Color Transparency and DVMP
Forward vs Backward meson hard exclusive electroproduction

Journées GDR coherent/incoherent, IJCLab - Orsay, October 2023

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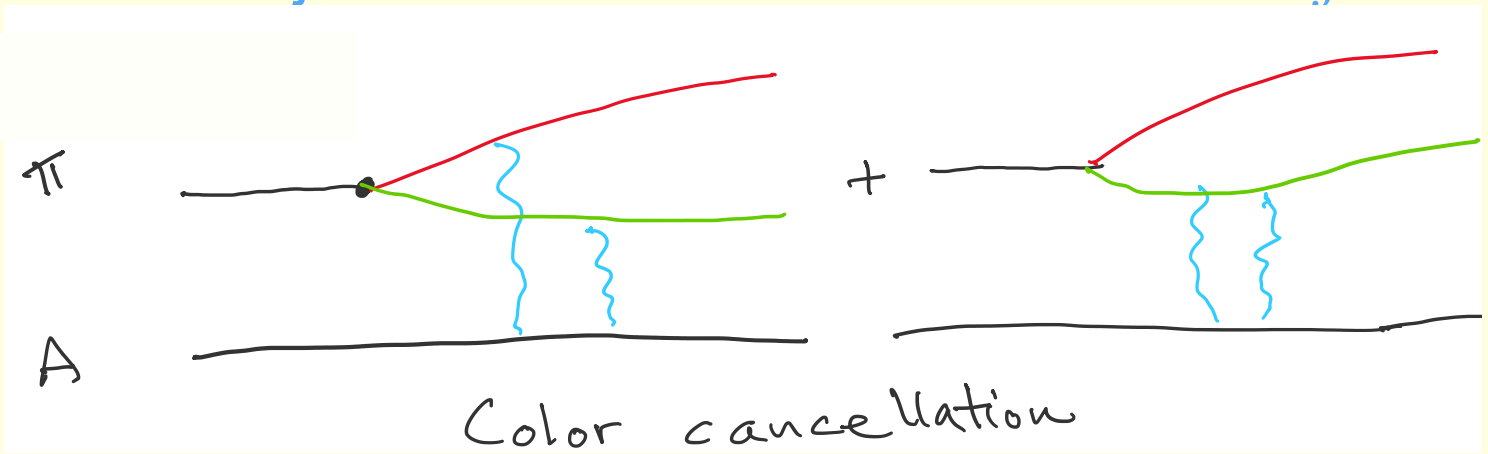
based on work with K Semenov-Tian-Shansky, L Szymanowski, B. Li, G. Huber, W. Cosyn

G. A. Miller, UW, Seattle

Color transparency- reduced initial/final state interactions in coherent reactions

1. high-momentum transfer reactions make point-like color singlet states PLC

2. Small objects have small cross sections $Im f \propto b^2$



Diffractive Dissociation

3. PLC are not eigenstates-expand as they move Frankfurt& Strikman, Jennings & Miller

Office of Science
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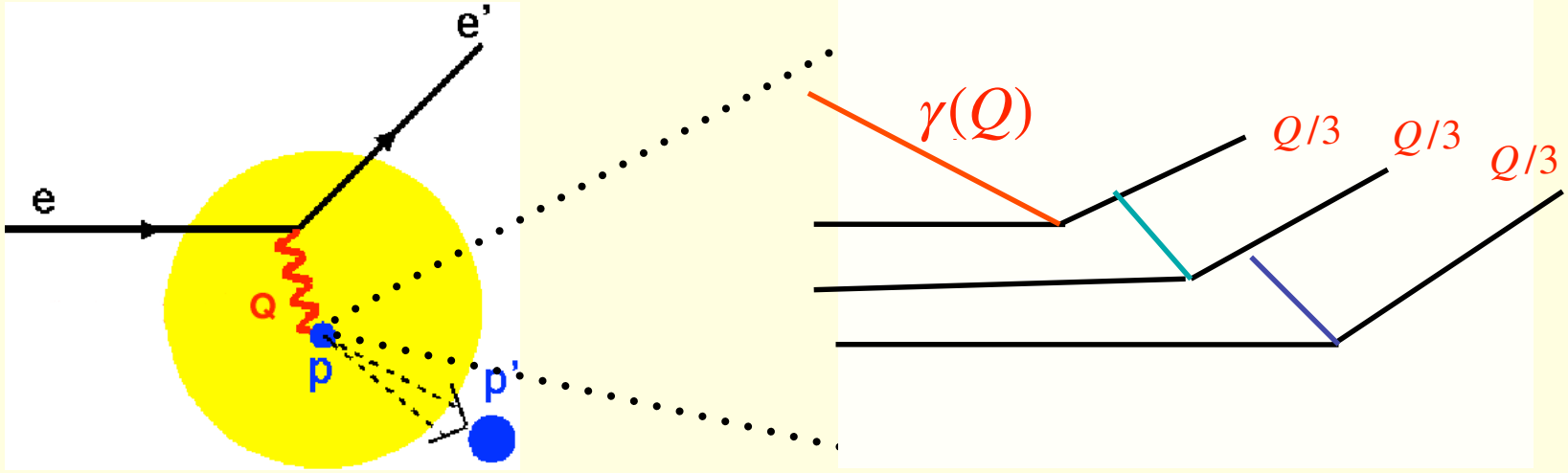
Why PLC at high momentum transfer?

Example: e-p scattering



Form factor enters

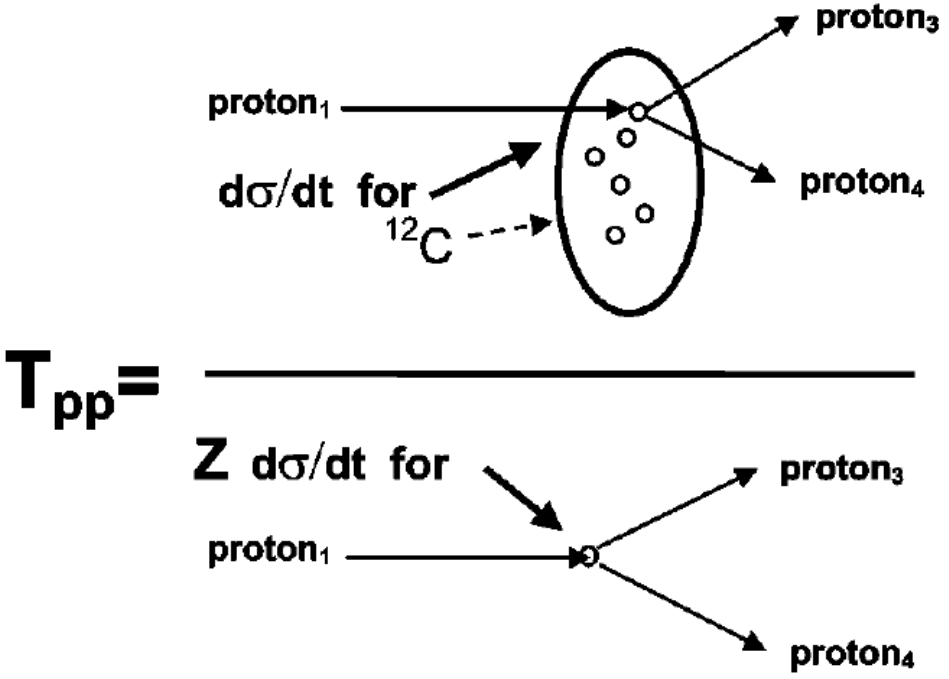
Momentum of exchanged gluon ~Q, separation ~1/Q

- **At high enough Q an exclusive interaction occurs if the transverse size of the hadron is smaller than the equilibrium size.**

First experiment - Fixed angle regime

Nuclear Transparency for A(p,2p) (3/3)

- Measurements were performed near 90° in the pp CM
- Elastic scattering at such large angles is supposed to single out **Point Like Configurations (PLC)** of the protons
- When in PLC, quark colors are assumed to 'overlap', rendering the proton **color transparent**, significantly decreasing ISI and FSI
- As incident momentum increases, PLC is assumed to become more dominant
- Thus, an increase of T_{pp} (90° CM) as a function of incident momentum may be **a signature of color transparency**



$$T = \frac{(d\sigma/dt)(p\text{-}p \text{ elastic in nucleus})}{(d\sigma/dt)(p\text{-}p \text{ elastic in hydrogen})}$$

First &Second Evidence?

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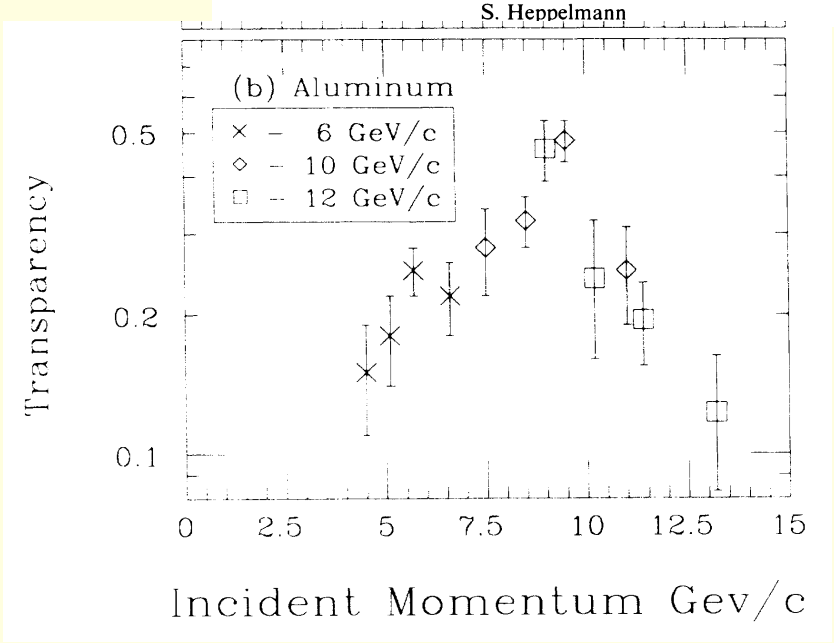
Nuclear Transparency to Large-Angle *pp* Elastic Scattering

A. S. Carroll, D. S. Barton, G. Bunce, S. Gushue, and Y. I. Makdisi
Brookhaven National Laboratory, Upton, New York 11973

S. Heppelmann

σ/σ_B



Nuclear transparency raises as predicted...then drops !

From Color Transp. to Nuclear Filtering (J.Ralston, BP, PRL 61)

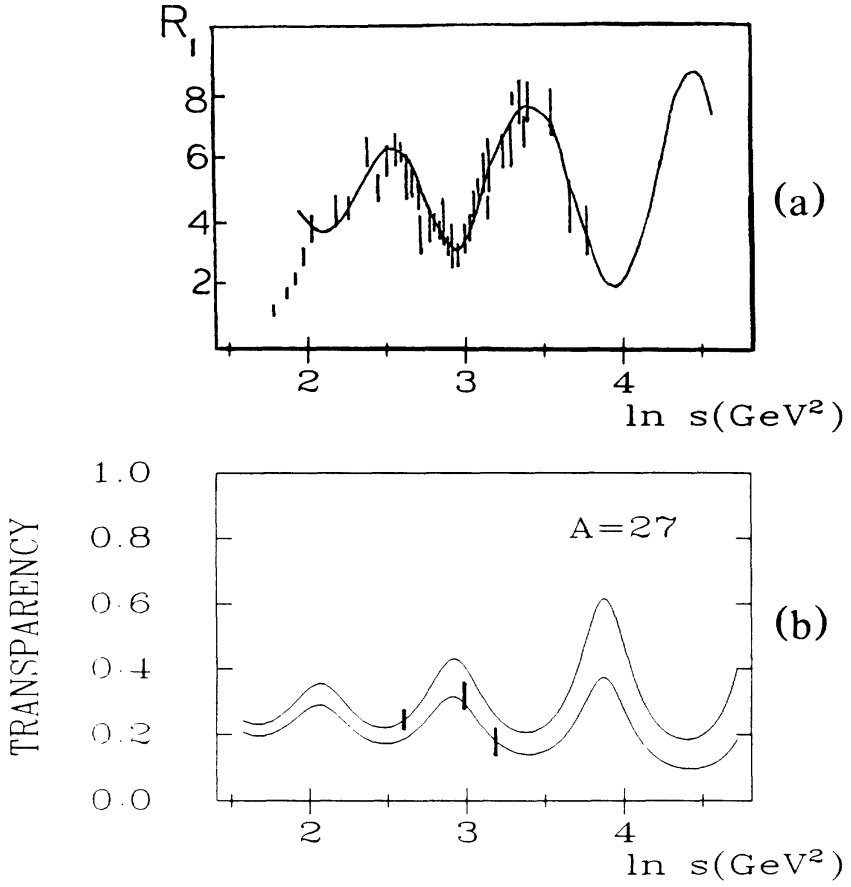
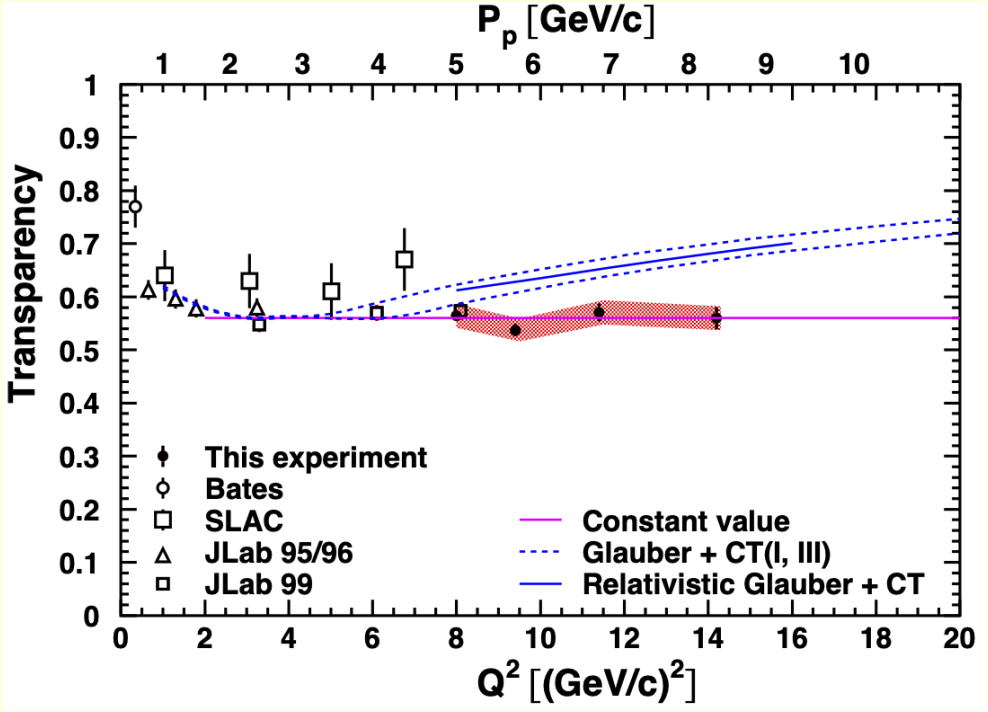


FIG. 1. (a) The energy dependence of $R_1(s) = \text{const}\, s^{10} d\sigma/dt(pp)|_{90°}$ for the high-energy pp elastic scattering at 90° c.m. angle compared to Eq. (5) (solid line), as taken from Ref. 7. (b) Prediction of oscillating transparency $T(s)$ [Eq. (7)] for $A = 27$ after varying over all possible nuclear phases δ_A (upper and lower limits are shown); data from Carroll *et al.* (Ref. 2).

Ruling out color transparency in quasi-elastic ^{12}C(e,e$'$p) up to Q^2 of 14.2 (GeV/c)^2

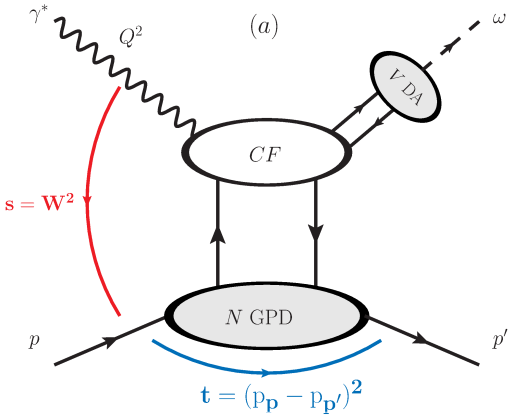
Phys. Rev. Lett. 126, 082301

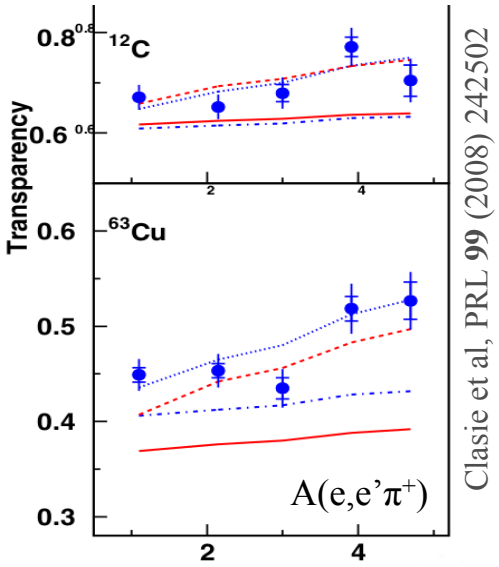


Nucleon form-factor does not probe PLCs !

Not so surprising - Problem with F_2/F_1 ratio.

Forward DVMP (Half Color Transparency)





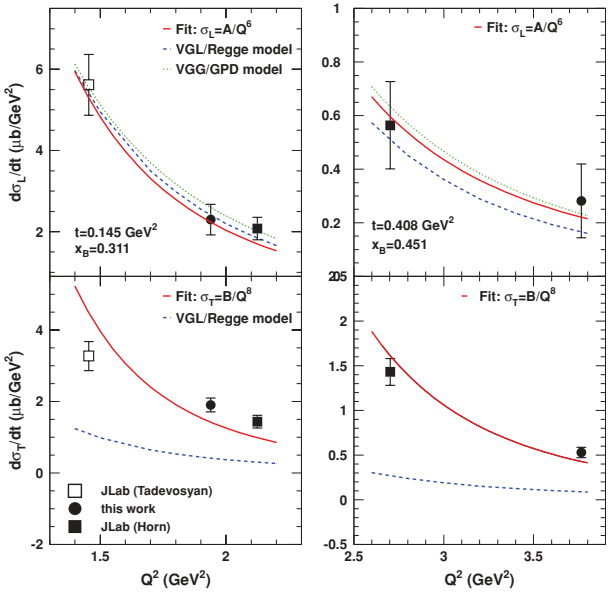
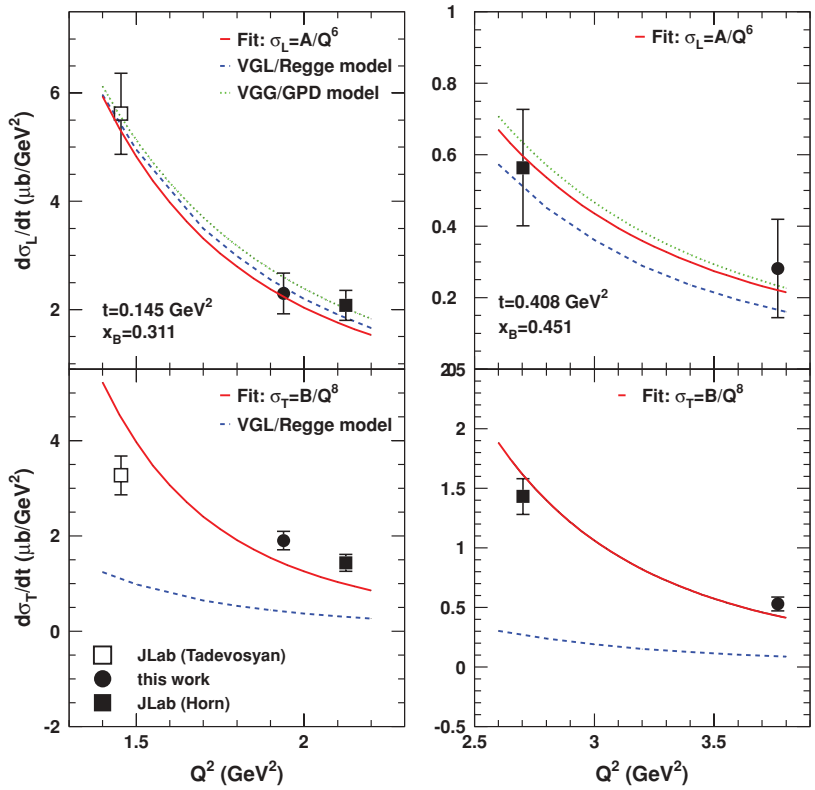


FIG. 2. (Color online) The Q^2 dependence of the separated cross sections at fixed values of $-t$ and x_B. The error bars denote the statistical and systematic uncertainties combined in quadrature. The

Clear signal of π CT at JLab in GPD physics

Contradictory with usual interpretation (HT) of π electroproduction data

ZOOM of the problem



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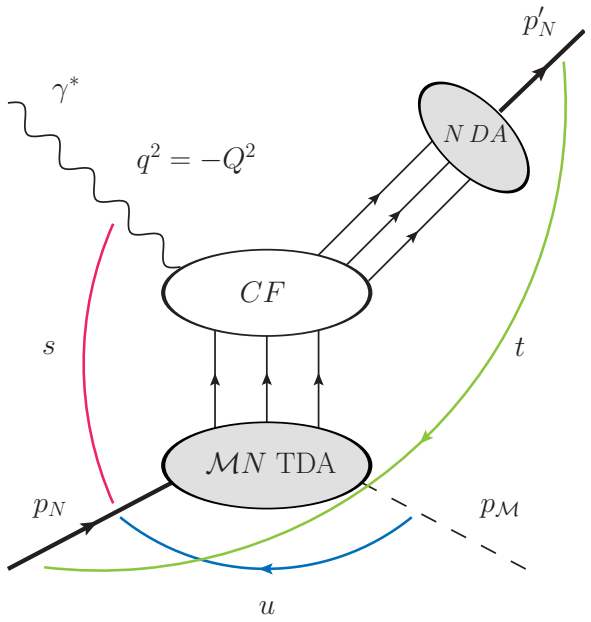
Should we see nuclear filtering ?

look for $\frac{\sigma_L}{\sigma_T}$ increase on nuclei.

Backward DVMP (the Other Half of Color Transparency)



Is there a signal of *nucleon* CT at JLab in TDA physics ?

A crucial test of LT dominance in TDA physics !

A Jefferson Lab PAC 51 Letter of Intent

Nuclear Color Transparency via u-Channel Electroproduction Observables

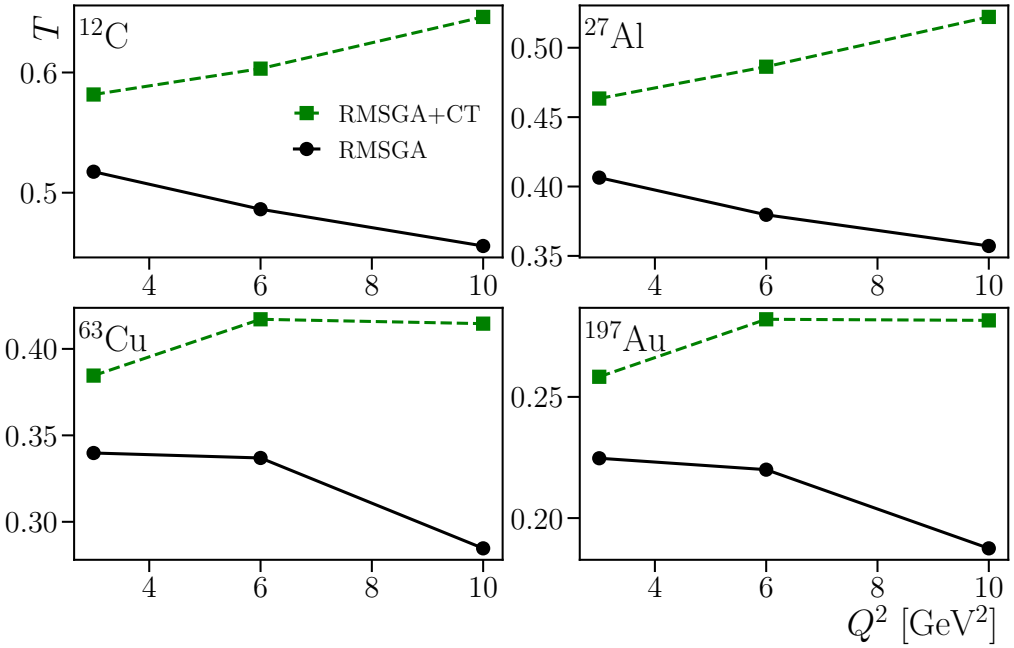


FIG. 8: RMSGA nuclear transparency calculations for ^{12}C, ^{27}Al, ^{63}Cu, and ^{197}Au as a function of Q^2. Full curves are regular Glauber calculations, the dashed curves include the color transparency in the quantum diffusion model.

Predicted (W. Cosyn) signal at JLab Hall C with 4 targets

Join the proposal (Cosyn, Huber, Li, BP) !