PHOTON 03

Frascati(Italy) April $7 - 11$

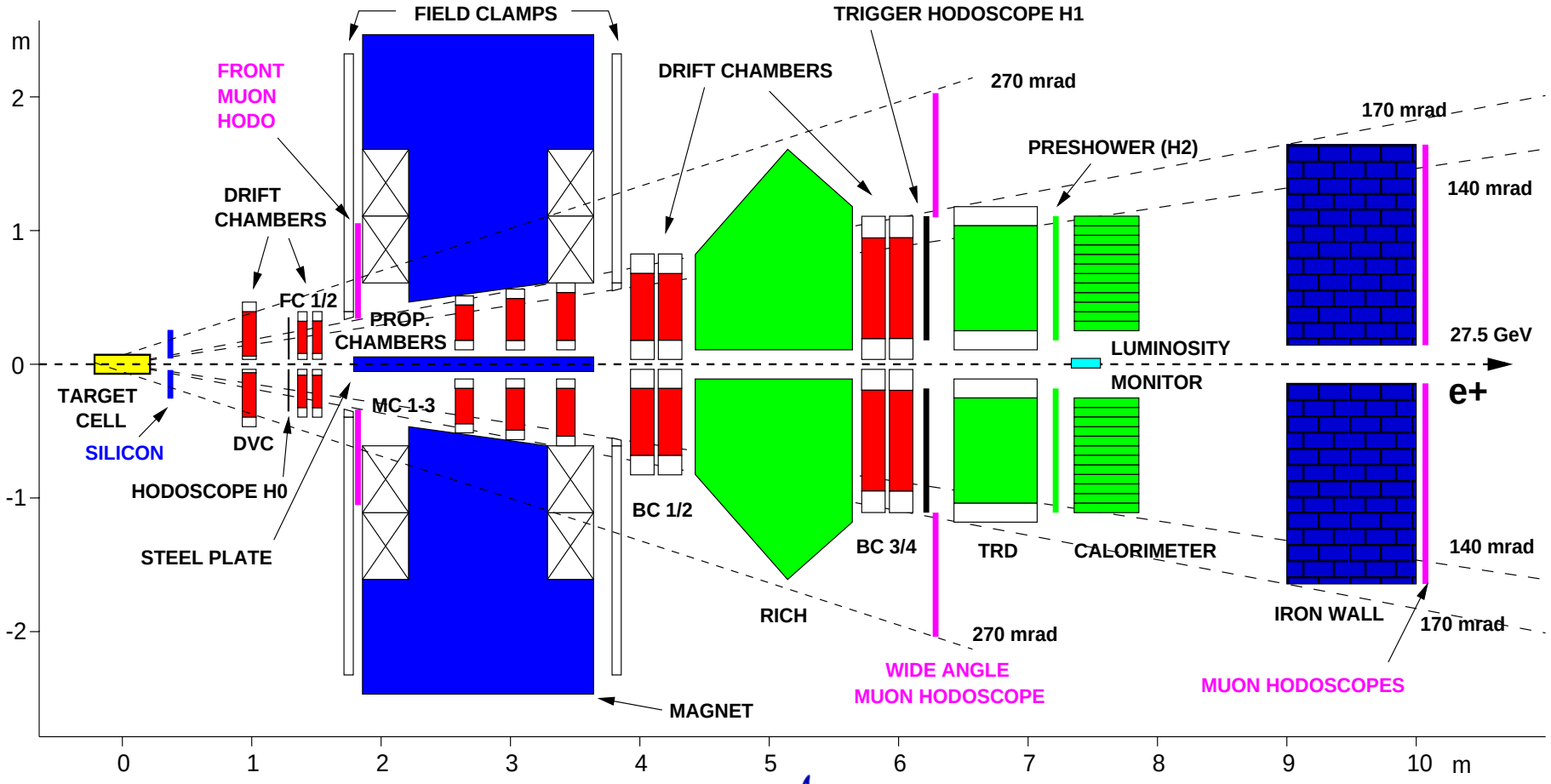
VECTOR MESON PRODUCTION

at

Avetik Airapetian University of Michigan

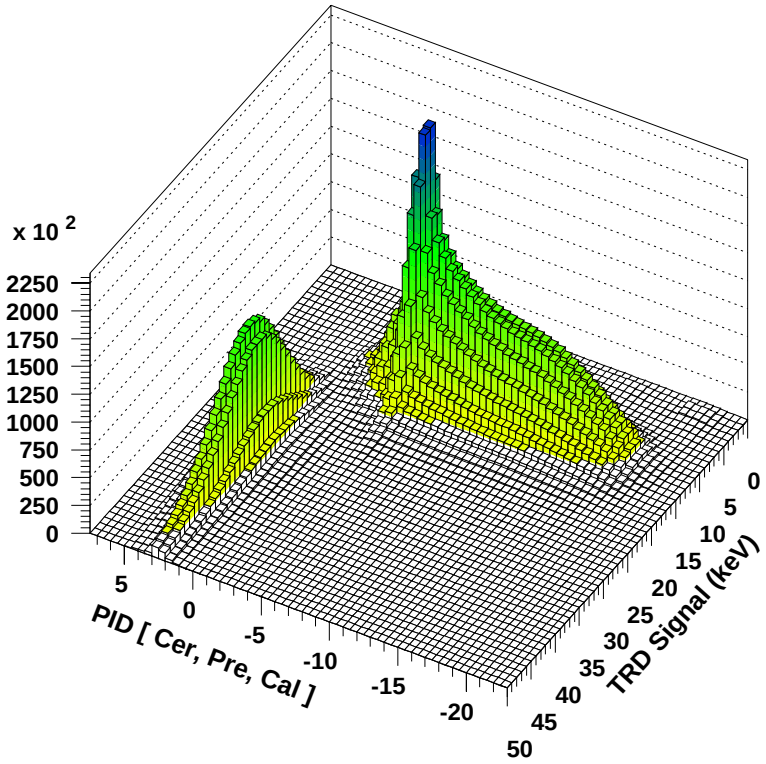
on behalf of the HERMES Collaboration

HERMES Detector

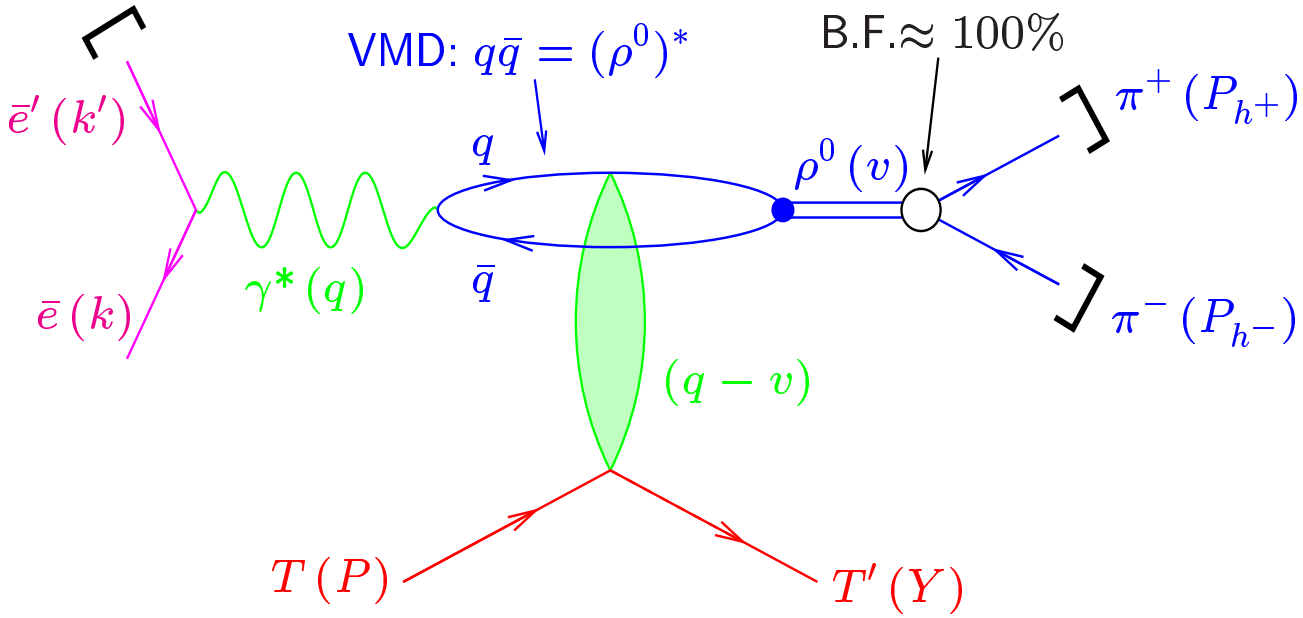


Our DATA and Event selection

gas	luminosity, pb^{-1}
^1H	261.3
^2D	371.3
^3He	109.0
^{14}N	49.5
^{20}Ne	88.4
^{84}Kr	25.0



Exclusive, Diffractive ρ^0 Electroproduction



4-momentum	Mass^2	Description
$q = k - k'$	$-Q^2$	γ^*
$v = P_{h+} + P_{h-}$	$M^2_{\pi\pi}$	ρ^0 candidate
P	M^2 (^{1}H target)	struck nucleon (T)
$P_Y = P + q - v$	M^2_Y	undetected final state Y
$(q-v) = (Y - P)$	$t\,(<0)$	momentum transfer to target

$$\nu = q \cdot P/M$$

$$\Delta E \equiv (M_Y^2 - M_T^2)/2M_T = \nu - E_{\pi\pi} + t/2M_T$$

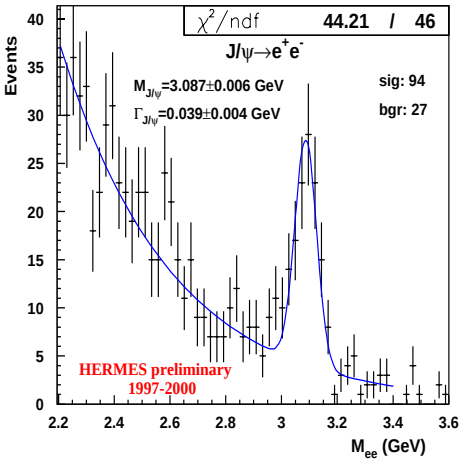
$$t_0 \equiv \max t|_{(Q^2,\nu,M_Y,M_{\pi\pi})\text{ fixed}} = t(\theta^{CM}_{\gamma\rho} = 0)$$

$$t' \equiv t - t_0 \sim -v_t^2$$

- Exclusive: $M_{T'} = M_T$
- Diffractive: $d\sigma/dt \sim e^{bt}$ (note $t < 0$)
  - Incoherent: $\gamma^* N \to \rho^0 N$, $b_N \approx 7\ \mathrm{GeV}^{-2}$ (for $A > 1$, this is nuclear inelastic)
  - For $A > 1$, coherent: $\gamma^* A \to \rho^0 A$, $b_{^{14}\mathrm{N}} \approx 55\ \mathrm{GeV}^{-2}$
- HERMES acceptance: $Q^2 > 0.4\ \mathrm{GeV}^2$, $9 < \nu < 20$ GeV
  $0.015 < x_{\mathrm{Bj}} \lesssim 0.2$ ($x_{\mathrm{Bj}} \equiv Q^2/2M\nu$)

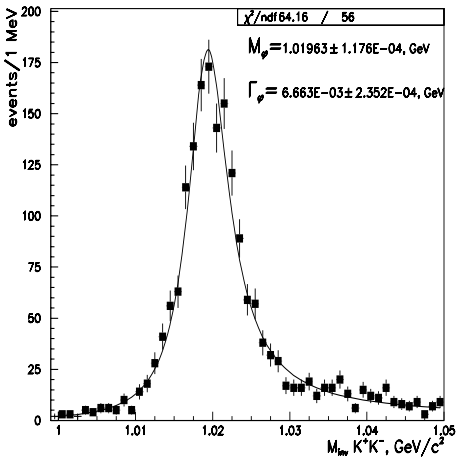
Vector Mesons at HERMES

J/ψ



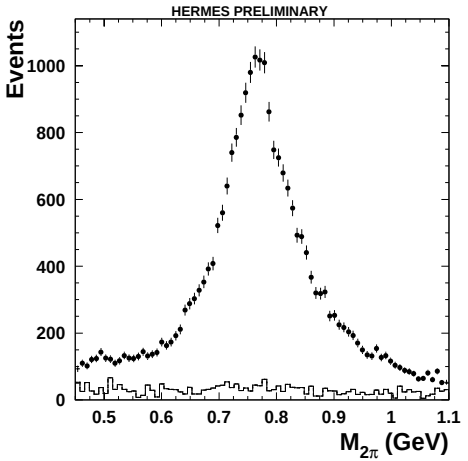
cross section

ϕ



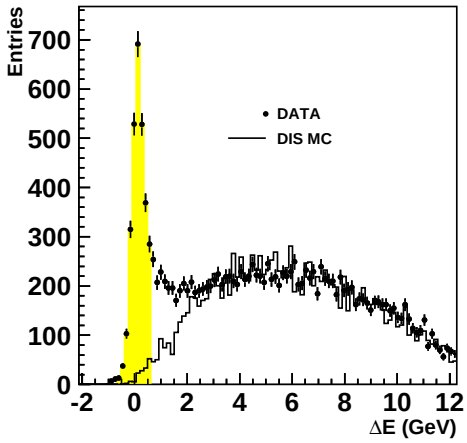
cross section
angular distribution
cross section ratios

ρ^0



cross section
angular distribution
cross section ratios
Asymmetry(beam, target)
Coherence length
Color transparency

Cross section, Ratios,definition and spectrums



Nuclear incoherent Transparency:

$Tr^{incoh}=\sigma^{A}_{incoh}(Q^2)/A\sigma_H(Q^2)$

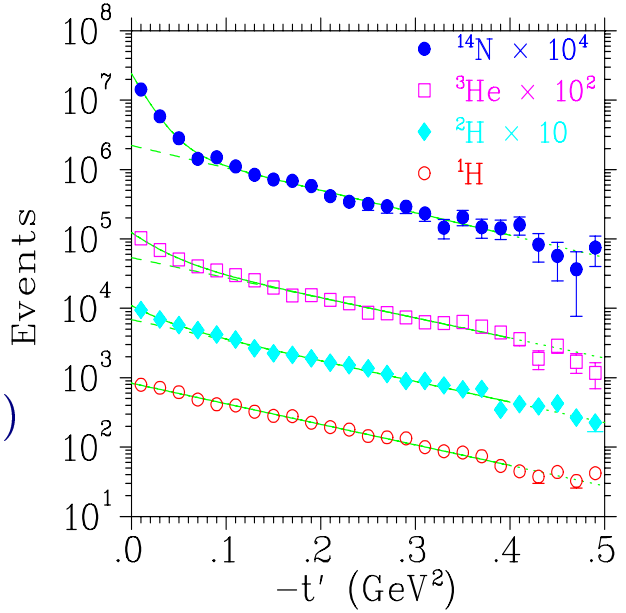
Nuclear coherent Transparency:

$Tr^{coh}=\sigma^{A}_{coh}(Q^2)/A\sigma_H(Q^2)$

Coherent to incoherent Cross section Ratio:

Ratio=$\sigma^{A}_{coh}(Q^2)/\sigma^{A}_{incoh}(Q^2)$,where

$\sigma = \int \frac{d\sigma}{dt} dt$



Cross section measurements

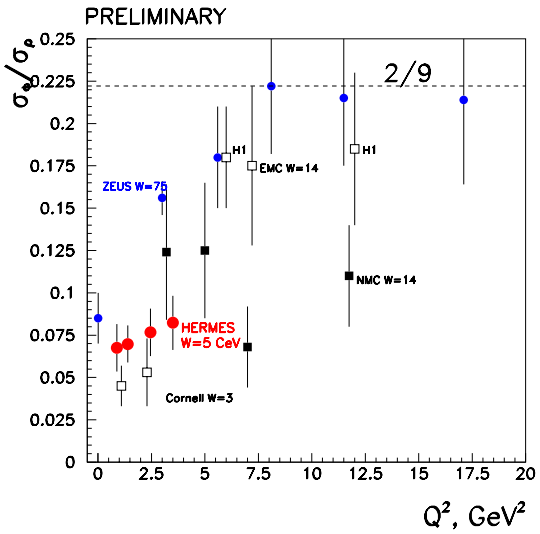
J/ψ Electroproduction Cross Section

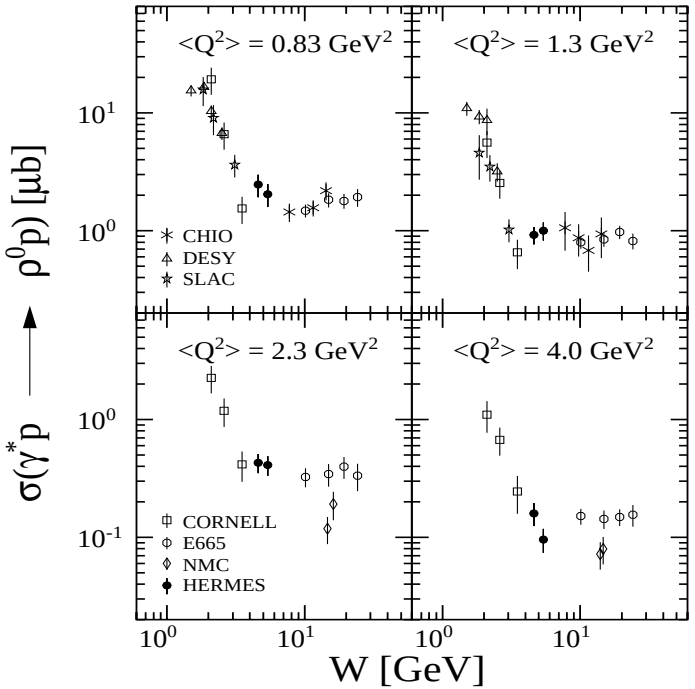
$\sigma_{eN\to J/\psi X}(e^+e^-) = 0.042 \pm 0.005\,(stat) \pm 0.005\,(sys)$ nb
$\sigma_{eN\to J/\psi X}(\mu^+\mu^-) = 0.062 \pm 0.013\,(stat) \pm 0.007\,(sys)$ nb

HERMES preliminary

$\sigma_{eN\to J/\psi X} = 0.045 \pm 0.005\,(stat) \pm 0.005\,(sys)$ nb

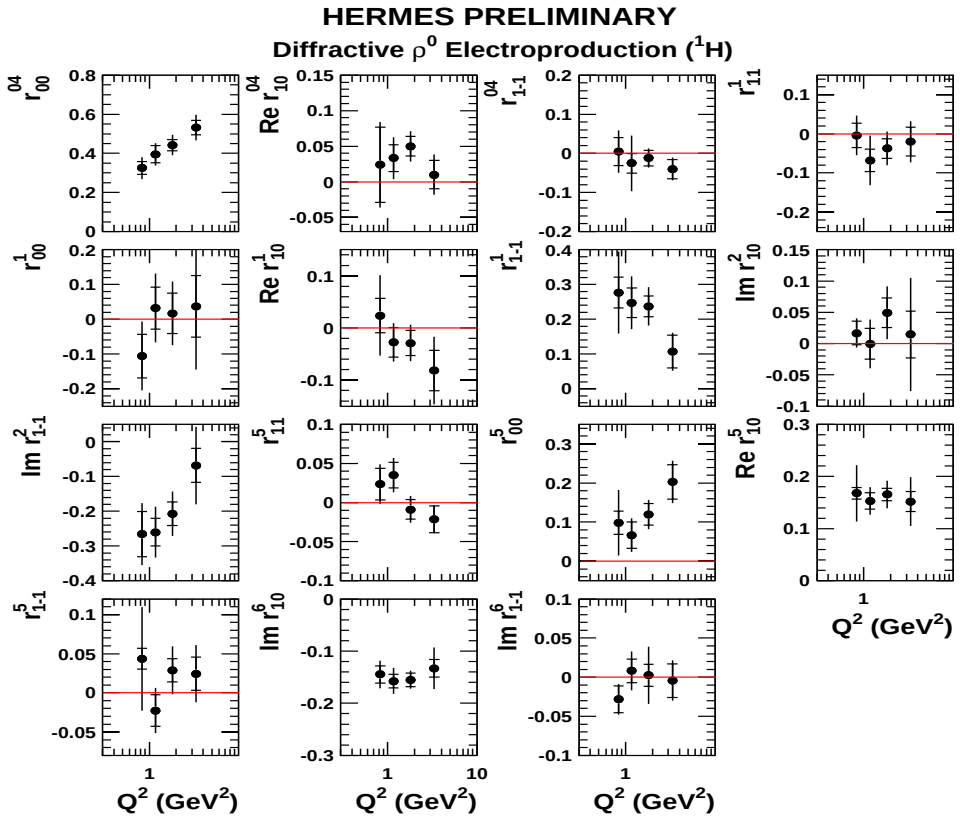
Cross sections are calculated in the framework of elastic J/ψ production MC model (EPJPSI).





Eur. Phys. Jour. C 17 (2000) 389-398

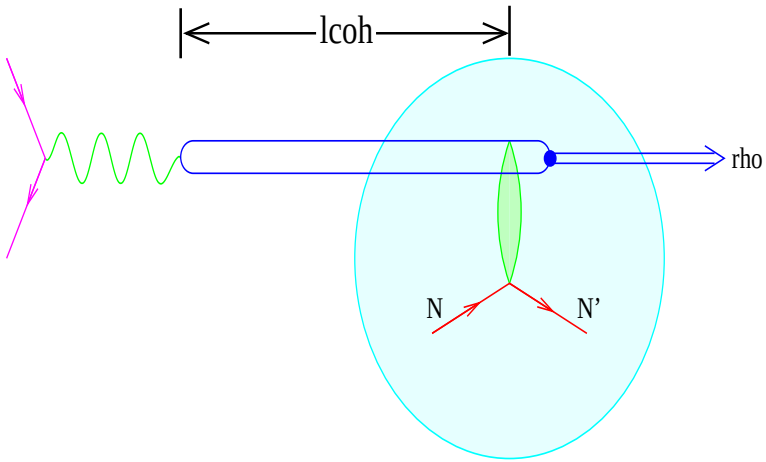
Angular distributions

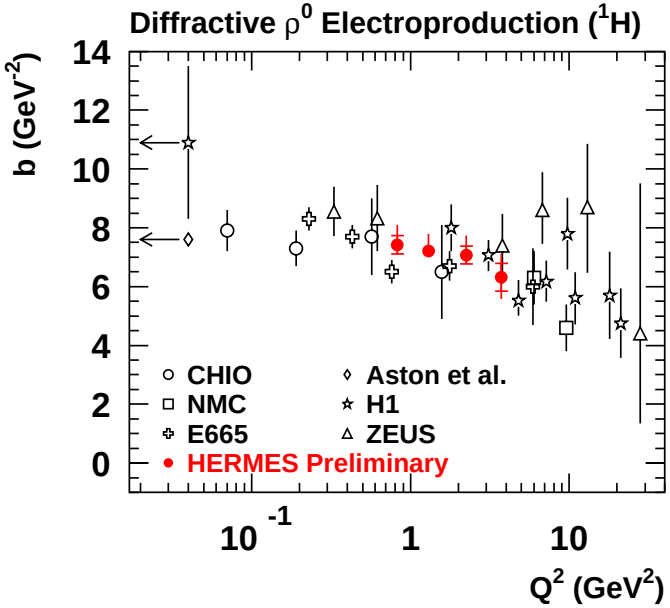


Stressing S Channel Helisity Conservation and access to Imaginary part of amplitudes for ρ^0

Why we highlight ρ^0

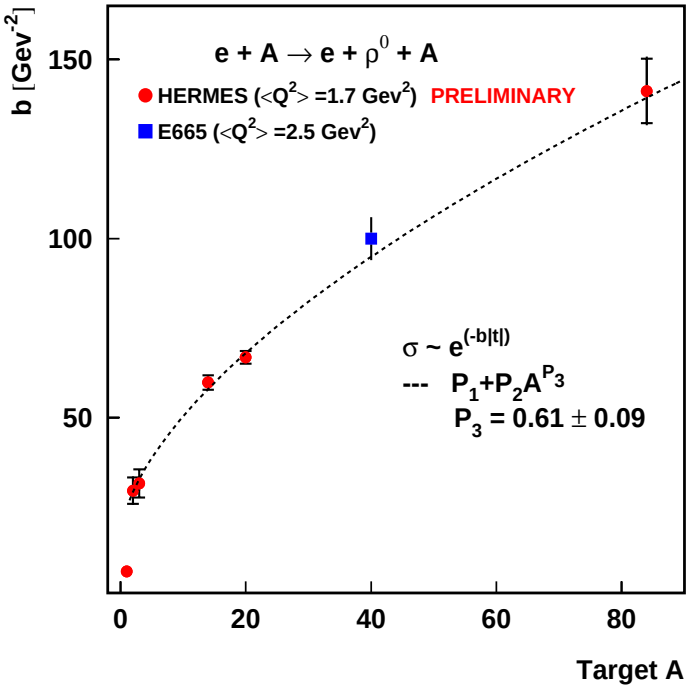
Coherence length $l_c = \frac{2 \cdot \nu}{Q^2 + m_V^2}$ "Shrinking photon"



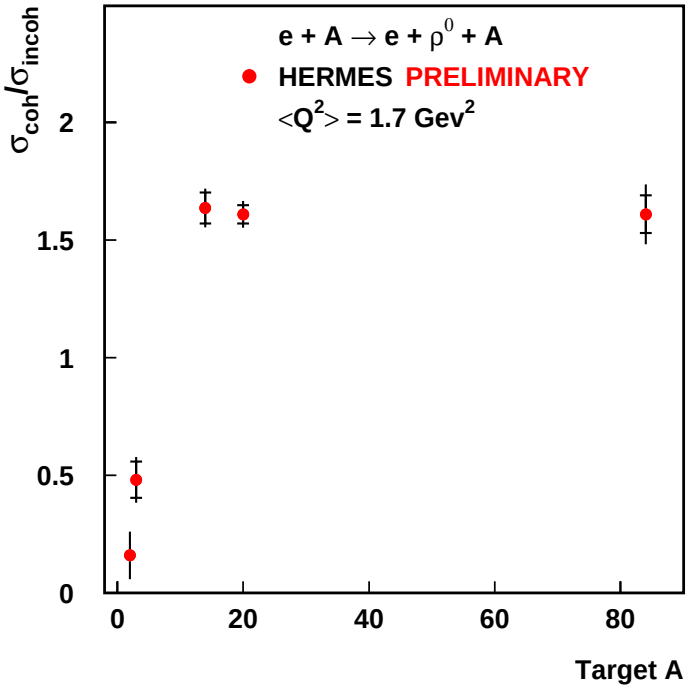


$$\frac{d\sigma}{dt} \sim \exp^{-bt}$$

Nuclear size and $\sigma_{coh}(A)/\sigma_{incoh}(A)$

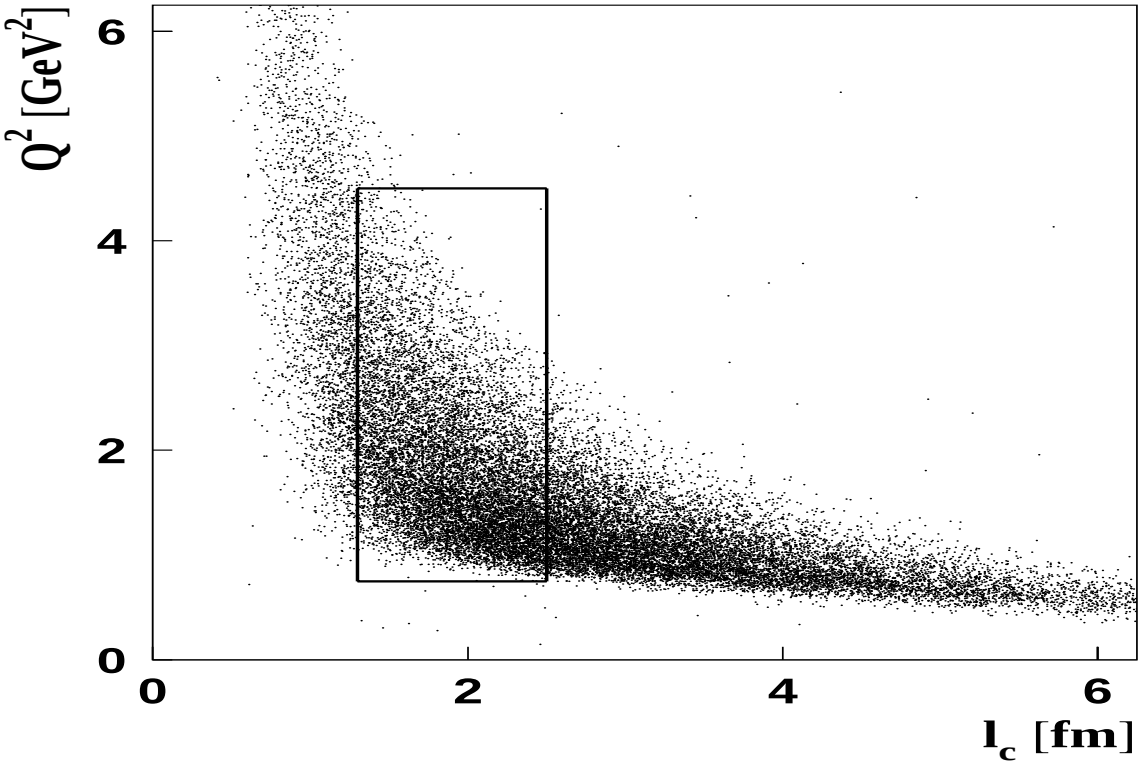


Nuclear radii scales as charged



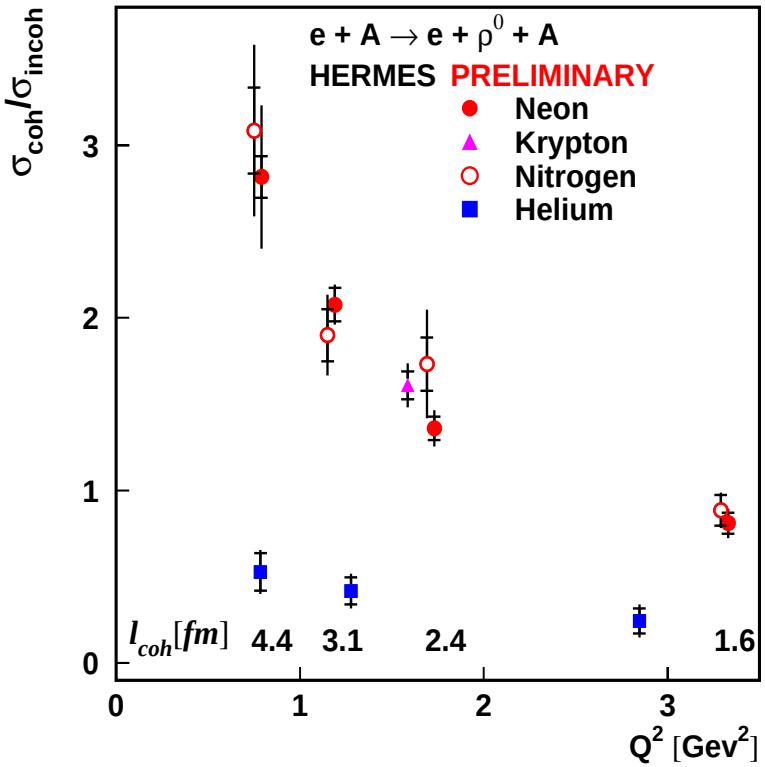
Coherent and incoherent behaves similar

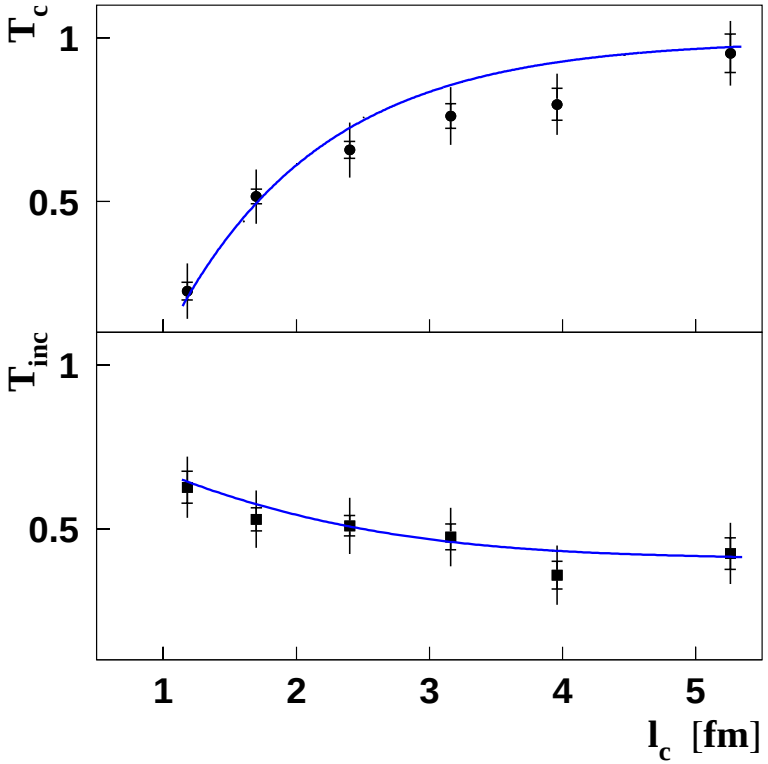
HERMES acceptance in Q^2 versus l_c



In marked region two dimensional analyse was performed

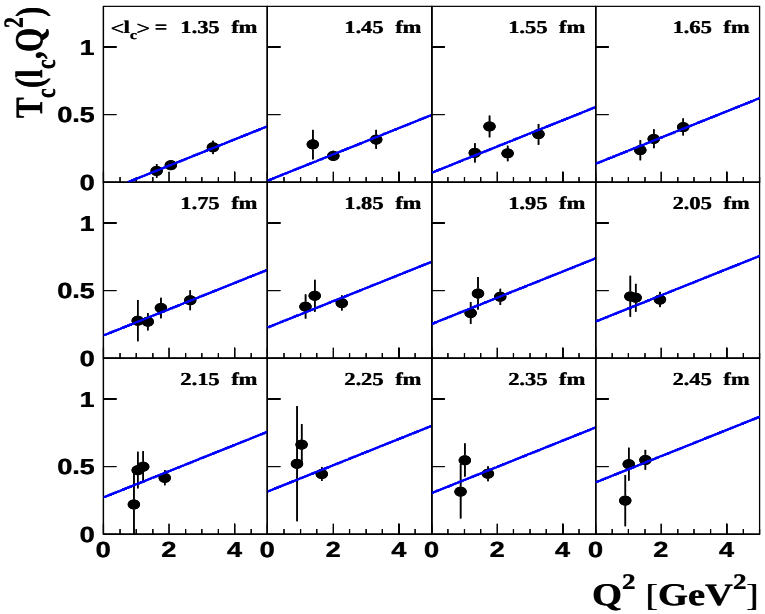
Coherence length effect, $\sigma_{coh}(Q^2)/\sigma_{incoh}(Q^2)$





Phys. Rev. Lett. 90 (2003) 052501

$Tr^{coh}, Tr^{incoh}(Q^2)$ at fixed l_{coh}



Data sample	Measured Q^2 slope (GeV^{-2})	Prediction (GeV^{-2})
coherent	$0.070 \pm 0.021 \pm 0.012$	0.060
incoherent	$0.089 \pm 0.046 \pm 0.008$	0.048

Conclusions

- HERMES has as large DATA sample to address different aspects of VM Production on Nucleon and Nuclei
- In addition to 27.5 GeV beam energy running we collected also DATA on 12 GeV , Analyses of this data is in progress.
- Measurement of Coherent part of cross section is NEW and shows an interesting evidence of the existence of COLOR TRANSPARENCY
- HERMES Plans ...RUN II will end more data both Polarised and unPolarized