Personal summary of the first half of 2022(2022H1)

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2022.09.12

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- PWA of $e^+e^- \to KK\pi$
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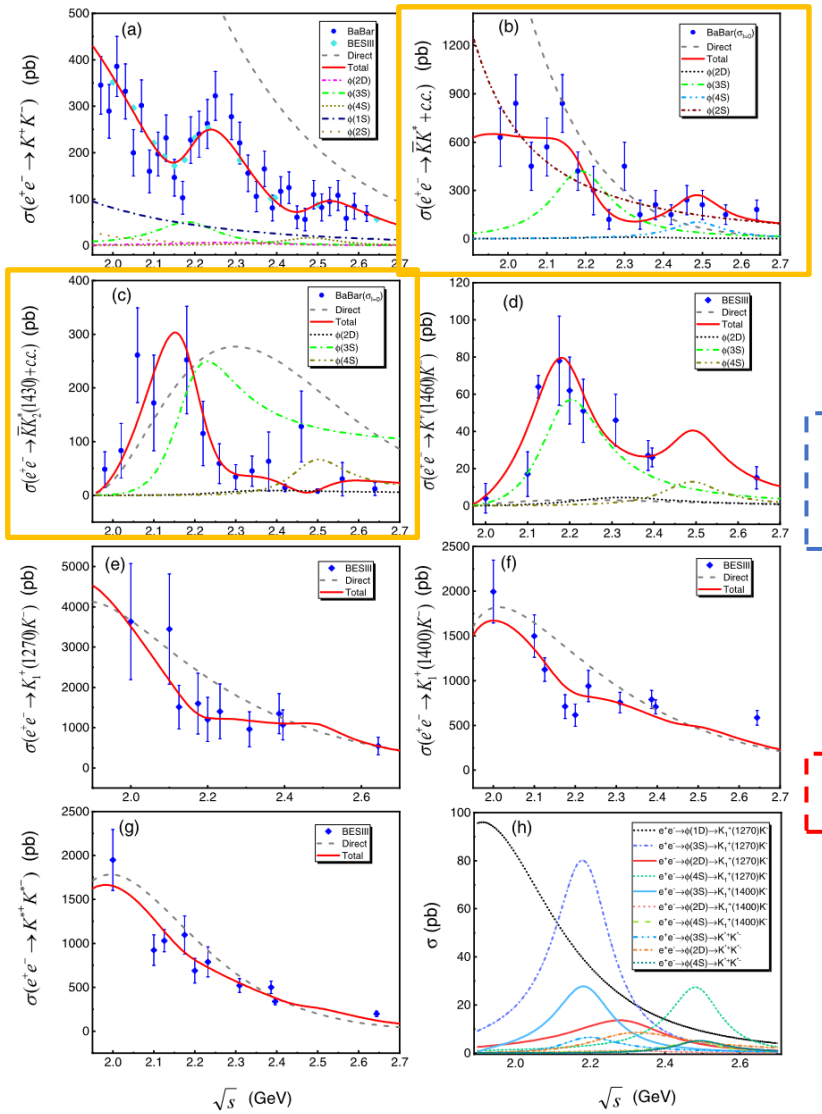
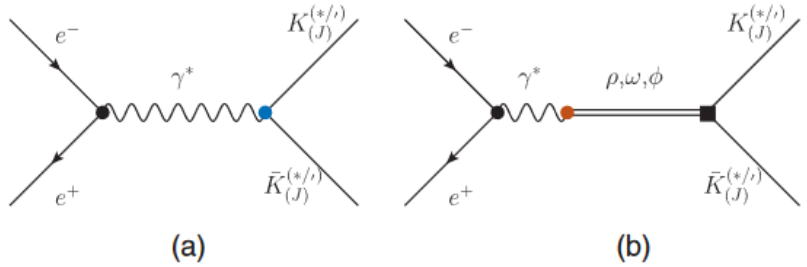
- Summary

PWA of $e^+e^- \to KK\pi$

A combined fit of open-strange channels via e^+e^- annihilation.



10.1103/PhysRevD.104.054045



a) The direct production("Form Factor")
b) Light vector meson contribution("BW")

Problems:

Why only R(I=0) is considered in "VMD"

Experimentally

BaBar: Dalitz amplitude analysis of $e^+e^- \to K_S K\pi$

I. I started Couple-channel PWA of $e^+e^- \to KK\pi$ in Sept. 2021

$e^+e^- \to K^+K^-\pi^0$

$e^+e^- \to K_S^0 K^\pm \pi^\mp$

II. In Feb. 2022, we found the system is incomplete and neutral channel is necessary.

$e^+e^- \to K^0\bar{K}^0\pi^0$

Timeline

I. In Feb. 2022, the analysis "PWA of $e^+e^- \to K_S^0 K_L^0 \pi^0$" is started.
II. From Feb. to March, the event selection part is ready.
III. I gave a report on this job at the BESIII workshop.

IV. From Apr. to June, the PWA fit part is ready and a talk is given on Tau-QCD group meeting.

V. From June to July, the systematic uncertainty related to PWA and unrelated part are ready and a talk is given on Tau-QCD group meeting.

Timeline

VI. From Aug.28 to now, the memo of is reviewed by conveners.

Study of e+e- to ksklpi0 from 2.00 to 3.08 GeV *(liuweimin - Aug 28, 16:20)* NEW

1 Re: Study of e+e- to ksklpi0 from 2.00 to 3.08 GeV *(Xiaorong Zhou - Sep 02, 16:26)* NEW

1 Re: Study of e+e- to ksklpi0 from 2.00 to 3.08 GeV *(liuweimin - Sep 04, 21:22)* NEW

... 1 Message(s) NEW

2 Re: Study of e+e- to ksklpi0 from 2.00 to 3.08 GeV *(liuweimin - Sep 11, 15:56)* NEW

VII. A talk will be reported on the next workshop, Sept. 13, 2022

4:20 PM **Study of e+e- -> Ks KL pi0 from 2.00 to 3.08 GeV at BESIII** 25m

Speaker: weimin Liu (University of Science and Technology of China)

Summary of this work:

A. In the last semester(2022H1), a PWA work is finished. The memo is being reviewed by conveners and Prof. Zhou is satisfied with it and agreed that we can move on.
B. One talk is given at the BESIII workshop.
C. Two status reports are given at the Tau-QCD group meeting.
D. One talk is being prepared for the next BESIII workshop(Sept.13, 2022).

Cross section measurement of $e^+e^- \to \omega\eta'$

I. Since August, I began to answer coordinator's questions.

Re: Re: [Bes3_member] BESIII Physics and Software meeting this week (Apr. 01, 2022) *(Wu Yan - Aug 16, 19:09)*
Re: Re: [Bes3_member] BESIII Physics and Software meeting this week (Apr. 01, 2022) *(Wu Yan - Aug 16, 19:10)*
1 Re: [Bes3_member] BESIII Physics and Software meeting this week (Apr. 01, 2022) *(Dayong Wang - Aug 17, 20:01)*
1 Re: [Bes3_member] BESIII Physics and Software meeting this week (Apr. 01, 2022) *(Wu Yan - Sep 02, 17:01)* NEW
2 Re: [Bes3_member] BESIII Physics and Software meeting this week (Apr. 01, 2022) *(Wu Yan - Sep 06, 16:20)* NEW

Start with this one

白羽	[收件箱] Re:Re: Re:Re: Re:Re: Re:Re: Re:Re: Re:Re: Re:用BW多解包求解多解的疑惑		09-06
我	[已发送] Re: Re:Re: Re:Re: Re:Re: Re:Re: Re:Re: Re:用BW多解包求解多解的疑惑		09-06
白羽	[收件箱] Re:Re: Re:Re: Re:Re: Re:Re: Re:Re: Re:用BW多解包求解多解的疑惑		09-06
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白羽	[收件箱] Re:Re: Re:Re: Re:Re: Re:Re: Re:用BW多解包求解多解的疑惑		09-05
白羽	[收件箱] Re:Re: Re:Re: Re:Re: Re:Re: Re:用BW多解包求解多解的疑惑		08-31
我	[已发送] Re: Re:Re: Re:Re: Re:Re: Re:用BW多解包求解多解的疑惑		08-31
白羽	[收件箱] Re:Re: Re:Re: Re:Re: Re:用BW多解包求解多解的疑惑		08-31
我	[已发送] Re: Re:Re: Re:Re: Re:用BW多解包求解多解的疑惑		08-31
白羽	[收件箱] Re:Re: Re:Re: Re:用BW多解包求解多解的疑惑		08-31
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白羽	[收件箱] Re:Re: Re:用BW多解包求解多解的疑惑		08-30
我	[已发送] Re: Re:用BW多解包求解多解的疑惑	📎	08-30
白羽	[收件箱] Re:用BW多解包求解多解的疑惑		08-29

Cross section measurement of $e^+e^- \to \omega\eta'$

II. Repeat the result and redo the cross-section fit part and update the memo

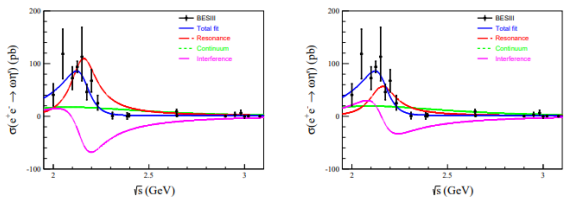
Rewrite by me

$$P_f(\sqrt{s}) = q(\sqrt{s})^3,$$
$$q(\sqrt{s}) = \frac{1}{2\sqrt{s}}\sqrt{\left(s - \left(M_\omega^{PDG} - M_{\eta'}^{PDG}\right)^2\right)\left(s - \left(M_\omega^{PDG} + M_{\eta'}^{PDG}\right)^2\right)}. \quad (13)$$

In total, there are 6 independent parameters in this fit: ϕ, c_0, p_0, M_R, Γ_R and $\Gamma_R^{e^+e^-}\mathcal{B}_R^{\omega\eta'}$.

Figure 20 shows the fit results with Equation 10. The goodness of fit is $\chi^2/n.d.f. = 12.02/13 \approx 0.93$, where $n.d.f.$ is the number of degree of freedom. All the parameters are listed in Table 11. The significance of this resonance is also estimated by comparing χ^2 value with and without the resonant amplitude in the fit, and taking the change of number of degree of freedom($\Delta n.d.f. = 4$) into account, which is 9.6σ.

After scanning ϕ from 0 to 2π, there are two sets of parameters possibly as multi-solutions in this fit. The muti-solutions have been cross-checked by the method provided by [24]. The values of phase between f_1 and f_2 in the amplitude formula which are obtained from fitting are the same within the margin of errors in my understanding. But the integral of amplitude of interference term is a little different which may be the reason for the existence of multi-solutions. After the discussion with the author of BW-MULTI-SOLUTION [24] package, these two solutions are calculated with the smallest two zero points. The other zeros are far away from the pole and have a very small impact. There is also a negative solid zero point, which is very close to the negative pole of $\sqrt{s}$, but the impact of that is also minimal. In this case, it is very likely that there are multiple approximate multi-solutions in a small interval. At this time, the distribution of -ln$\mathcal{L}$ is no longer a parabolic surface in normal parameter space, and it is difficult to find the usually reasonable multi-solution in fitting. So the solutions are approximate.



(a) Solution 1 (b) Solution 2

Figure 20: Results from this work(black dots) including statistical and systematic uncertainties for the $e^+e^- \to \omega\eta'$ Born cross section and a fit(blue solid curve) to the results. The red dashed curve presents the contribution of resonant part, while the green dashed curve presents the contribution of none-resonant part.

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Inclusive production of $\pi^{\pm}, K^{\pm}, p/\bar{p}$ in e^+e^- annihilation

Experimental observable:

$$\frac{N_{h+x}^{obs}}{N_{had}^{obs}} \cdot \frac{1}{\Delta p_h}$$

N_{h+x}^{obs}: the numbers of observed $e^+e^- \to h + X$

N_{had}^{obs}: the numbers of observed $e^+e^- \to hadrons$

h: $\pi^{\pm}, K^{\pm}, p/\bar{p}$

X: the non-detected part of the final state

⟺ R value measurement

Problems:

$\pi^{\pm}, K^{\pm}, p/\bar{p}$: ⟺ PID Mis-identifications: $N_{h+x}^{obs} \neq N_{h+x}^{"raw"}$

Correction:

$$N_{\pi^+}^{raw} = f_{\pi^+\to\pi^+} \cdot N_{\pi^+}^{obs} + f_{K^+\to\pi^+} \cdot N_{K^+}^{obs} + f_{p\to\pi^+} \cdot N_p^{obs}$$

$$N_{K^+}^{raw} = f_{\pi^+\to K^+} \cdot N_{\pi^+}^{obs} + f_{K^+\to K^+} \cdot N_{K^+}^{obs} + f_{p\to K^+} \cdot N_p^{obs}$$

$$N_p^{raw} = f_{\pi^+\to p} \cdot N_{\pi^+}^{obs} + f_{K^+\to p} \cdot N_{K^+}^{obs} + f_{p\to p} \cdot N_p^{obs}$$

⟺ $J/\psi \to \pi^+\pi^-\pi^0$ $(0.1,1.5)\ GeV/c$ Linqin

⟺ $J/\psi \to K_S K^{\pm}\pi^{\mp}$ $(0.4,1.4)\ GeV/c$ Weimin

⟺ $J/\psi \to p\bar{p}\pi^+\pi^-$ $(0.2,1.4)\ GeV/c$ Geling

Kaon PID efficiency study start from Sept. 2022 to now

- Channel: $J/\psi \to K_S K^{\pm}\pi^{\mp}$

- Four good charged tracks: $|\cos\theta| < 0.93, \Sigma Q_i = 0$
- K_S reconstruction

- For the tracks not from K_S:
  - ➢ PID: at least one of them is identified as pion.
    - ☐ Prob_Kaon > Prob_Pion && Prob_Kaon >Prob_proton
    - ☐ Prob_Pion > Prob_Kaon && Prob_Pion >Prob_proton
    - ☐ Prob_proton > Prob_Pion && Prob_proton >Prob_Kaon

PID efficiency:

$$\epsilon = \frac{n}{N}$$

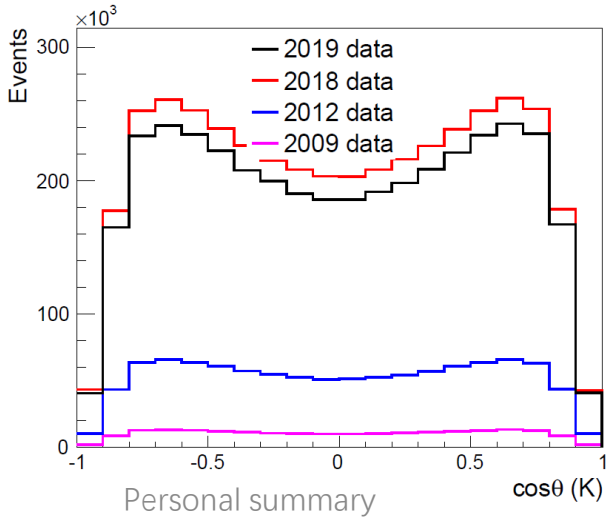
n: the number of events which the concerned track is identified as Kaon/pion/proton
N: the number of events in the selected sample.

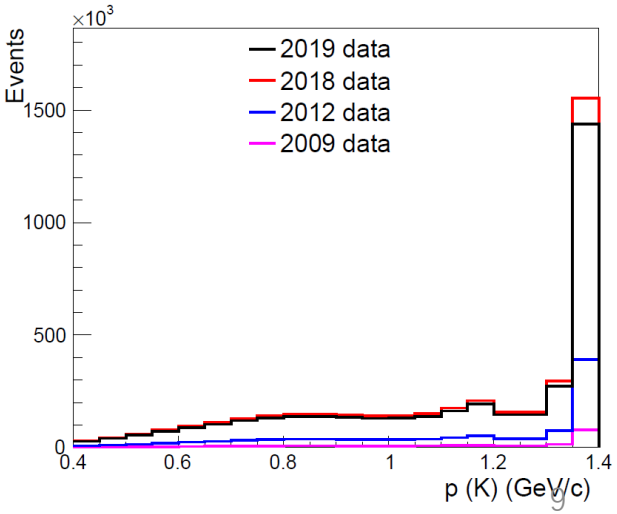
$f_{K^+\to\pi^+}$

$f_{K^+\to K^+}$

$f_{K^+\to p}$

In each bin





Summary

In the first half of 2022, I

- finished a PWA analysis. The memo is being reviewed by conveners.(2022.02-2022.08)
- inherited the analysis of $e^+e^- \to \omega\eta'$. (2022.08-now)
- started a Kaon PID mis-identification study.(2022.08-now)

- gave one talk at BESIII workshop and two reports at Tau-QCD group meeting.
- usually stay in the office from 9:30 AM to 10:00 PM.