



Measurements of $e^+e^- \rightarrow \phi K^+ K^-$ and $2K^+ 2K^-$ cross sections at 2.00 -3.08 GeV

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Outline

• **BESIII experiment**

✓ BEPCII and BESIII detector

✓ Data samples

• Cross sections of $e^+e^- \rightarrow K^+K^-K^+K^-$ and ϕK^+K^-

- \checkmark Motivation
- ✓ Event selection
- ✓ Method of extracting signal events
- ✓ Preliminary results of cross sections

Summary

Beijing Electron Positron Collider II [BEPCII]



≈126 GeV/c²

SONS

BO

GAUGE

Н

Higgs

g

BeiJing Spectrometer III [BESIII]





Motivation 1

The states with $J^{PC} = 1^{--}$ include $\phi(2170)$, $\rho(2150)$ and so on. $\phi(2170)$, so called ** Y(2175), is interpreted as a $s\bar{s}g$ hybrid; a $2^3D_1s\bar{s}$ state; or a $s\bar{s}s\bar{s}$ tetraquark state.



- Theorists have predicted a neat resonance peak around * 2.150 GeV in the three-meson system ϕK^+K^- (the solid).
 - The dashed-dotted line and dashed (solid) line are the theoretical calculation.
 - The data, which corresponds to $e^+e^- \rightarrow \phi(\pi\pi)_{I=0}$ reaction (triangles for charged pions and boxes for neutral pions), are from BABAR Collaboration.

$$e^+e^- \rightarrow \phi(2170) \rightarrow \phi f_0(980) \rightarrow \phi K^+K^-$$

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√s (MeV)

2200

0.6

0.5

0.3

 $\sigma\left(\phi f_{0}
ight)\left(nb
ight)$ 0.4

Motivation 2

♦ Cross section line shape of $e^+e^- \rightarrow \gamma_{ISR}K^+K^-K^+K^-$.



Event selection

Good Charged Track:

 $|V_z| < 10.0 \& |V_r| < 1.0 \& |\cos\theta| < 0.93;$ N_{Good} ==3||4; (To improve statistic uncertainty: Missing one Kaon.)

• PID with dE/dx and TOF:

Kaon: prob_K>prob_p && prob_K>prob_π;

At least three Kaons are indentified:

N(K+) = N(K-) = 2; or N(K+) = 2 & N(K-) = 1; or N(K+)=1 & N(K-) = 2;

• Vertex fit ($K^+K^-K^\pm$).

✓ Momentum(Kaon_PID)<=0.8*P_beam
 (To veto background events)

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e^+e^- \rightarrow K^+K^-K^+K^-
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✓ 1C kinematic fit (K⁺K⁻K[±]) (χ^{2}_{1c} (K⁺K⁻K[±]) < 20)

 $e^+e^- \rightarrow \phi K^+K^-$

Signal extraction@3.08GeV

(1) K_Missing Fitting:
 Signal: MCShape⊗ Gaussian;
 Background:
 Chebyshev Polynomial;

N=3693.7±73.1

- (1) $\chi^2_{1C}(K^+K^-K^+K^-) < 20;$
- (2) φ(1020) Fitting:
 Signal: P-wave BW⊗ Gaussian;
 Background: Argus;



N=1690.8± 50.1

Weighting method@3.08GeV

- Weighting method is applied
 - The momentum for K⁺K⁻K⁺K⁻ process
 - The invariant mass distribution of K+K- for φ K+K- process





Summary

- ✓ With R-scan data in [2.0, 3.08]GeV, cross sections of $e^+e^- \rightarrow K^+K^-K^+K^-$ and $\phi K^+ K^-$ have been measured.
- ✓ Enhancement at \sqrt{s} =2.232 GeV is observed in the line shapes of these cross sections.
- ✓ There is no strong indication that enhancement is from Y(2175).



 $Breit - Weigner \otimes Gaussan + Polynorimal$

Thanks for your attention!