The impact of event-by-event fluctuations in the nucleon positions on nuclear PDFs

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Las Negras, Cabo de Gata (Spain) – Hot Quarks 2014

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The impact of e+A collisions on nuclear PDFs

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Why e+A collisions are interesting?

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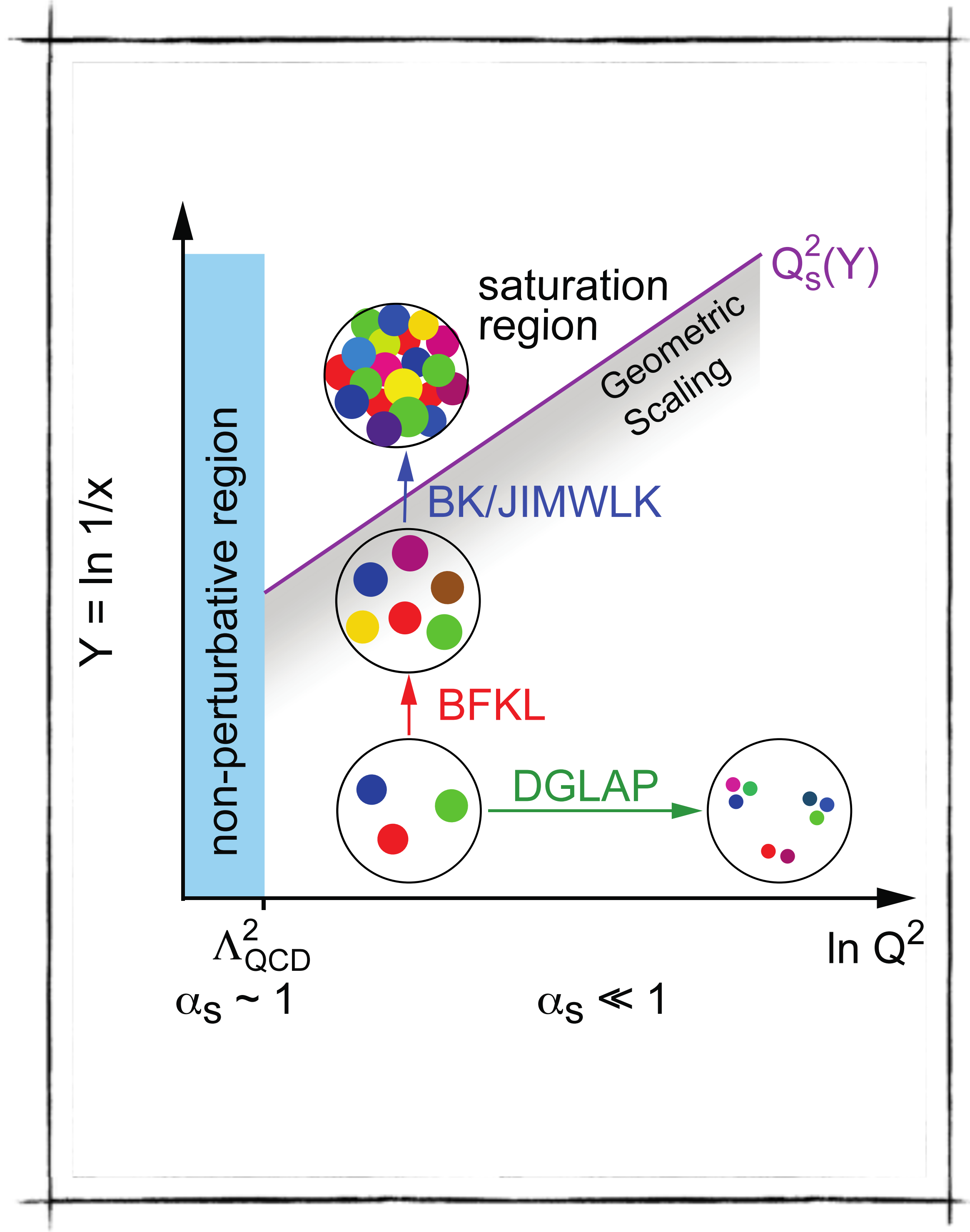
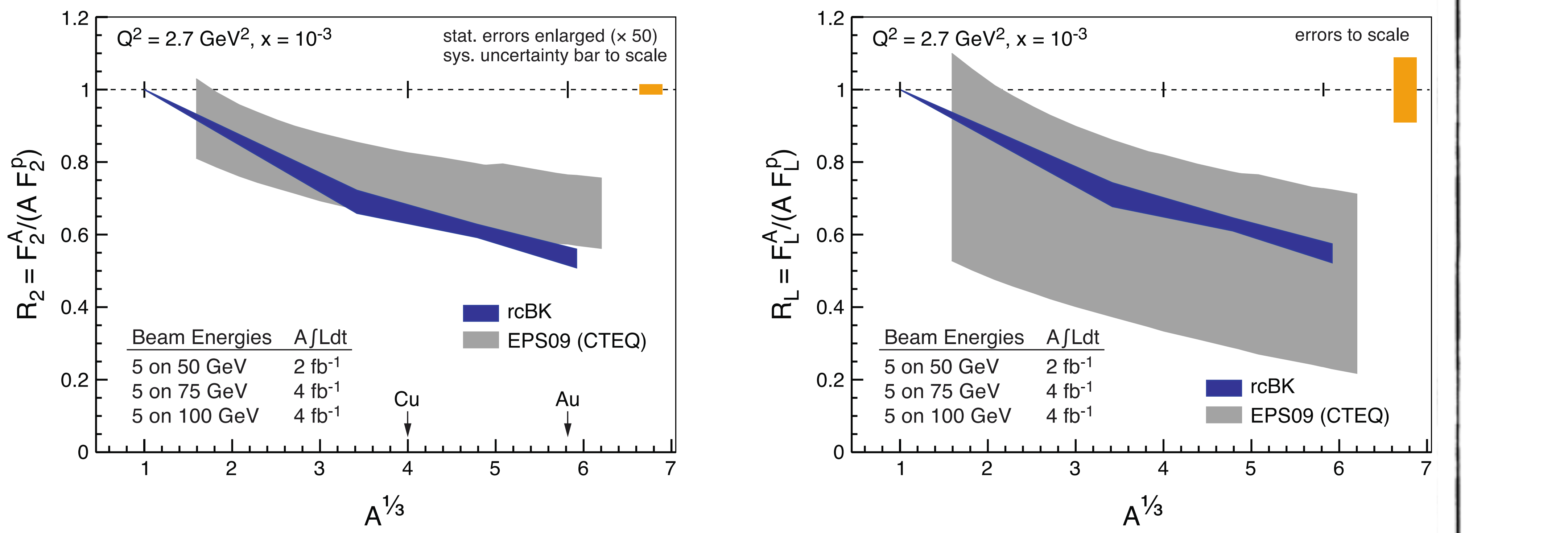
- At asymptotically small-x:
  - QCD evolution becomes non-linear
  - Particle production becomes non-linear



Why e+A collisions are interesting?

- e+A can provide:
  - measurements that will prove non-linear QCD evolution to be indispensable/irrelevant.
  - smoking guns for saturation (unlike, most likely, p+A/A+A)
  - data on the impact parameter dependence of the gluon density and Q_s .
  - data on the transition from the saturation regime to confinement.
  - data on the universality properties of saturation regime.



Albacete, Lamont

Can NLO DGLAP simultaneously accommodate F_2 and F_L data if saturation sets in according to the current models?

What do we want to do?

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Constrain the nuclear PDF’s using e+A (pseudo)data

How do we do it?

How do we do it?

- e+A Deep Inelastic Scattering:
  - Dipole frame

$$F_2(x,Q^2) = \frac{Q^2}{4\pi^2\alpha_{\rm em}}(\sigma_T + \sigma_L)$$

  - Bjorken frame

$$F_2(x,Q^2) = x\sum_q e_q^2\left(q(x,Q^2) + \bar{q}(x,Q^2)\right)$$

- Reweighting

DIS dipole frame

- e+p collisions

$$\sigma_{T,L}^{\gamma^* h}(x, Q^2) = \sum_q \int_0^1 \mathrm{d}z \int \mathrm{d}^2\mathbf{r} |\Psi_{T,L}^q(e_q, m_q, z, Q^2, \mathbf{r})|^2 \sigma_{dip}^{e+p}(r, x)$$

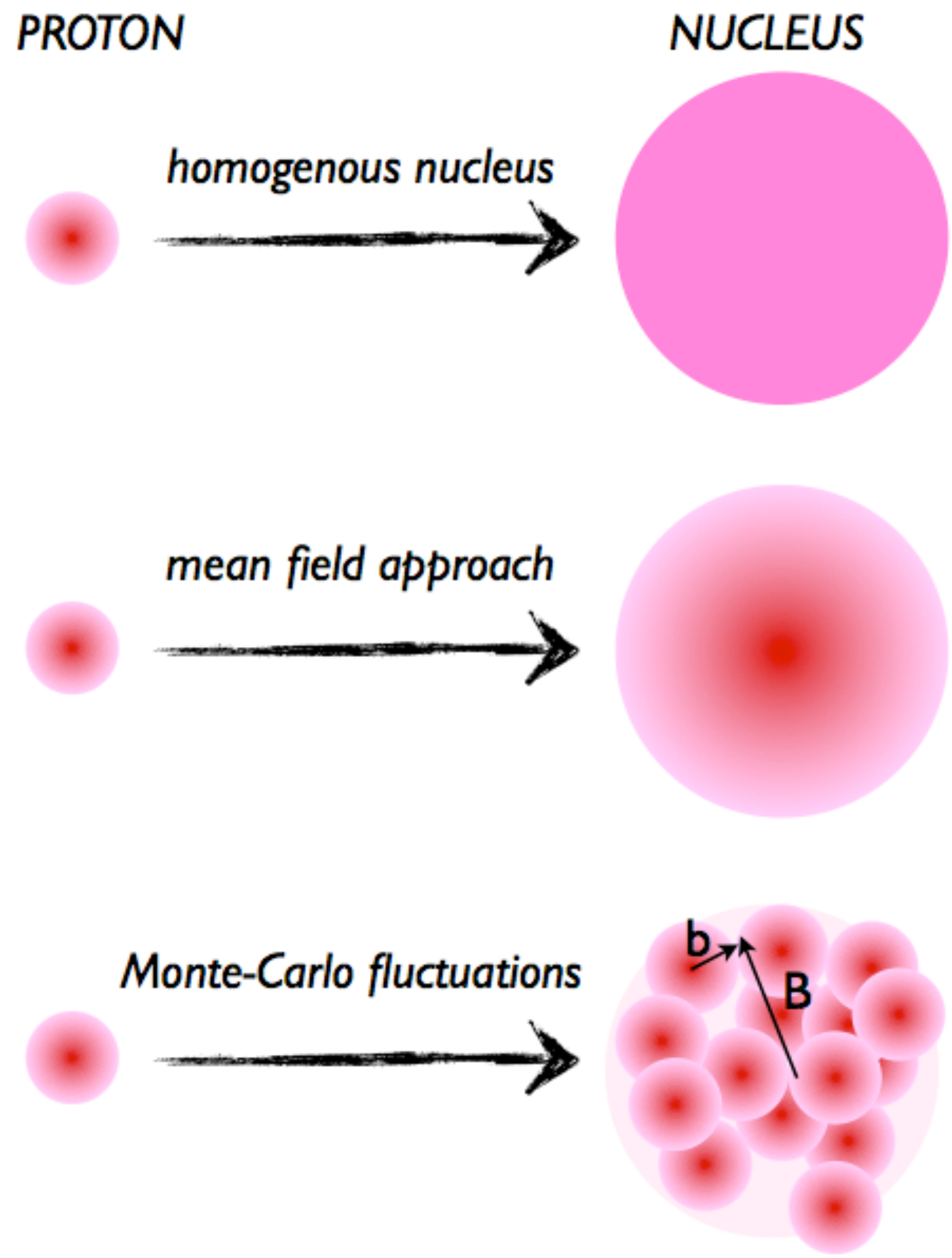
- Extension to e+A collisions

$$\sigma_{dip}^{e+A}(r, x) = \int \mathrm{d}^2 b \; \sigma_{dip}^{e+A}(r, x, b)$$

$$\sigma_{dip}^{e+A}(r, x, b) = 2\left[1 - \exp\left(-\frac{1}{2} A\, T_A(b) \sigma_{dip}^{e+p}(r, x)\right)\right]$$

Armesto [hep.ph/0206017]
Lappi,Mäntysaari [1309.6963v1]

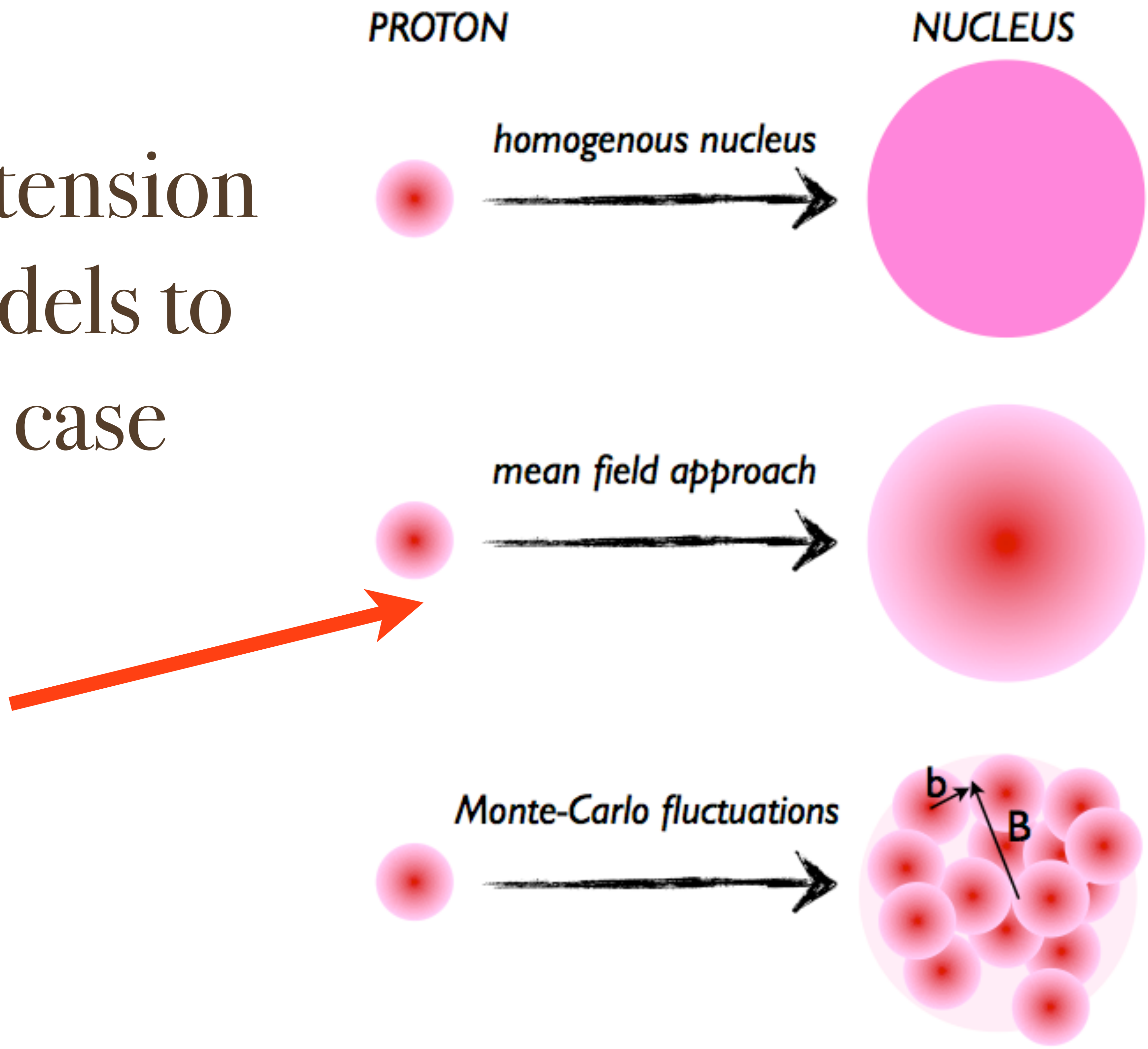
Geometric extension of proton models to the nuclear case



Albacete, Marquet [1401.4866v1]

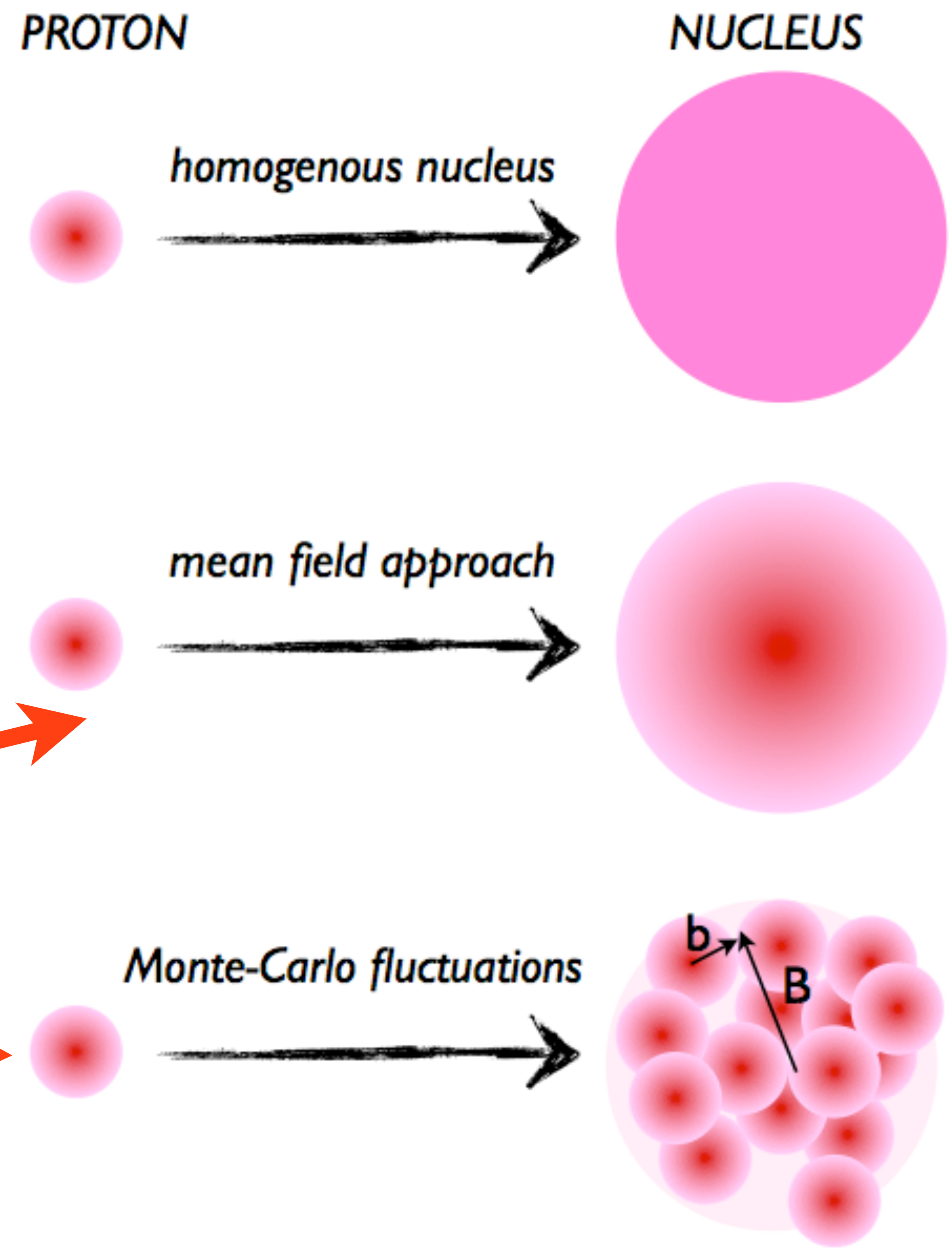
Geometric extension of proton models to the nuclear case

The model we have



Albacete, Marquet [1401.4866v1]

Geometric extension of proton models to the nuclear case



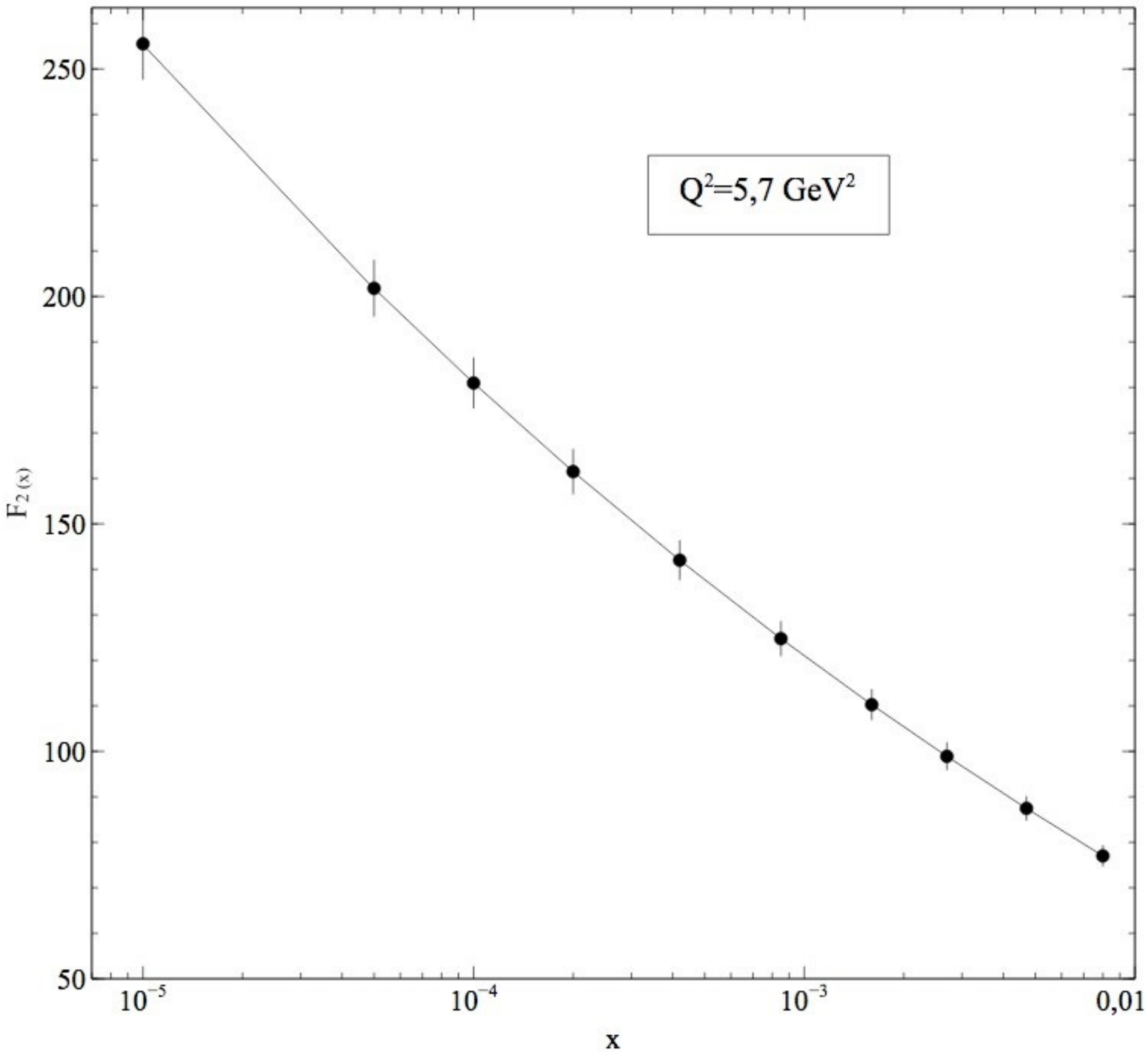
The model we have

The model we want

Albacete, Marquet [1401.4866v1]

We have the (pseudo)data, now what?

A=Au-197



Reweighting time!!

Why do a reweighting?

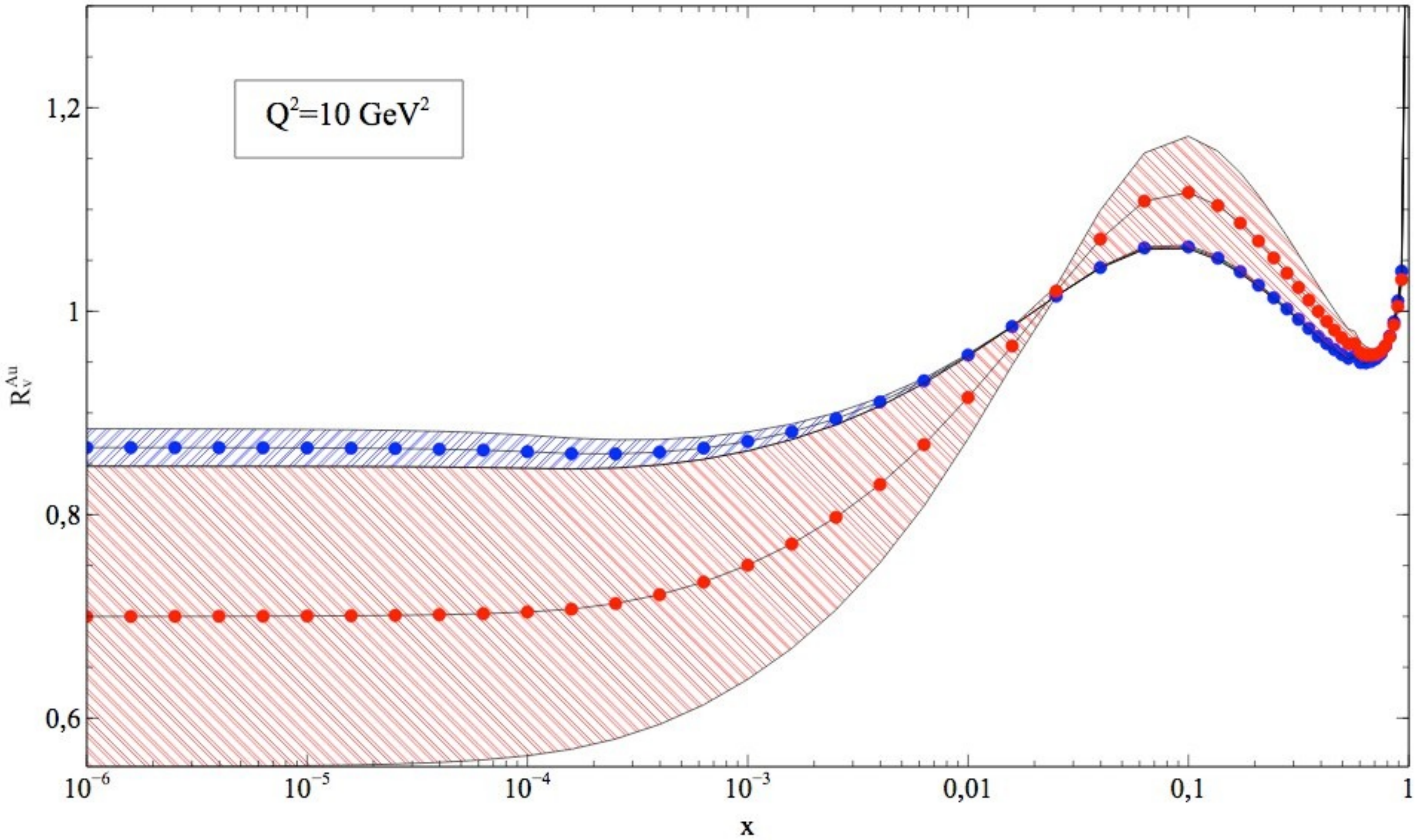
- Technique developed to save time
- Quantitative estimation of data/theory incompatibility

What do we get?

(Very) preliminary results…

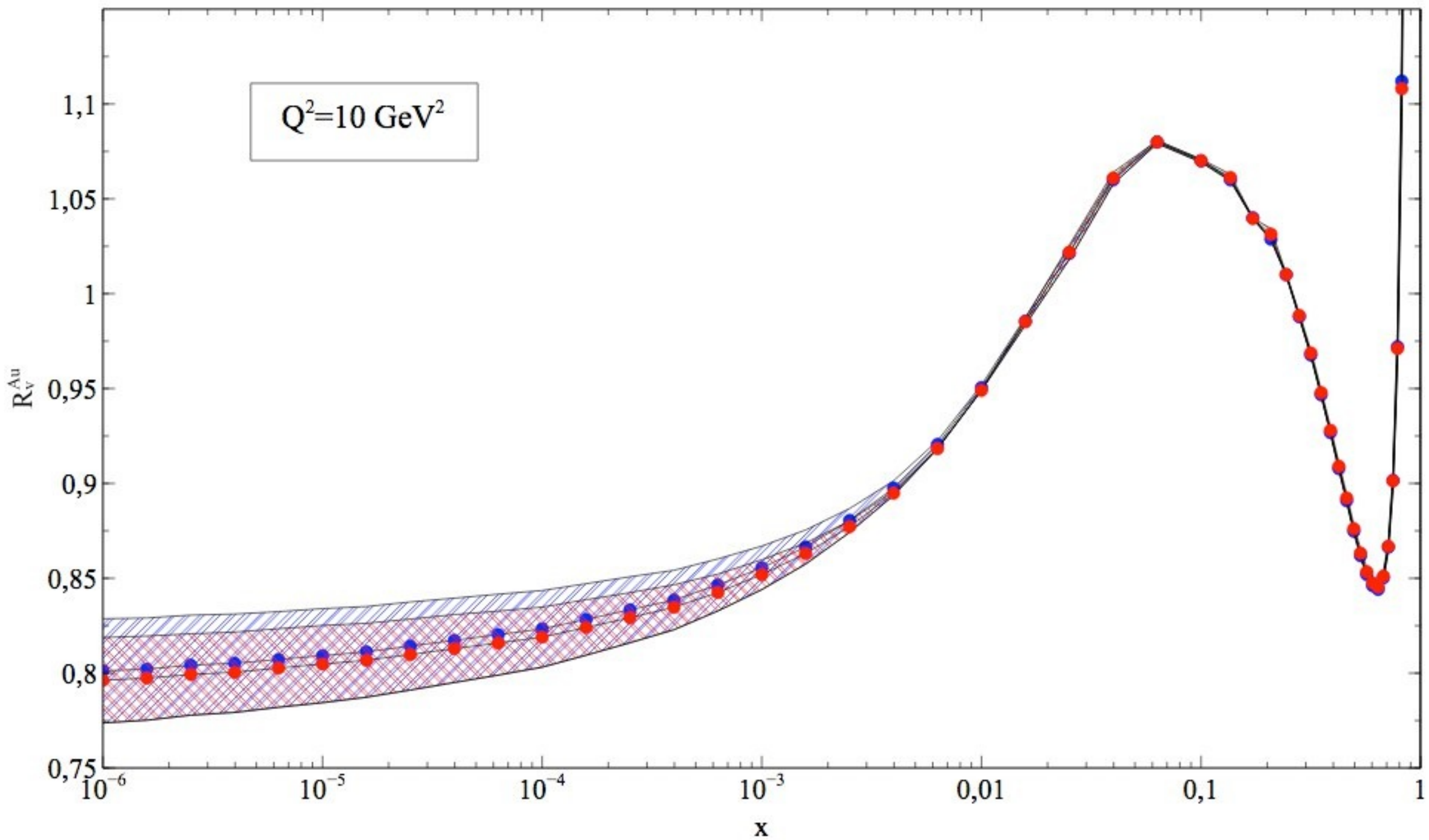
Valence

DSSZ



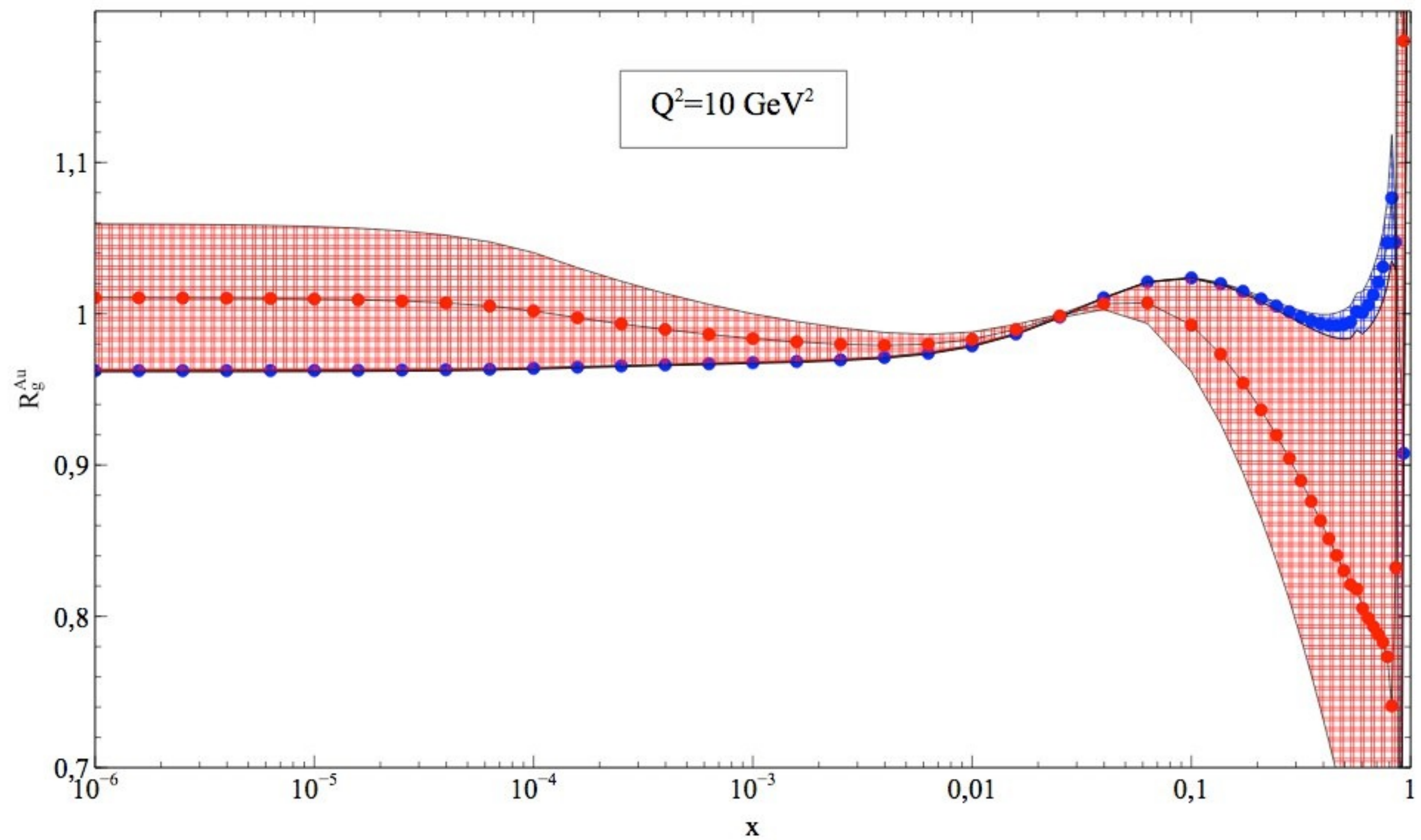
Red: new data
Blue: old data

EPS09



Gluons

DSSZ



Red: new data
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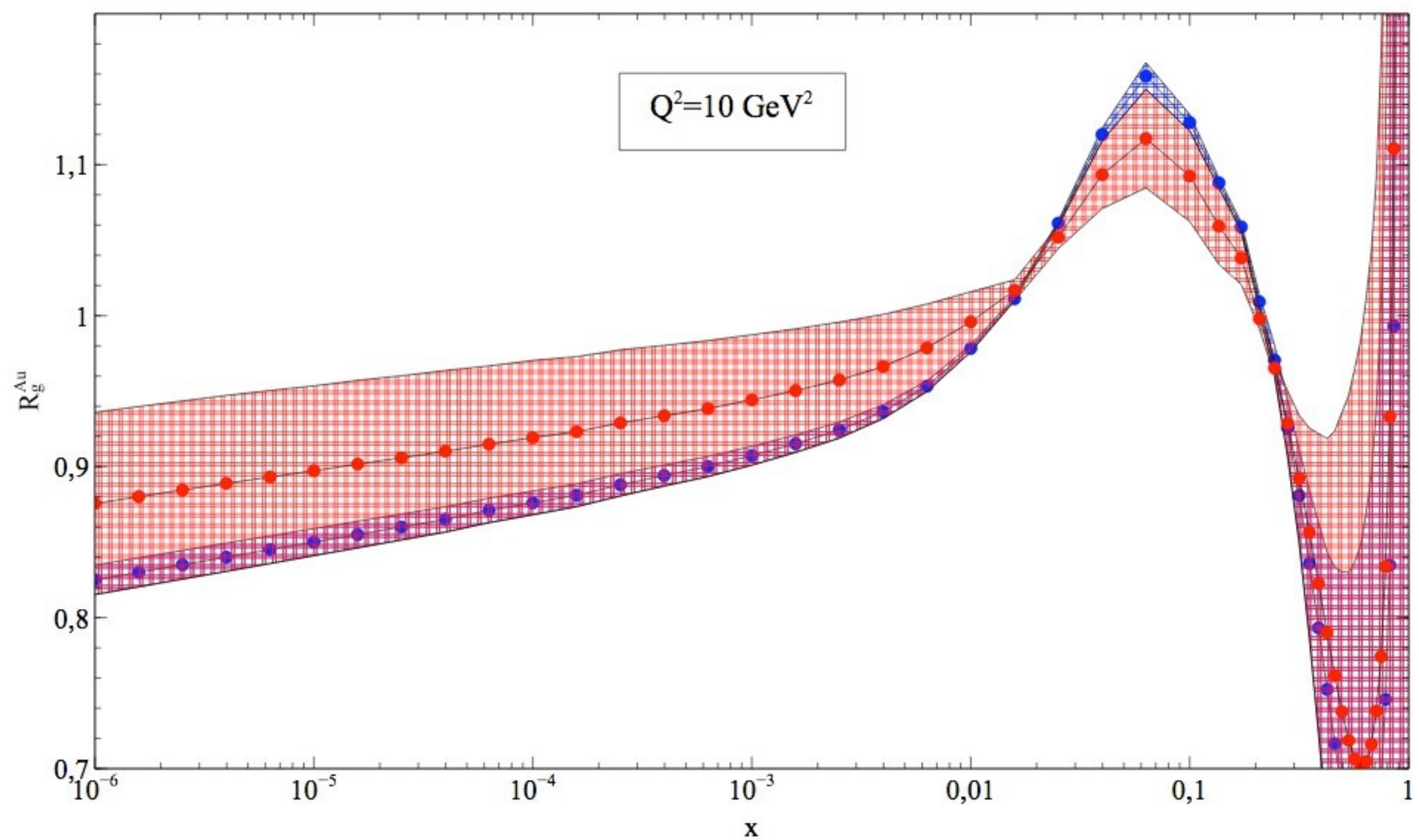
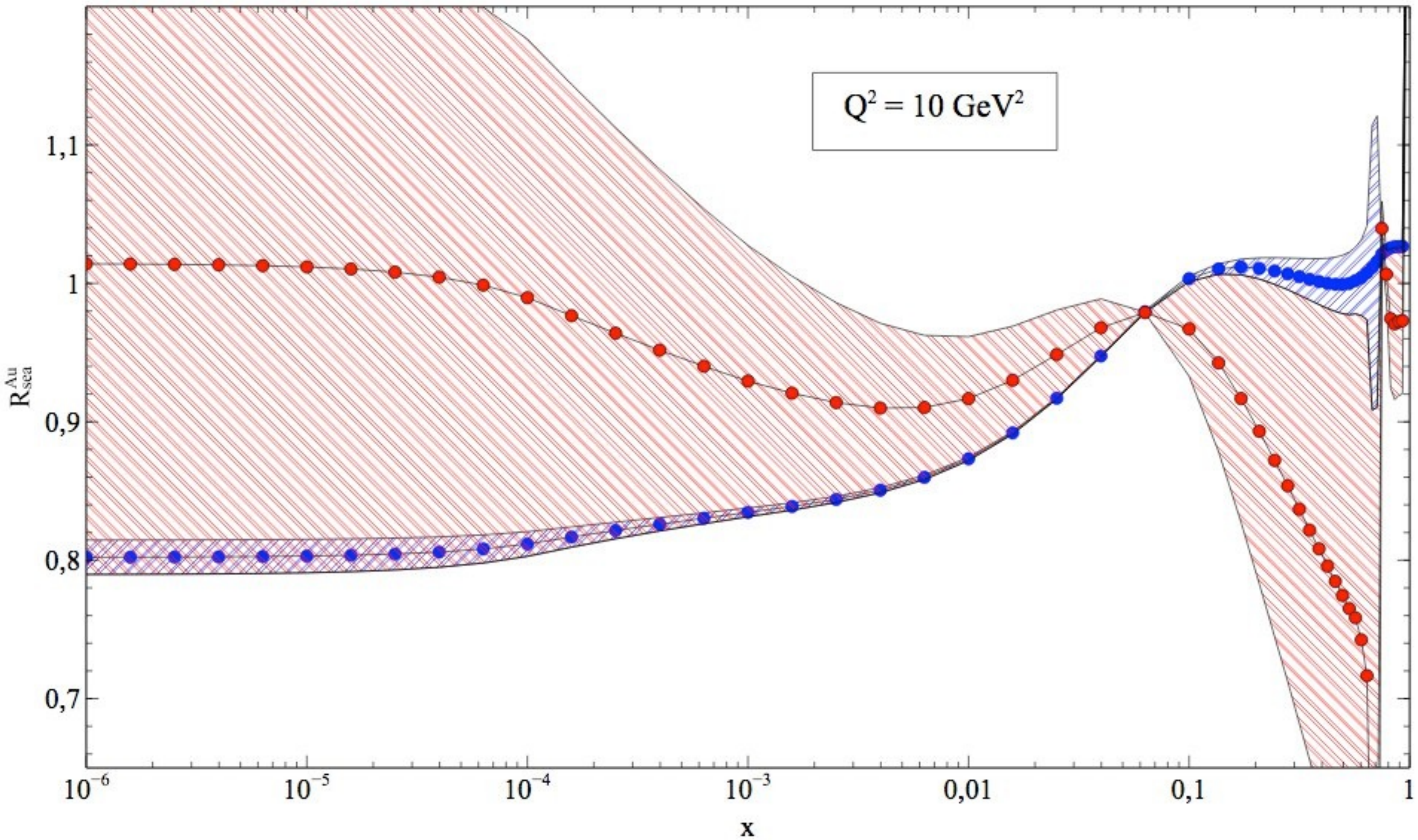
EPS09



Sea

DSSZ



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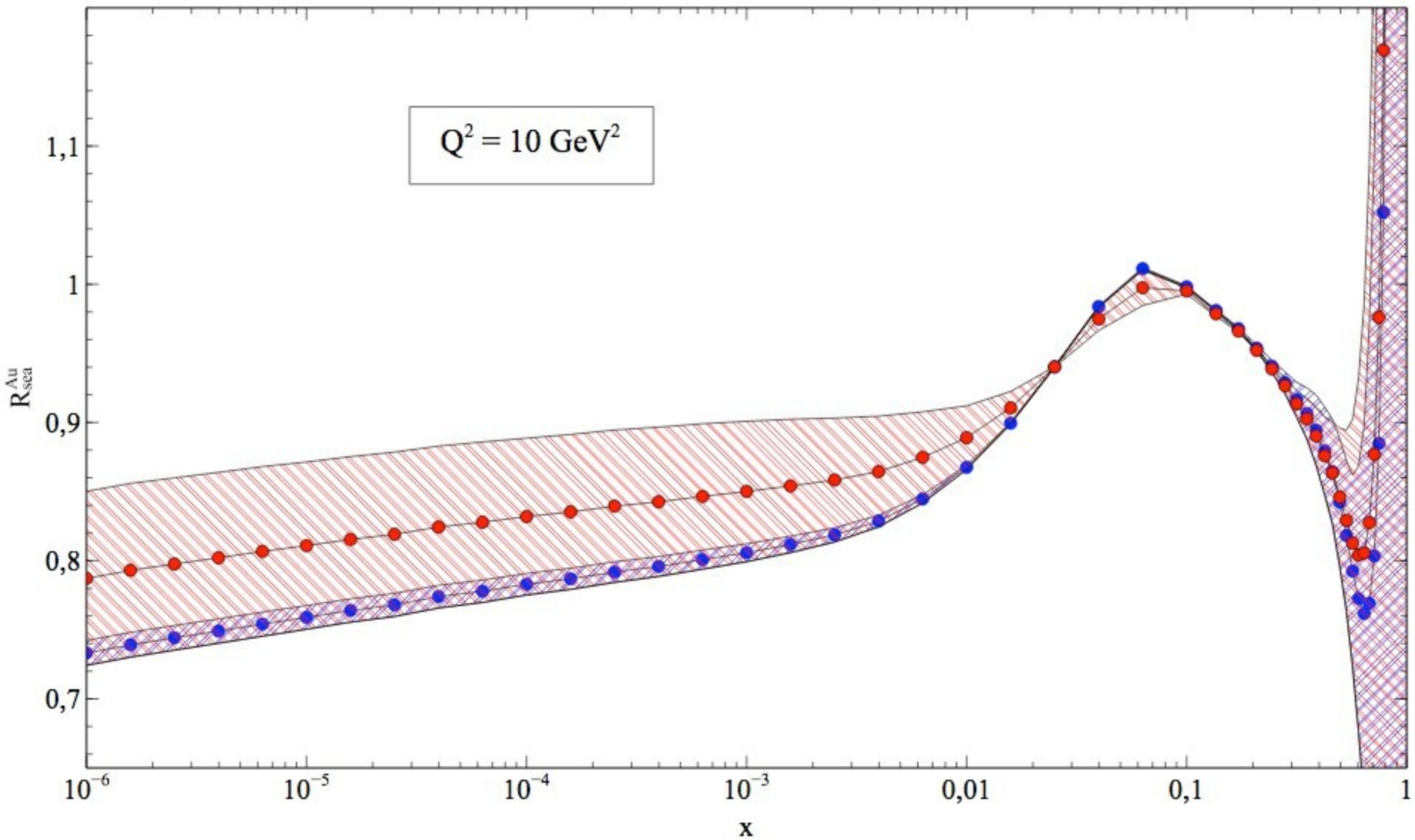
EPS09



Reweighting penalties

	EPS09	DSSZ
Penalty term	17.23	111.88
$\Delta\chi^2$	50	30

Conclusions

- e+A collisions can give us a lot of useful information.
- Reweighting methods are useful to treat data in a fast way.
- Results are still (very) preliminary.
- Event-by-event fluctuations to be implemented.