HALL B EXPERIMENTS
ON
STRANGE PARTICLE PRODUCTION

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PAC17 Meeting
January 26–29, 2000

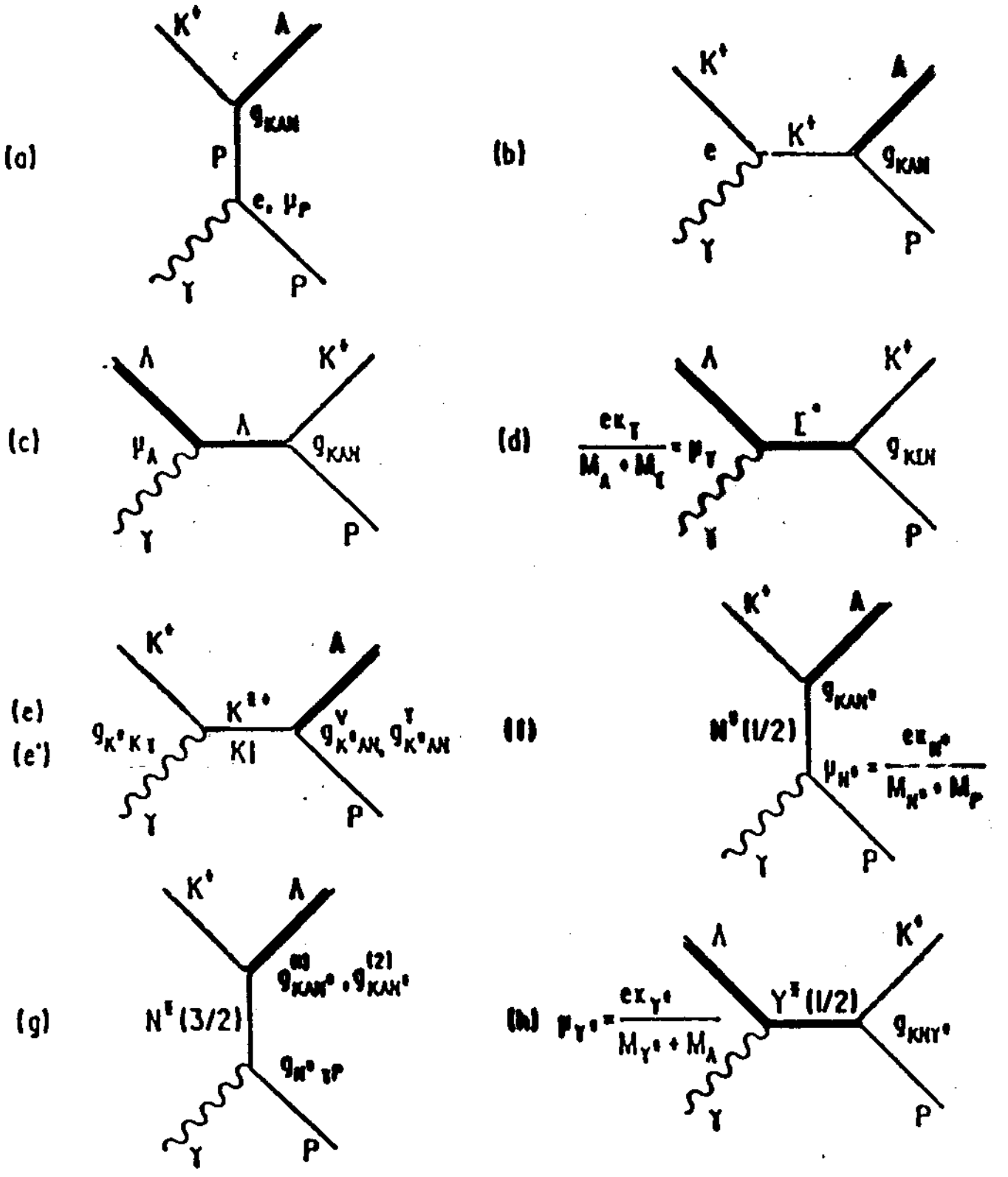
GOAL OF HALL B PROGRAM

*** **Clarify mechanism for elementary production of hyperons (both photo- and electro-production)**

- coupling constants, e.g. $g_{K\Lambda N}$
- contribution of N*–resonances
- form factors of hadronic vertices

* **use excited hyperon Y* photoproduction to study hyperon decays,** e.g.: $Y^* \to \gamma\Lambda$, $Y^* \to \gamma\Sigma$

* **study K and Y interactions in nuclear environment**



Feynman diagrams used in the description of the **elementary kaon** photoproduction process $\gamma+p\rightarrow K^+\Lambda$ (from /ADE89/)

HALL B EXPERIMENTS

Number	Authors and Title	days	priority
E89-004	R. Schumacher Electromagnetic Production of Hyperons Status: 61% of data taken (g1) 15% of data analyzed preliminary differential cross sections for $\gamma\, p \rightarrow\ K^+\, \Lambda^o\, (\Sigma^o)$	65	B^+
E-89-024	G. Mutchler Radiative Decays of the Low-Lying Hyperons Status: 61% of data taken (g1) 15% of data analyzed preliminary value for BR($\Sigma^*(1385) \rightarrow \gamma\Lambda$)	65	B^+
E-89-027	L. Dennis Measurements of the Electroproduction of the Λ, $\Lambda^*(1520)$ and $f_o(975)$ via the K^+K^-p, and the $K^+\pi^-$ Final States Status: 27% of data taken (e1) 5% of data analyzed preliminary cross sections for $e\, p \rightarrow\ e'\, K^+\, \Lambda^*(1520)$	48	A^-
E89-045	B. Mecking Study of Kaon Photoproduction on Deuterium Status: 72% of data taken (g2)	23	B^+
E-91-014	C. Hyde-Wright Quasi-Free Strangeness Production in Nuclei Status: 76% of data taken (g3)	25	B^-

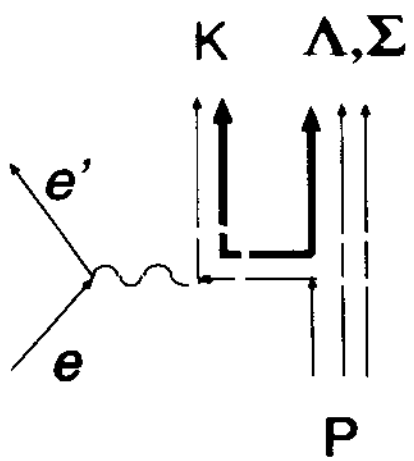
Number	Authors and Title	days	priority
E-93-022	E. Smith Measurement of the Polarization of the $\Phi(1020)$ in Electroproduction Status: 27% of data taken (e1) 5% of data analyzed preliminary cross sections for $e\ p \rightarrow\ e'\ p\ \Phi$	15	B^+
E-93-030	M. Mestayer **Measurement of the Structure Functions for Kaon Electroproduction** **Status: 27% of data taken (e1)** 5% of data analyzed preliminary cross sections for $e\ p \rightarrow\ e'\ K^+\ \Lambda^o\ (\Sigma^o)$	50	B^+
E-95-003	R. Schumacher **Measurement of K^o Electroproduction** **Status: 27% of data taken (e1)** **5% of data analyzed**	**80**	B^+
E-98-109	D. Tedeschi Photoproduction of Φ–Mesons with Linearly Polarized Photons Status: no data (requires linearly polarized photons)	33	B^+
E-99-006	D. Carman Polarization Observables in $H(e,e'K^+)\Lambda^o$ Status: no data taken (requires 6 GeV running)		B

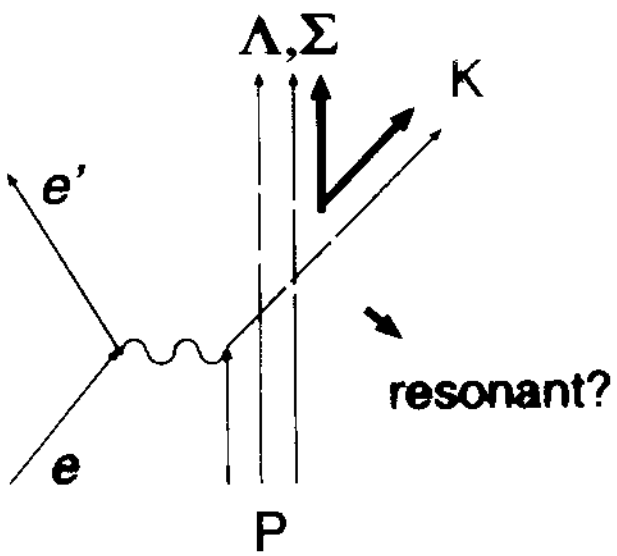
Physics Motivation: Hyperon Electroproduction

- **Physical Questions**
  - Which S-CHANNEL RESONANCES go to Λ , Σ , Λ^* , Σ^* ?
  - Which Mesons DOMINATE t-CHANNEL?
  - QUANTUM STATE of $S\bar{S}$?

eP -> e' K (X)

t-channel





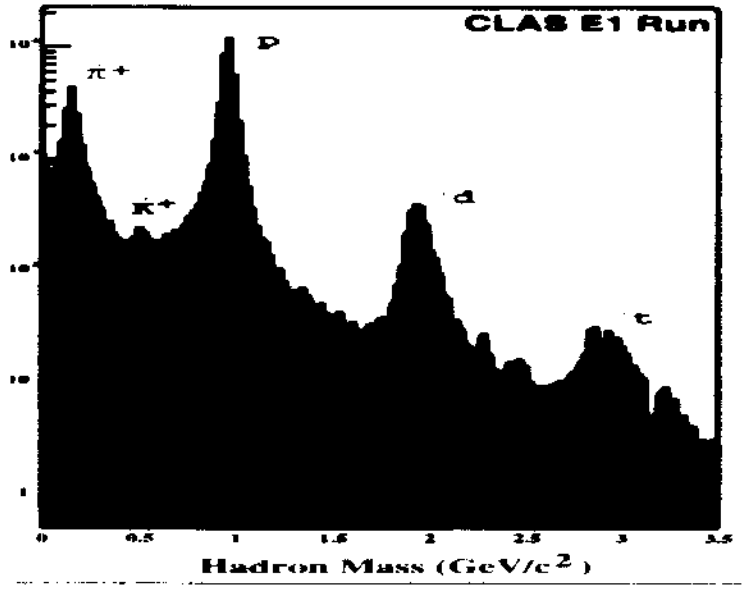
-K form factor
-hyperon-proton overlap

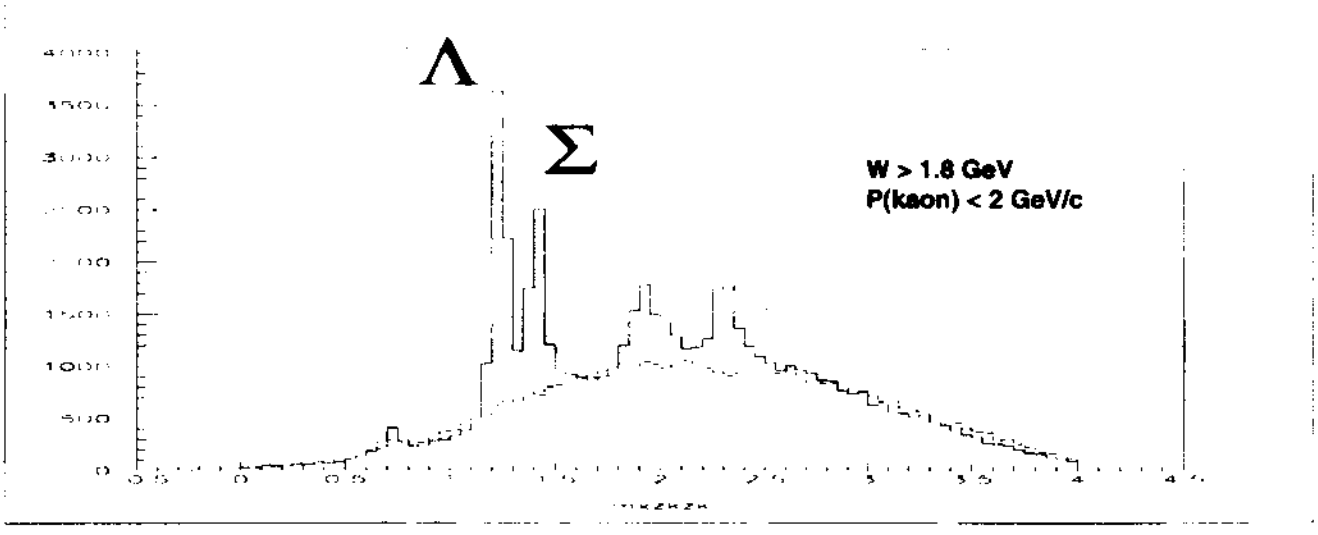
- S channel resonances
- quark distributions
- quark pair creation

CLAS Event Analysis - Selection Procedure

Select events with good electron

- **additional positive charged track candidate**
  - **calculate Kaon mass from time-of-flight**
    - **calculate hyperon's missing mass**
      - **background shape using real pions**





Missing Mass (GeV/c)

ep ⟶ e' K⁺ X

$Q^2 = 0.60\ (GeV/c^2)^2$

$e + p \rightarrow e' + K^+ + \Lambda, \Sigma^0$

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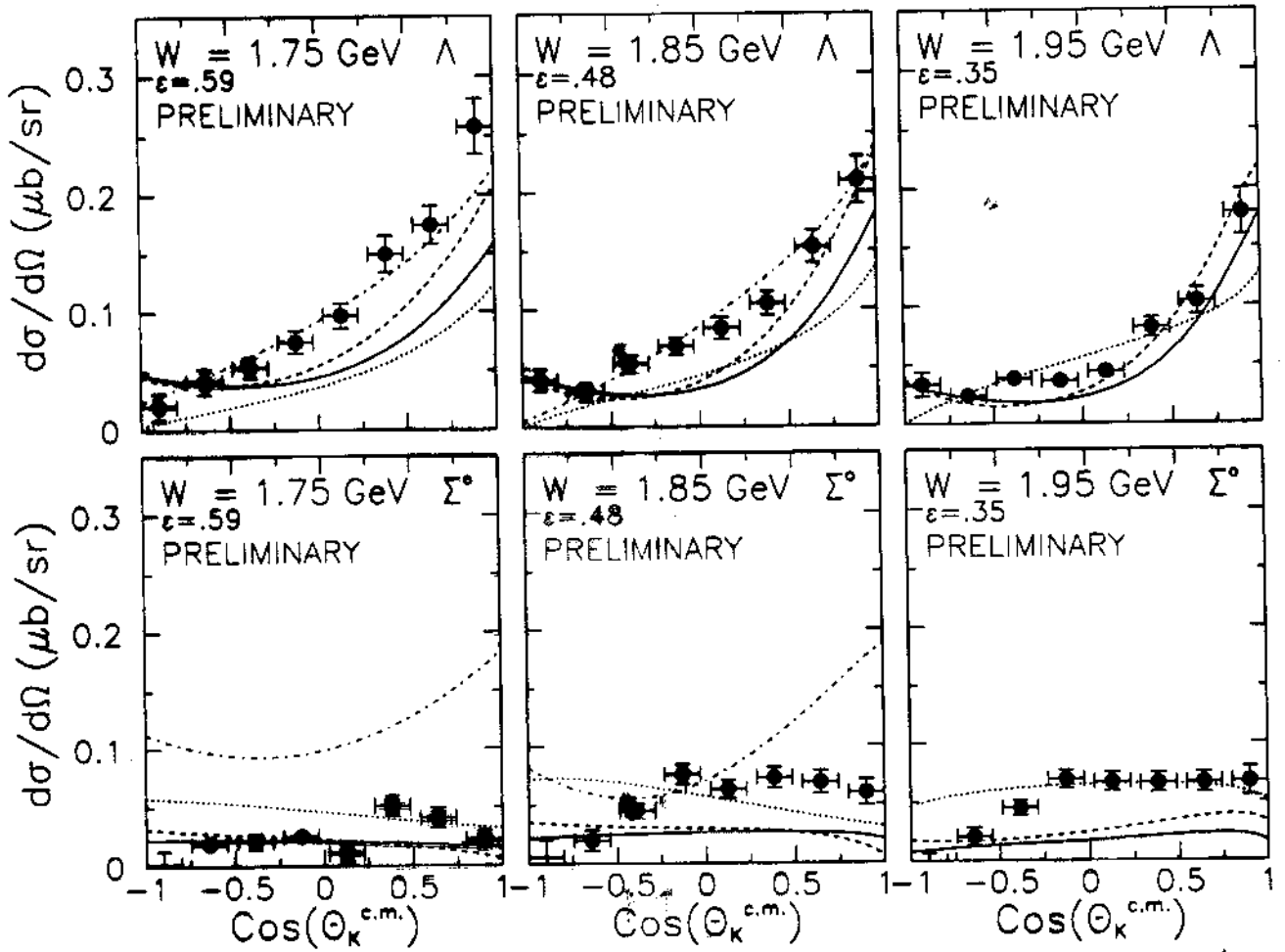

K^+ angular distributions, averaged over all ϕ. Only statistical errors are quoted.
The models are:

- **Adelseck** and Wright (88) for Λ, **Bennhold** (88) **for Σ^0**,
- **Williams, Ji, Cotanch (92),**
- **Mart et al** (98) **(s=t), and**
- **Mart et al** (98) **(s=u).**

Robert Feuerbach, Carnegie Mellon University, March 1999.

e2a Run $E_0 = 4.2$ GeV

$\Lambda(1520)$ Electroproduction

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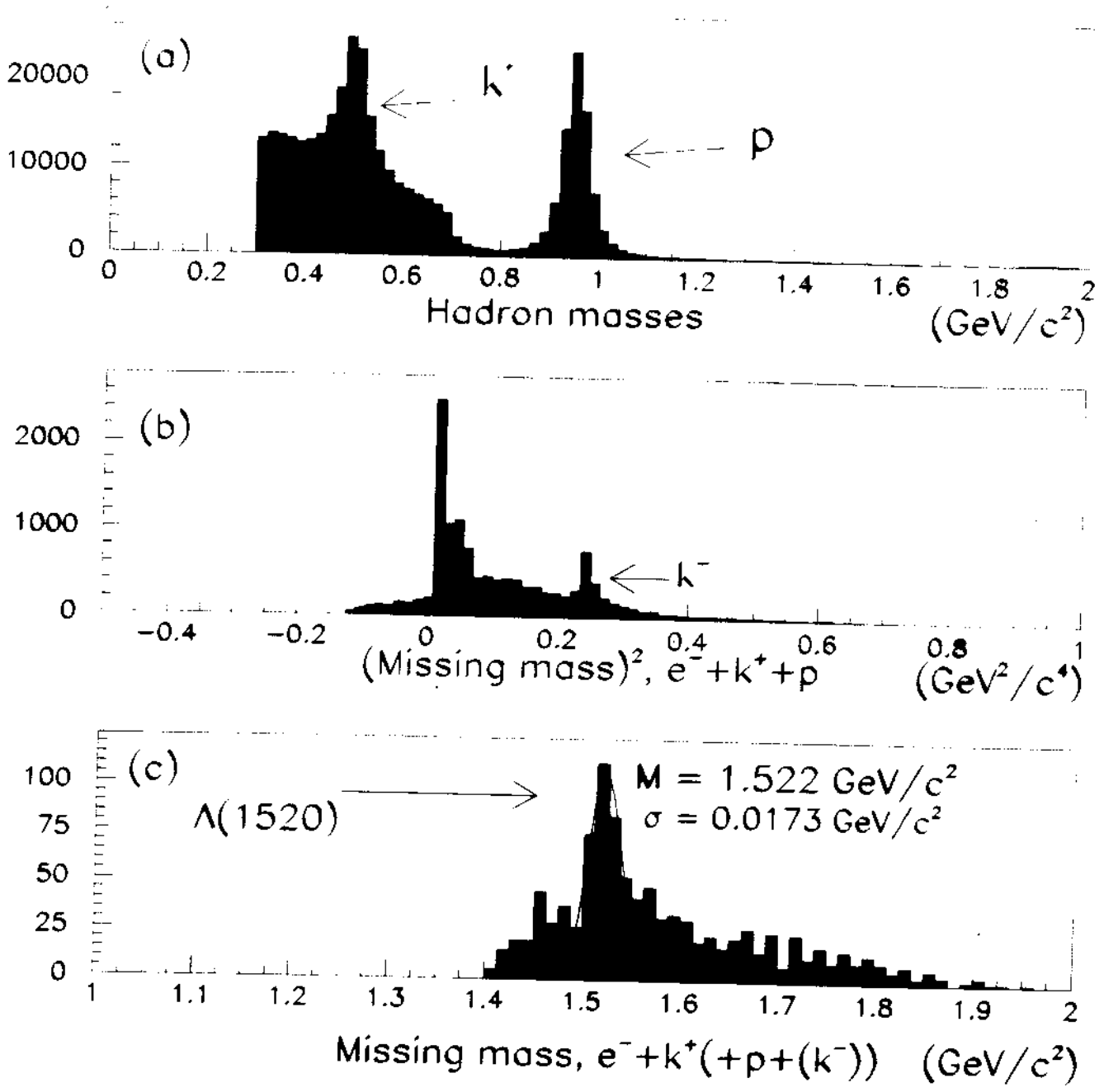

e2a Run $E_0 = 4.2$ GeV

Λ(1520) Electroproduction

K^+ angular distribution

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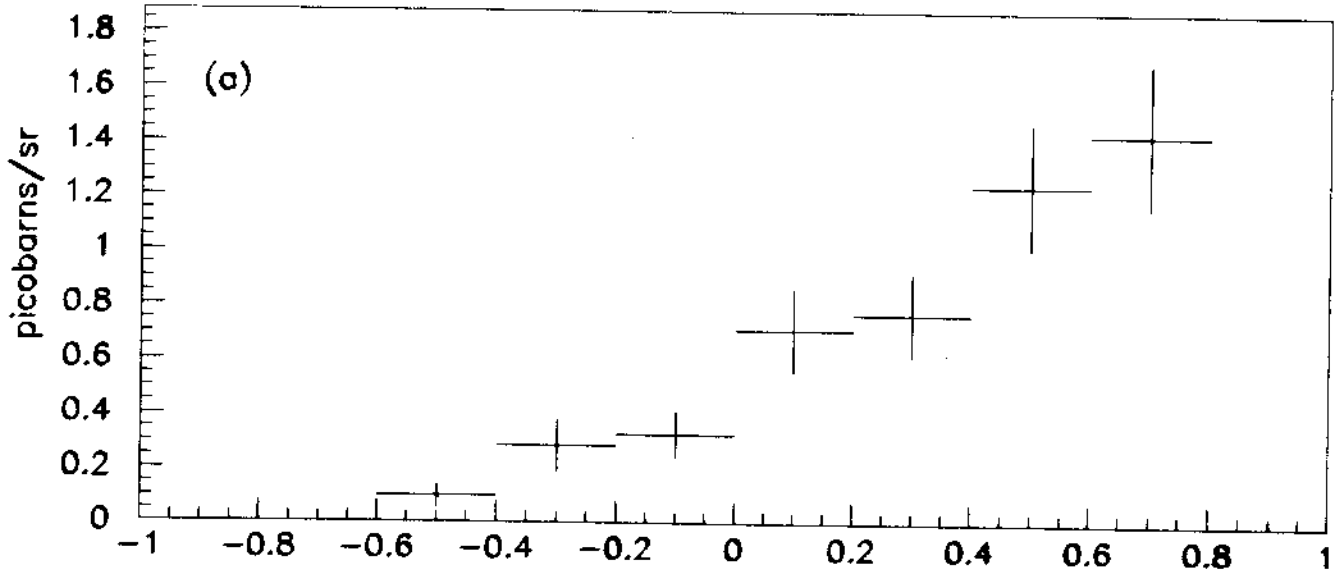

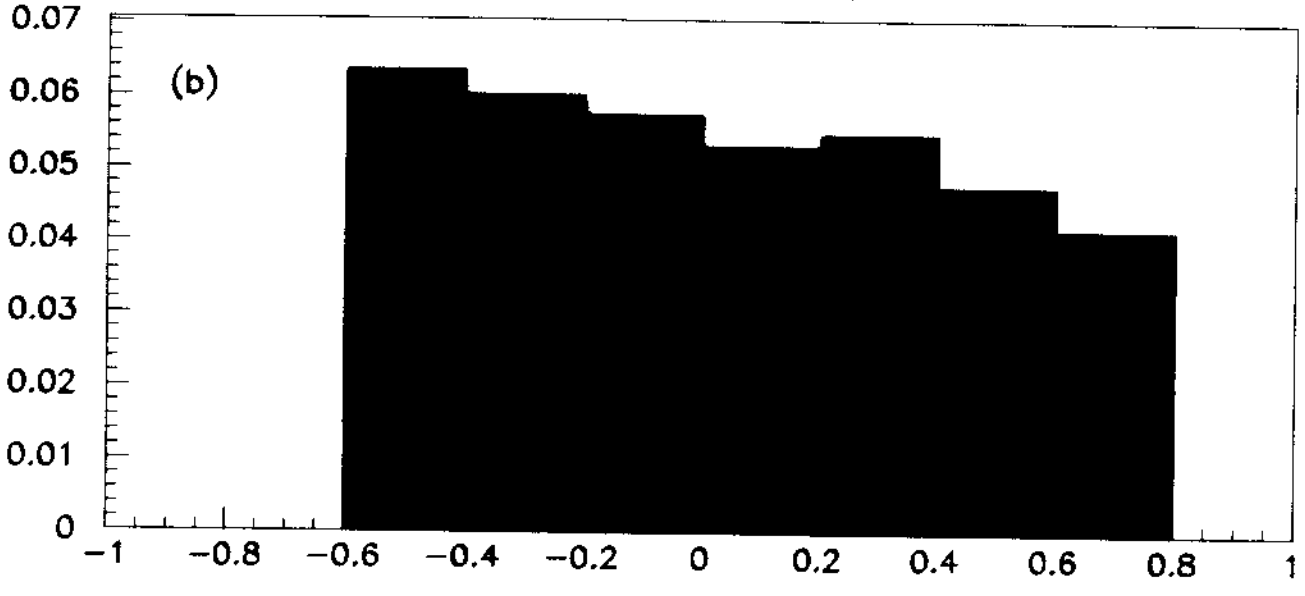

e2a Run $E_0 = 4.2$ GeV

W dependence of $\Lambda(1520)$ Production

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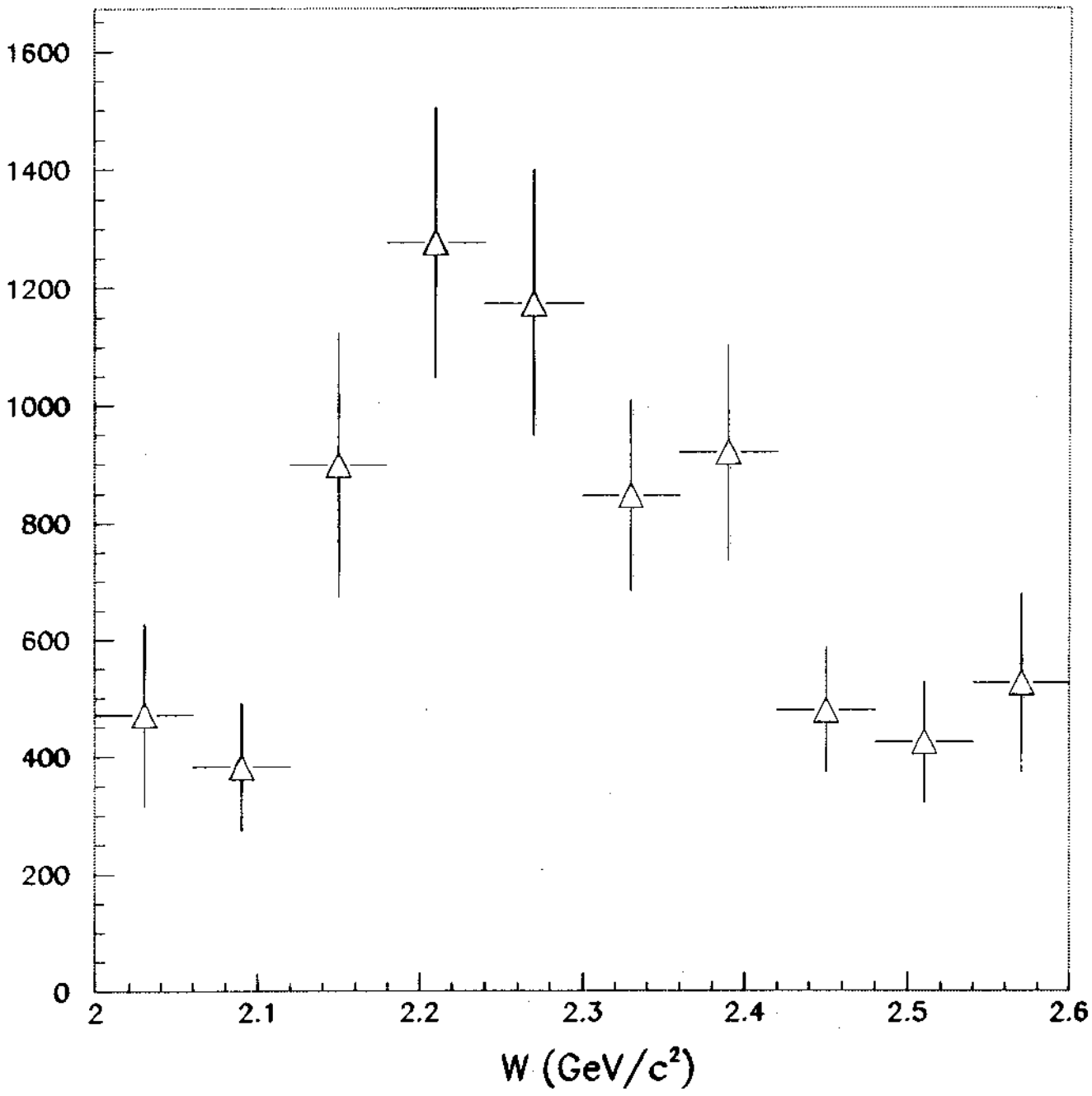
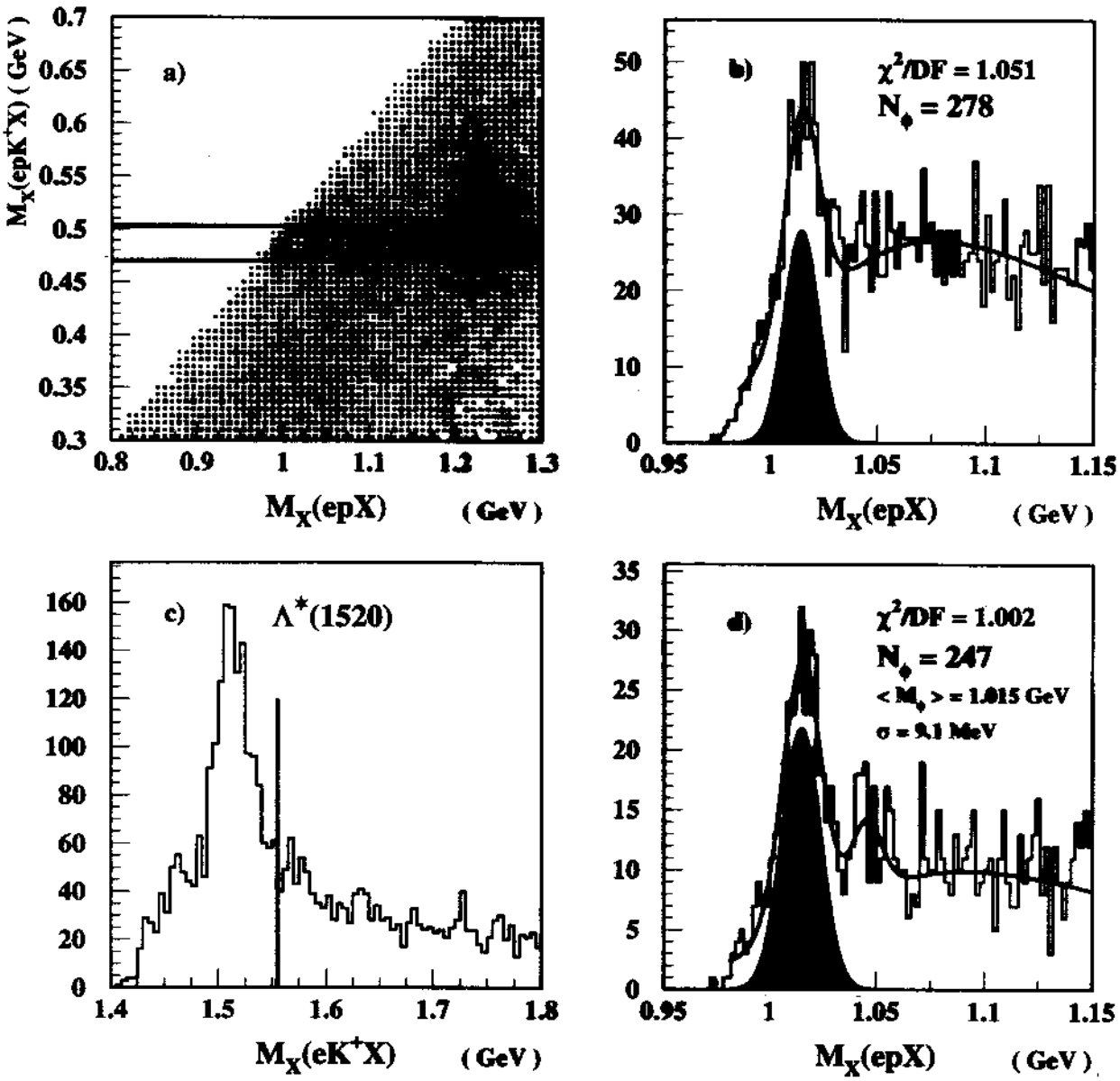


e2a Run $E_0 = 4.2$ GeV

ϕ - electroproduction $ep \to e' p K^+(K^-)$

3.2. PARTICLE IDENTIFICATION

$\phi(1020)$ ID

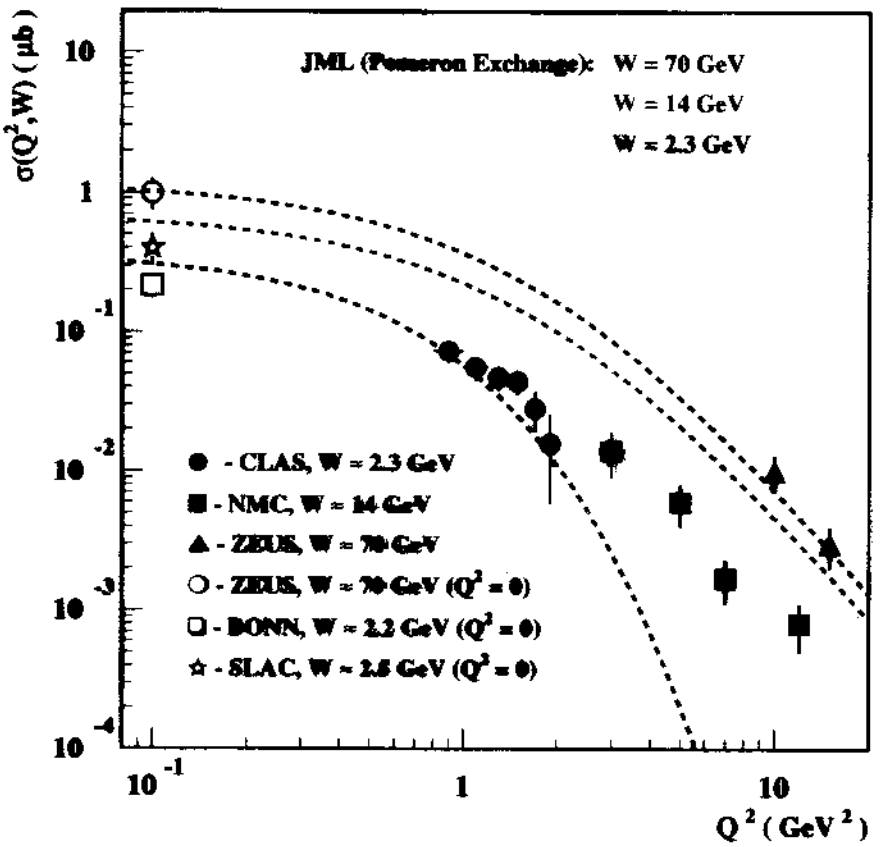


e2a Run

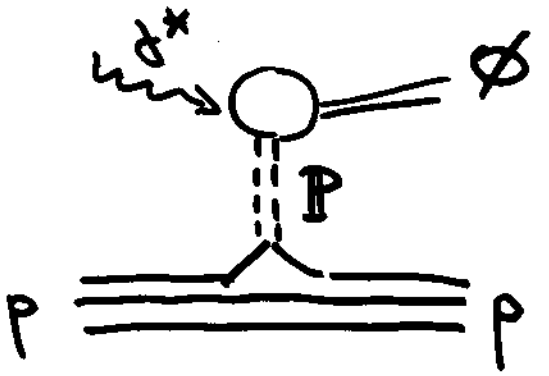
$ep \to e'p\phi$

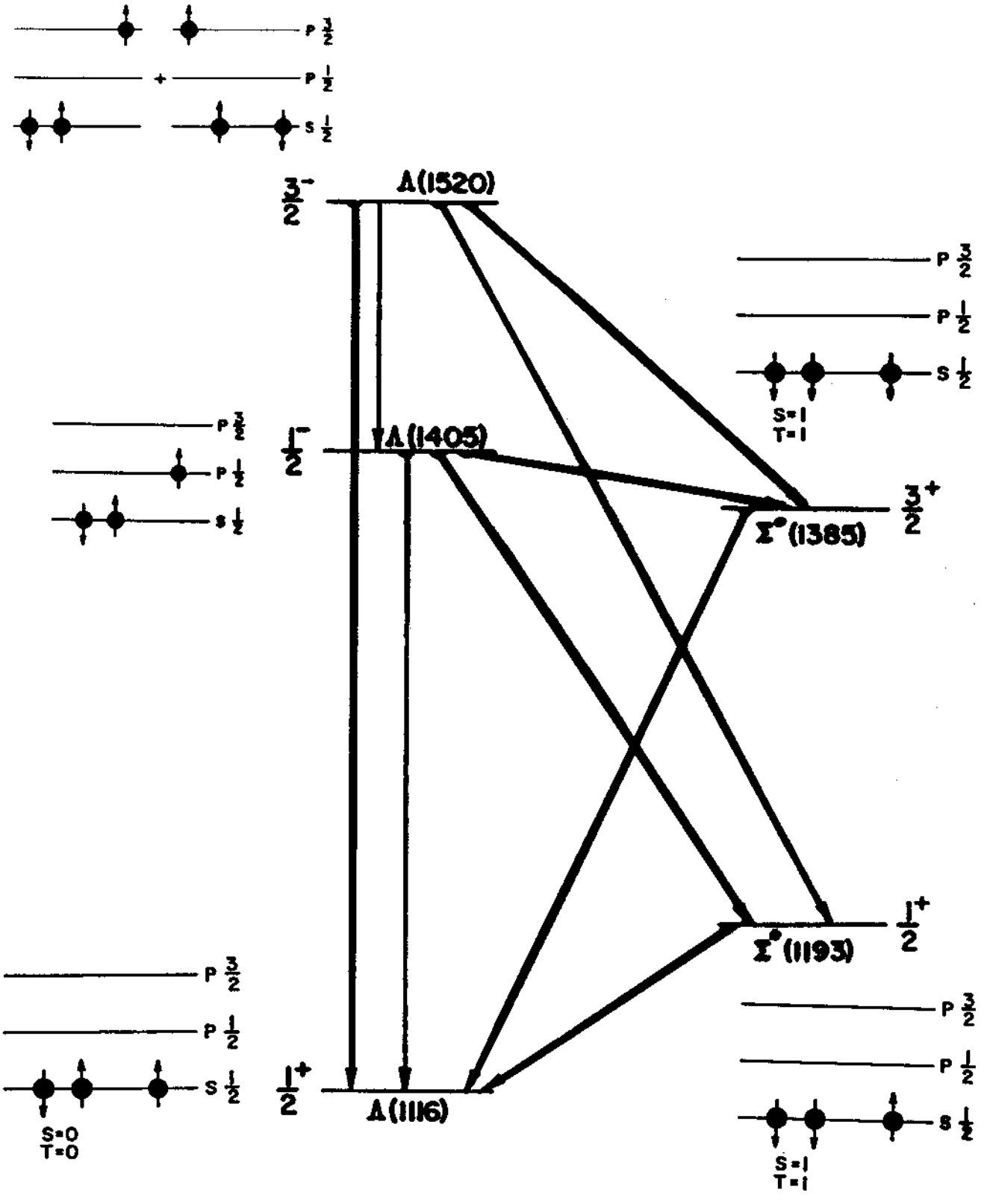
IV. PHYSICS RESULTS

4.2. The Cross-Section Dependence on Q^2



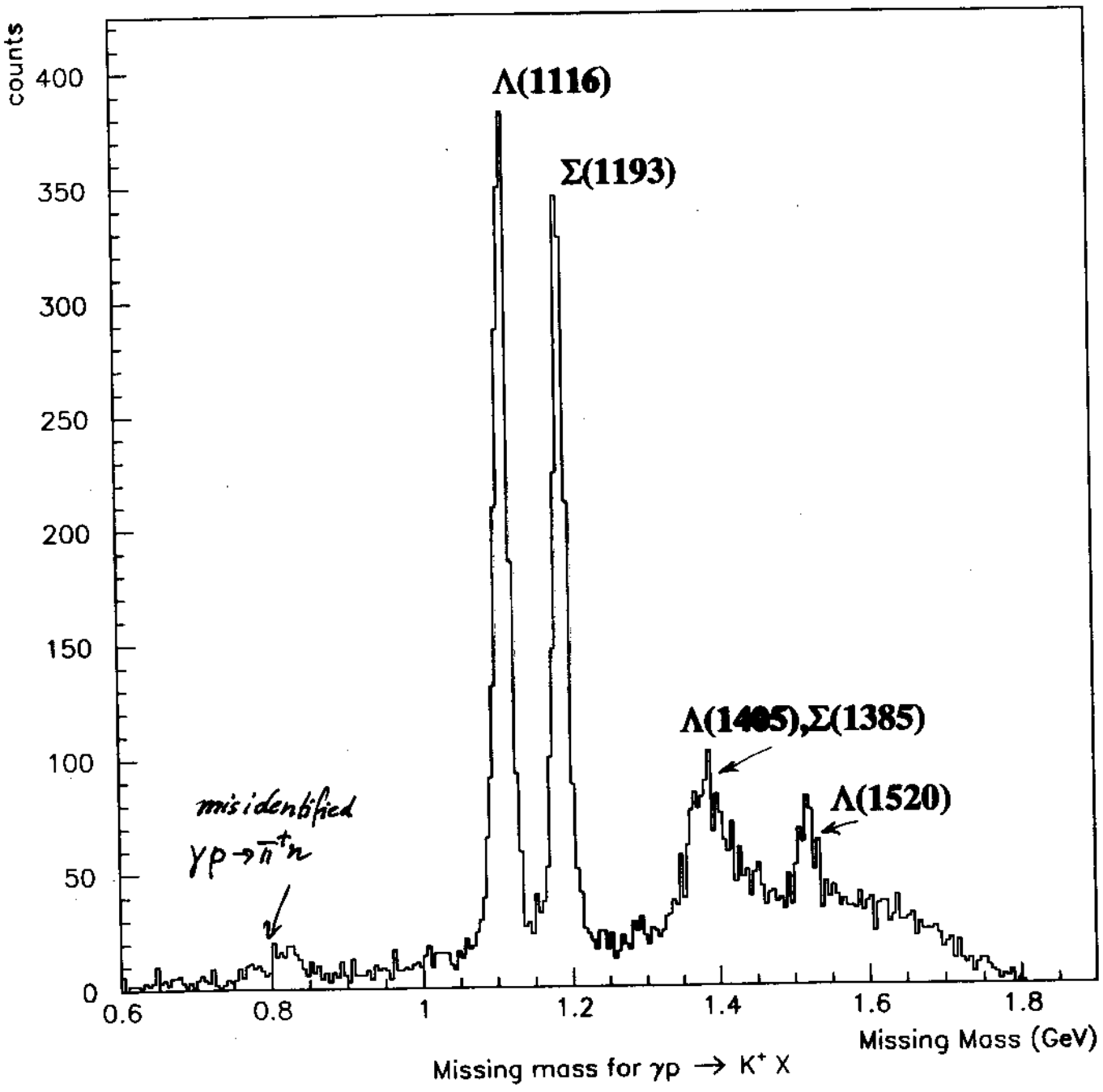
J.M Laget, Nucl. Phys. A581, 397 (1995)





$A^*(1520)$ radiative decay scheme

G1 Result for $\gamma p \to K^+ X$

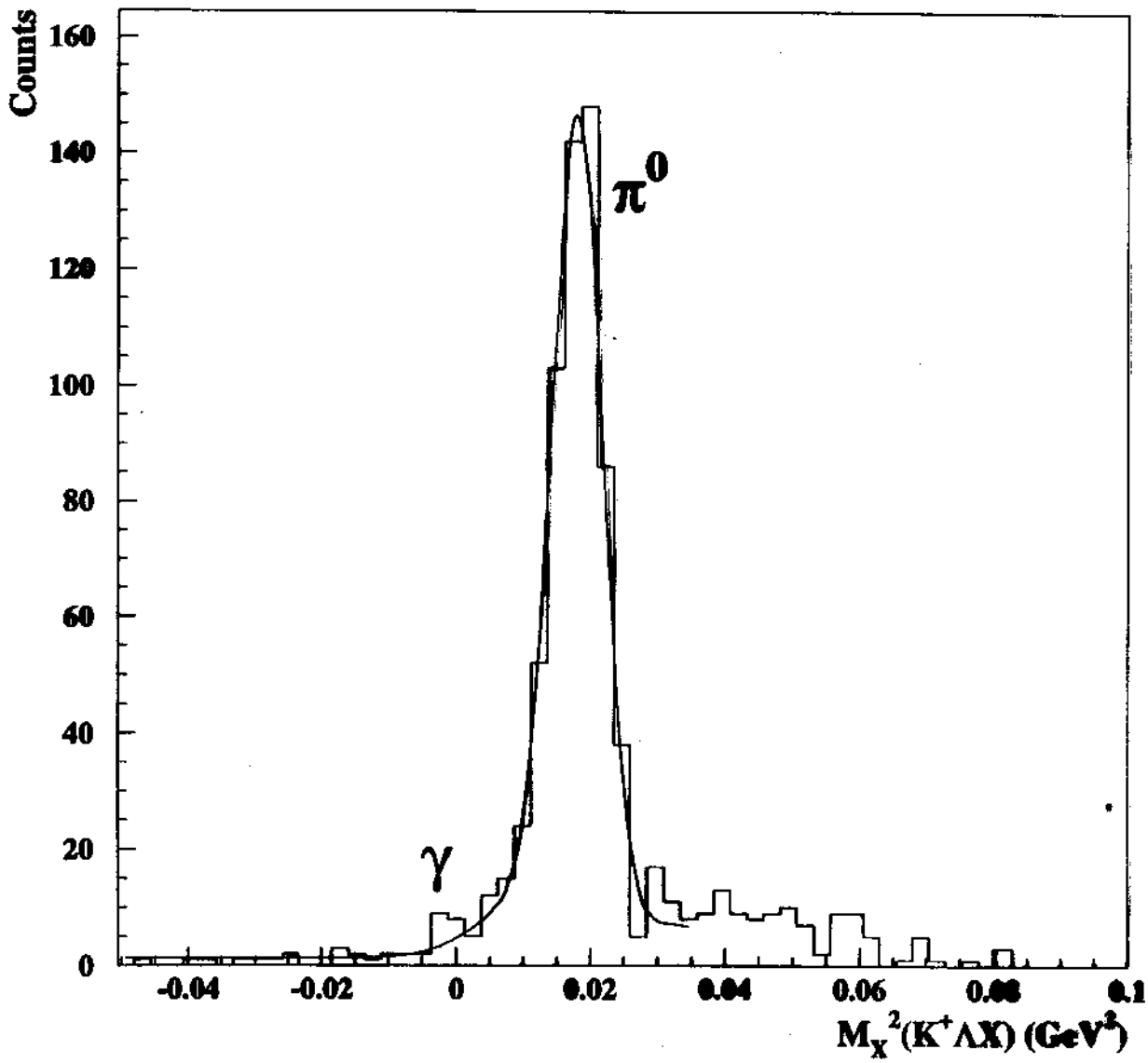


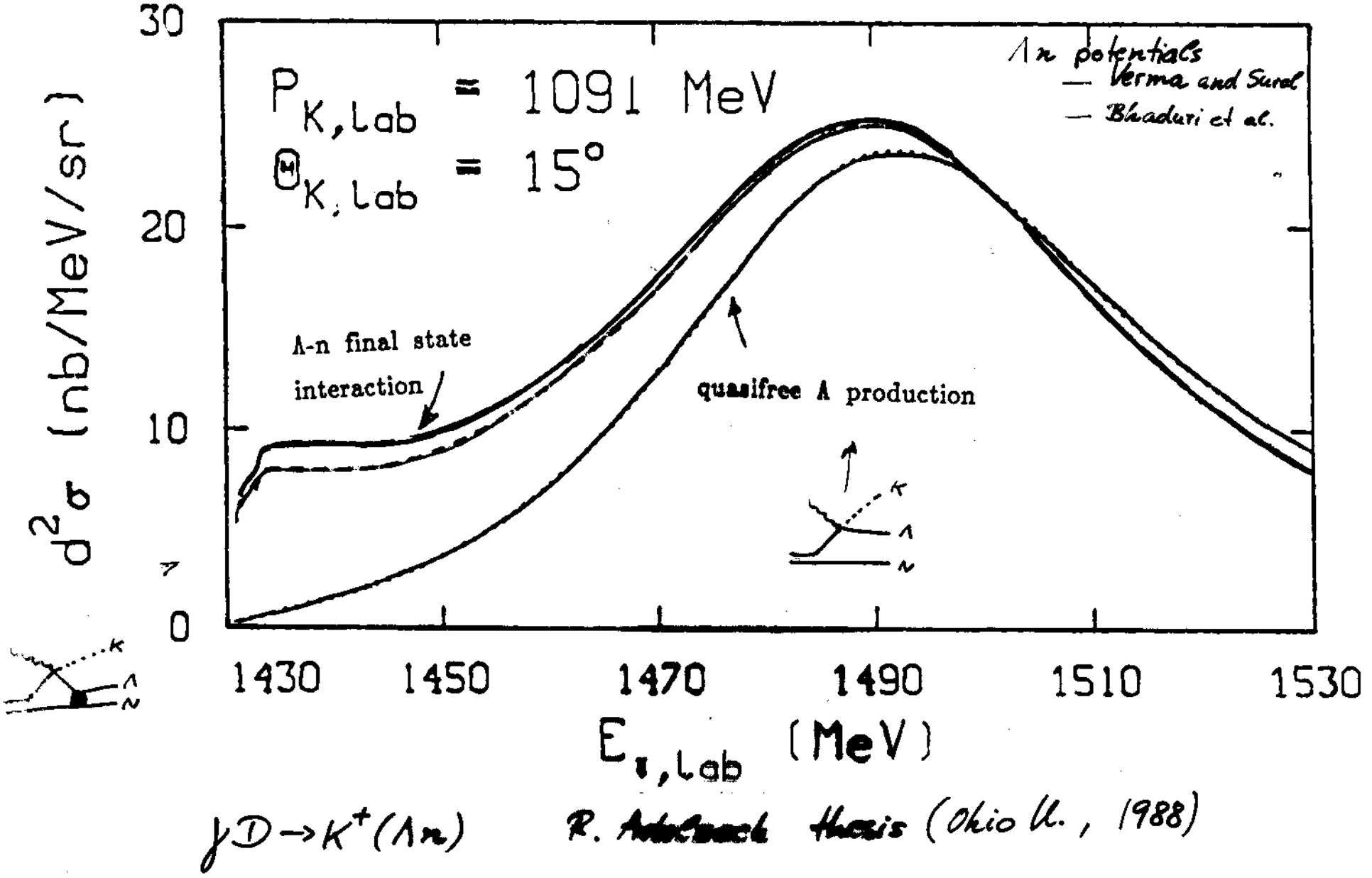
$\gamma p \to K^+ \Sigma^*(1385)$

$E_\gamma = 2.5$ GeV, g1a data

Identifying missing particles

Missing mass squared for $Y^* \to \Lambda X$





Theoretical prediction for the double differential cross section for inclusive kaon emission off the deuteron for a kaon laboratory angle of θ_K = 15° and fixed kaon momentum of 1091 MeV/c as a function of the photon energy, from /ADE88/.