PHOTON 03

Frascati(Italy) April $7-11$

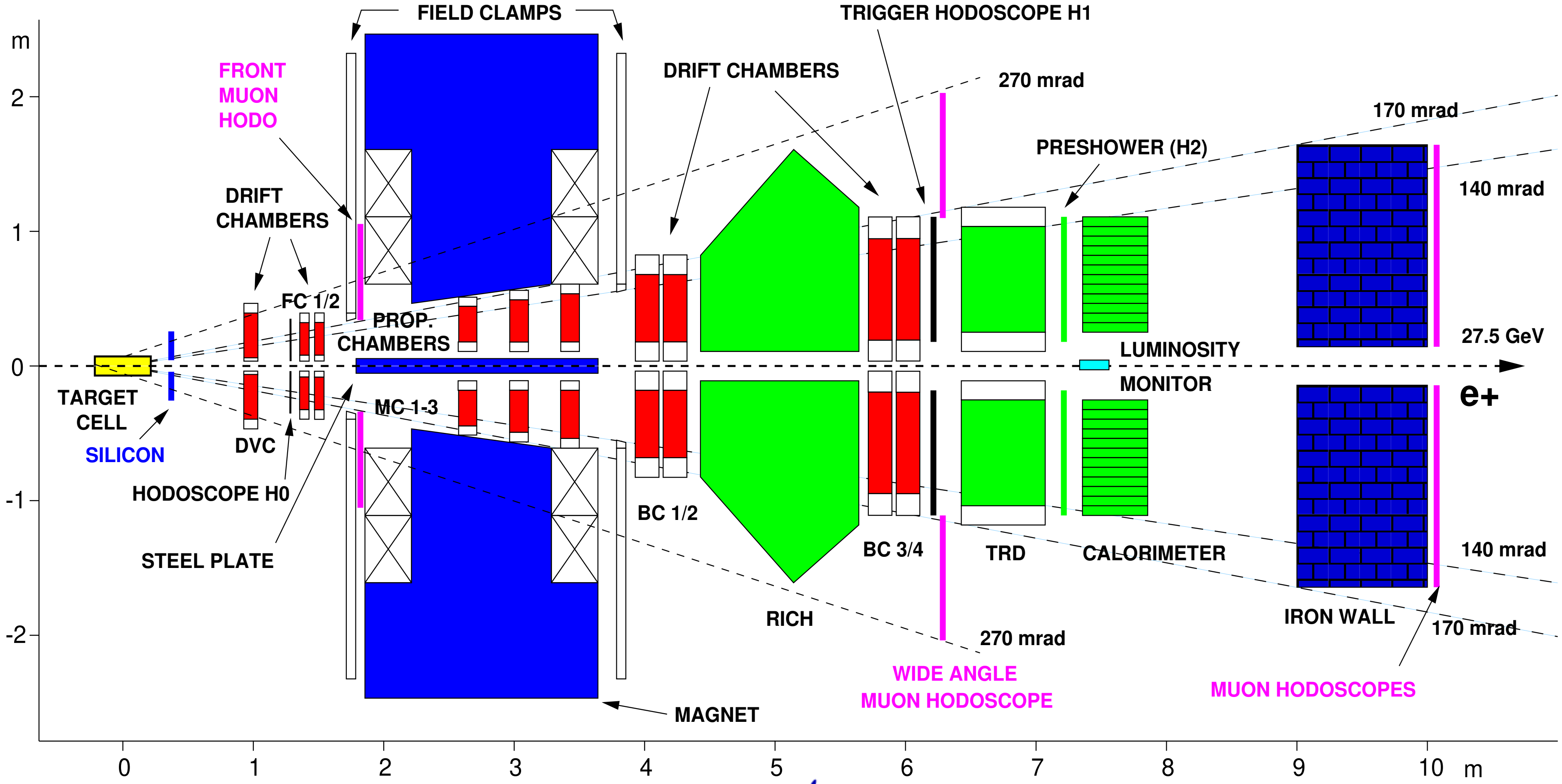
VECTOR MESON PRODUCTION

at

Avetik Airapetian University of Michigan

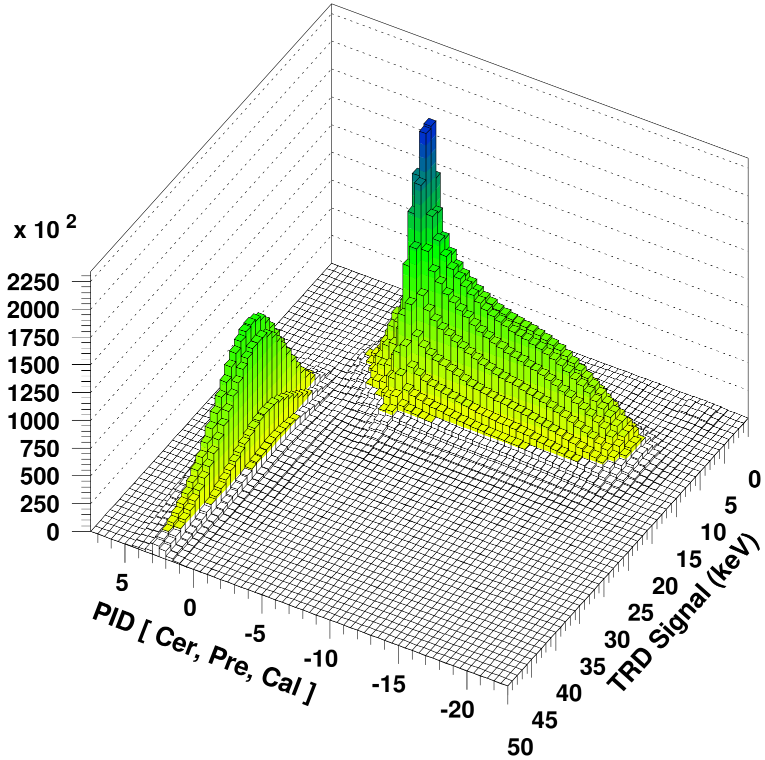
on behalf of the HERMES Collaboration

HERMES Detector

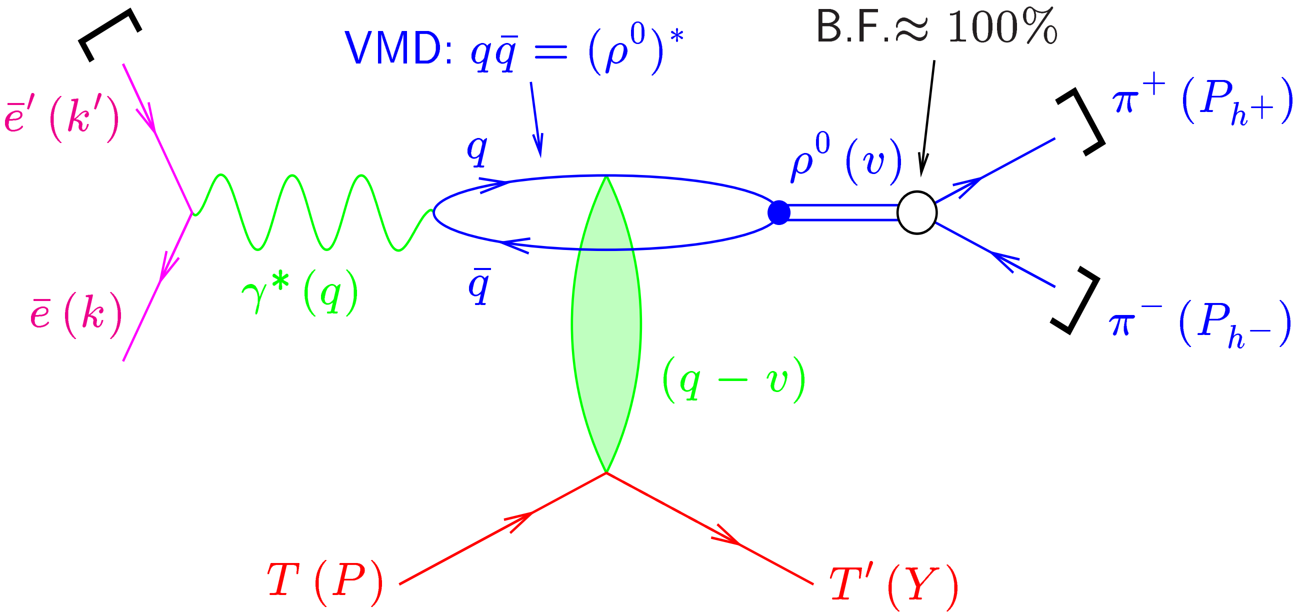


Our DATA and Event selection

gas	luminosity, pb^{-1}
^{1}H	261.3
^{2}D	371.3
^{3}He	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_Y^2	undetected final state Y
$(q-v) = (Y-P)$	$t\ (< 0)$	momentum transfer to target

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

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

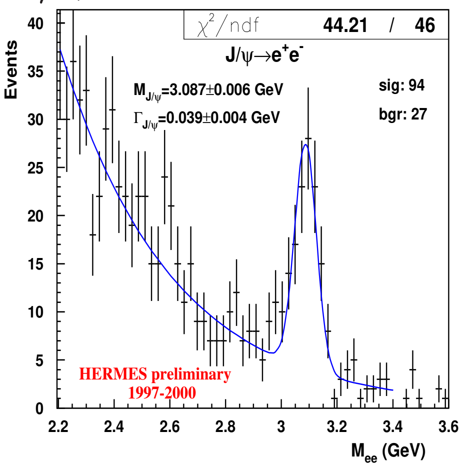
$$t_0 \equiv \max t|_{(Q^2,\nu,M_Y,M_{\pi\pi})\ \mathrm{fixed}} = t(\theta^{CM}_{\gamma\rho} = 0)$$

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

- 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: $Q^2 > 0.4\ \mathrm{GeV}^2$, $9 < \nu < 20\ \mathrm{GeV}$
  $0.015 < x_{\mathrm{Bj}} \lesssim 0.2$ ($x_{\mathrm{Bj}} \equiv Q^2/2M\nu$)

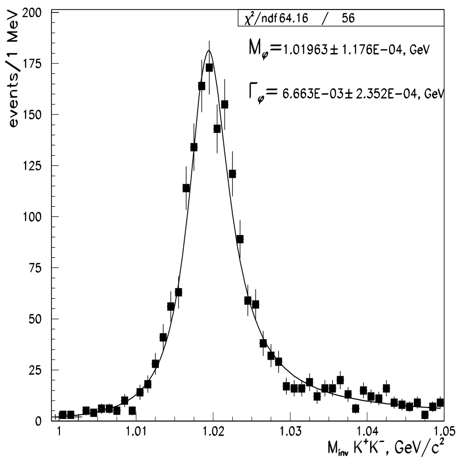
Vector Mesons at HERMES

J/ψ



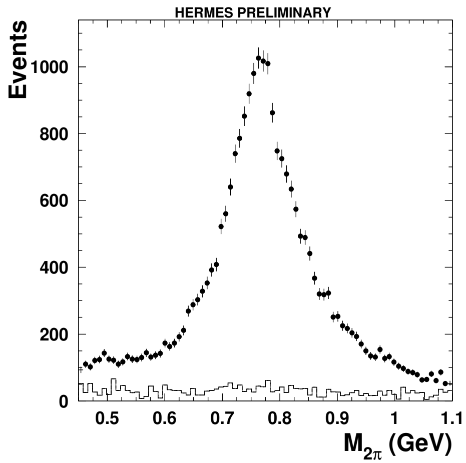
cross section

ϕ



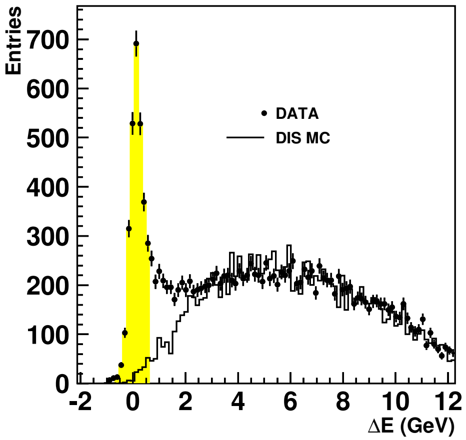
cross section
angular distribution
cross section ratios

ρ^0

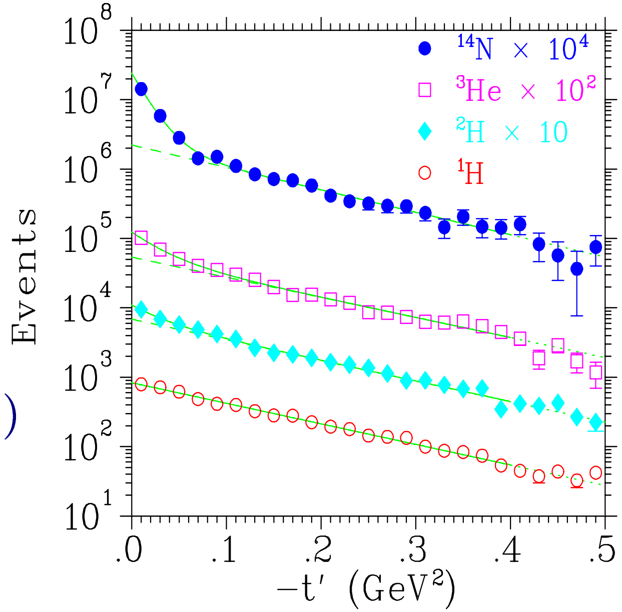


cross section
angular distribution
cross section ratios
Asymmetry(beam, target)
Coherence length
Color transparency

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

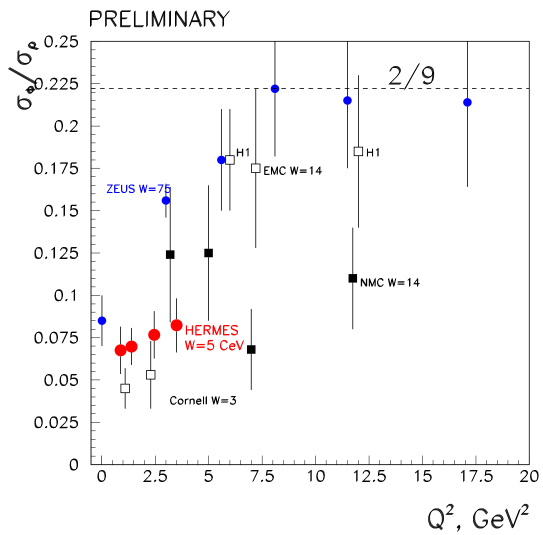
J/ψ Electroproduction Cross Section

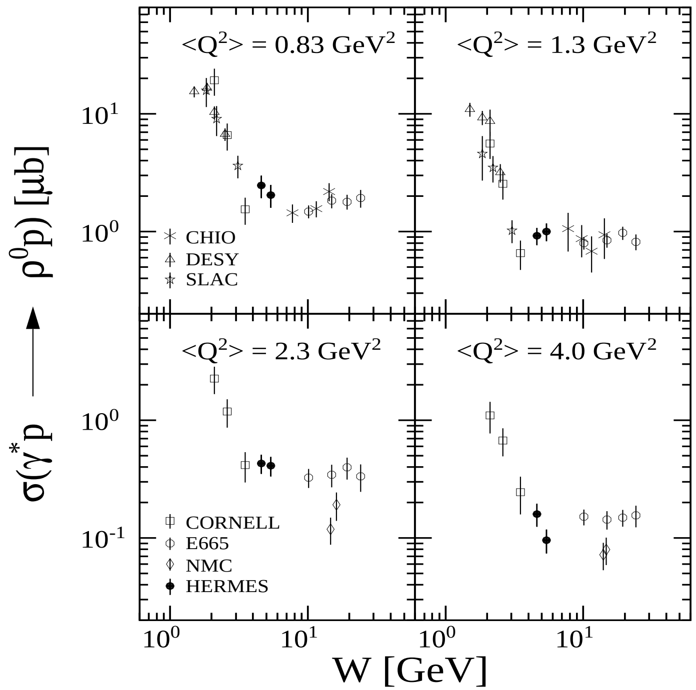
$\sigma_{eN \to J/\psi X}$ (e^+e^-) = 0.042 ± 0.005 (stat) ± 0.005 (sys) nb
$\sigma_{eN \to J/\psi X}$ $(\mu^+\mu^-)$ = 0.062 ± 0.013 (stat) ± 0.007 (sys) nb

HERMES preliminary

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

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





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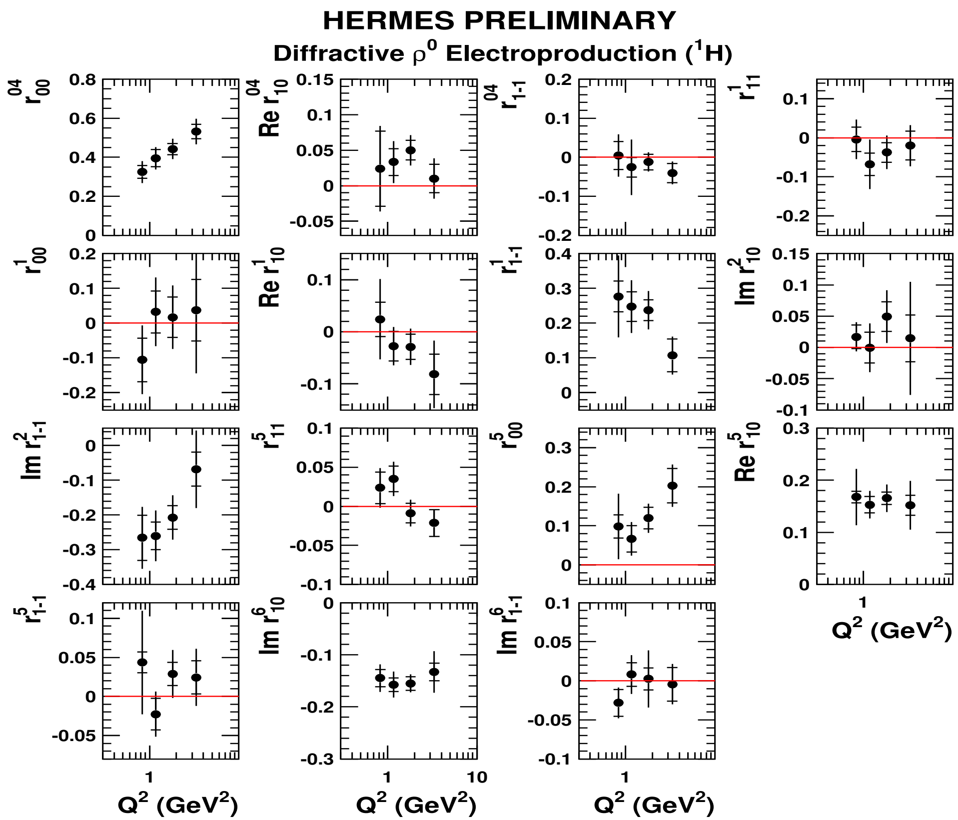
Angular distributions

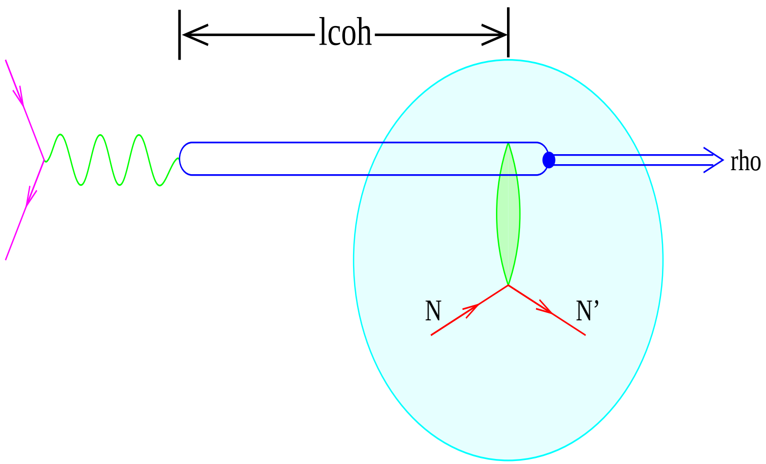


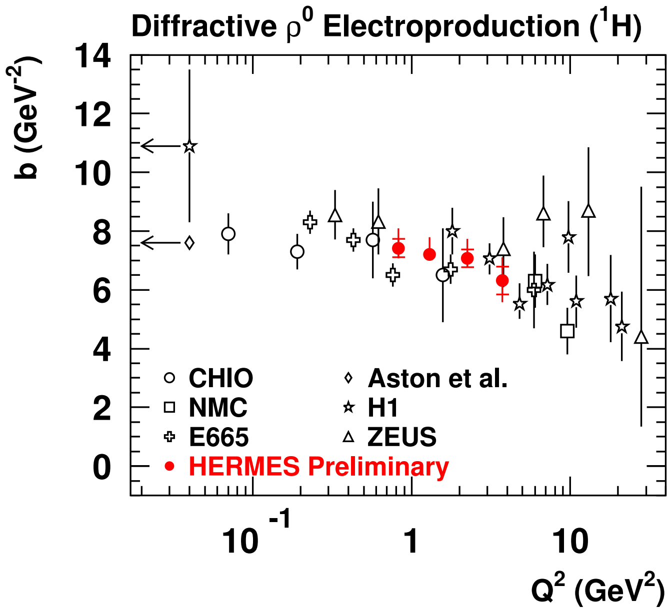
Stressing S Channel Helisity Conservation and access to Imaginary part of amplitudes for ρ^0

Why we highlight ρ^0

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

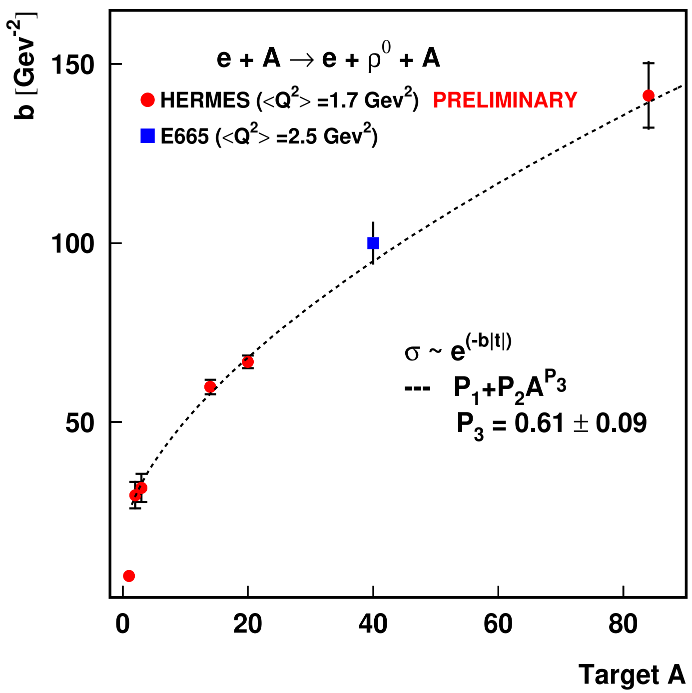
"Shrinking photon"

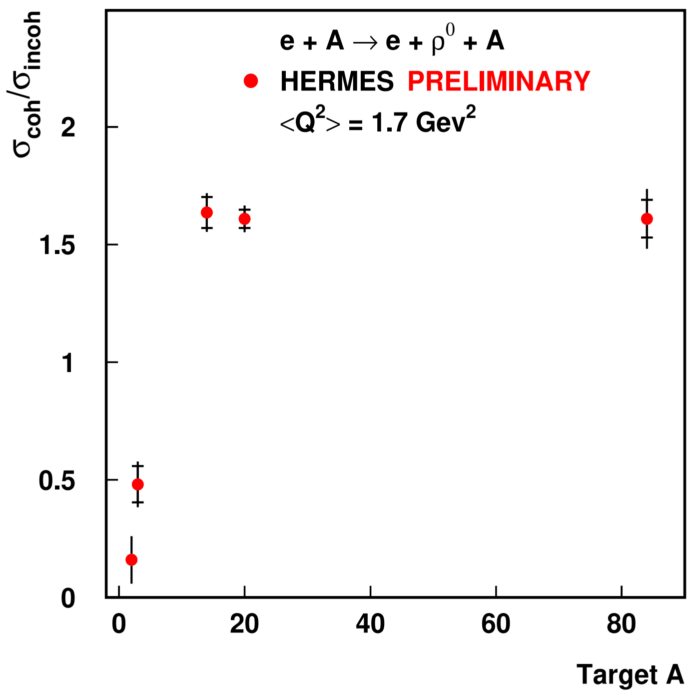




$$\frac{d\sigma}{dt} \sim \exp^{-bt}$$

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

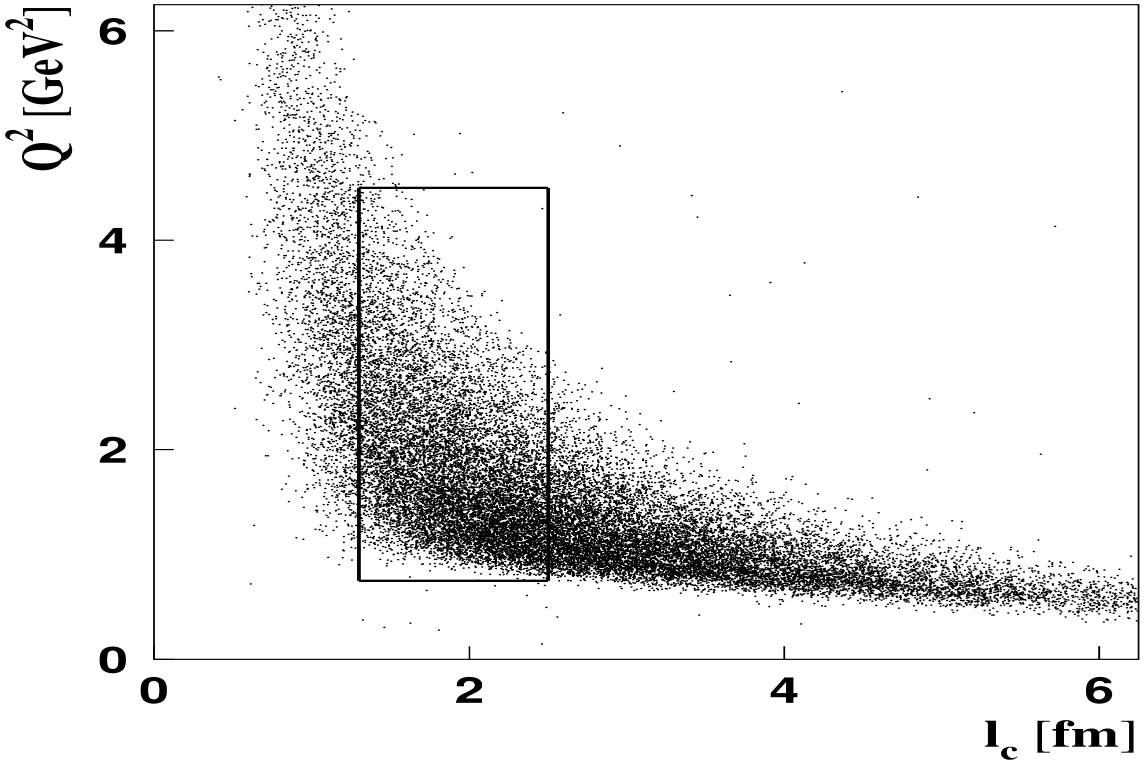




Nuclear radii scales as charged

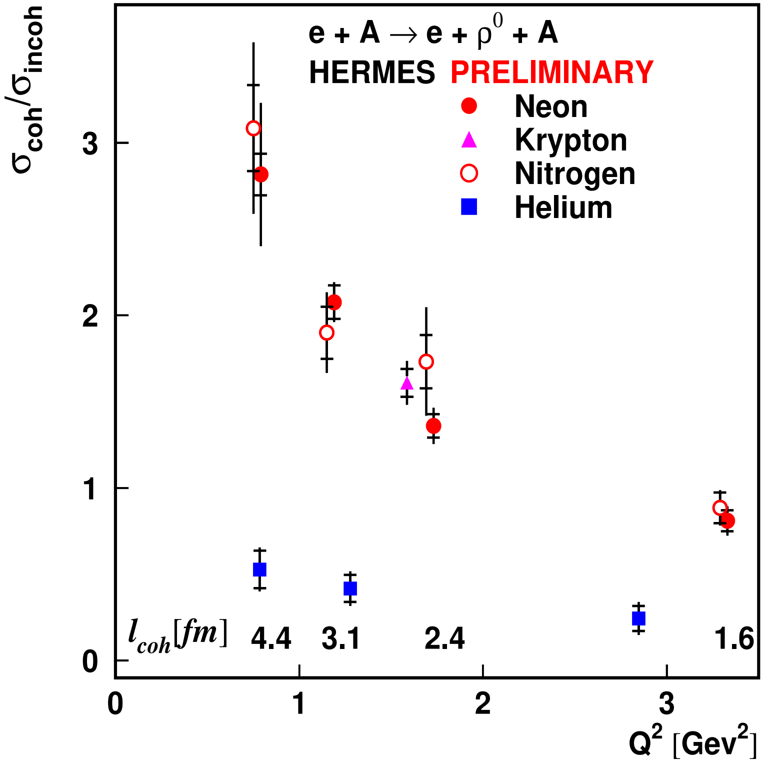
Coherent and incoherent behaves similar

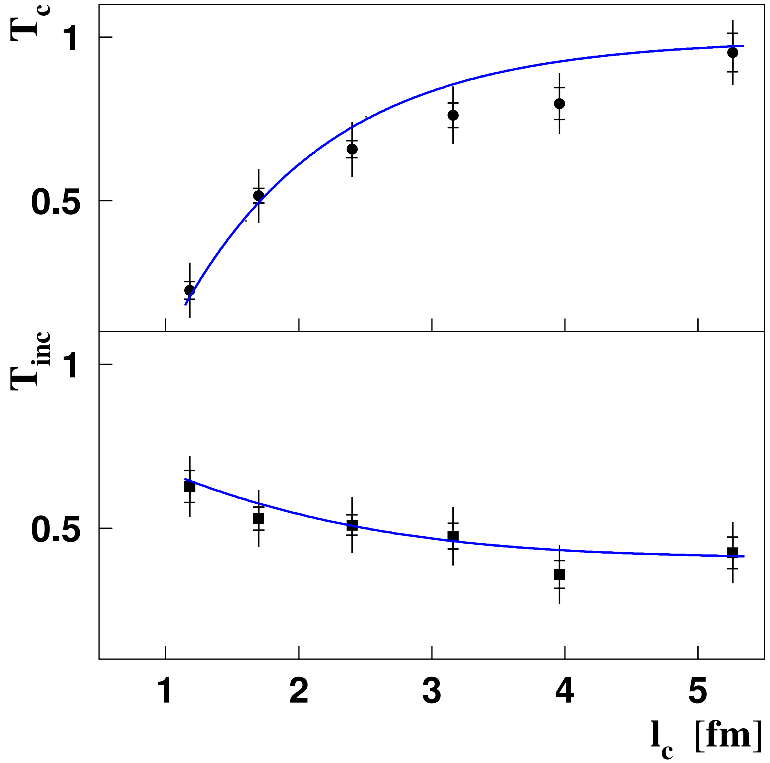
HERMES acceptance in Q^2 versus l_c



In marked region two dimensional analyse was performed

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





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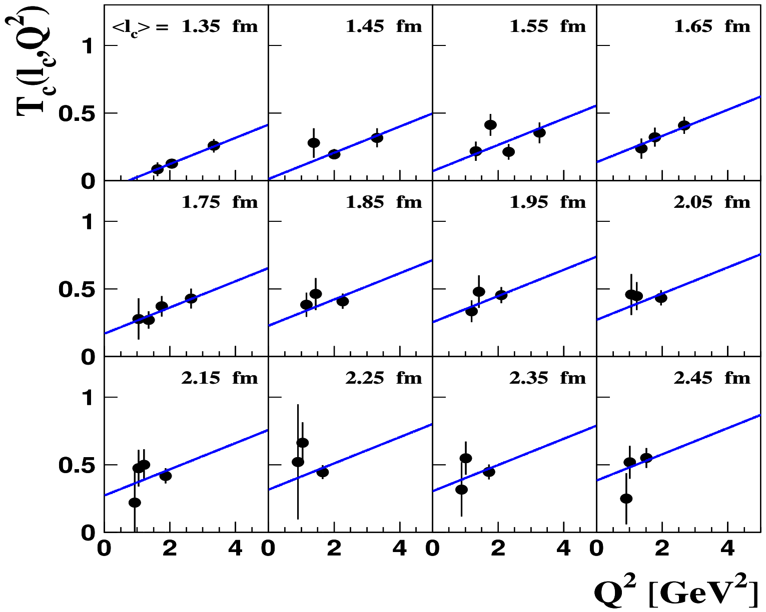
$Tr^{coh}, Tr^{incoh}(Q^2)$ at fixed l_{coh}



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