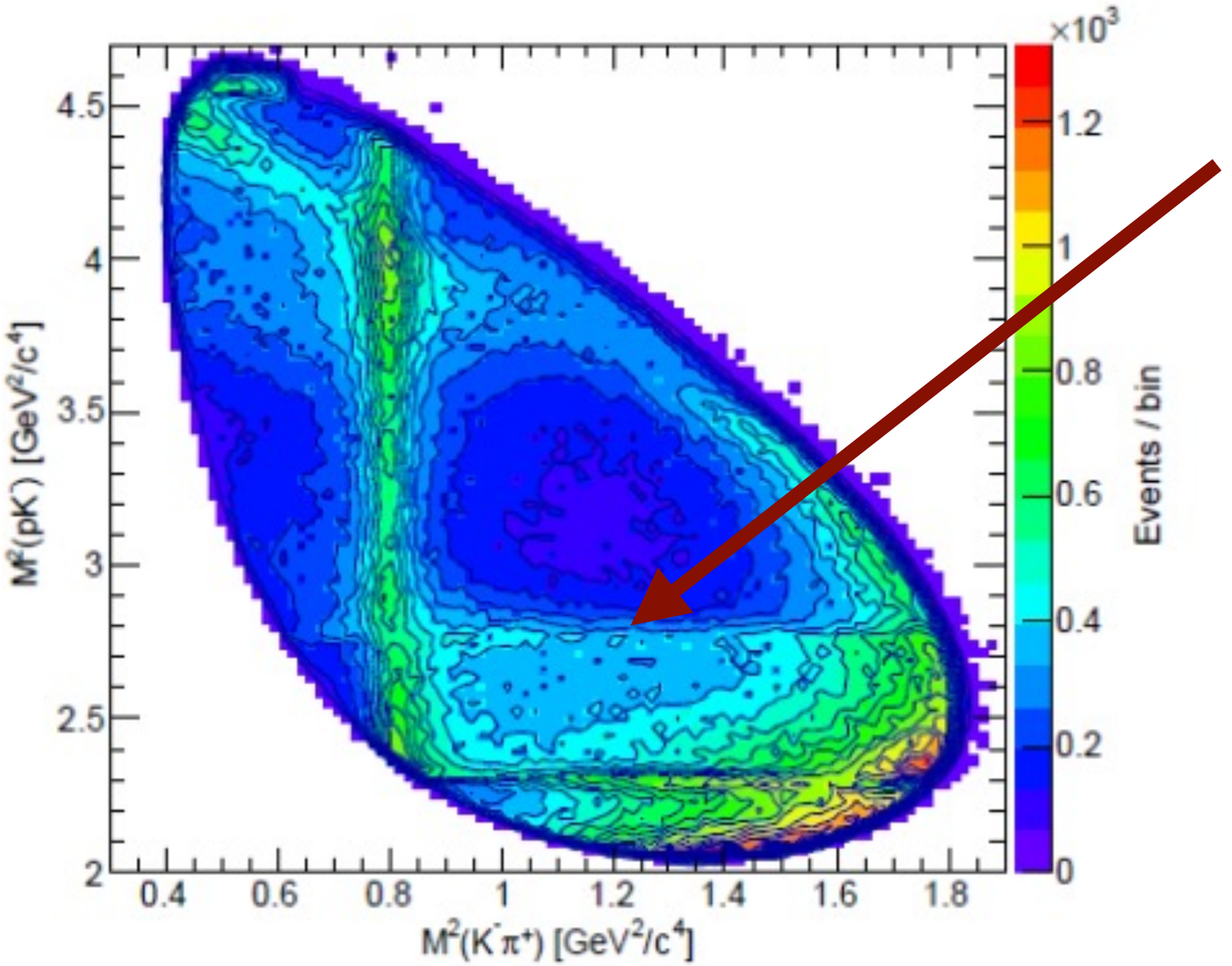
Analysis Topic

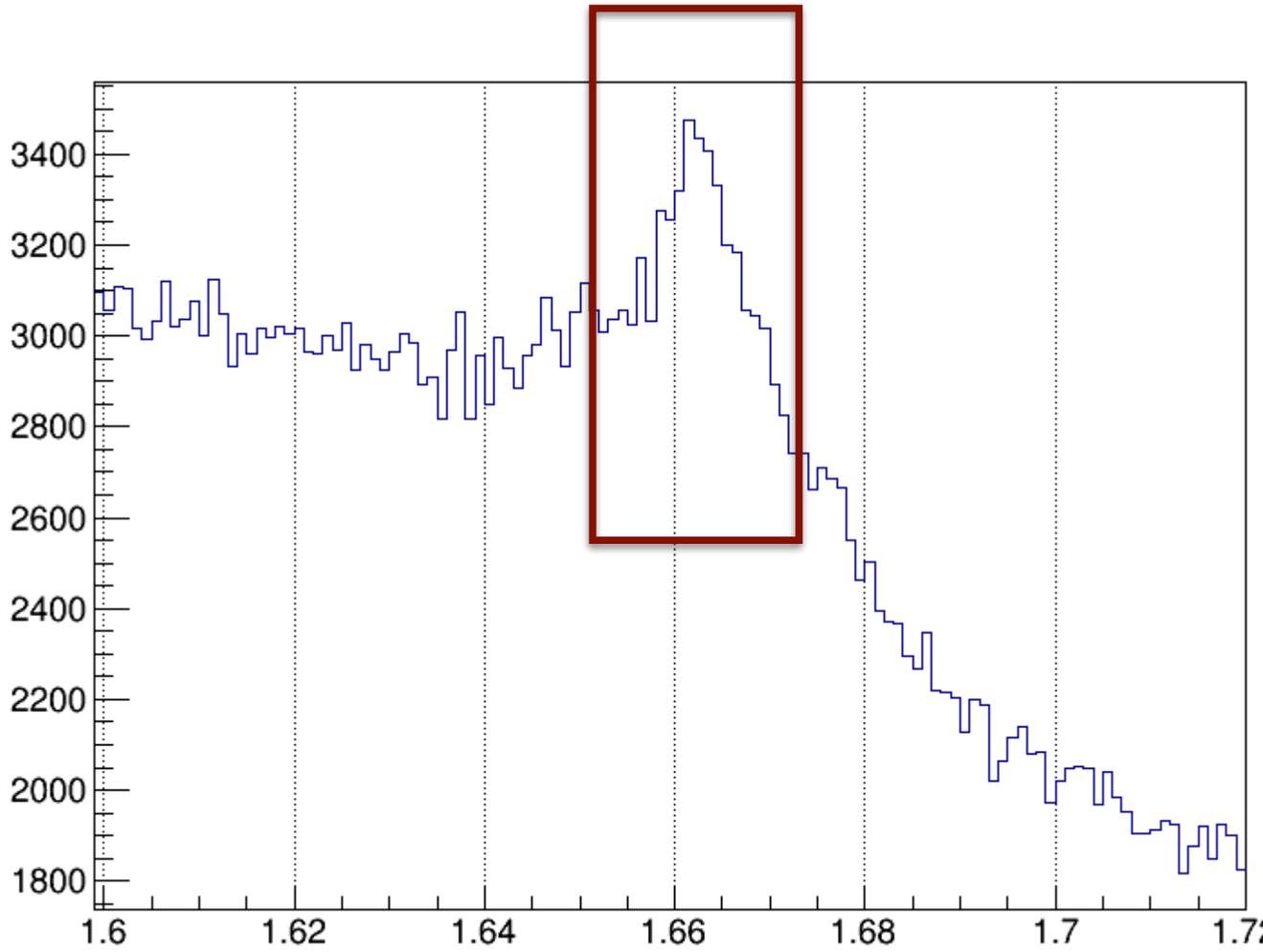
A possible new resonance at Belle

Jaeyong Lee

A new resonance?



A new resonance from Seongbae's analysis



Peak Position is at around 1663 with width ~ 10 MeV (narrower)

Λ(1670): 25-50 MeV

S(1660): 40-200 MeV

S(1670): 40-80 MeV

$M(\eta)+M(\Lambda) \approx 1663.545$

Very close to 1663

Not in PDG!

Related Papers

One experiment: Crystal ball experiment ($K^-p \rightarrow \eta\Lambda$) (PRC64.055205)
→ evidence for a narrow resonance around p_k = 734 MeV/c ($\sqrt{s} = 1669$MeV)

Two independent Theory group:
Kamano et al. [PRC90.065204, PRC92.025205]
→$J^p=3/2^+$(P03), M=1671+2-8 MeV, Γ=10+22-4 MeV

Liu & Xie [PRC85.038201, Eur.Phys.J. A51 (2015) 10, 130]
→$J^p=3/2^-$(D03), M=1668.5±0.5 MeV, Γ=1.5±0.5 MeV

Differential cross section (Crystal ball)

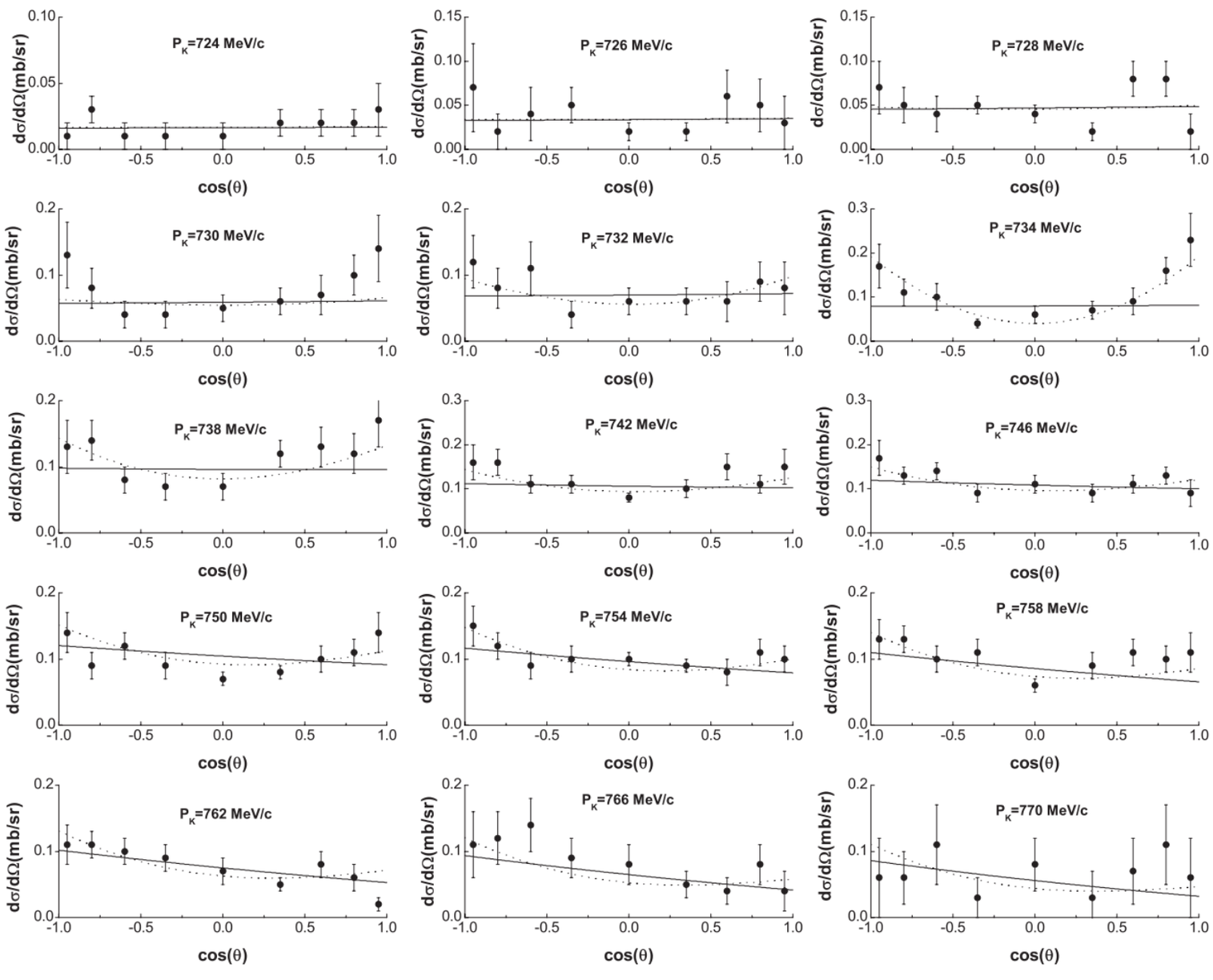


FIG. 3. The best-fitting results for differential cross sections. The solid lines represent the results by considering only $\Lambda(1670)$ and background contributions, while the dashed lines represent the results by including also a narrow D_{03} resonance.

Total cross section (Crystal ball)

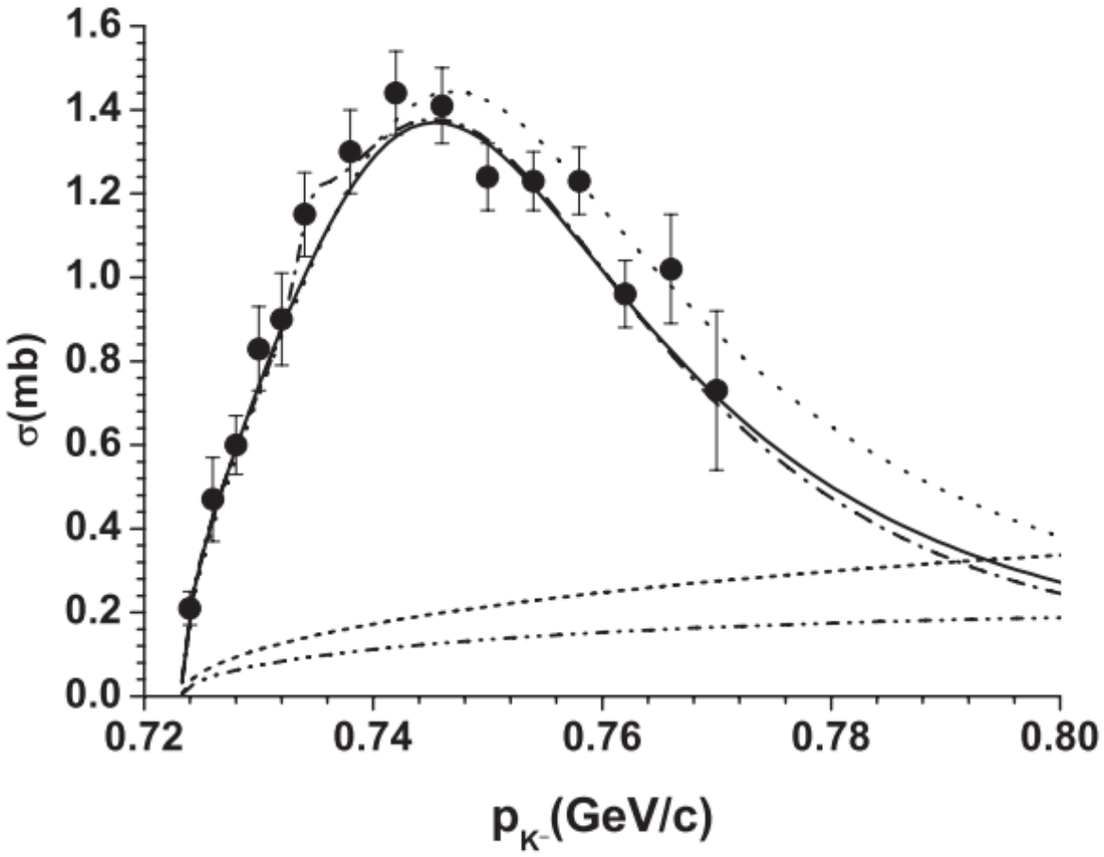


FIG. 2. $K^- p \to \eta\Lambda$ total cross sections compared with the data [1]. Results have been obtained from the best χ^2 fit. The solid line represents the full results, while the contribution from $\Lambda(1670)$, t-channel, and u-channel diagrams are shown by the dotted, dashed, and dot-dot-dashed lines, respectively. The dot-dashed line represents the best results for the total cross sections after including the D_{03} state.

Key measurements

- Peak이 새로운 것을 확인하기 위하여 J=3/2를 확인 (Angular Distribution 분석을 통해)
- K-p→ηΛ 실험에서 J=3/2 컴포넌트가 Differential cross section에서 narrow하게 보였으므로 Resonance(1663)→ηΛ로 가는 채널도 확인해 보고 이 채널의 Angular Distribution도 확인

Spin Measurements

- $\Lambda_c^+ \rightarrow J=1/2$, $\pi \rightarrow J=0$, $\Lambda(1663) \rightarrow J=(?)$

- $\Lambda_c^+ \rightarrow \Lambda(1663) + \pi^+$ Decay Mode 에서 Λ_c^+의 C.M. frame 에서 $\Lambda(1663)$의 모멘텀 방향을 z 축으로 잡으면, $L_z = 0$ 이 되고 따라서 $\Lambda(1663)$의 $|J_z|=1/2$ 로 Polarized.

- $\Lambda(1663)$의 Polarization을 알면, decay particle의 angular distribution으로 부터 $\Lambda(1663)$의 스핀을 결정

- $\Lambda(1663) \rightarrow (\eta\Lambda, Kp)$
  $\eta\Lambda$, Kp 채널 모두 $J=(?) \rightarrow J=0+J=1/2$ 채널

Spin Measurements

1. Λ(1663) J=1/2, $|J_z|$=1/2 일 때, J=1/2→J=0+J=1/2
   L=0 (S-wave) 밖에 안되고 Angular Distribution→Flat

2. Λ(1663) J=3/2, $|J_z|$=1/2 일 때, J=1/3→J=0+J=1/2
   L=1 (P-wave)

J_z=1/2 → J_z'=1/2, -1/2: m=ΔJ_z=0,1 (weight by C-G coefficient)

$$W(\theta,\varphi) \propto \frac{2}{3}|Y_{10}|^2 + \frac{1}{3}|Y_{11}|^2 \propto 3\cos^2\theta + 1$$

L=2 (D-wave)

J_z=1/2 → J_z'=±1/2: m=ΔJ_z=0,1

$$W(\theta,\varphi) \propto \frac{2}{5}|Y_{20}|^2 + \frac{3}{5}|Y_{21}|^2 \propto 3\cos^2\theta + 1$$

Angular Ditsribution → U shape distribution (though P and D waves can not be distinguished