Study of $a_0^0(980) - f_0(980)$ mixing at BESIII

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In this talk,we present direct measurements of $a_0^0(980) - f_0(980)$ mixing in the processes $J/\psi \to \phi f_0(980) \to \phi a_0^0(980) \to \phi\eta\pi^0$ and $\psi' \to \gamma\chi_{c1}, \chi_{c1} \to \pi^0 a_0^0(980) \to \pi^0 f_0(980) \to \pi^0\pi^+\pi^-$ with 2.25×10^8 J/ψ data and 1.06×10^8 ψ' data at BESIII.

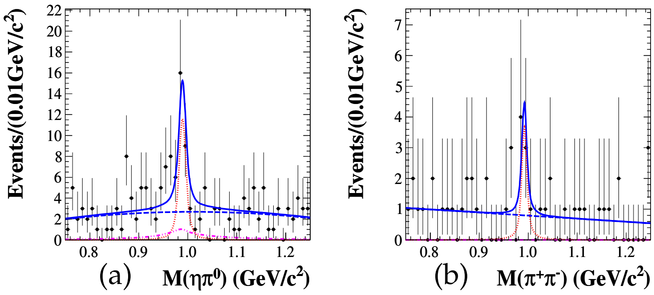
1 Introduction

BESIII/BEPCII [1] is a major upgrade of the BESII detector and BEPC accelerator. The primary physics purposes are aimed at the study of hadron spectroscopy and τ-charm physics.
The nature of the scalar mesons $a_0^0(980)$ and $f_0(980)$ has been a hot topic in light hadron physics for many years. The mixing between $a_0^0(980)$ and $f_0(980)$ is expected to shed light on the nature of these two resonances. In this talk,we present the recent result from the study of $a_0^0(980) - f_0(980)$ mixing at BESIII [2].

2 Study of $a_0^0(980) - f_0(980)$ mixing at BESIII

The leading contribution to the isospin-violating mixing transition amplitudes for $f_0(980) \to a_0^0(980)$ and $a_0^0(980) \to f_0(980)$ are shown to be dominated by the difference of the unitarity cut which arises from the mass difference between the charged and neutral kaons. As a consequence, a narrow peak of about 8 MeV/c^2 is predicted between the charged and neutral kaon thresholds. Using the samples of 2.25×10^8 J/ψ and 1.06×10^8 ψ' events,we perform direct measurements of $a_0^0(980) - f_0(980)$ mixing in the processes $J/\psi \to \phi\eta\pi^0$ and $\psi' \to \gamma\chi_{c1}, \chi_{c1} \to \pi^0 a_0^0(980) \to \pi^0 f_0(980) \to \pi^0\pi^+\pi^-$.

FIG.(a) shows the fitting results of $\eta\pi^0$ mass spectrum recoiling against ϕ signal in $J/\psi \to \phi f_0(980) \to \phi a_0^0(980) \to \phi\eta\pi^0$.The dotted line shows the mixing signal. The dash-dotted line denotes the $a_0^0(980)$ from virtual photon or $K^*\overline{K}$ loop. The dashed line is a polynomial background constrained to the ϕ sideband. The significance of $f_0(980) \to a_0^0(980)$ mixing signals is 3.3 σ. The mixing branching ratio is determined to be $\mathcal{B}(J/\psi \to \phi f_0(980) \to \phi a_0^0(980) \to \phi\eta\pi^0)$($< 5.4 \times 10^{-6}$ at the 90% C.L.).



For $a_0^0(980) \to f_0(980)$ transition, the mass spectrum of $\pi^+\pi^-$ in the χ_{c1} mass window is fitted in a similar style, shown in FIG. (b).The significance of $a_0^0(980) \to f_0(980)$ mixing signals is 1.9 σ. The mixing branching ratio is determined to be $\mathcal{B}(\psi' \to \gamma\chi_{c1} \to \gamma\pi^0 a_0^0(980) \to \gamma\pi^0 f_0(980) \to \gamma\pi^0\pi^+\pi^-)(< 6.0 \times 10^{-7}$ at the 90% C.L.).The mixing intensities ξ_{fa} for $f_0(980) \to a_0^0(980)$ transition and ξ_{af} for $a_0^0(980) \to f_0(980)$ transition are defined and calculated as:

$$\xi_{fa} = \frac{\mathcal{B}(J/\psi \to \phi f_0(980) \to \phi a_0^0(980) \to \phi\eta\pi^0)}{\mathcal{B}(J/\psi \to \phi f_0(980) \to \phi\pi^+\pi^-)} \text{ (< 1.1\% at the 90\% C.L.)},$$

$$\xi_{af} = \frac{\mathcal{B}(\psi' \to \gamma\chi_{c1} \to \gamma\pi^0 a_0^0(980) \to \gamma\pi^0 f_0(980) \to \gamma\pi^0\pi^+\pi^-)}{\mathcal{B}(\psi' \to \gamma\chi_{c1} \to \gamma\pi^0 a_0^0(980) \to \gamma\pi^0\pi^0\eta)} \text{ (< 1.0\% at the 90\% C.L.)}.$$

3 Summary

A new facility for physics in the charm-τ region BEPCII/BESIII has become operational. With the world¡¯s largest samples of J/ψ and ψ' collected at BESIII, the direct measurement of a_0 and f_0 mixing is performed for the first time.The measurements will be very helpful for pinning down the natures of $a_0^0(980)$ and $f_0(980)$.

References

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