Comments on Physics at New LEPS

K.Imai (Kyoto)

A unique new device can always lead us to a discovery, since the nature is richer than human being can imagine.

LEPS new beam line should be such a unique (in the world) device.

-> highest intensity and/or highest energy

Compton γ beam

keyward; nuclear target

Higher Intensity

- 10^6 -> $10^7 \sim 10^8$ /sec

- High precision (statistics)

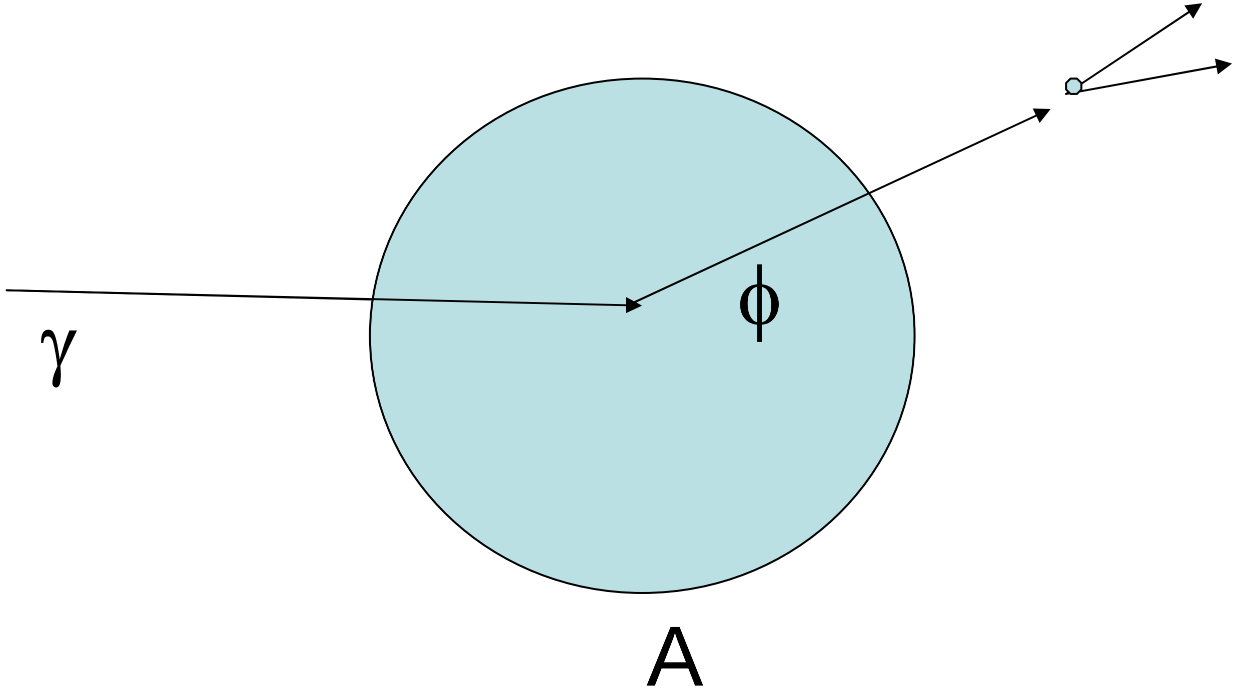
  Physics limited by statistics get new opportunity of discovery !

- New physics

  Physics which is only possible with high intensity !

ϕN cross section from mean free path in nuclear matter

- A-dependence -> cross section



A-dependence of ϕ photo-production

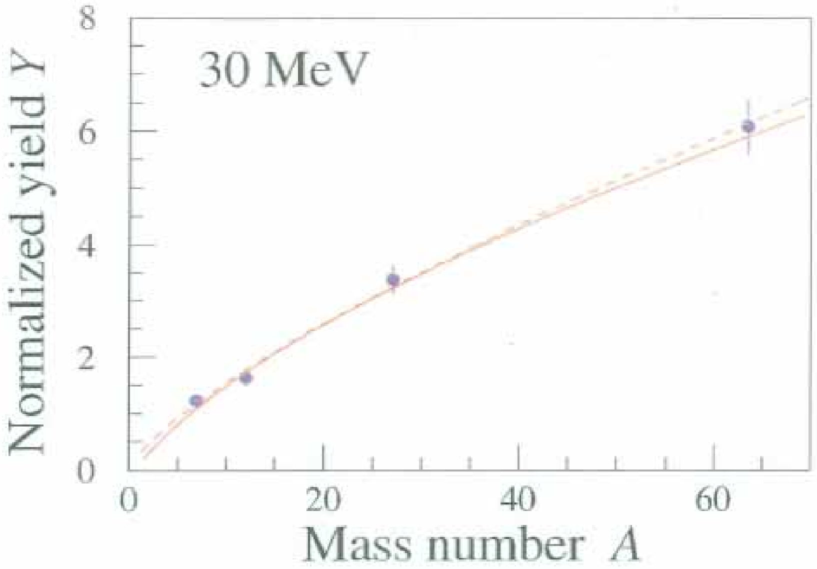


Figure 4.15: A-dependence with the 30 MeV missing energy cut. The solid and dashed curves show the fitting results with the functions $Y(A) = Y_N A_{\mathrm{eff}}(A)$ ($\sigma_{\phi N} = 29.7^{+11.7}_{-8.2}$ mb) and $Y(A) = Y_0 A^{\alpha}$ ($\alpha = 0.742 \pm 0.057$), respectively. The fitting results are summarized in Table 4.4.

$\sigma(\phi n)$ ~ 30mb !!

T.Ishikawa et al., Phys. Lett. B608 (2005) 215.

T.Ishikawa, PhD thesis

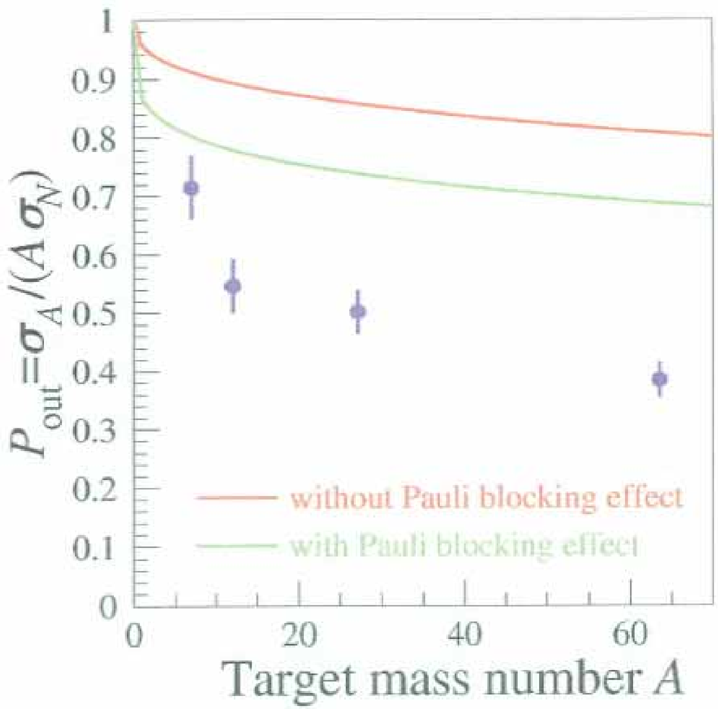


Figure 4.18: Comparison of P_{out} in the kinematical region of the incoherent process. The red and green curves show the theoretical calculations as same as Figure 4.16. The overall normalization error (18%) is not included in this figure.

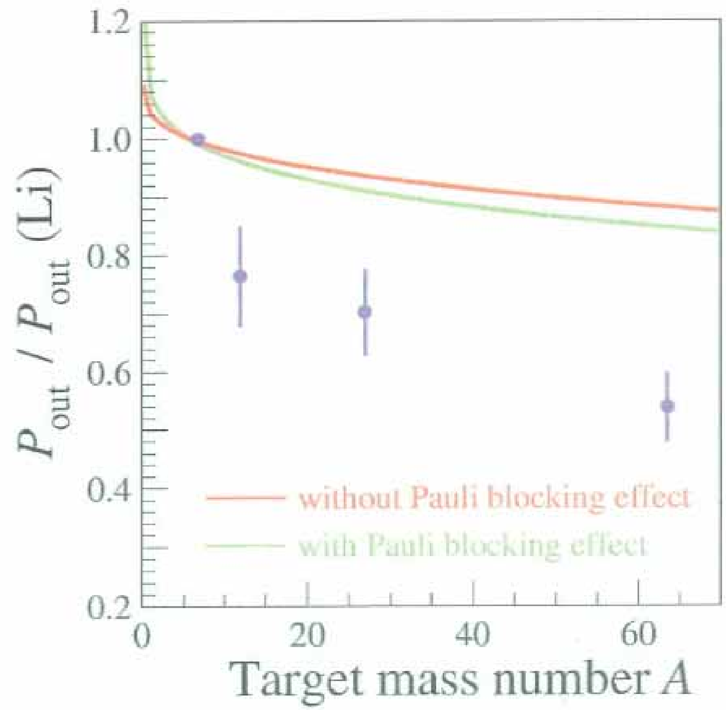


Figure 4.19: Comparison of $P_{\text{out}}/P_{\text{out}}(\text{Li})$ for the yields in the kinematical region of the incoherent process. The red and green curves show the same theoretical calculations as Figure 4.17.

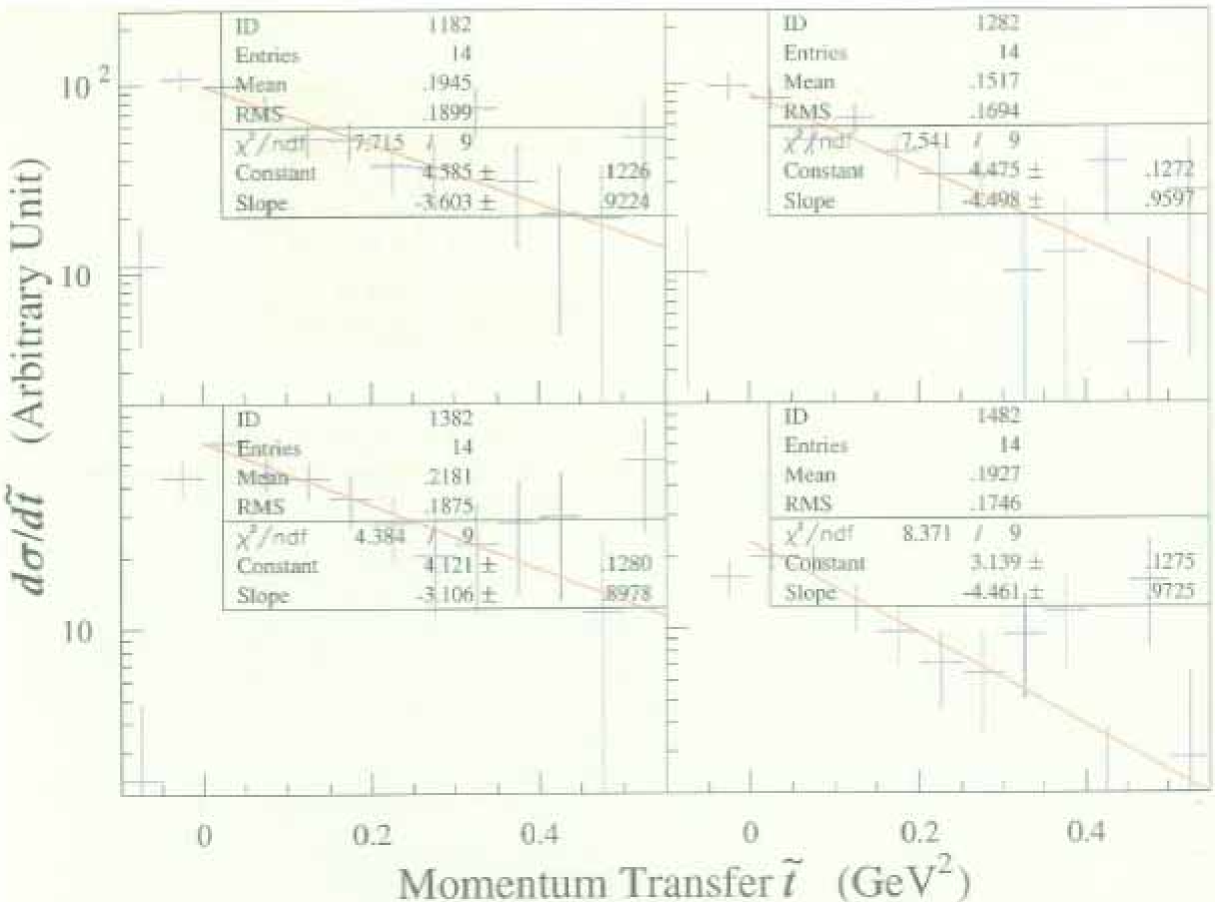
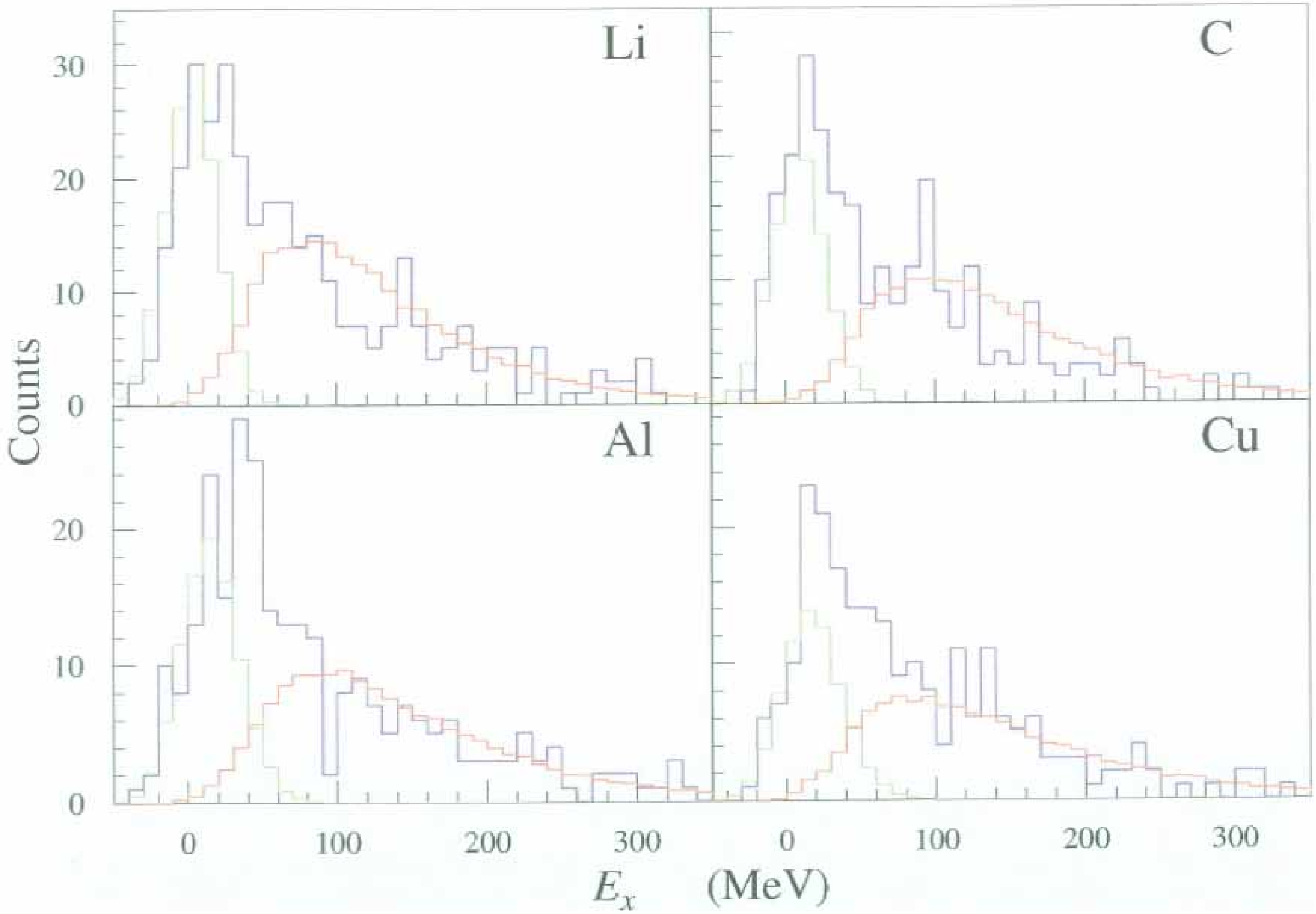


Figure 3.31: Acceptance corrected yield as a function of $\tilde{t}$. The yield is fitted with an exponential function as shown in the red lines.


Li
C
Al
Cu
Counts
30
20
10
0
0
100
200
300
E_x (MeV)

Hypernuclei with γ-beam

- (K-,π-), (π+,K+) reaction n->Λ
- (e,e'K+) reaction (JLab) p->Λ

  high intensity, high resolution
- (γ,K+) reaction p->Λ

  decay particle measurement

  nonmesic weak decay ΔI=1/2 rule?

  -> ${}^{4}H_{\Lambda}$ $\gamma + {}^{4}He \rightarrow K^{+} + {}^{4}H_{\Lambda}$

Decay widths of ${}^4_\Lambda$He			Decay widths of ${}^4_\Lambda$H	
Decay	Results	Zeps[10]	Decay	Results
$\Gamma_{total}/\Gamma_\Lambda$	$1.03^{+0.12}_{-0.10}$	1.07 ± 0.11	$\Gamma_{total}/\Gamma_\Lambda$	$1.36^{+0.21}_{-0.15}$
$\Gamma_{\pi^0}/\Gamma_\Lambda$	0.53 ± 0.07	0.60 ± 0.08		
$\Gamma_{\pi^-}/\Gamma_\Lambda$	0.33 ± 0.05	0.26 ± 0.03	$\Gamma_{\pi^-}/\Gamma_\Lambda$	$1.00^{+0.18}_{-0.15}$*
$\Gamma_{\pi^0}/\Gamma_{\pi^-}$	1.59 ± 0.20	2.3 ± 0.4	$\Gamma_{\pi^-\,{}^4\mathrm{He}}/\Gamma_\Lambda$	$0.69^{+0.12}_{-0.10}$*
Γ_p/Γ_Λ	0.16 ± 0.02	0.16 ± 0.02	$\Gamma_{\pi^-\,{}^4\mathrm{He}}/\Gamma_{\pi^-}$	0.69 ± 0.02*
Γ_n/Γ_Λ	$0.01^{+0.04}_{-0.01}$	0.04 ± 0.02		
$\Gamma_{nm}/\Gamma_\Lambda$	0.17 ± 0.05	0.20 ± 0.03	$\Gamma_{nm}/\Gamma_\Lambda$	0.17 ± 0.11*
$\Gamma_{nm}/\Gamma_{\pi^-}$	0.51 ± 0.16	0.77 ± 0.15		
Γ_n/Γ_p	$0.06^{+0.28}_{-0.06}$	$0.25^{+0.05}_{-0.13}$		

From Outa

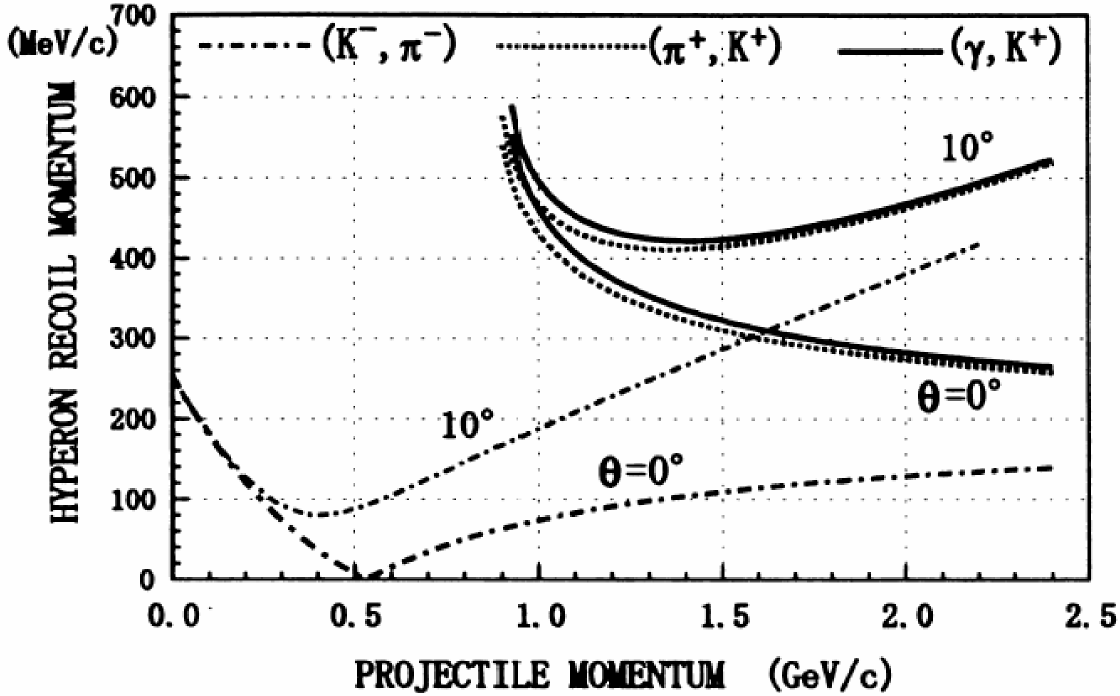


Figure 1. Hyperon recoil momentum q_Λ as a function of projectile lab momentum. Two curves for each reaction correspond to the meson lab scattering angles: $\theta_{\mathrm{lab}} = 0$ and 10 deg.

Motoba et al.,

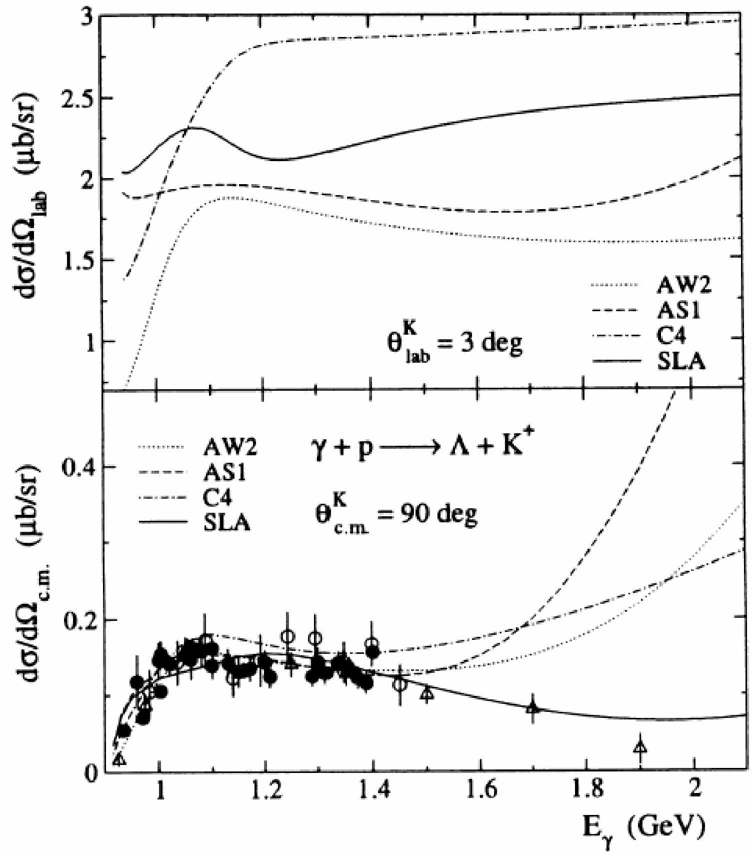


Figure 2. Experimental and theoretical differential cross sections for the $\gamma p \rightarrow \Lambda K^+$ reaction are plotted as a function of the photon lab energy at a fixed kaon scattering angle. See text for the models denoted as AW2, AS1, C4, and SLA. The data are from Refs. [8] (solid circles), [9] (empty circles), and [10] (triangles).

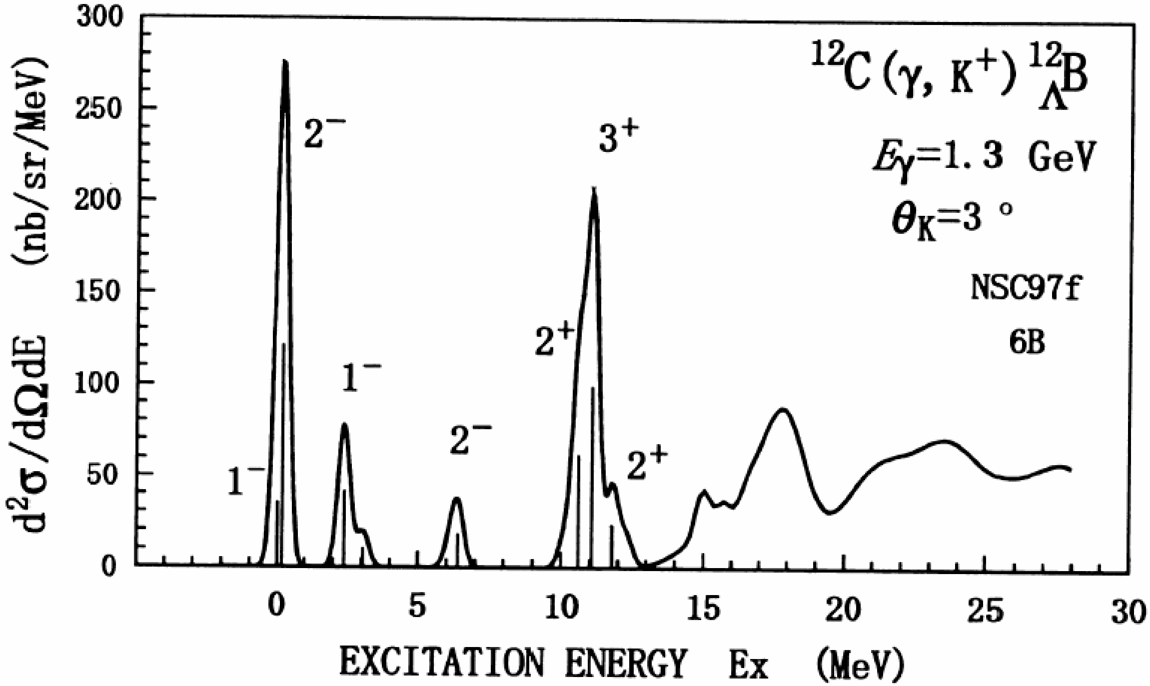


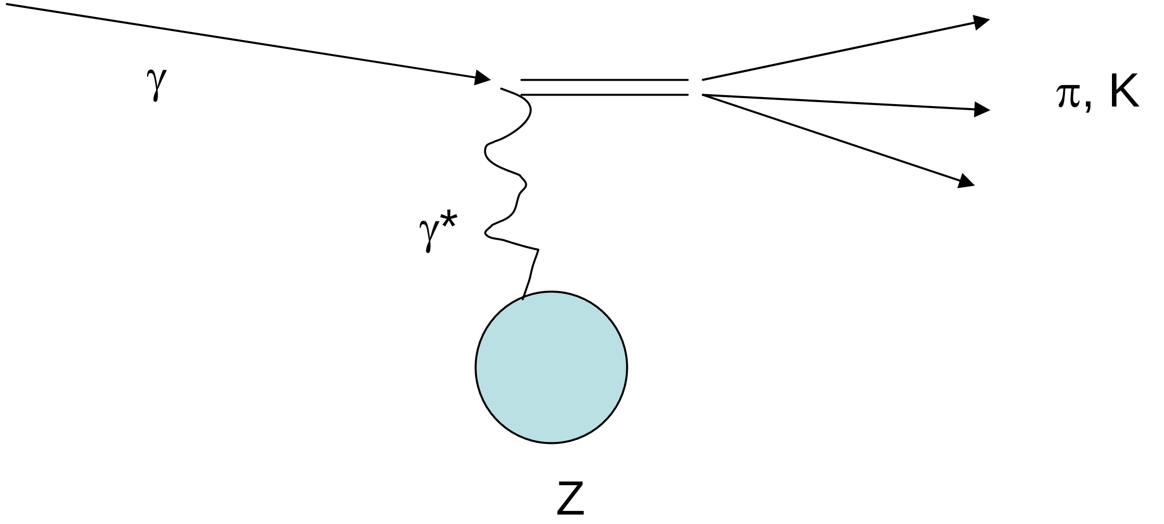
Figure 7. Calculated spectrum for the $^{12}C(\gamma, K^+)^{12}_{\Lambda}B$ reaction at E_γ = 1.3 GeV and θ_K^{Lab} = 3 deg.

Yield?

- Beam; 5×10^7, He target; 2×10^{23}
- Production cross section; 100nb/sr 10^{-31}
- Spectrometer acceptance; 100mstr
- Yield; 0.1 $^4H_\Lambda$/sec -> 4×10^4 /100hours

Higher Energy

- 5~6 GeV high quality photon beam
- Photo-hadron production from nuclei
- Primakoff process



Exotic (structure) hadron search by mean-free path measurements

- Higher mass exotics for higher energy γ beam
  such as Λ(1405) at LEPS TPC
- A-deppendence of photo-hadron production cross section
  - -> mean free path of hadrons
  - -> size of hadrons
  - -> 2quark? 4quark? 5quark? 6quark?
    hybrid? glue ball?

→ 4π general detector for invariant mass measurements

Primakoff process

- Life time measurement of π^0 and η
- Mesons ($J^\pi = 0^{+-}, 2^+$) ->$\gamma\gamma$ coupling

  -> Structure of mesons

  $\pi, \eta, \sigma, a_0, f_0,$ glue ball
- Cross section increases as γ energy increases

→ Forward spectrometer (charged and γ)