

Weekly Report

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July 24, 2023

Plan

- 1) Study the interference behavior between $J/\psi \rightarrow \phi\pi^0$ and $KK\pi^0$.
 - ▶ > measure the distribution of the decay products and analysing data (BES III with release number 7.0.9).
 - **Approach:** measure the differential decay rate as a function of the invariant mass of the π^0 or $KK\pi^0$, provide info about interference between different decay amplitudes. The between different amplitudes can result in constructive or **destructive interference**, leading to peaks or dips in the invariant mass distribution.
 - ▶ >
- 2) Measure the branching ratio of $J/\psi \rightarrow \phi\pi^0$, considering the $KK\pi$ contribution,
- 3) Comparing results:

$$\begin{cases} J/\psi \rightarrow \phi\pi^0 \\ \psi(2S) \rightarrow \pi^+\pi^-(K^+K^-\pi^0), \end{cases} \quad (1)$$

(2S, state of $c\bar{c}$ quark pair)

Materials using and Main purpose:

- 1) BES III data with release number 7.0.9.
- 1) FSFilter, **a package** used to convert BES III data into a **format** that can be easily **analyzed**.
 - ▶ FSFilter, "Filter" information from the **"Final States"** into root trees.
 - ▶ Any number of final states can be selected using input parameters in job options files (a control programming of running BESIII BOSS Framework).
 - ▶ BOSS,
- 2) Using BOSS framework to simulate, reconstruct, and analyze the physical results that we are interested (Main task now **to get familiar with boss environment**).
 - ▶ MC Simulation
 - ▶ Reconstruction,
 - ▶ Analysis.
- 3) **Purpose**: Have good results from good models that we will find, have physical signification and compare the results from the above processes.

Histogram Data VS MC:

$$\psi(2S) \rightarrow \pi^+\pi^- J/\psi (\text{with } J/\psi \rightarrow K^+K^-\pi^0)$$

► Run No. list_67372_67374_85574.txt

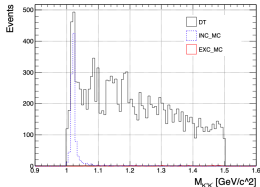


Figure: (a)

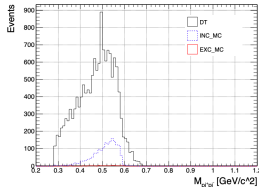


Figure: (b)

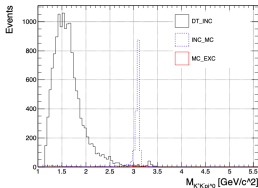


Figure: (c)

Inclusive and Exclusive data

- ▶ used to study the properties and interaction of subatomic particles.
- ▶ 1) **Inclusive data** a data of including all possible outcomes of a particular experimental process or interaction.
 - ▶ > All particles produced in the interaction are included in the data set.
- ▶ **Exclusive data** to data that only includes a specific subset of particles produced in a interaction.
 - ▶ Only particles with certain properties or characteristics are included in the data set, and other particles are excluded.
 - ▶ Suppose X a data set of $J/\psi \rightarrow Y$ (with Y any particles produced after collisions) from BESS III detector.



$$J/\psi \rightarrow Y \subset J/\psi \rightarrow \phi\pi^0$$

Okubo -Zweig - Lizuka (OZI)

- ϕ meson $|\phi\rangle = |\bar{s}s\rangle$, $S = 1$, $Q_\phi = 0$, $\Gamma = 1.5 \times 10^{-22} \text{s}$

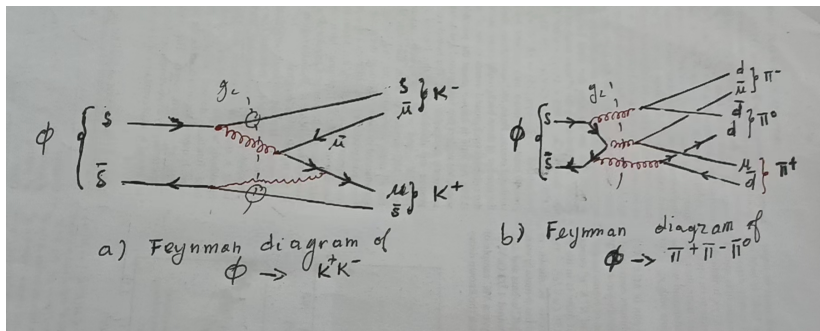


Figure: Feynman diagram of $\phi \rightarrow K^+ K^-$, and $\phi \rightarrow \pi^+ \pi^- \pi^0$, respectively.

- ▶ Q- value: energy absorbed
- ▶ $m_\phi \sim 1020 \text{ MeV}$, $m_{K^\pm} \sim 494 \text{ MeV}$, $m_\pi \sim 140 \text{ MeV}$,

$$\begin{cases} \Delta\phi_1 = (m_\phi - (m_{K^+} + m_{K^-})) \sim 32 \text{ MeV, Small phase space} \\ \Delta\phi_2 = (m_\phi - (m_{\pi^+} + m_{\pi^-} + m_{\pi^0})) \sim 600 \text{ MeV large phase space} \end{cases}$$

- ▶ Experiment 84 percent of ϕ mesons decay into kaons (much more likely).

Feynman diagram



(b) Electromagnetic

Figure: b

Task

- 1) Study the interference behavior between $J/\psi \rightarrow \phi\pi^0$ and $KK\pi^0$.
 - ▶ > measure the distribution of the decay products and analysing data (BES III with release number 7.0.9).
- 2) Measure the braching ratio of $J/\psi \rightarrow \phi\pi^0$, considering the $KK\pi$ contribution,
- 3) Comparing results:

$$\begin{cases} e^+e^- \rightarrow \gamma^* \rightarrow \phi\pi^0 \\ \psi(2S) \rightarrow \pi^+\pi^-(K^+K^-\pi^0), \end{cases} \quad (2)$$

(2S, state of $c\bar{c}$ quark pair)

Data needed

- ▶ Exp. data Dst: 2021 psi(3686) =>
/bes3fs/offline/data/709-1/psip/round14/tag
- ▶ MC production: 2021 psi(3686), 2.3B =>
/bes3fs/offline/data/709-1/psip/round14/mc/tag

INCLUSIVE Data information (Total events = 14094637)

INCO_0_0_110111

- 0) Input Number of Evts : 14094637 100.00\%
- 1) After maximum E&P Cut : 7260603 51.51\%
- 2) Events input FS loop : 7260603 100.00\%
- 3) nChrg protection Cut : 7260603 100.00\%
- 4) nCombo greater than 0 : 17097 0.24\%
- 5) Before E and P Cut : 64359 376.43\%
- 6) Missing Energy Cut : 64359 100.00\%
- 7) Missing Momentum Cut : 64359 100.00\%
- 8) Missing Mass Cut : 64359 100.00\%
- 9) Raw 4-Momentum Cut : 14717 22.87\%
- 10) Vertex Fit Successful : 14172 96.30\%
- 11) Int 4-Momentum Cut : 14172 100.00\%
- 12) Kine Fit Successful : 14172 100.00\%
- 13) KineFit Chisq Cut : 14172 100.00\%
- 14) Fit 4-Momentum Cut : 14172 100.00\%

EXCLUSIVE DATA

EXC0_0_0_110111

0)	Input Number of Evts :	14094637	100.00\%
1)	After maximum E&P Cut :	7260603	51.51\%
2)	Events input FS loop :	7260603	100.00\%
3)	nChrg protection Cut :	7185549	98.97\%
4)	nCombo greater than 0 :	13763	0.19\%
5)	Before E and P Cut :	393225	285.00\%
6)	Missing Energy Cut :	15165	38.66 \%
7)	Missing Momentum Cut :	15165	100.00\%
8)	Missing Mass Cut :	15165	100.00\%
9)	Raw 4-Momentum Cut :	948	6.25 \%
10)	Vertex Fit Successful :	919	96.94\%
11)	Int 4-Momentum Cut :	919	100.00\%
12)	Kine Fit Successful :	31	100.00\%
13)	Kine Fit Chisq Cut :	31	100.00\%
14)	Fit 4-Momentum Cut :	31	100.00\%

INCO_0_0_110111 fill number : 14172

EXCO_0_0_110111 fill number : 31

Simple particle preparing	takes	:	0,	515.79	secs
Combination partile ...	takes	:	1,	10,92	secs
D meson list preparing	takes	:	2,	4.98	secs
Combinations preparing	takes	:	3,	21.68	secs
2nd vertex fit (1st fit)	takes	:	4,	0,00	secs
2nd vertex fit (2nd fit)	takes	:	5,	0,00	secs
1st vertex fit	takes	:	6,	3.18	secs
kinematic fit	takes	:	7,	6.57	secs
Filling variables	takes	:	8,	8.75	secs
Writing ntuple	takes	:	9,	7.10	secs