Transparency studies in large angle exclusive $\gamma + A \to$ meson + baryon + $(A-1)^*$ reactions

based on Larionov & Strikman, 2016

Three kinematic regions and corresponding motivations

$2 > -t > 1$ GeV^2

Geometric regime, vector dominance

does VDM really works? comparing strange and non strange channels

$-t > 3 \div 2$ GeV^2

"photon transparency" regime

Discovering transition from regime of VDM photon to of unresolved photon acting as elementary particle (point-like)

comparing strengths of interactions of various mesons , baryons

$-t > 4 \div 3$ GeV^2

Search for onset of the color transparency regime

resolving old puzzles, understanding of the dynamics of the two body hard reactions, point-like configurations in hadrons, link to CT studies at Jlab with (e,ep), (e,e'π)

Revealing mechanism of two body processes like $\gamma(\gamma^*) + N \to \gamma(\pi) + N$

Question: at what t the processes become hard? At what t does transition occurs from hadronic to quark degrees of freedom?

Expect a rather fast change of A-dependence from $A^{1/3}$ to $A^{2/3}$

$$T = \sigma_{\gamma A} / A\sigma_{\gamma N}$$

low transverse momentum transfer $|-t|$

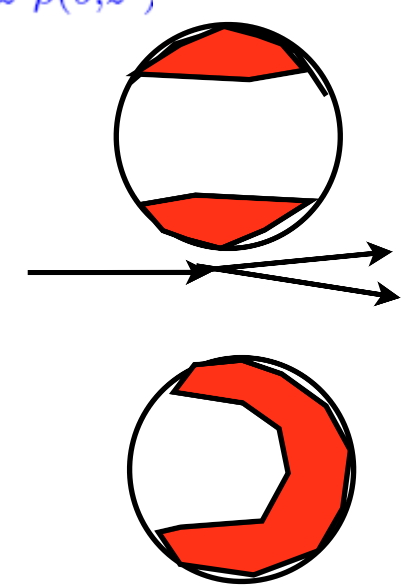
$$T_{\text{Low}}(A) = \int d^2b \int_{-\infty}^{\infty} dz \rho(b,z) e^{-\sigma_{\rho N} \int_{-\infty}^{z} dz' \rho(b,z')} e^{-(\sigma_{\pi N} + \sigma_{NN}) \int_{z}^{\infty} dz' \rho(b,z')}$$

$$T_{\text{Low}}(A) \propto A^{1/3}$$

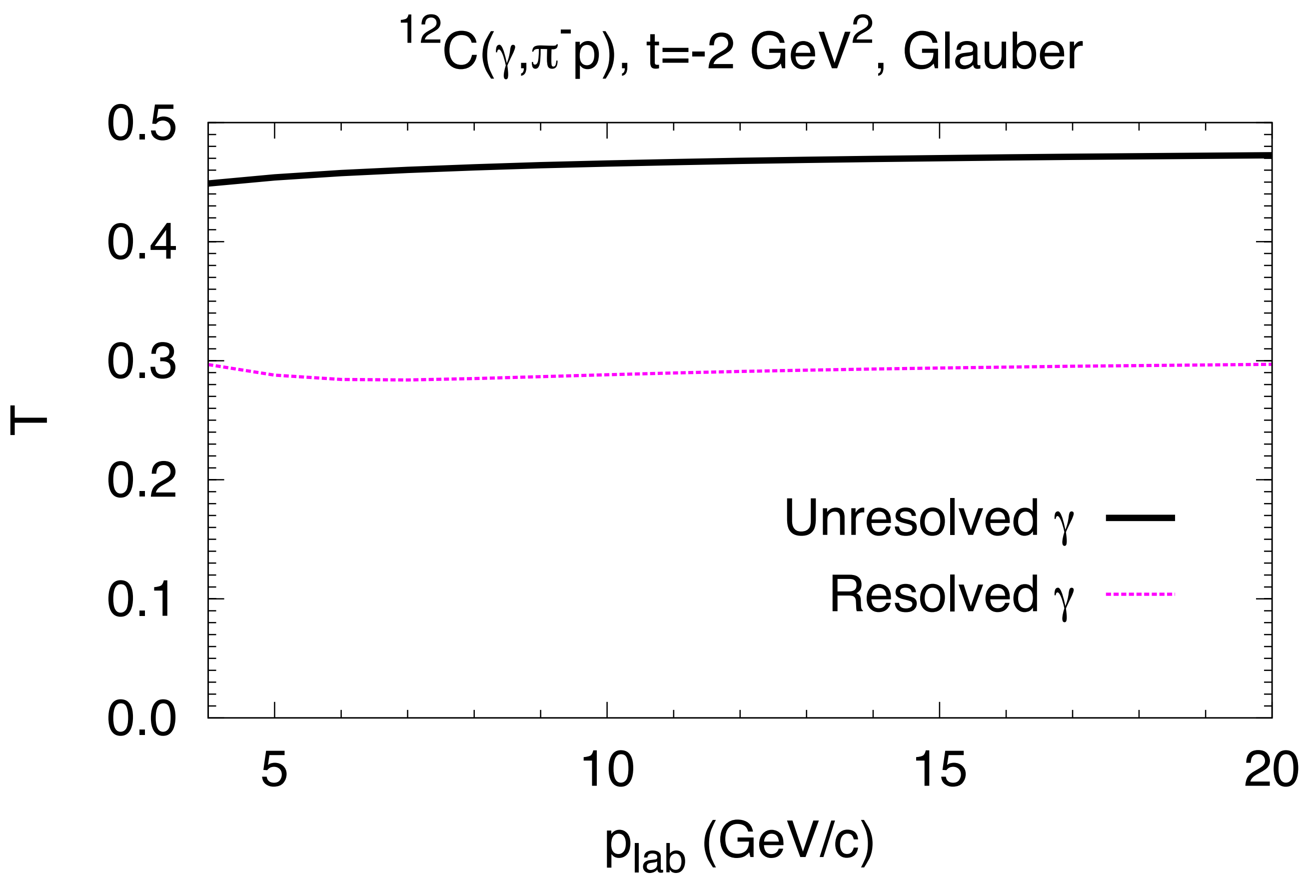
High transverse momentum transfer $|-t|$

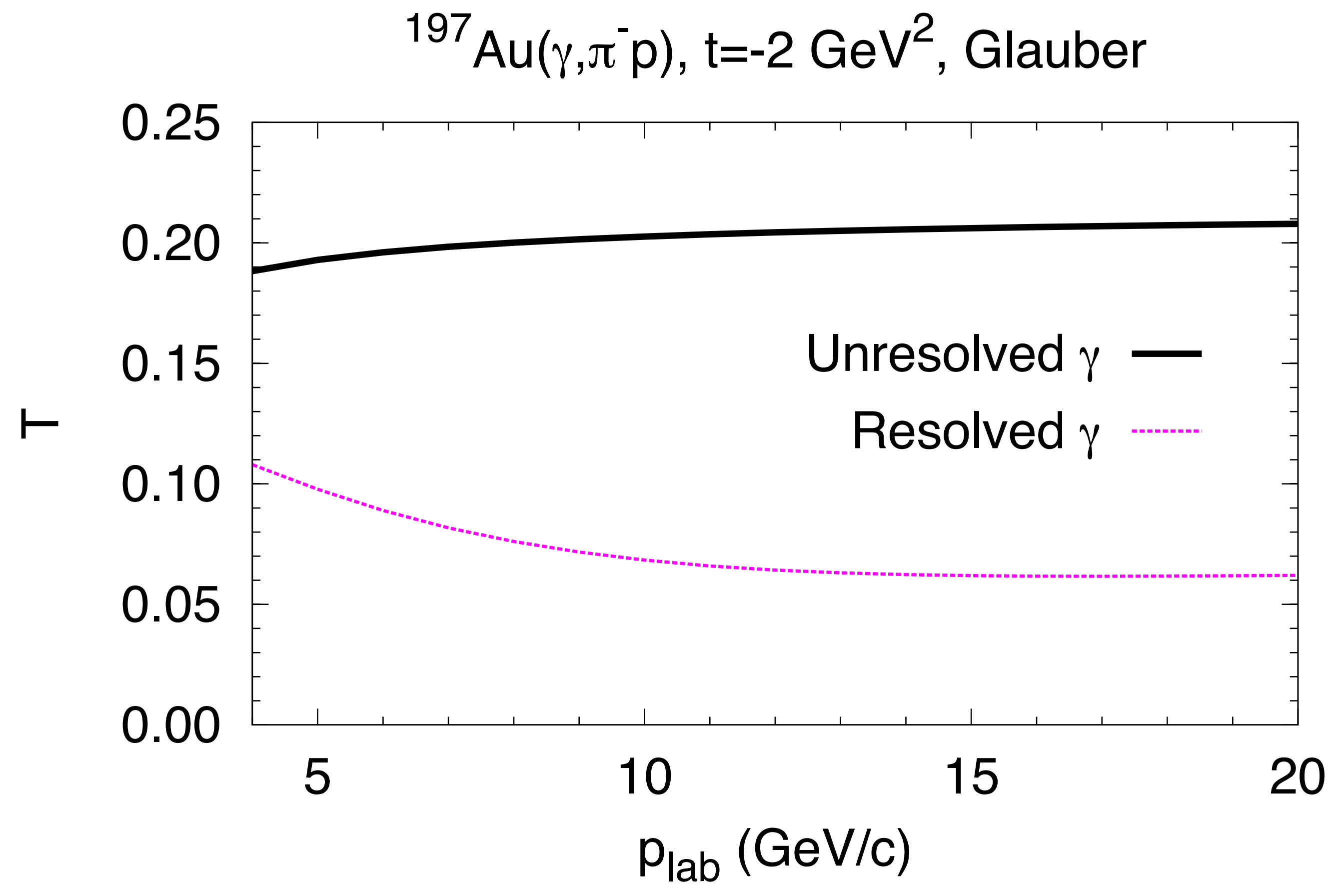
$$T_{\text{High}}(A) = \int d^2b \int_{-\infty}^{\infty} dz \rho(b,z) 1 e^{-(\sigma_{\pi N} + \sigma_{NN}) \int_{z}^{\infty} dz' \rho(b,z')}$$

$$T_{\text{High}}(A) \propto A^{2/3}$$



G.Miller and MS





Prediction: large photon transparency effect already for A=12; huge effect for A=200

Using regime of photon transparency for comparing strength of interactions of mesons (π, ρ,η, η',K,...), baryons (N,Δ) with nucleons*

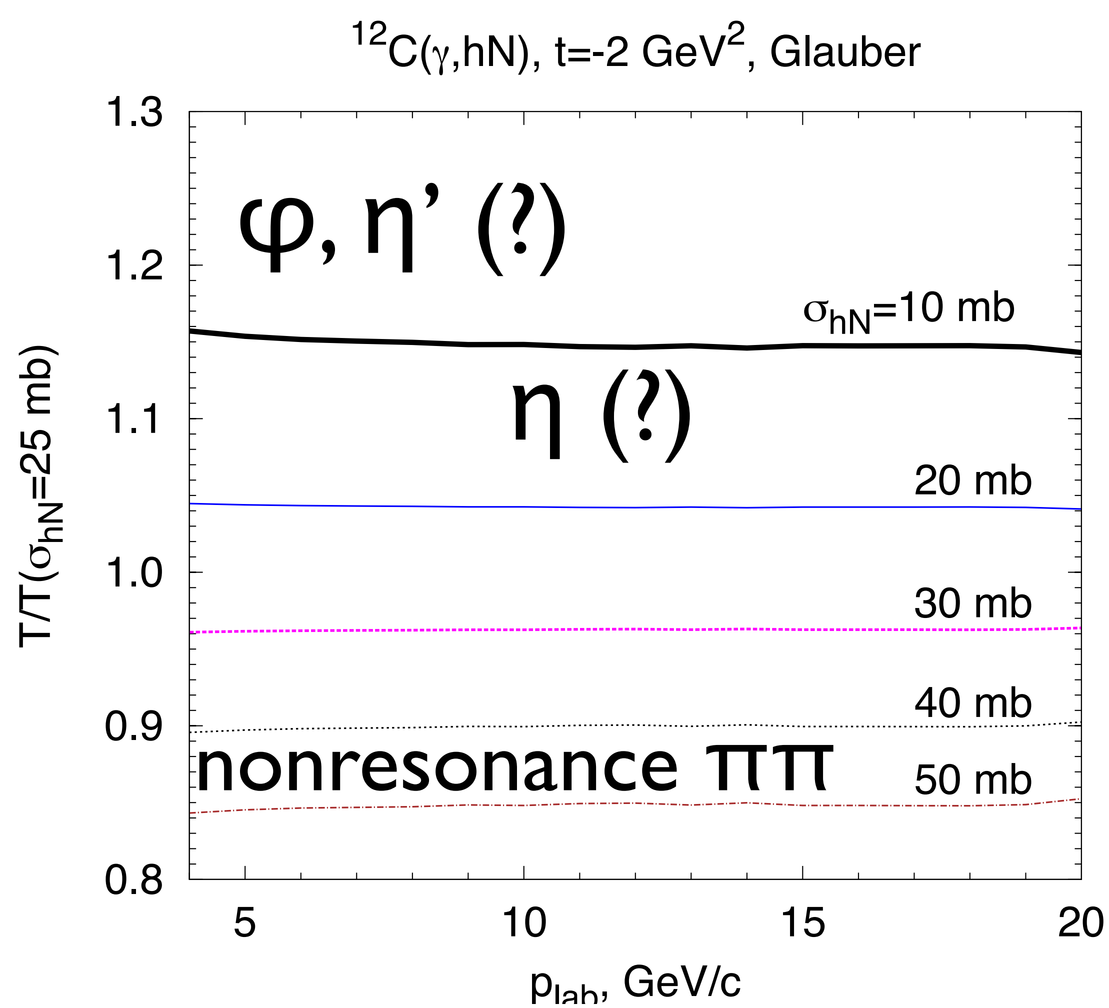
Starting point - Geometric model (semiclassical Glauber) works well in a large range of s,t.

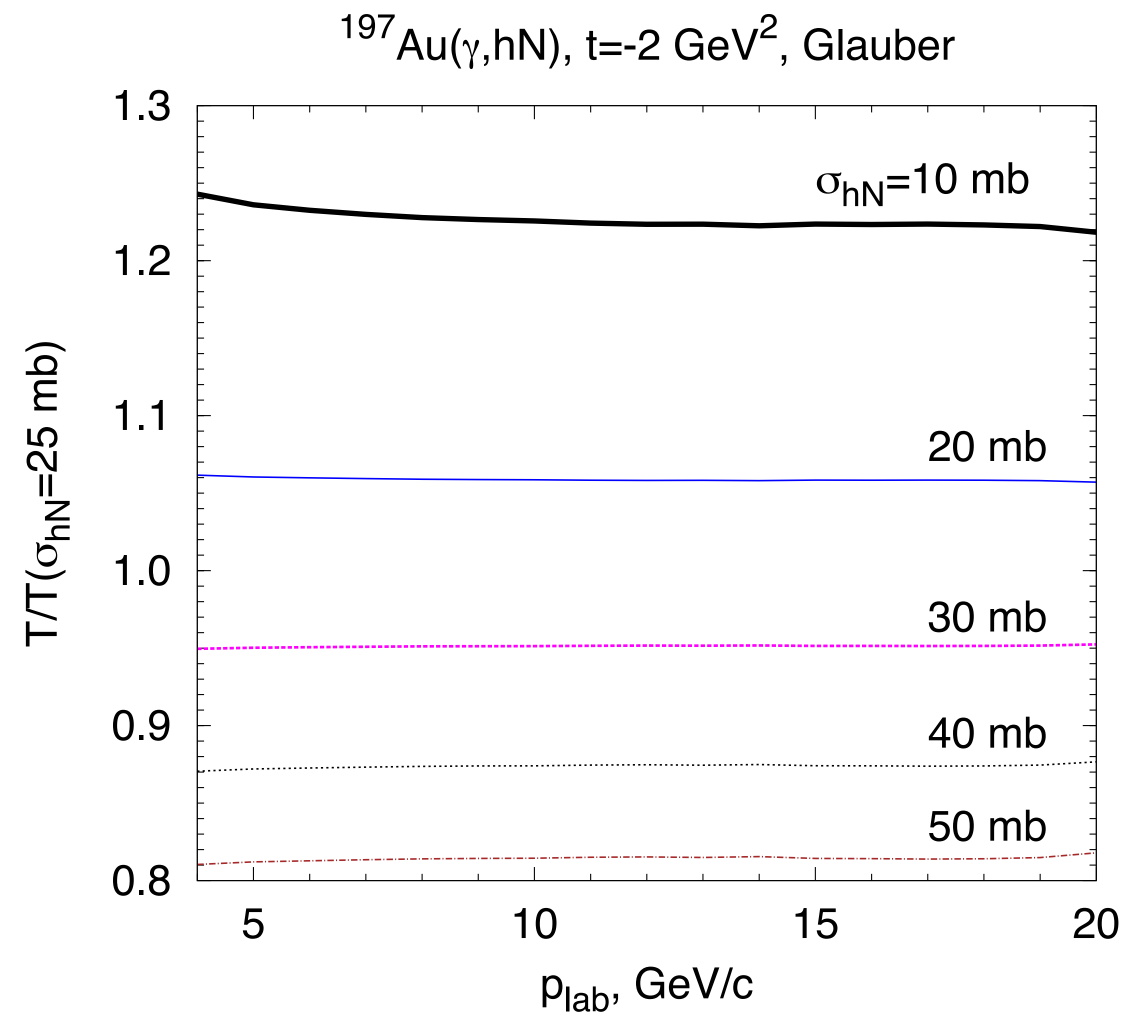
➡ **Double ratio**

$$R(A) = \frac{\sigma(\gamma + A \to h_1 + N + (A-1)^*)}{\sigma(\gamma + A \to h_2 + N + (A-1)^*)} \Big/ \frac{\sigma(\gamma + N \to h_1 + N)}{\sigma(\gamma + N \to h_2 + N)}$$

is sensitive to $\sigma_{in}(h_1 N)/\sigma_{in}(h_2 N)$

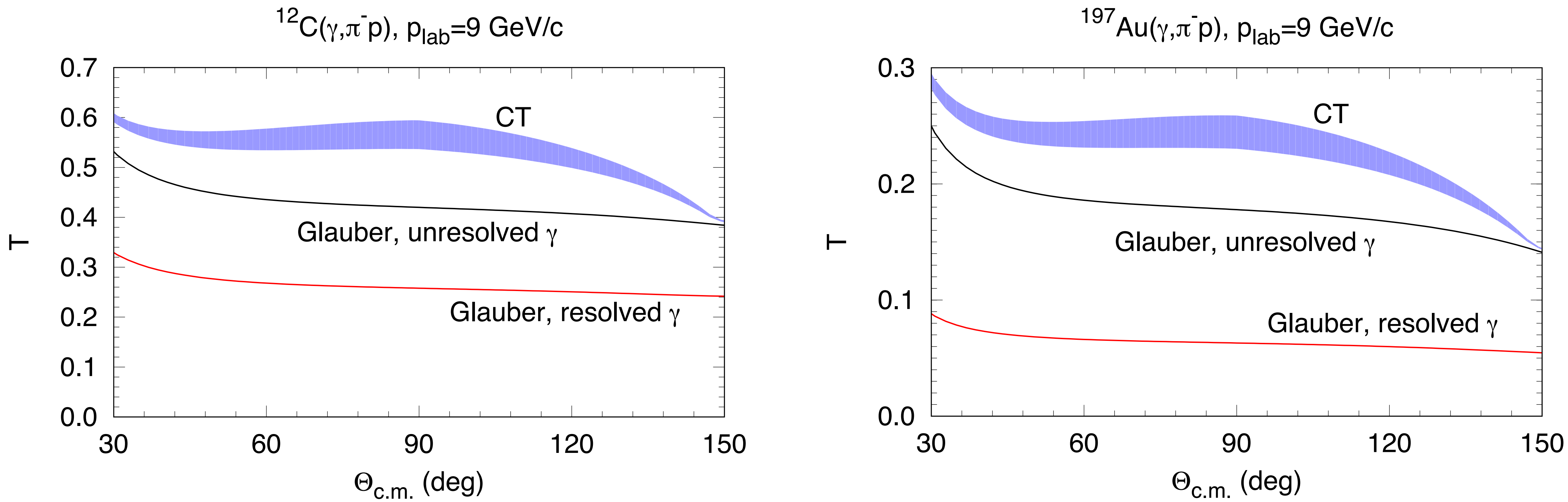
R(meson/π)





AL&MS

Side question - naively absorption of non-resonance system of say pion by nucleus is much larger than for a resonance - it could help resonances searches program of Hall D



The bands are CT calculations with a fast squeezing, unresolved photon and the standard expansion parameter of the color diffusion model

$$\Delta M^2 = 0.7\ (1.1)\ \mathrm{GeV}^2$$

which predicted well transparency variation of the Jlab (e,e' π) and (e,e' ρ) data

Conclusions

Discussed reactions have a strong potential to discover new features of the QCD dynamics at intermediate energies. By far more than I had time to mention: for example spin effects - initial state (γ), final state - ρ, Δ,..

Transparency studies also important for interpretation of SRC studies: different geometry of recoil nucleon emission from (e,epN); selection of point - like configurations in nucleons in CT regime leading to EMC like effect,...