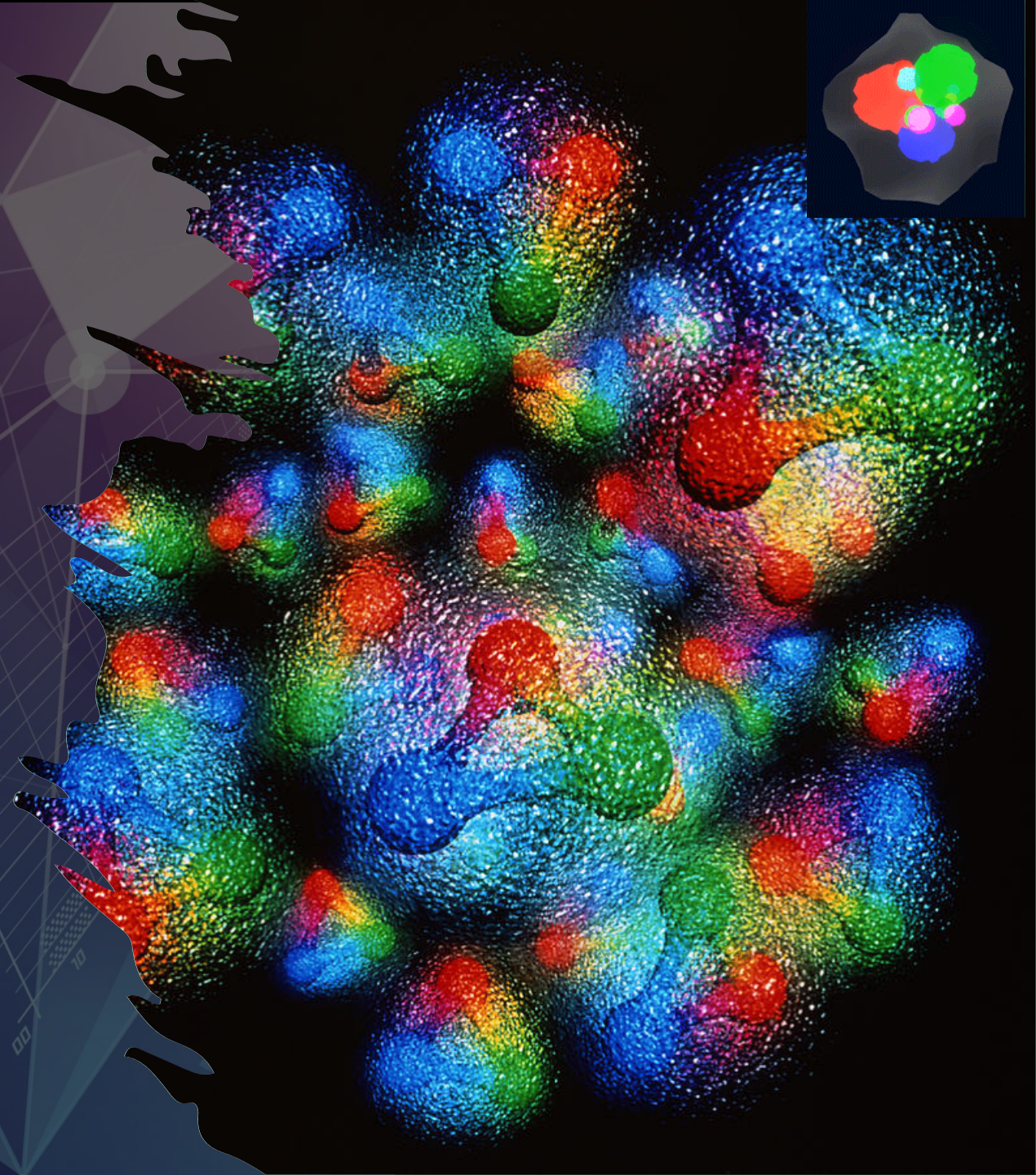
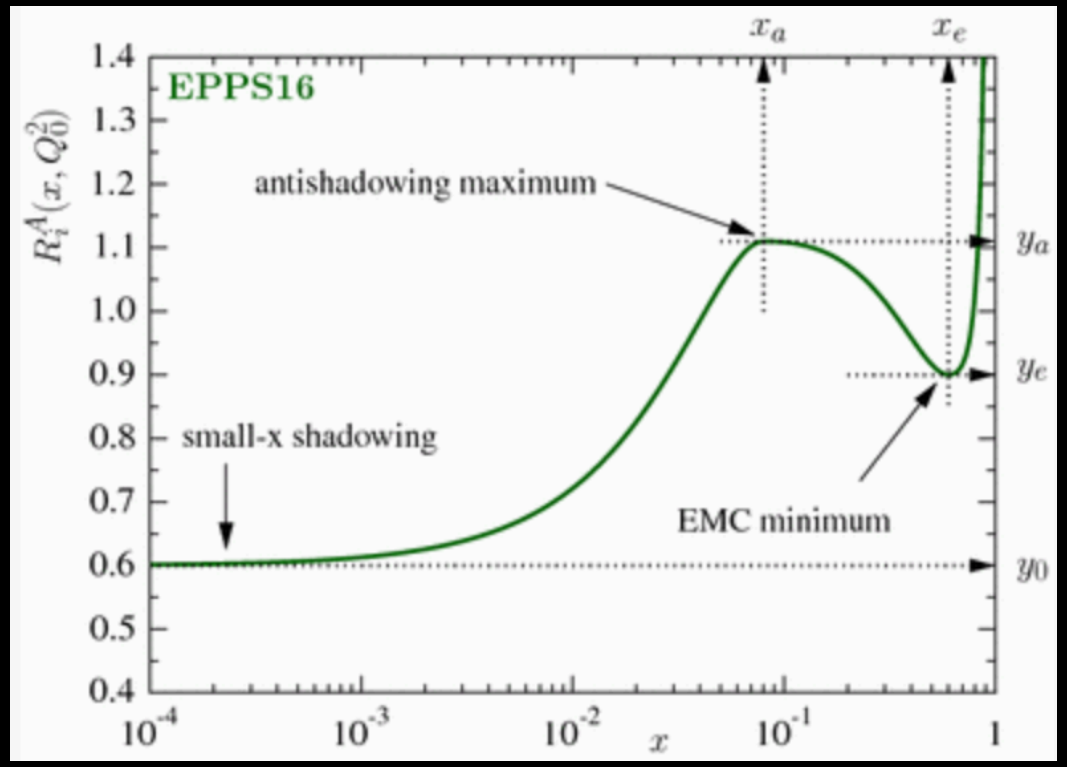
EMC effect in QCD

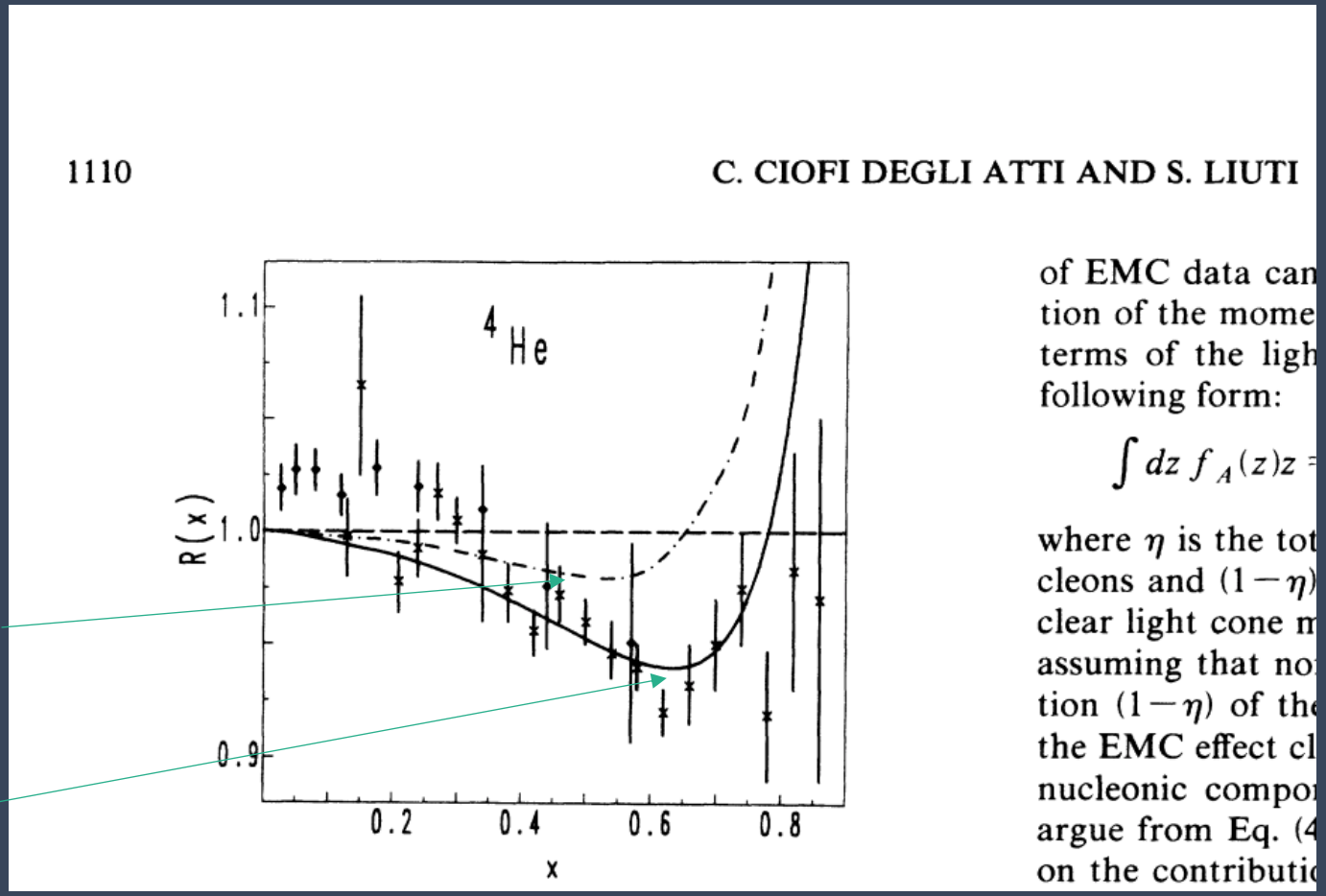
Simonetta Liuti



EMC Effect


EPPS16
antishadowing maximum
small-x shadowing
EMC minimum
x_a
x_e
y_a
y_e
y_0
$R_i^A(x, Q_0^2)$
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
x

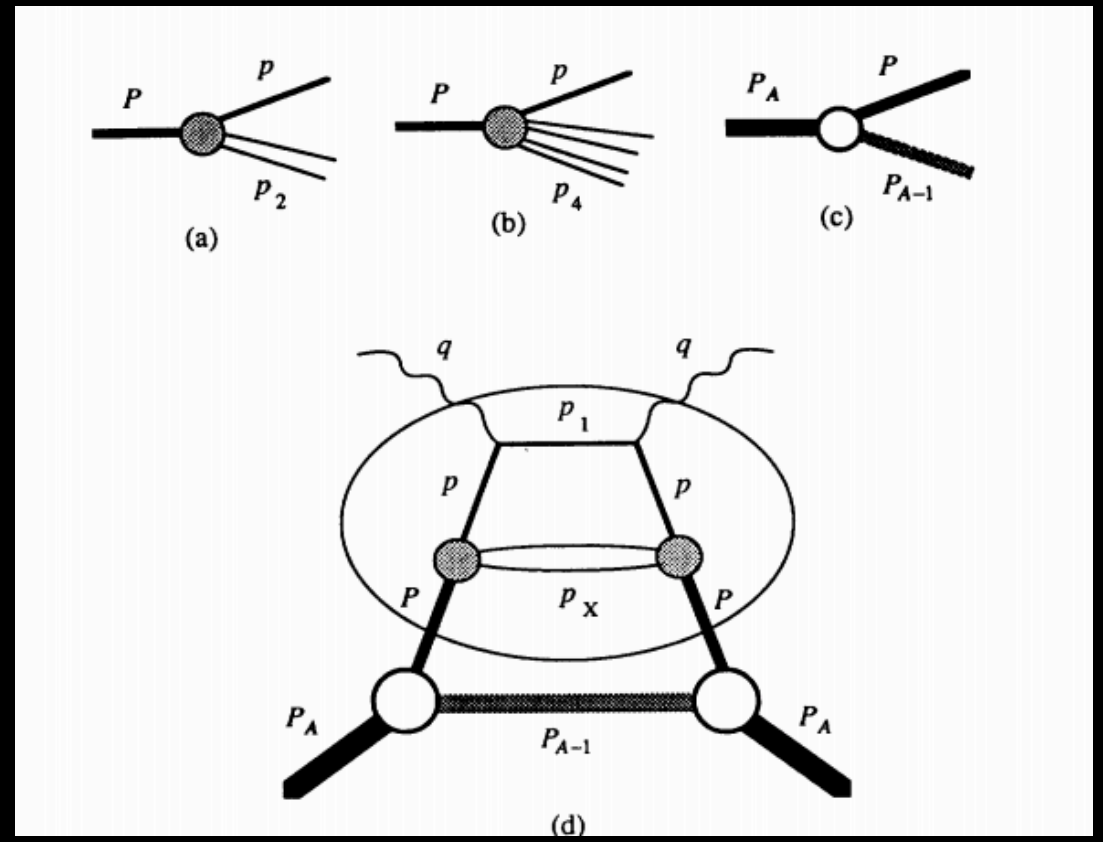
The impact of nucleon nucleon correlations



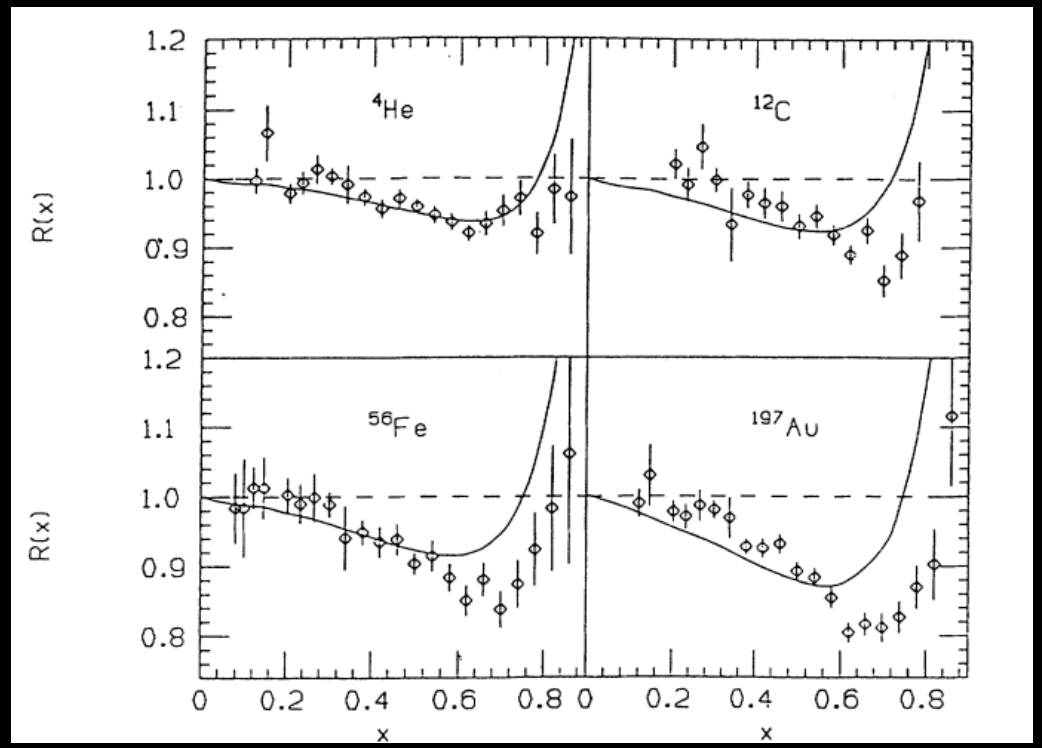
binding, no correlations

NN correlations

C. Ciofi degli Atti, S. Liuti *Phys.Rev.C* 41 (1990) 1100


P
p
p 2
(a)
P
p
p 4
(b)
P A
P
P A−1
(c)
q
q
p 1
p
p
P
p X
P
P A
P A−1
P A
(d)

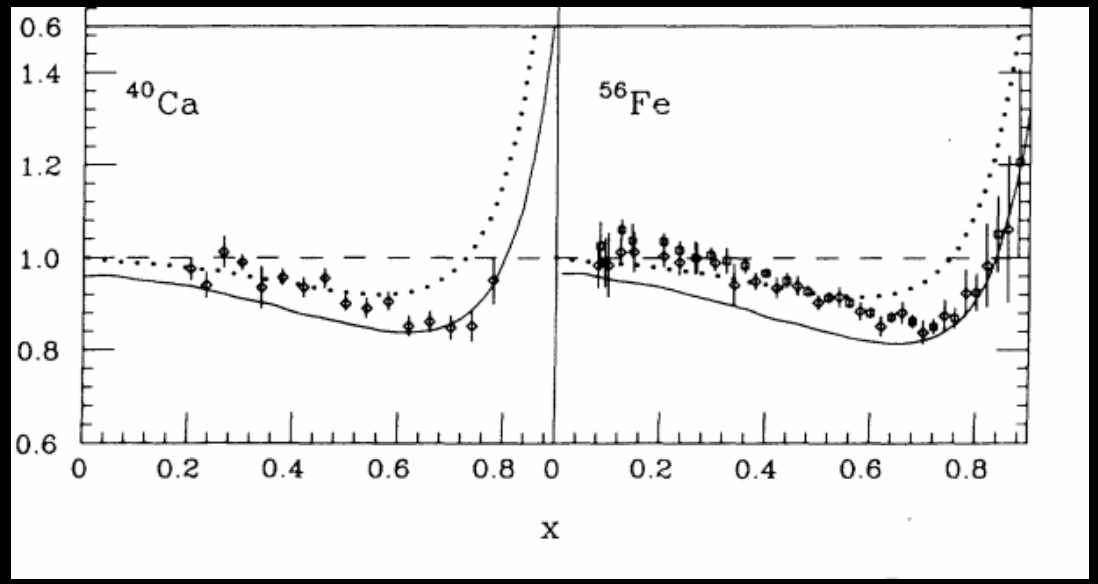
Binding alone cannot explain all of the effect



C. Ciofi degli Atti, S. Liuti *Phys.Rev.C* 44 (1991) R1269

C. Ciofi degli Atti, SL, PLB (1989)

Role of "relativistic effects" (proper LC treatment)



F. Gross, S. Liuti, PRC45 (1992)

Scroll on to the new century…

QCD correlation functions and gauge links give us the key to interpret the EMC effect

Nucleon medium modifications and off-shell effects result from the combination of x-rescaling (binding) and the transverse motion of quarks

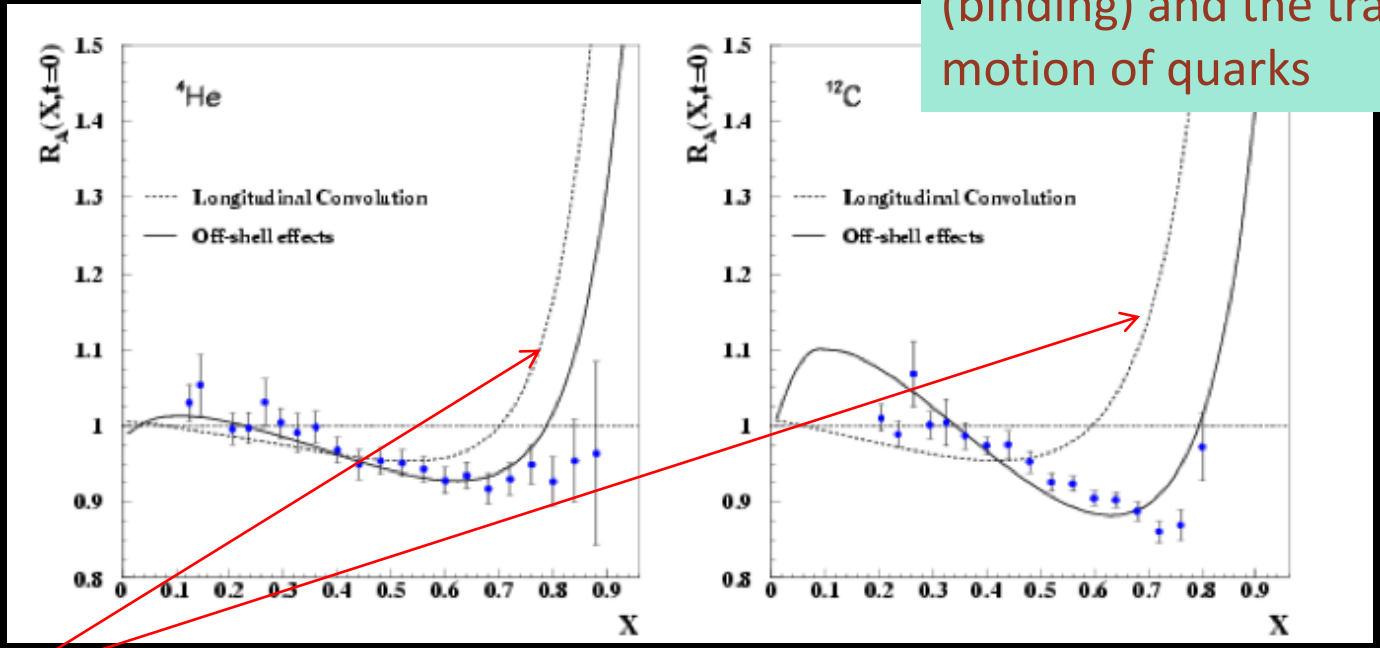
New work in progress

GPDs in nuclei

Liuti and Taneja (2005)

$R_A = F_2^A(x)/F_2^D(x)$

nucleon medium modifications and off-shell effects result from the combination of x-rescaling (binding) and the transverse motion of quarks

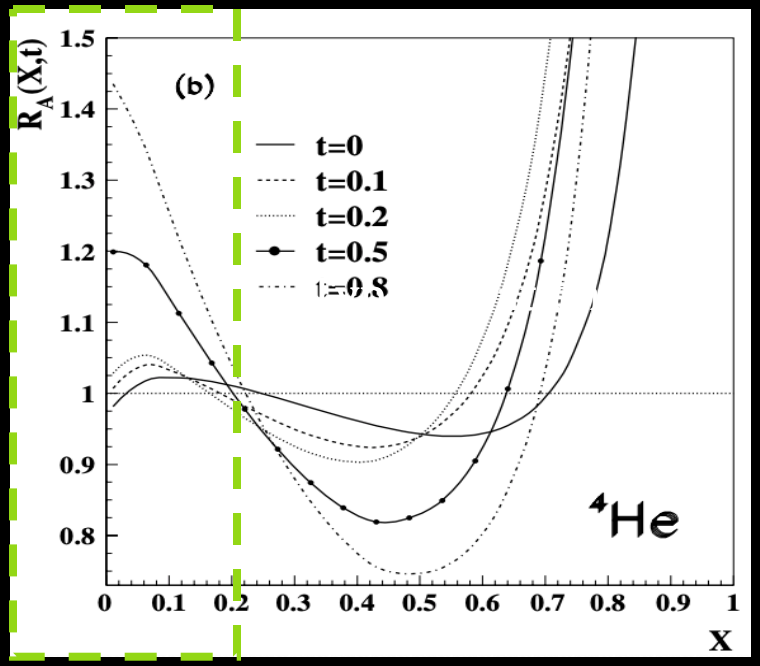


✓ Calculation including SRC (AV8) with unmodified nucleons

➔ Main constraint provided by Koltun sum rule

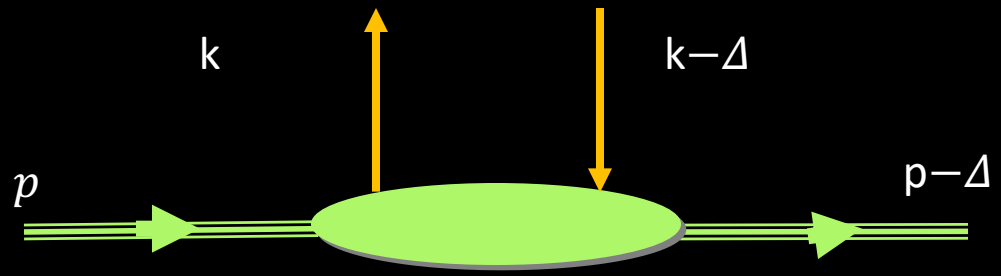
Similarities/Future Measurements: Deeply Virtual Compton Scattering (DVCS) and GPDs/Wigner functions

$$R_A(x,0,t) = \frac{H_A\,(x,0,t)}{H_N(x,o,t)}$$



SL, SK Taneja, PRC72(2005)

… is this trend observable…??



k_T unintegrated free nucleon

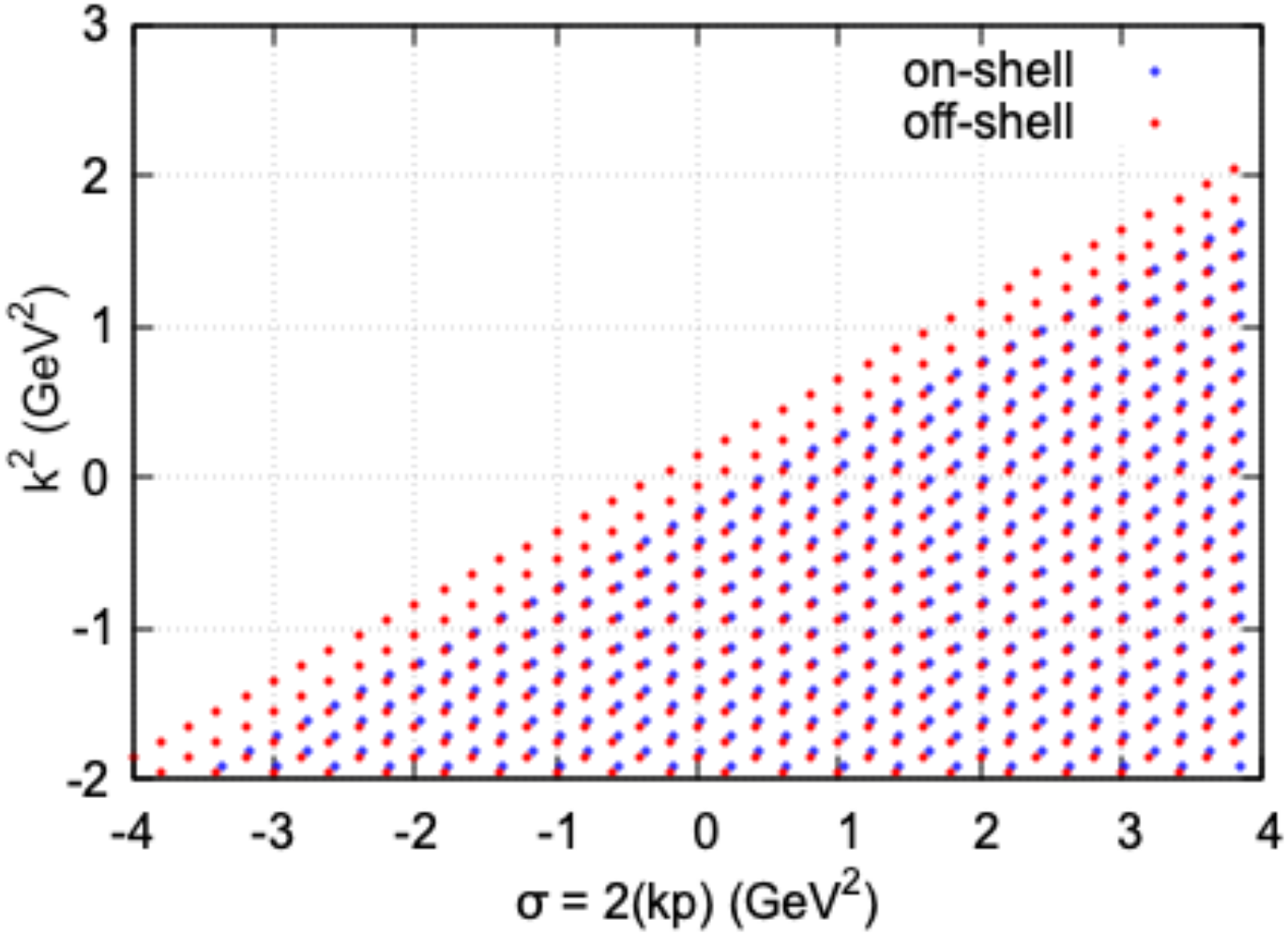
$$f(x,\mathbf{k}_T) = \int dk^- W(x,\mathbf{k}_T,k^-) = \int dy^- d^2\mathbf{y}_T\, e^{i(k^+y^- - \mathbf{k}_T\cdot\mathbf{y}_T)} \langle p \mid \bar{\psi}(0,0,0)\mathcal{U}(0,y)\gamma^+\psi(0,y^-,\mathbf{y}_T) \mid p\rangle_{y^+=0}$$

k_T unintegrated off-shell nucleon

$$f(x',\mathbf{k}'_T) = \int dy^- d^2\mathbf{y}_T\, e^{i(x'p^+y^- - \mathbf{k}'_T\cdot\mathbf{y}_T)} \langle p \mid \bar{\psi}(0,0,0)\mathcal{U}(0,y)\gamma^+\psi(0,y^-,\mathbf{y}_T) \mid p\rangle_{y^+=0}$$

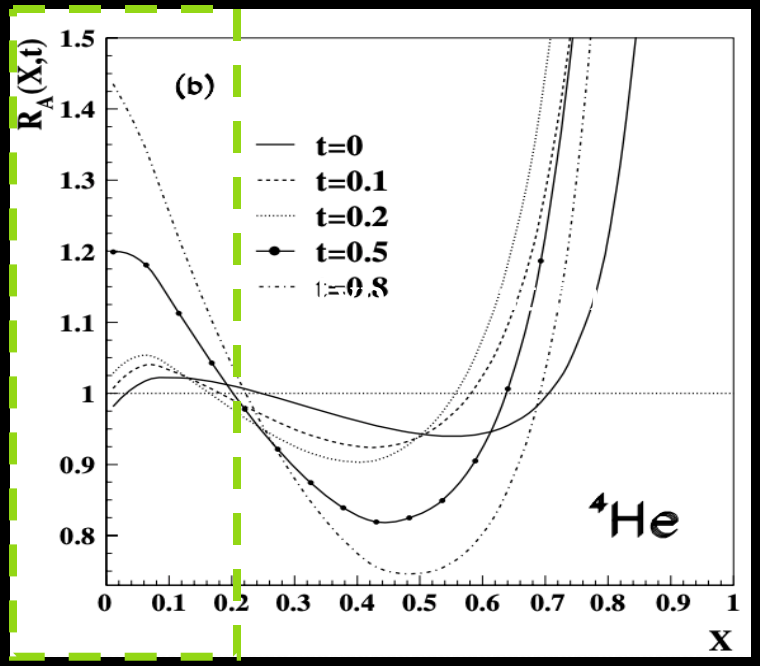
quark off shellness

$$k^2 = 2x(kp) - x^2M^2 - k_T^2 \quad \rightarrow \quad k^2 = 2\frac{x}{z}(kp) - \left(\frac{x}{z}\right)^2 p^2 - \left(k_T - \frac{x}{z}p_T\right)^2$$


on-shell
off-shell
3
2
1
0
-1
-2
k^2 (GeV^2)
-4
-3
-2
-1
0
1
2
3
4
σ = 2(kp) (GeV^2)

Establishing an inclusive/exclusive connection: Deeply Virtual Compton Scattering (DVCS) and GPDs/Wigner functions

$$R_A(x,0,t) = \frac{H_A(x,0,t)}{H_N(x,o,t)}$$



SL, SK Taneja, PRC72(2005)

… is this trend observable…??