zhou



Q = m$_c$

Thanks

Backup

JAM17: motivation

Spin sum rule $$\Delta\Sigma(Q^2) = \int_0^1 dx \left(\Delta u^+(x,Q^2) + \Delta d^+(x,Q^2) + \Delta s^+(x,Q^2)\right)$$

$$\frac{1}{2} = \frac{1}{2}\Delta\Sigma + \Delta G + L_q + L_g$$

$$\Delta G(Q^2) = \int_0^1 dx \Delta g(x,Q^2)$$

$$\Delta\Sigma(Q^2_{\mathrm{EMC}}) \sim 0.1$$

- First moment of polarized structure function g_1:

$$\int_0^1 dx g_1^p(x,Q^2) = \frac{1}{36}\left[8\Delta\Sigma + 3g_A + a_8\right]\left(1 - \frac{\alpha_s}{\pi} + \mathcal{O}(\alpha_s^2)\right) + \mathcal{O}(\frac{1}{Q^2})$$

→ DIS requires assumptions about triplet and octet axial charges to extract $\Delta\Sigma$

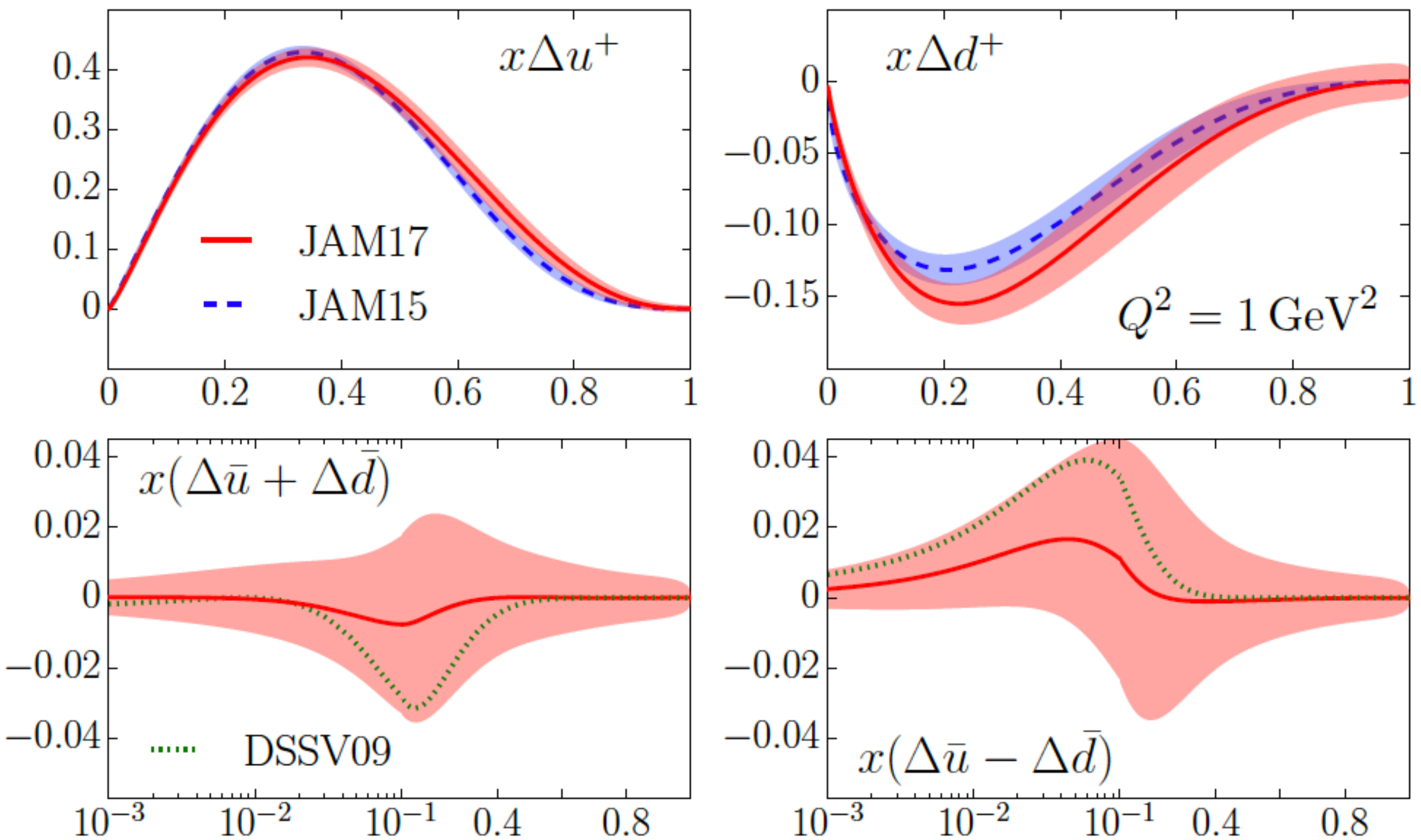
- Assuming exact $SU(2)_f$ and $SU(3)_f$ values from weak baryon decays

$$\int dx \left(\Delta u^+ - \Delta d^+\right) = g_A \sim 1.269 \qquad \int dx \left(\Delta u^+ + \Delta d^+ - 2\Delta s^+\right) = a_8 \sim 0.586$$

$$\Delta\Sigma_{[10^{-3},0.8]} \sim 0.3$$

Released in JAM17

JAM17: Polarized PDFs

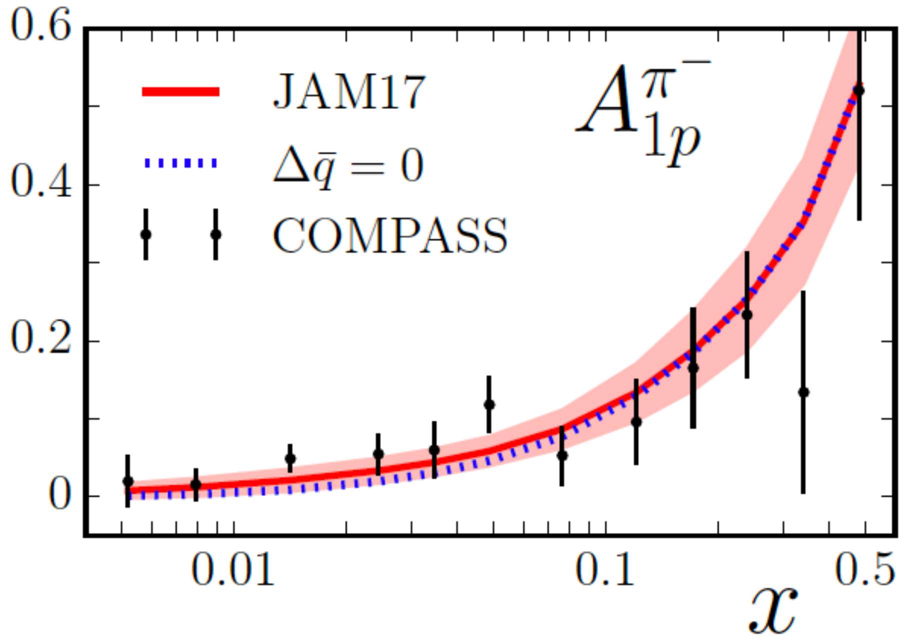


- Δu^+ consistent with previous analysis
- Δd^+ slightly larger in magnitude

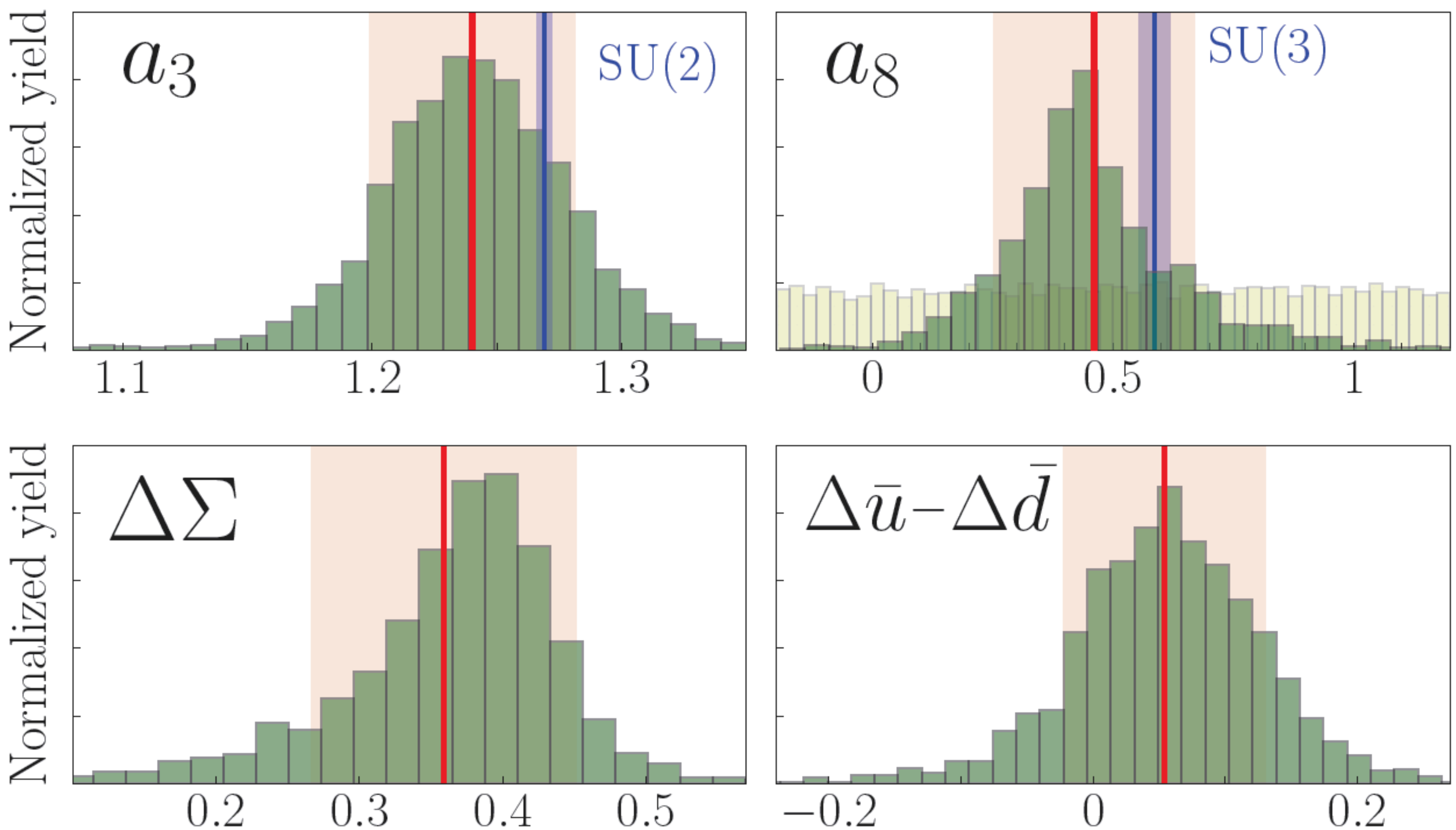
  → Anti-correlation with Δs^+, which is less negative than JAM15 at $x \sim 0.2$

- Isoscalar sea distribution consistent with zero
- Isovector sea slightly prefers positive shape at low x

  → Non-zero asymmetry given by small contributions from SIDIS asymmetries



JAM17: Lowest moments



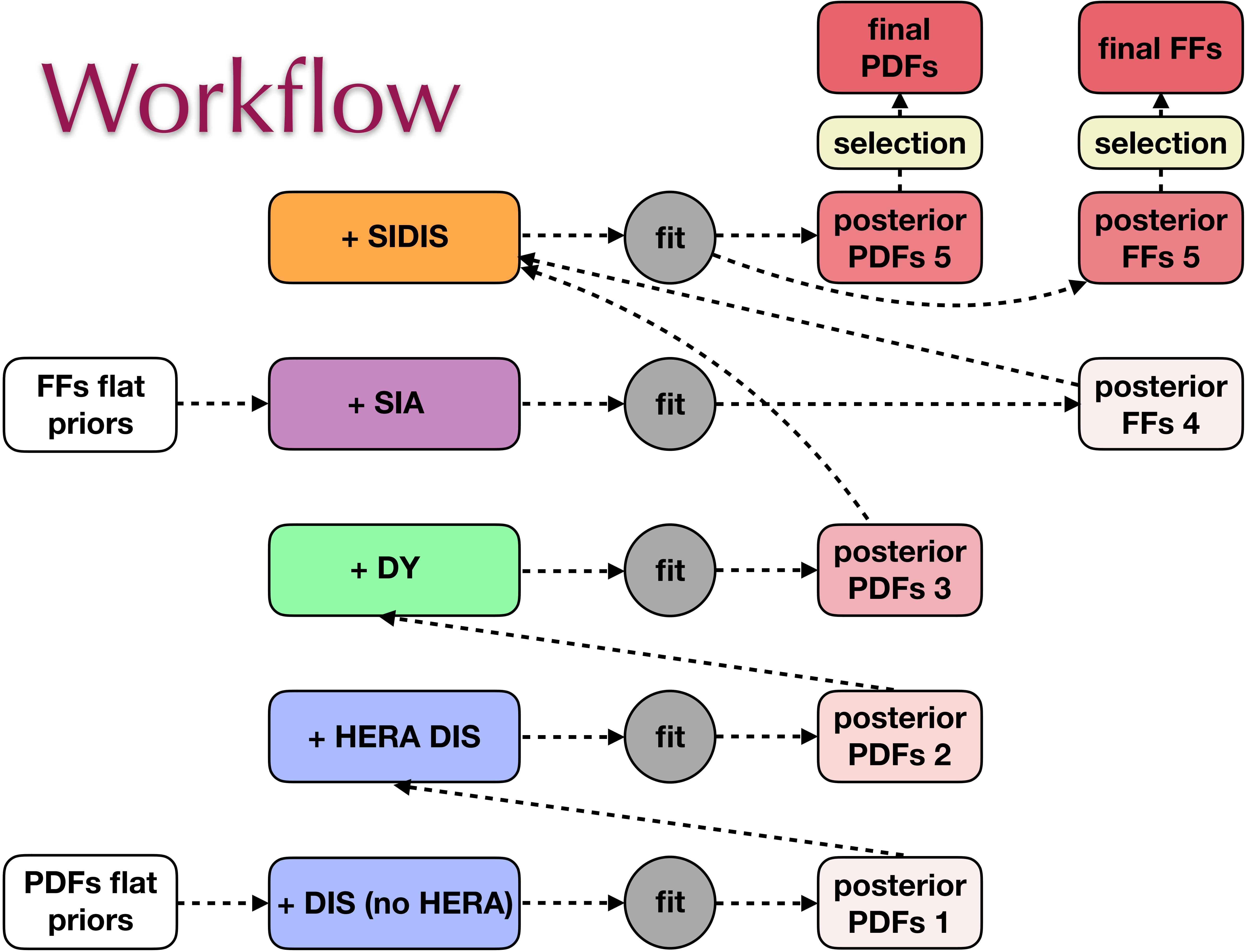
$$g_A = 1.24 \pm 0.04$$ Confirmation of SU(2) symmetry to ~2%

$$a_8 = 0.46 \pm 0.21$$ ~20% SU(3) breaking ± ~20%; large uncertainty

- Need better determination of Δs^+ moment to reduce a_8 uncertainty!

$$\Delta \mathbf{s}^+ = -0.03 \pm 0.09$$
$$\Delta\Sigma = 0.36 \pm 0.09$$

Workflow



final PDFs
final FFs
selection
selection
+ SIDIS
fit
posterior PDFs 5
posterior FFs 5
FFs flat priors
+ SIA
fit
posterior FFs 4
+ DY
fit
posterior PDFs 3
+ HERA DIS
fit
posterior PDFs 2
PDFs flat priors
+ DIS (no HERA)
fit
posterior PDFs 1

Chi2

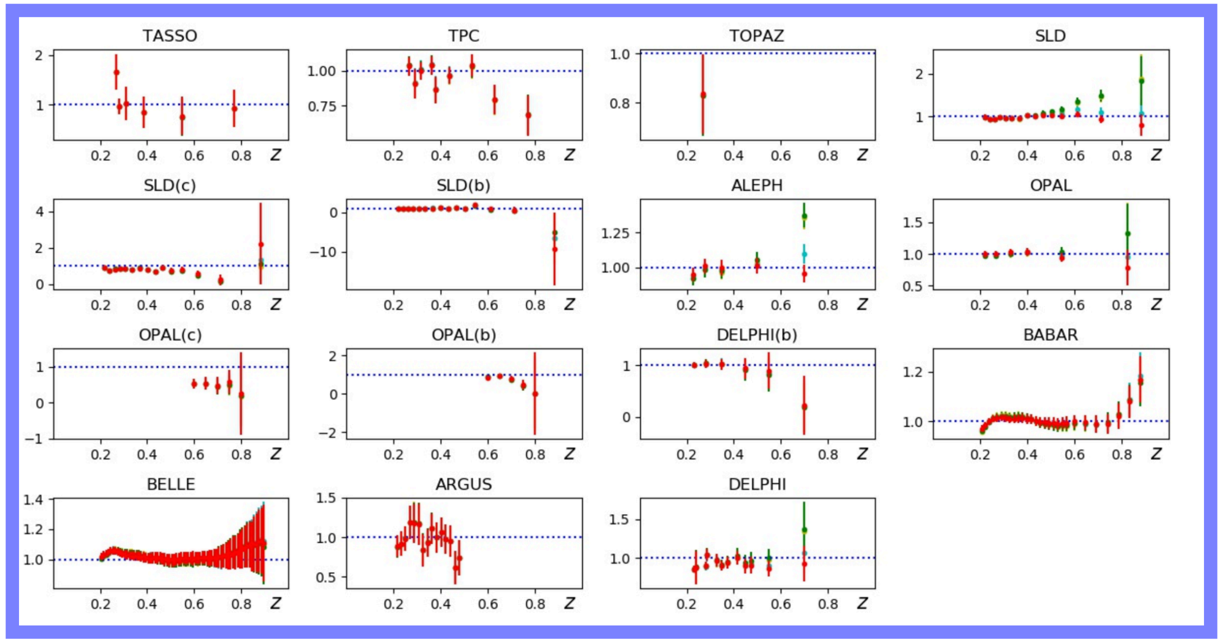
Reaction	$N_{\rm dat}$	χ^2	$\chi^2/N_{\rm dat}$
SIDIS	992	1243.12	1.25
SIA	444	562.80	1.27
DIS	2680	3437.96	1.28
DY	250	416.29	1.67

Reaction	$N_{\rm dat}$	χ^2	$\chi^2/N_{\rm dat}$
SIDIS ($\pi^\pm$)	498	585.48	1.18
SIDIS($K^\pm$)	494	657.64	1.33
SIA($\pi^\pm$)	231	247.27	1.07
SIA ($K^\pm$)	213	315.53	1.48

Experiment	target	hadron	$N_{\rm dat}$	$\chi^2/N_{\rm dat}$
COMPASS	d	π^+	249	1.26
COMPASS	d	π^-	249	1.09
COMPASS	d	K^+	247	1.24
COMPASS	d	K^-	247	1.43

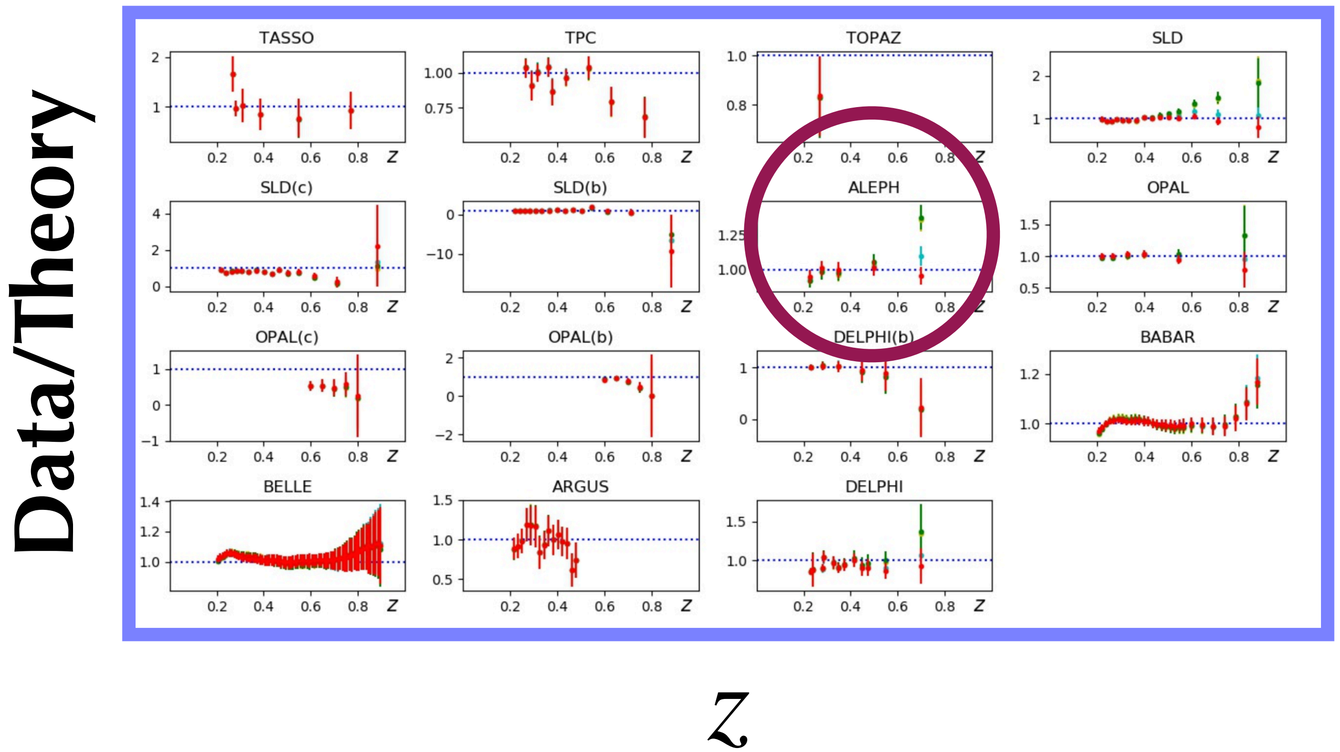
SIA K+/K- data

Data/Theory



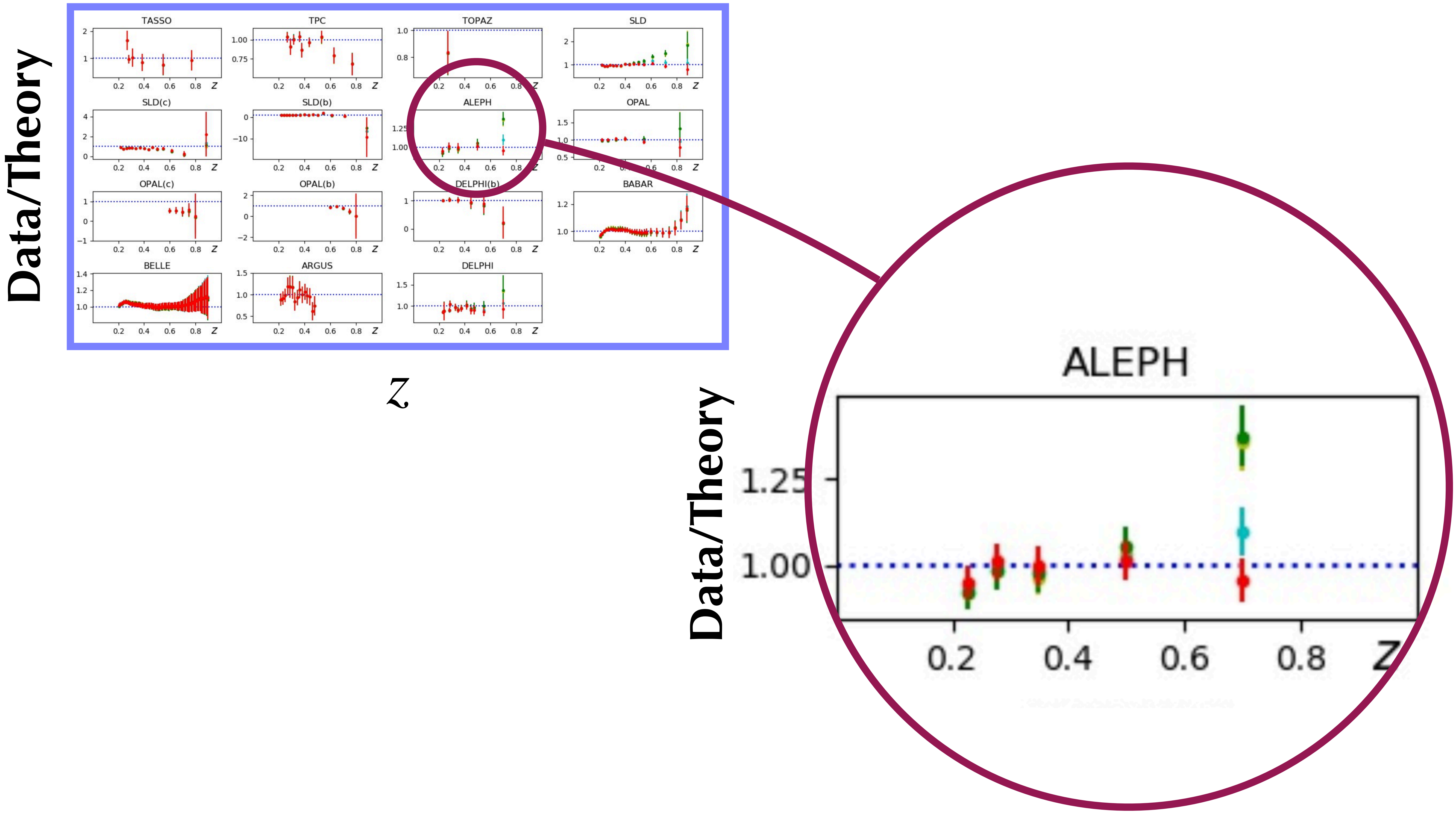
z

SIA K+/K- data



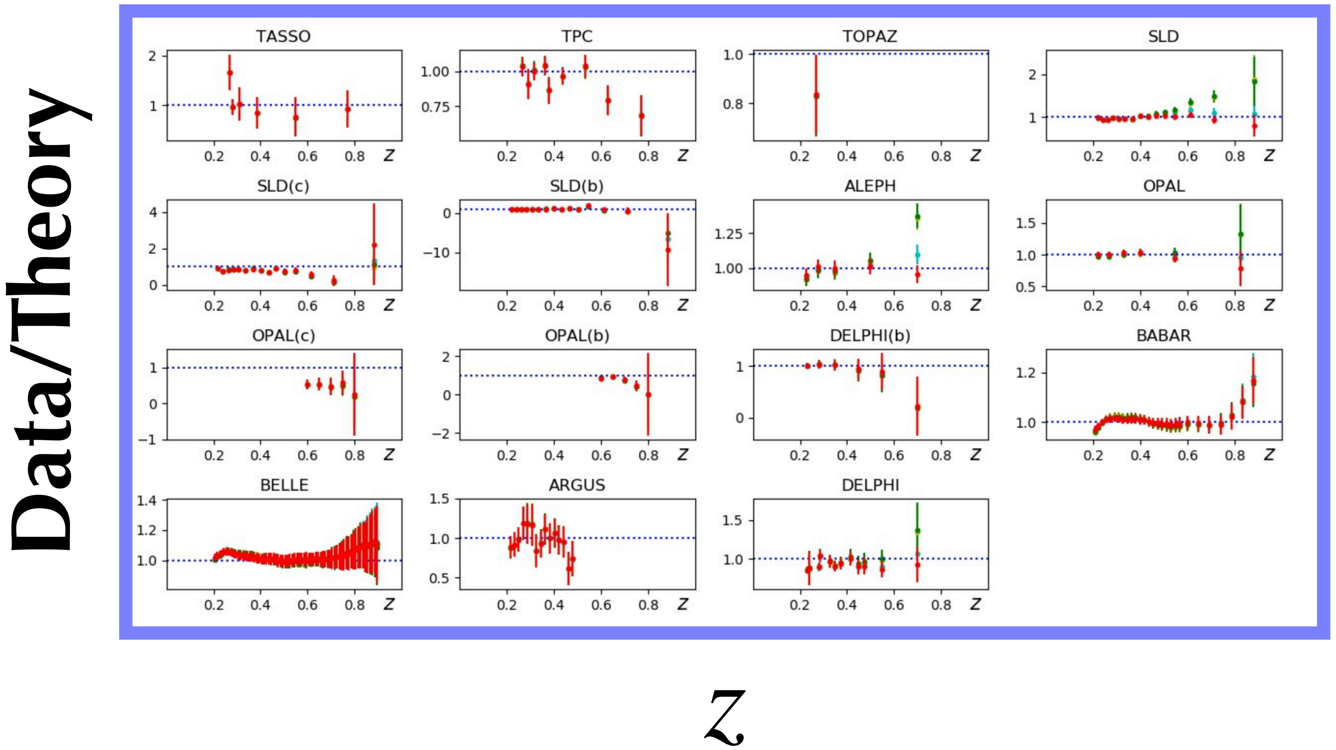
Data/Theory
TASSO
TPC
TOPAZ
SLD
SLD(c)
SLD(b)
ALEPH
OPAL
OPAL(c)
OPAL(b)
DELPHI(b)
BABAR
BELLE
ARGUS
DELPHI
z

SIA K+/K- data

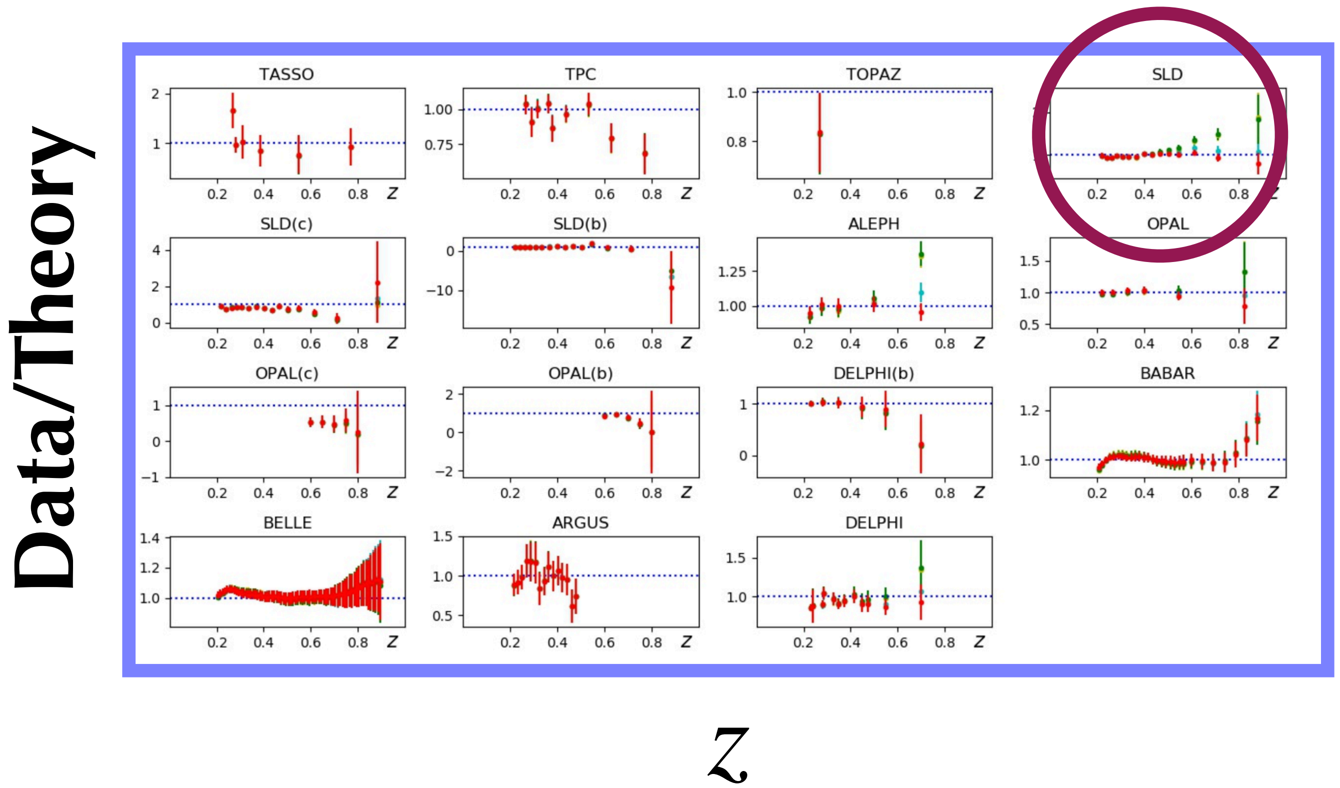


Data/Theory
TASSO
TPC
TOPAZ
SLD
SLD(c)
SLD(b)
ALEPH
OPAL
OPAL(c)
OPAL(b)
DELPHI(b)
BABAR
BELLE
ARGUS
DELPHI
z
ALEPH
Data/Theory
1.25
1.00
0.2
0.4
0.6
0.8
z

SIA K+/K- data


Data/Theory
TASSO
TPC
TOPAZ
SLD
SLD(c)
SLD(b)
ALEPH
OPAL
OPAL(c)
OPAL(b)
DELPHI(b)
BABAR
BELLE
ARGUS
DELPHI
z

SIA K+/K- data


Data/Theory
TASSO
TPC
TOPAZ
SLD
SLD(c)
SLD(b)
ALEPH
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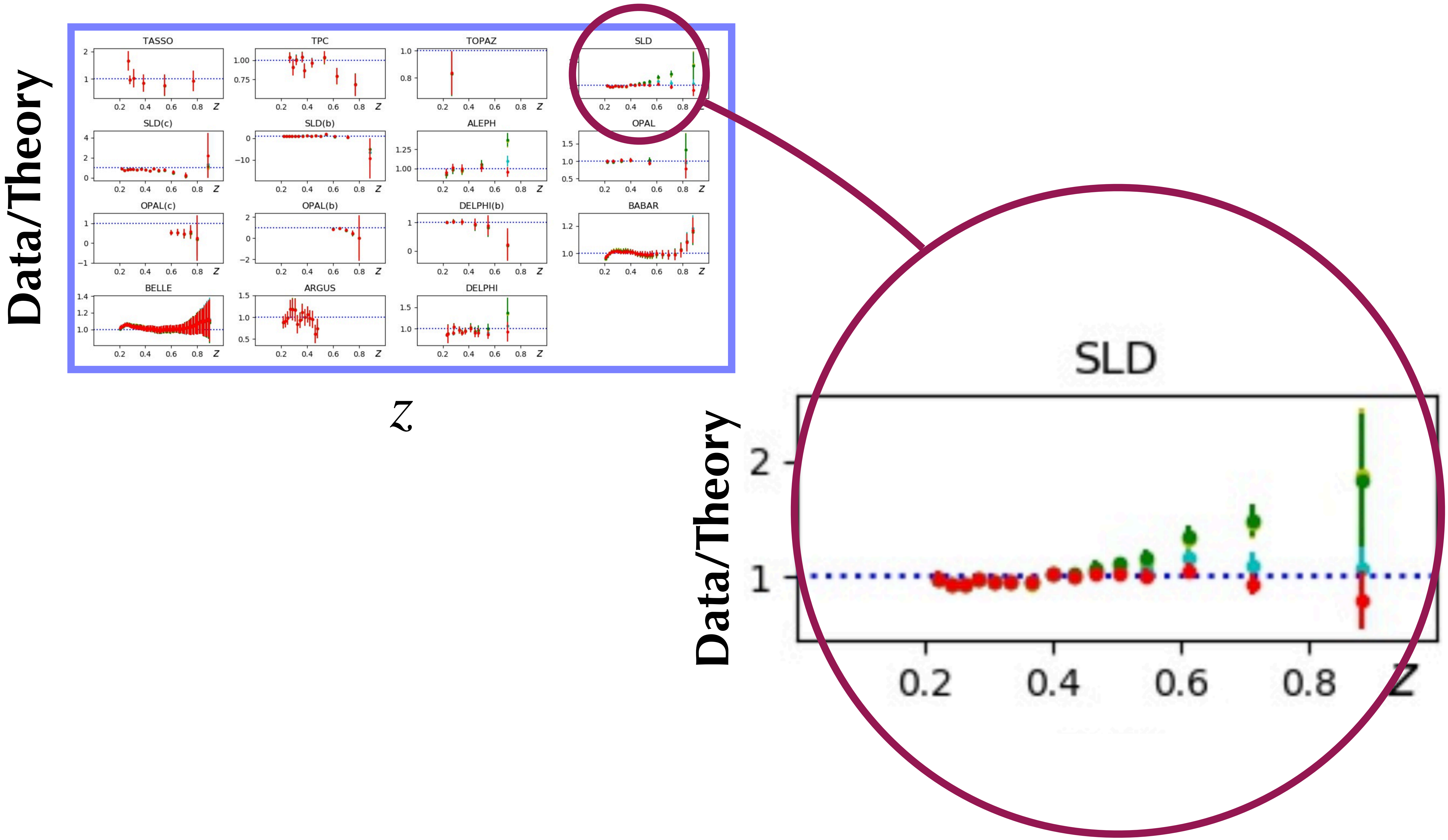
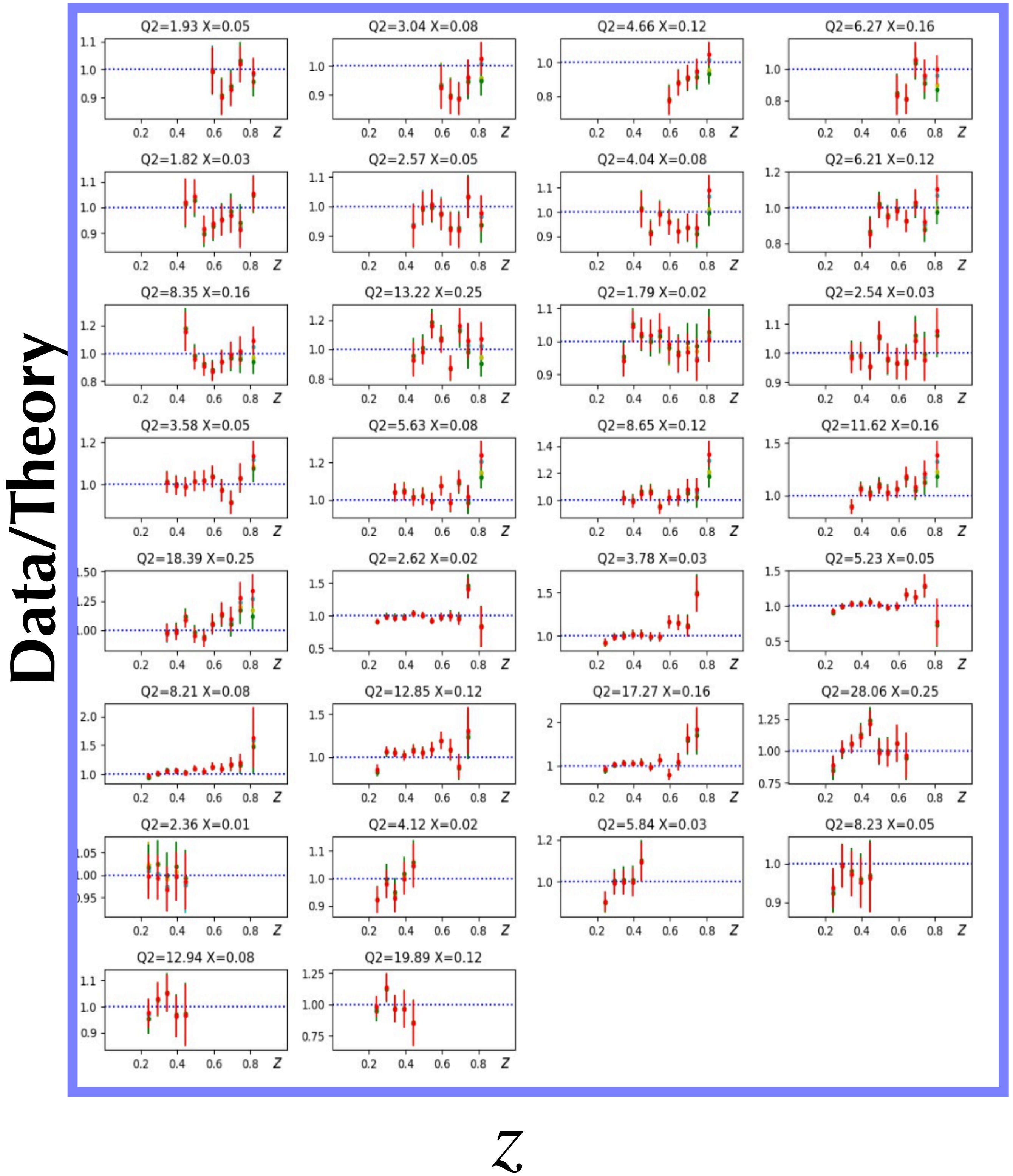
OPAL(c)
OPAL(b)
DELPHI(b)
BABAR
BELLE
ARGUS
DELPHI
z

SIA K+/K- data


Data/Theory
TASSO
TPC
TOPAZ
SLD
SLD(c)
SLD(b)
ALEPH
OPAL
OPAL(c)
OPAL(b)
DELPHI(b)
BABAR
BELLE
ARGUS
DELPHI
z
SLD
Data/Theory
0.2
0.4
0.6
0.8
z

SIDIS K- data



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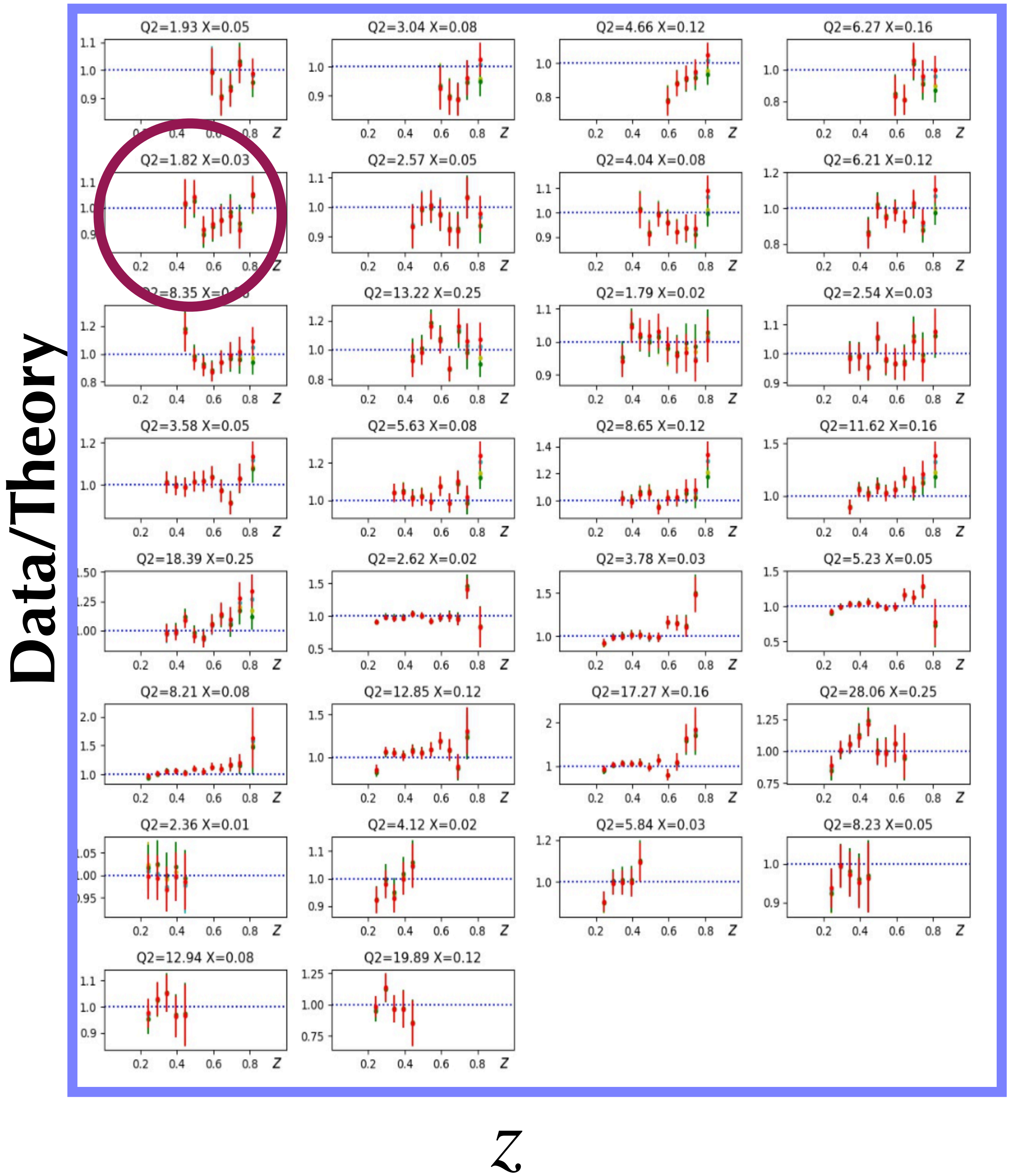
Q2=3.04 X=0.08
Q2=4.66 X=0.12
Q2=6.27 X=0.16
Q2=1.82 X=0.03
Q2=2.57 X=0.05
Q2=4.04 X=0.08
Q2=6.21 X=0.12
Q2=8.35 X=0.16
Q2=13.22 X=0.25
Q2=1.79 X=0.02
Q2=2.54 X=0.03
Q2=3.58 X=0.05
Q2=5.63 X=0.08
Q2=8.65 X=0.12
Q2=11.62 X=0.16
Q2=18.39 X=0.25
Q2=2.62 X=0.02
Q2=3.78 X=0.03
Q2=5.23 X=0.05
Q2=8.21 X=0.08
Q2=12.85 X=0.12
Q2=17.27 X=0.16
Q2=28.06 X=0.25
Q2=2.36 X=0.01
Q2=4.12 X=0.02
Q2=5.84 X=0.03
Q2=8.23 X=0.05
Q2=12.94 X=0.08
Q2=19.89 X=0.12
z

SIDIS K- data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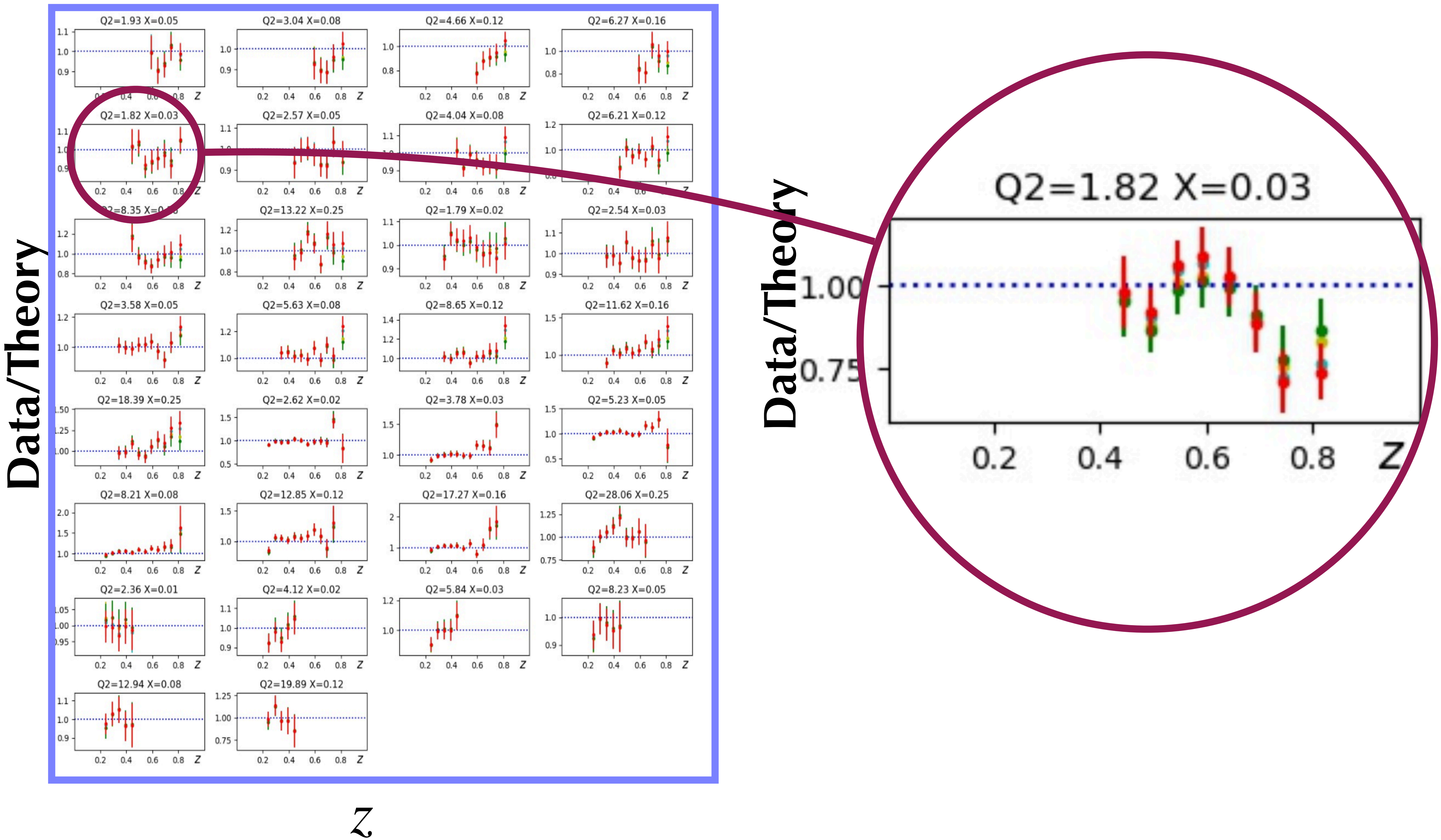
Q2=3.04 X=0.08
Q2=4.66 X=0.12
Q2=6.27 X=0.16
Q2=1.82 X=0.03
Q2=2.57 X=0.05
Q2=4.04 X=0.08
Q2=6.21 X=0.12
Q2=13.22 X=0.25
Q2=1.79 X=0.02
Q2=2.54 X=0.03
Q2=3.58 X=0.05
Q2=5.63 X=0.08
Q2=8.65 X=0.12
Q2=11.62 X=0.16
Q2=18.39 X=0.25
Q2=2.62 X=0.02
Q2=3.78 X=0.03
Q2=5.23 X=0.05
Q2=8.21 X=0.08
Q2=12.85 X=0.12
Q2=17.27 X=0.16
Q2=28.06 X=0.25
Q2=2.36 X=0.01
Q2=4.12 X=0.02
Q2=5.84 X=0.03
Q2=8.23 X=0.05
Q2=12.94 X=0.08
Q2=19.89 X=0.12
z

SIDIS K- data



Data/Theory
z
Q2=1.93 X=0.05
Q2=3.04 X=0.08
Q2=4.66 X=0.12
Q2=6.27 X=0.16
Q2=1.82 X=0.03
Q2=2.57 X=0.05
Q2=4.04 X=0.08
Q2=6.21 X=0.12
Q2=13.22 X=0.25
Q2=1.79 X=0.02
Q2=2.54 X=0.03
Q2=3.58 X=0.05
Q2=5.63 X=0.08
Q2=8.65 X=0.12
Q2=11.62 X=0.16
Q2=18.39 X=0.25
Q2=2.62 X=0.02
Q2=3.78 X=0.03
Q2=5.23 X=0.05
Q2=8.21 X=0.08
Q2=12.85 X=0.12
Q2=17.27 X=0.16
Q2=28.06 X=0.25
Q2=2.36 X=0.01
Q2=4.12 X=0.02
Q2=5.84 X=0.03
Q2=8.23 X=0.05
Q2=12.94 X=0.08
Q2=19.89 X=0.12
Data/Theory
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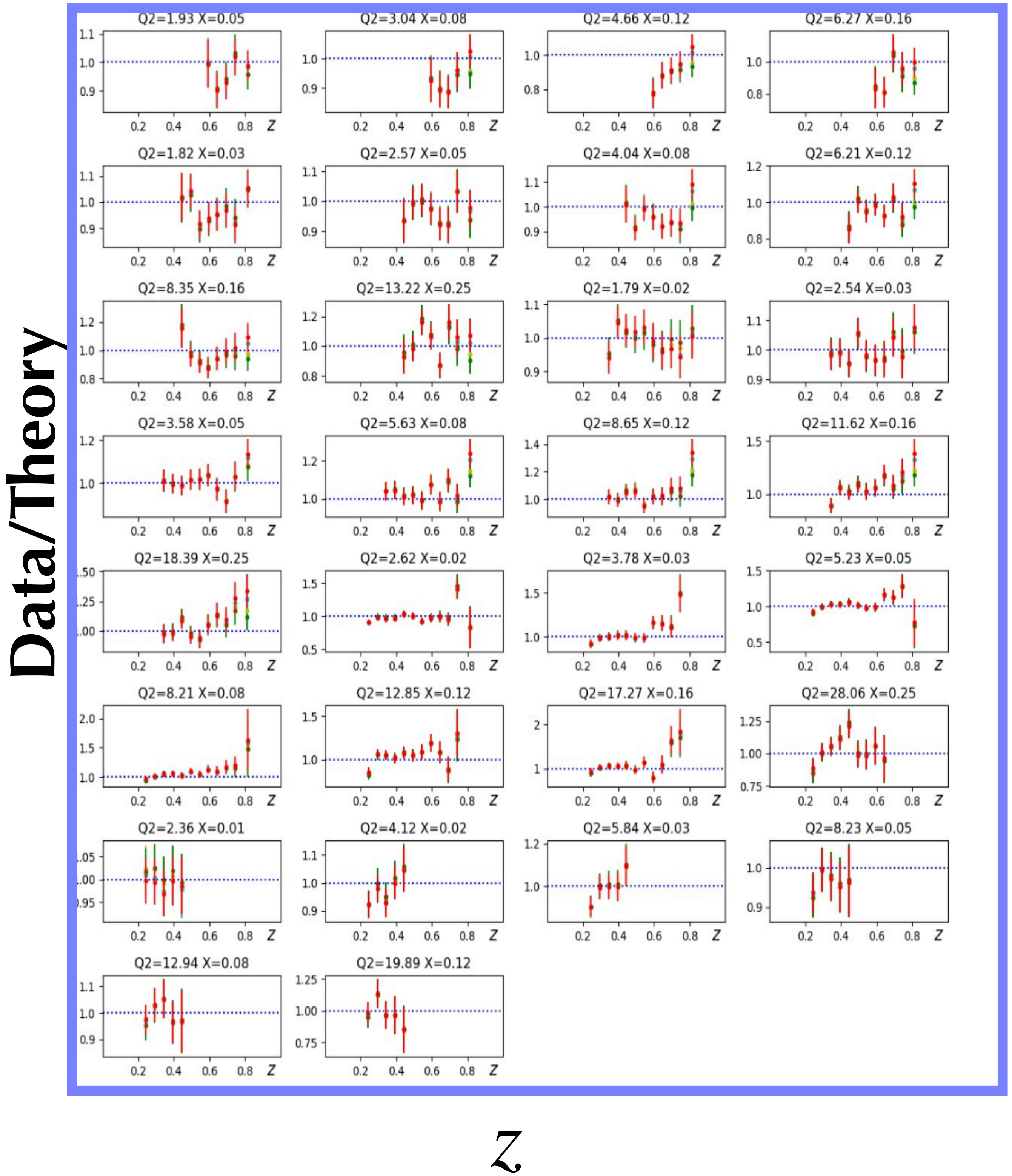
1.00
0.75
0.2
0.4
0.6
0.8
Z

SIDIS K+ data


Data/Theory
z
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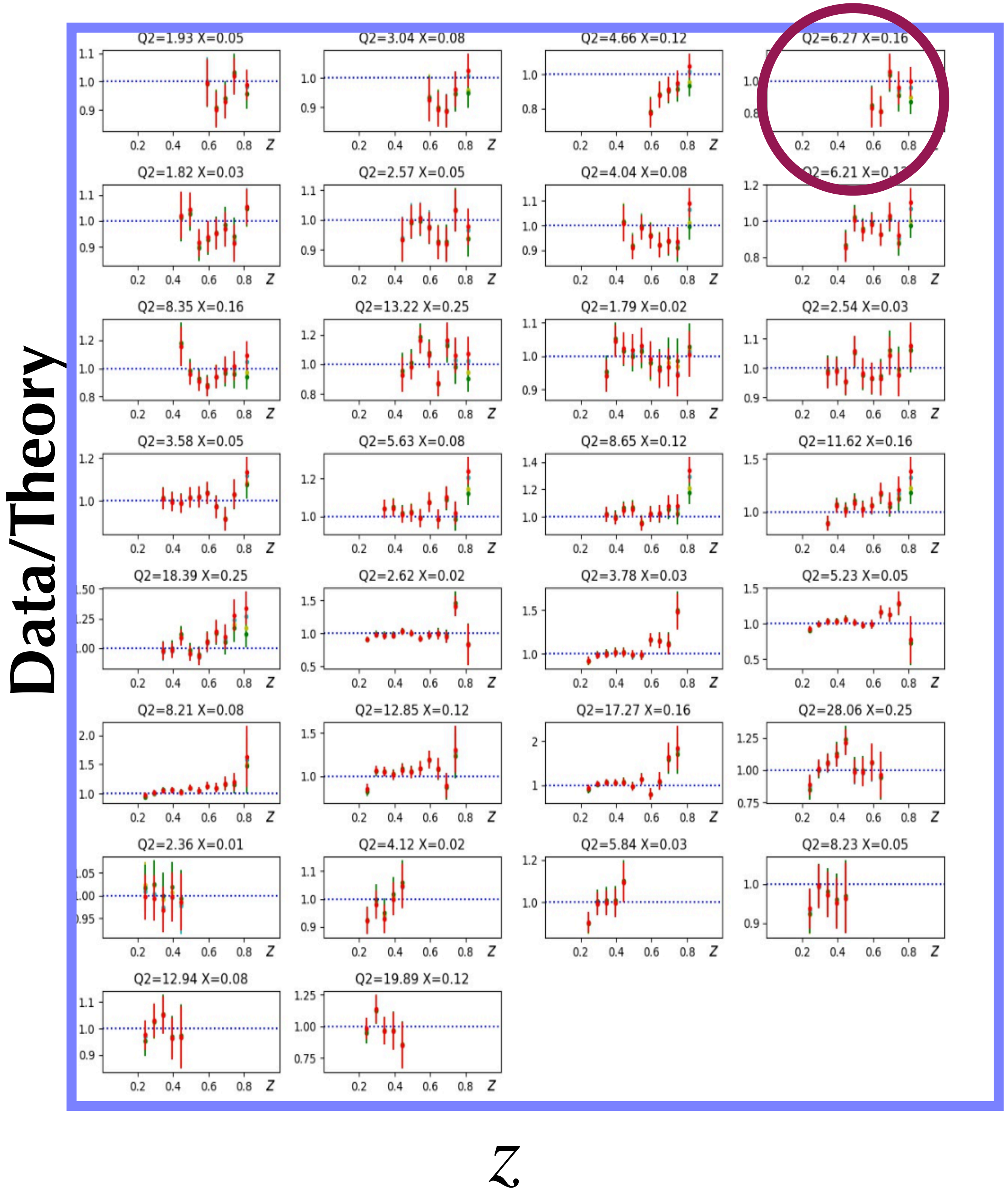
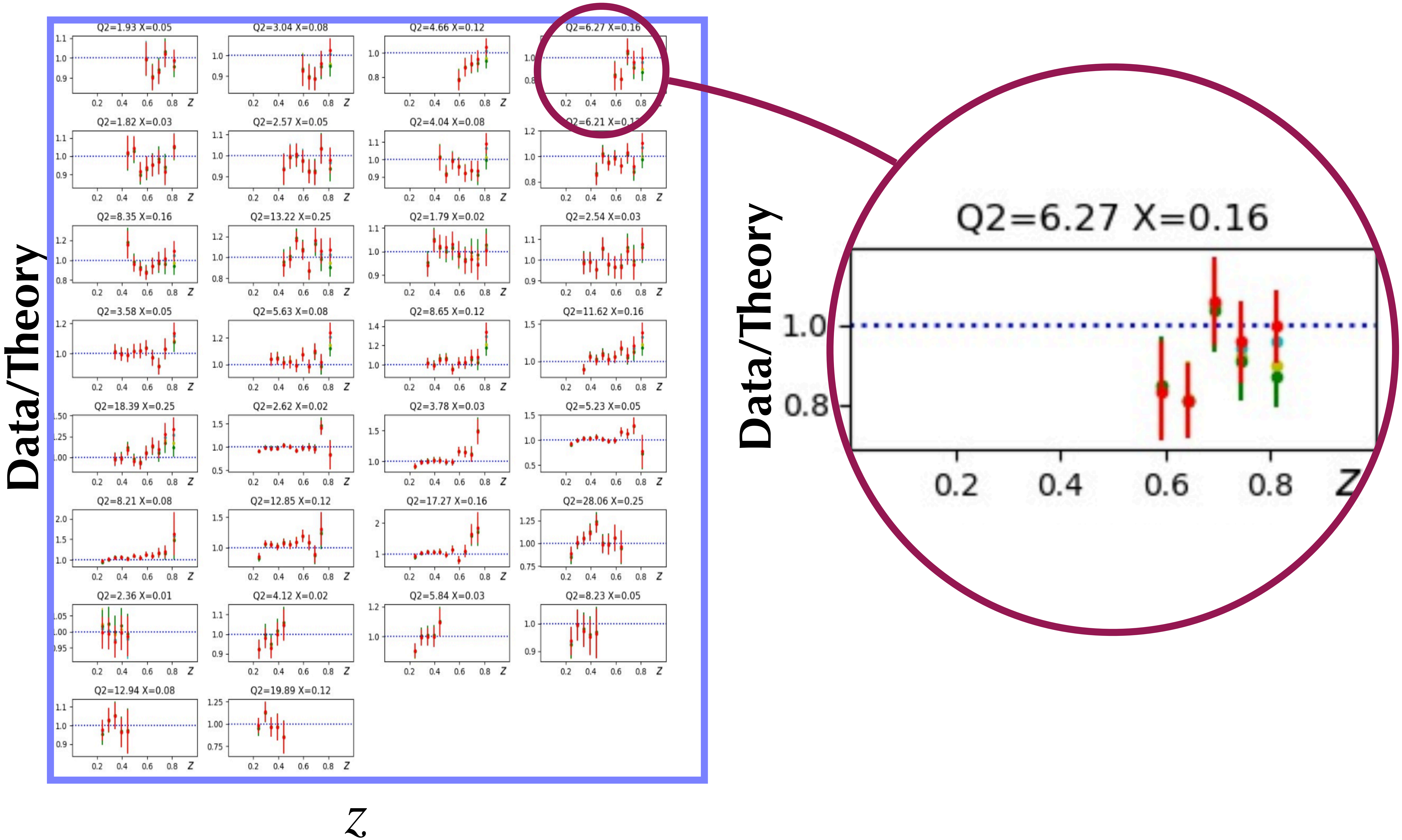
Q2=3.04 X=0.08
Q2=4.66 X=0.12
Q2=6.27 X=0.16
Q2=1.82 X=0.03
Q2=2.57 X=0.05
Q2=4.04 X=0.08
Q2=6.21 X=0.12
Q2=8.35 X=0.16
Q2=13.22 X=0.25
Q2=1.79 X=0.02
Q2=2.54 X=0.03
Q2=3.58 X=0.05
Q2=5.63 X=0.08
Q2=8.65 X=0.12
Q2=11.62 X=0.16
Q2=18.39 X=0.25
Q2=2.62 X=0.02
Q2=3.78 X=0.03
Q2=5.23 X=0.05
Q2=8.21 X=0.08
Q2=12.85 X=0.12
Q2=17.27 X=0.16
Q2=28.06 X=0.25
Q2=2.36 X=0.01
Q2=4.12 X=0.02
Q2=5.84 X=0.03
Q2=8.23 X=0.05
Q2=12.94 X=0.08
Q2=19.89 X=0.12

SIDIS K+ data



Data/Theory
Q2=1.93 X=0.05
Q2=3.04 X=0.08
Q2=4.66 X=0.12
Q2=6.27 X=0.16
Q2=1.82 X=0.03
Q2=2.57 X=0.05
Q2=4.04 X=0.08
Q2=6.21 X=0.12
Q2=8.35 X=0.16
Q2=13.22 X=0.25
Q2=1.79 X=0.02
Q2=2.54 X=0.03
Q2=3.58 X=0.05
Q2=5.63 X=0.08
Q2=8.65 X=0.12
Q2=11.62 X=0.16
Q2=18.39 X=0.25
Q2=2.62 X=0.02
Q2=3.78 X=0.03
Q2=5.23 X=0.05
Q2=8.21 X=0.08
Q2=12.85 X=0.12
Q2=17.27 X=0.16
Q2=28.06 X=0.25
Q2=2.36 X=0.01
Q2=4.12 X=0.02
Q2=5.84 X=0.03
Q2=8.23 X=0.05
Q2=12.94 X=0.08
Q2=19.89 X=0.12
z

SIDIS K+ data


Data/Theory
Q2=1.93 X=0.05
Q2=3.04 X=0.08
Q2=4.66 X=0.12
Q2=6.27 X=0.16
Q2=1.82 X=0.03
Q2=2.57 X=0.05
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Q2=12.94 X=0.08
Q2=19.89 X=0.12
z
Data/Theory
Q2=6.27 X=0.16