The hadronic decays of charmed mesons at BESIII

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on behavier of BESIII Collaboration

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Outline

- Introduction and BESIII datasets
- Charmed meson (D^0, D^+, D_s^+)
  - Amplitude analyses
  - Doubly-Cabibbio-suppressed decays
- Summary

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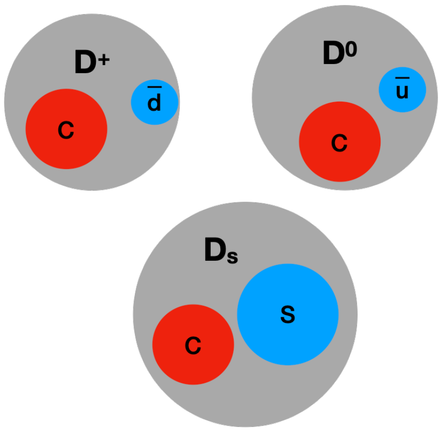
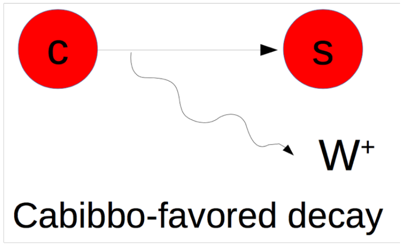
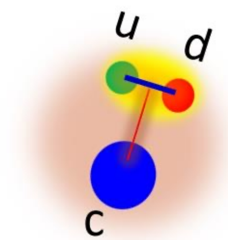
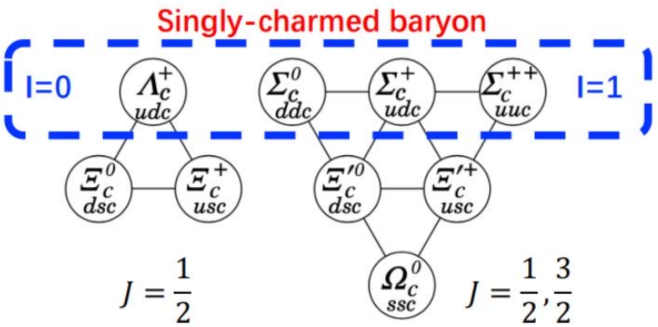








- The lightest charmed hadrons (D^0, D^+, D_s^+, Λ_c^+) $\longrightarrow$ study weak interaction
- b-hadrons and excited charmed hadrons decay to the lightest charmed hadrons
- The perturbative QCD is not applicable in the low energy region $\longrightarrow$ Test low-energy non-perturbative QCD phenomenological model and LQCD calculations in charm region.

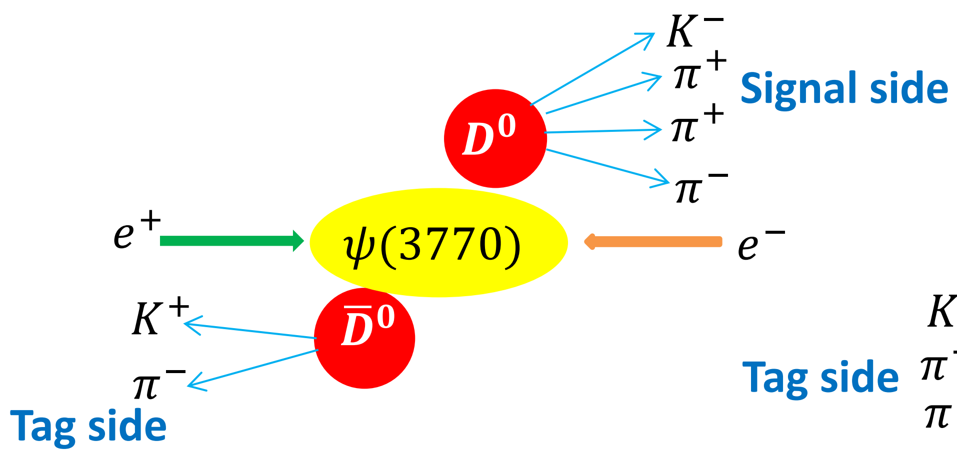
BESIII Dataset

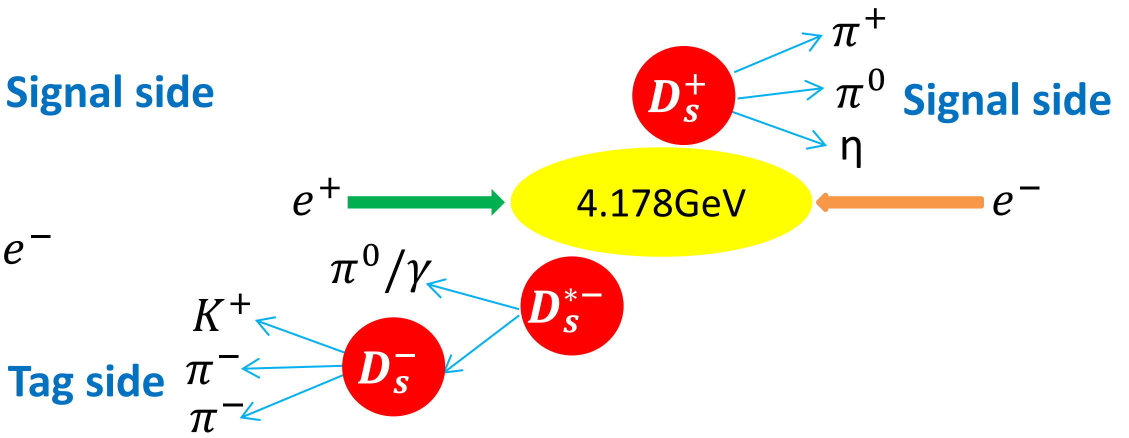
- 20.28 fb^{-1} at Ecm = 3.773 GeV:
  $e^+e^- \to \psi(3770) \to D\bar{D}$ (totally ~145M D^0 and ~114M D^+)

2021-2024, Submitted to CPC (arXiv:2406.05827)

- 7.33 fb^{-1} at Ecm = 4.128-4.226 GeV
  $e^+e^- \to D_s^\pm D_s^{*\mp}, D_s^{*\mp} \to \pi^0/\gamma D_s^\mp$ (~600k D_s)

- **Single Tag (ST):** reconstruct only one of the hadron
- **Double Tag (DT):** reconstruct both of the hadrons
  access to absolute BFs; clean samples





(Charge-conjugate states are implied throughout this talk)

- **Introduction and BESIII datasets**
- **Charmed meson (D^0, D^+, D_s^+)**
  - **Amplitude analyses**
  - **Doubly-Cabibbio-suppressed decays**
- **Summary**

Amplitude analysis of $D_s^+ \to \pi^+\pi^0\eta$

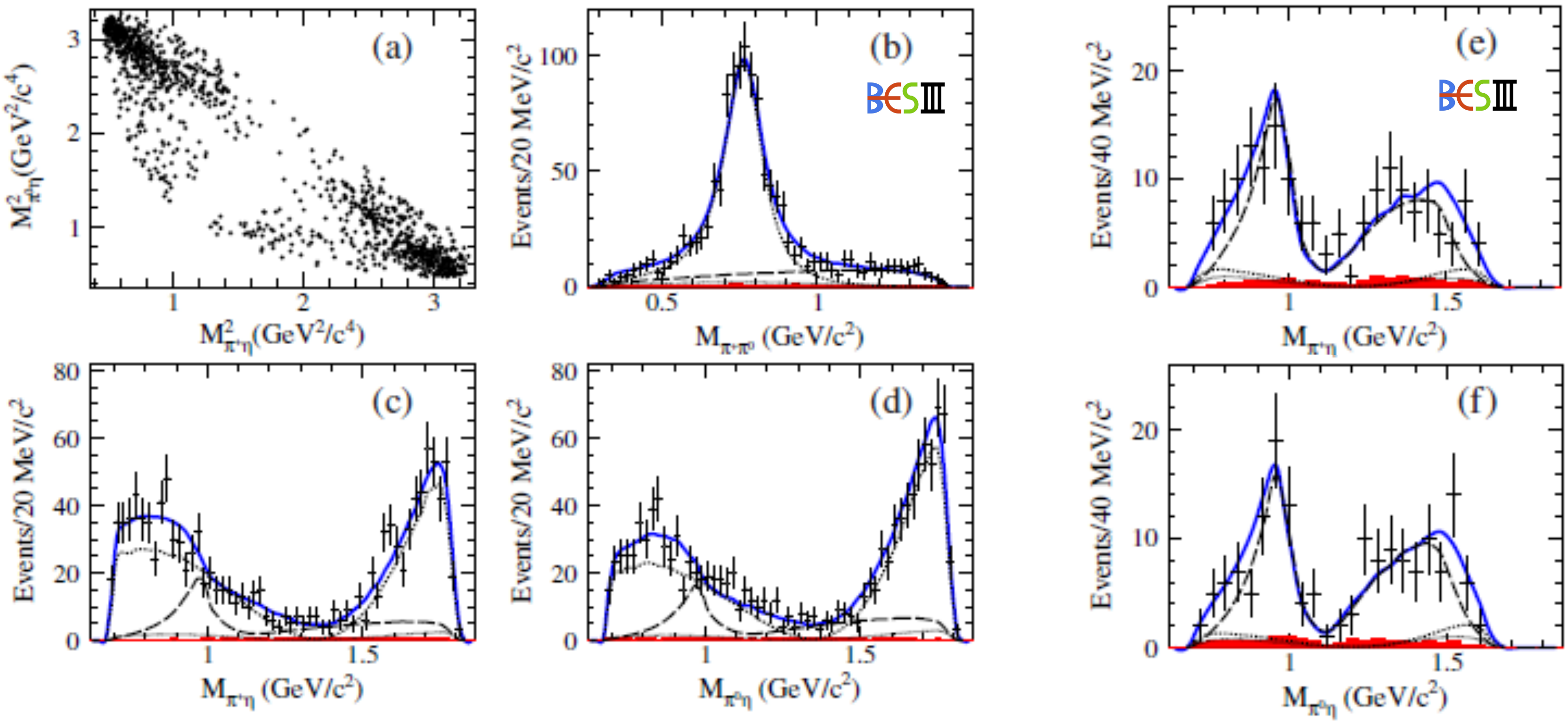
- Observation of $D_s^+ \to a_0(980)\pi$

PRL123, 112001 (2019)

$D_s^+ \to \pi^+\pi^0\eta$

Full sample

Sub-sample with $M_{\pi^+\pi^0} > 1.0$ GeV/c^2

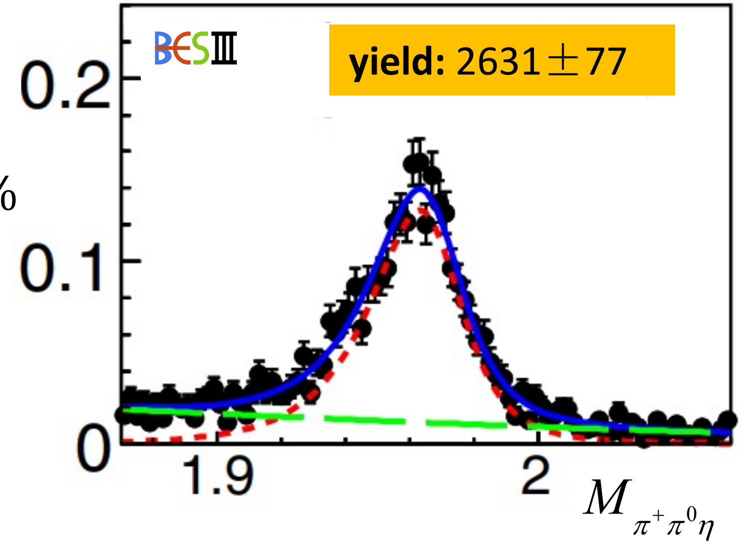


Dots with error bar: data; solid: total fit; dotted: $D_s^+ \to \rho^+\eta$; dashed: $D_s^+ \to a_0(980)\pi$ (**with a stat. significance of 16.2σ**).

Branching Fraction Results of $D_s^+ \to \pi^+\pi^0\eta$

PRL123, 112001 (2019)

Fit to the invariant mass $M_{\pi^+\pi^0\eta}$ to get the yield.



$$\mathcal{B}(D_s^+ \to \pi^+\pi^0\eta) = (9.50 \pm 0.28_{stat.} \pm 0.41_{syst.})\%$$

PDG value = $(9.2 \pm 1.2)\%$

BF(sub-mode n) = $\mathcal{B}(D_s^+ \to \pi^+\pi^0\eta) FF(n)$

Branching fraction (%) BESIII
$\mathcal{B}(D_s^+ \to \rho^+\eta) = 7.44 \pm 0.52_{stat.} \pm 0.38_{sys.}$
$\mathcal{B}(D_s^+ \to a_0(980)^+\pi^0)^* = 1.46 \pm 0.15_{stat.} \pm 0.23_{sys.}$
$\mathcal{B}(D_s^+ \to a_0(980)^0\pi^+)^* = 1.46 \pm 0.15_{stat.} \pm 0.23_{sys.}$

*here, $a_0(980) \to \pi\eta$

PDG value = $(8.9 \pm 0.9)\%$

First observation !

- $\mathcal{B}(D_s^+ \to a_0(980)^+\pi^0$ is larger than other measured pure W-annihilation decays ($D_s^+ \to p\bar{n}, D_s^+ \to \omega\pi^+$) by one order.

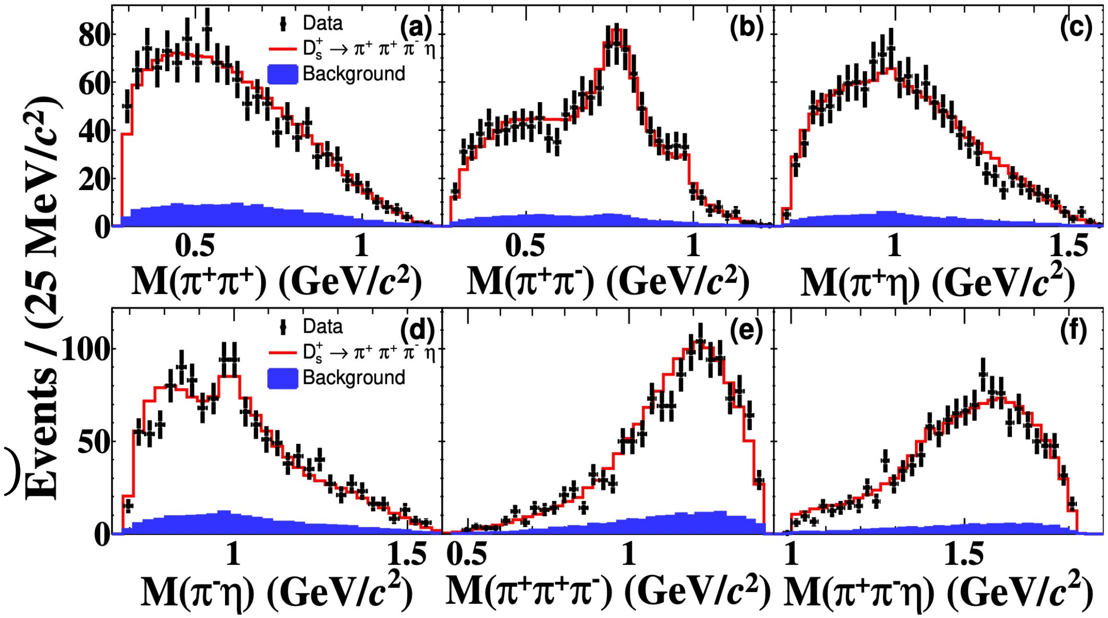
Amplitude analysis of $D_s^+ \to \pi^+\pi^+\pi^-\eta$

2139 events with purity > 85%

PRD 104, L071101 (2021)

$\mathcal{B}(D_s^+ \to \pi^+\pi^+\pi^-\eta)$
$=(3.12\pm0.13\pm0.09)\%$

$\mathcal{B}(D_s^+ \to a_0^+(980)\rho^0, a_0^+(980) \to \pi^+\eta)$
$=(0.21\pm0.08\pm0.05)\%$



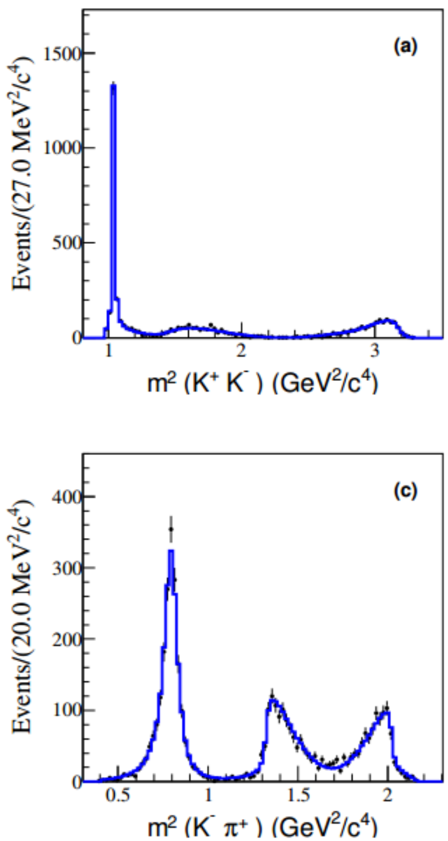
Amplitude	Phase	FF(%)
$a_1(1260)^+(\rho(770)^0\pi^+)\eta$	0.0(fixed)	$55.4\pm3.9\pm2.0$
$a_1(1260)^+(f_0(500)\pi^+)\eta$	$5.0\pm0.1\pm0.1$	$8.1\pm1.9\pm2.1$
$a_0(980)^+\rho(770)^0$	$2.5\pm0.1\pm0.1$	$6.7\pm2.5\pm1.5$
$\eta(1405)(a_0(980)^-\pi^+)\pi^+$	$0.2\pm0.2\pm0.1$	$0.7\pm0.2\pm0.1$
$\eta(1405)(a_0(980)^+\pi^-)\pi^+$	$0.2\pm0.2\pm0.1$	$0.7\pm0.2\pm0.1$
$f_1(1420)(a_0(980)^-\pi^+)\pi^+$	$4.3\pm0.2\pm0.4$	$1.9\pm0.5\pm0.3$
$f_1(1420)(a_0(980)^+\pi^-)\pi^+$	$4.3\pm0.2\pm0.4$	$1.7\pm0.5\pm0.3$
$[a_0(980)^-\pi^+]_S\pi^+$	$0.1\pm0.2\pm0.2$	$5.1\pm1.2\pm0.9$
$[a_0(980)^+\pi^-]_S\pi^+$	$0.1\pm0.2\pm0.2$	$3.4\pm0.8\pm0.6$
$[f_0(980)\eta]_S\pi^+$	$1.4\pm0.2\pm0.3$	$6.2\pm1.7\pm0.9$
$[f_0(500)\eta]_S\pi^+$	$2.5\pm0.2\pm0.3$	$12.7\pm2.6\pm2.0$

Larger than other w-annihilation decays.

How about $D_s^+ \to a_0^+(980)\rho^0$? Does it have the same branching fraction?

Amplitude analysis of $D_s^+ \to K^+K^-\pi^+$

Dalitz plot projections:



The best precision at present

$$\mathcal{B}(D_s^+ \to K^+K^-\pi^+) = (5.47 \pm 0.08_{stat.} \pm 0.13_{syst.})\%$$

Process	BF (%) BESIII (this analysis)	BF (%) PDG
$D_s^+ \to \bar{K}^*(892)^0K^+$, $\bar{K}^*(892)^0 \to K^-\pi^+$	$2.64 \pm 0.06_{\rm stat} \pm 0.07_{\rm sys}$	2.58 ± 0.08
$D_s^+ \to \phi(1020)\pi^+$, $\phi(1020) \to K^+K^-$	$2.21 \pm 0.05_{\rm stat} \pm 0.07_{\rm sys}$	2.24 ± 0.08
$D_s^+ \to S(980)\pi^+$, $S(980) \to K^+K^-$	$1.05 \pm 0.04_{\rm stat} \pm 0.06_{\rm sys}$	1.14 ± 0.31
$D_s^+ \to \bar{K}_0^*(1430)^0K^+$, $\bar{K}_0^*(1430)^0 \to K^-\pi^+$	$0.16 \pm 0.03_{\rm stat} \pm 0.03_{\rm sys}$	0.18 ± 0.04
$D_s^+ \to f_0(1710)\pi^+$, $f_0(1710) \to K^+K^-$	$0.10 \pm 0.02_{\rm stat} \pm 0.03_{\rm sys}$	0.07 ± 0.03
$D_s^+ \to f_0(1370)\pi^+$, $f_0(1370) \to K^+K^-$	$0.07 \pm 0.02_{\rm stat} \pm 0.01_{\rm sys}$	0.07 ± 0.05
$D_s^+ \to K^+K^-\pi^+$ total BF	$5.47 \pm 0.08_{\rm stat} \pm 0.13_{\rm sys}$	5.39 ± 0.15

Both $a_0(980)$ and $f_0(980)$ decays to K^+K^- . Impossible to sepatate them here

Black dots with error bars: data

Blue solid lines: fit results

Isospin configurations:

$a_0(980)$ I=1 $\to$ ($|K^+K^-\rangle$ - $|K^0\overline{K^0}\rangle$)

$f_0(980)$ I=0 $\to$ ($|K^+K^-\rangle$ + $|K^0\overline{K^0}\rangle$)

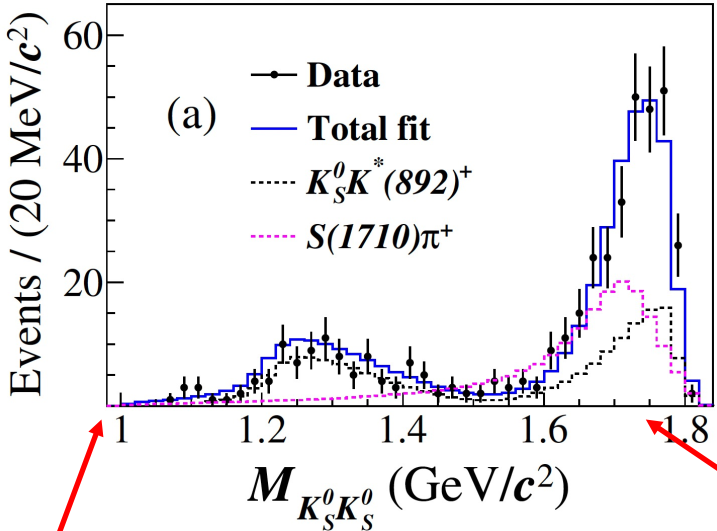
The comparison of K^+K^- and $K_S^0K_S^0$ spectrum will reveal more information!

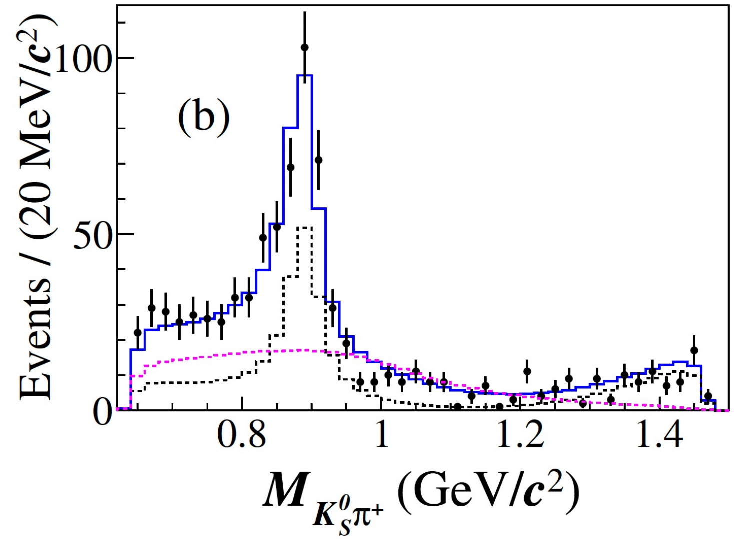
PRD 104. 012016 (2021)

Amplitude analysis of $D_s^+ \to K_S^0 K_S^0 \pi^+$ - Observation of interference between scalar mesons

PRD 105, L051103

412 events with purity of $(97.3 \pm 0.8)\%$.





destructive interference: $a_0(980)$ and $f_0(980)$

abnormarl enhancement at $f_0(1710)$

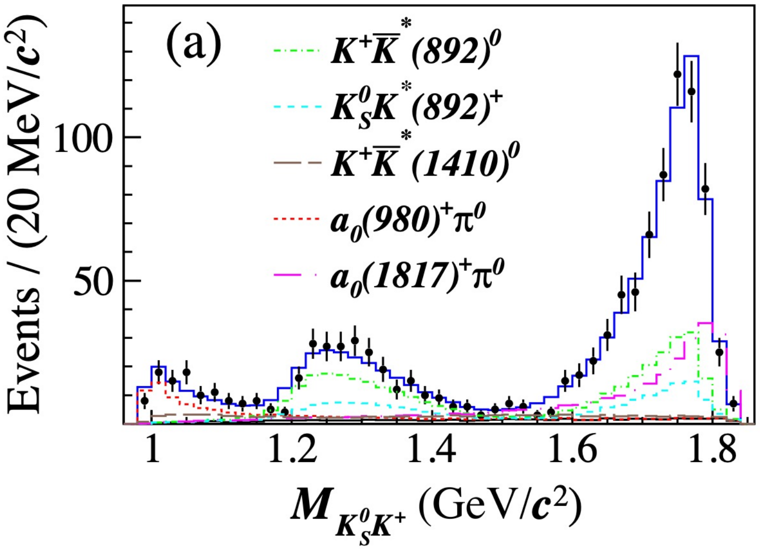
$$\mathcal{B}(D_s^+ \to K_S^0 K_S^0 \pi^+) = (0.68 \pm 0.04_{stat.} \pm 0.01_{syst.})\%$$

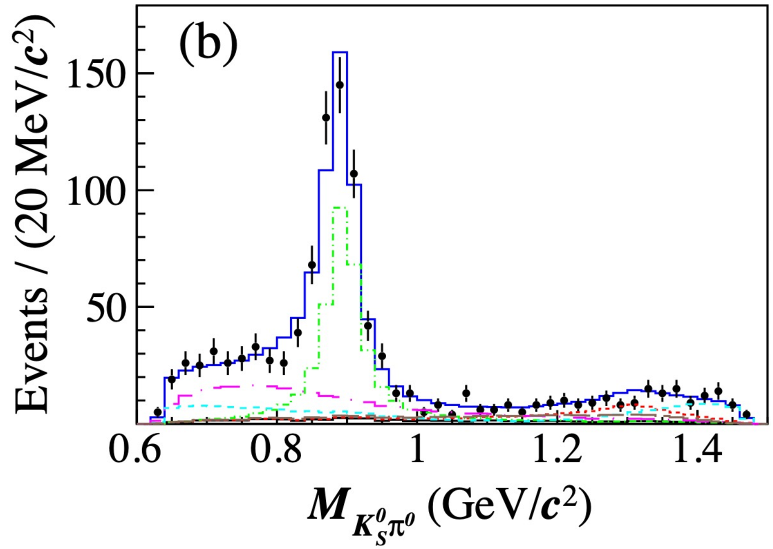
Amplitude	BF (10^{-3})
$D_s^+ \to K_S^0 K^*(892)^+ \to K_S^0 K_S^0 \pi^+$	$3.0 \pm 0.3 \pm 0.1$
$D_s^+ \to S(1710)\pi^+ \to K_S^0 K_S^0 \pi^+$	$3.1 \pm 0.3 \pm 0.1$

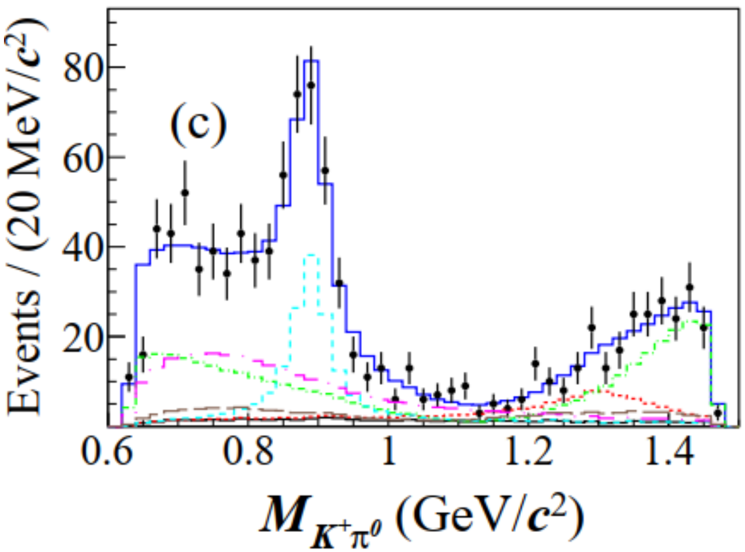
Amplitude analysis of $D_s^+ \to K_S^0 K^+ \pi^0$ -observation of a new-a_0 like state

PRL 129, 182001

1050 events with purity of $(94.7 \pm 0.7)\%$







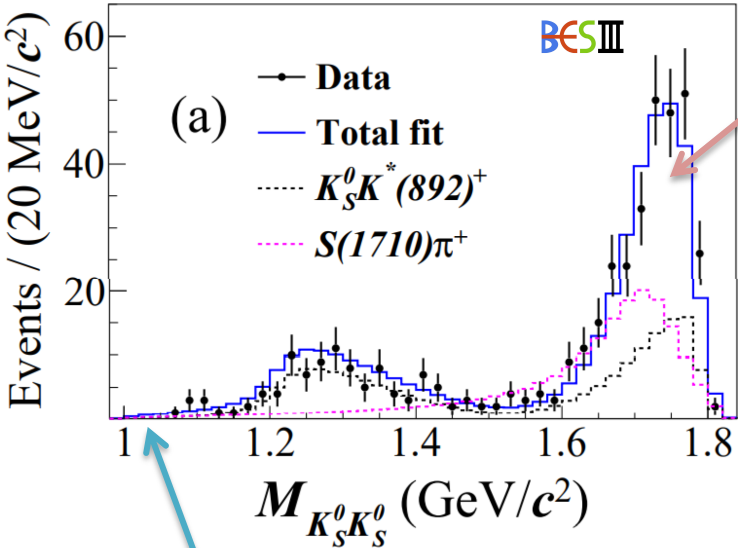
$D_s^+ \to a_0(1817)^+\pi^0$ is observed for the first time

Amplitude	BF (10^{-3})
$D_s^+ \to \bar{K}^*(892)^0K^+$	$4.77 \pm 0.38 \pm 0.32$
$D_s^+ \to K^*(892)^+K_S^0$	$2.03 \pm 0.26 \pm 0.20$
$D_s^+ \to a_0(980)^+\pi^0$	$1.12 \pm 0.25 \pm 0.27$
$D_s^+ \to \bar{K}^*(1410)^0K^+$	$0.88 \pm 0.21 \pm 0.19$
$D_s^+ \to a_0(1817)^+\pi^0$	$3.44 \pm 0.52 \pm 0.32$

$$\frac{\mathcal{B}(D_s^+ \to \bar{K}^*(892)^0K^+)}{\mathcal{B}(D_s^+ \to \bar{K}^0\bar{K}^*(892)^+)} = (2.35^{+0.42}_{-0.23} \pm 0.10)$$

Observation of $a_0(1817)$ in D_s decays

$D_s^+ \to K_S^0 K_S^0 \pi^+$ PRD 105, L051103 (2022)



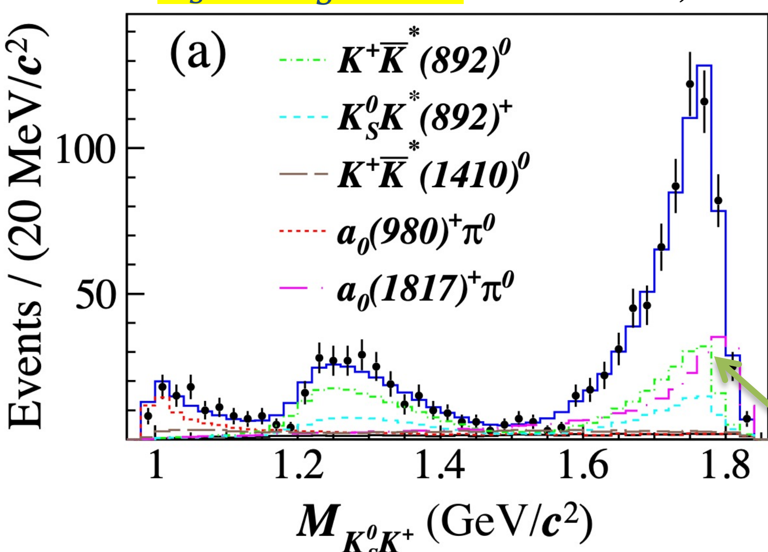
constructive interference: $a_0(1817)$ and $f_0(1710)$

- The isovector partner of $f_0(1710)$ or $X(1812)$?
- Same resonance observed in η_c to $\pi\pi\eta$ by BaBar?

destructive interference: $a_0(980)$ and $f_0(980)$

PRD 104, 072002 (2021)

$D_s^+ \to K_S^0 K^+ \pi^0$ PRL 129, 182001



- M=1.817 $\pm$ 0.008 $\pm$ 0.020 GeV/c^2
- Γ= 0.097 $\pm$ 0.022 $\pm$ 0.015 GeV/c^2
- $\mathcal{B}(D_s^+ \to a_0(1817)^+\pi^0)$ $= (3.44 \pm 0.52 \pm 0.32) \times 10^{-3}$
- Significance > 10σ

$a_0(1817)^+$ in $K_S^0 K^+$ mass spectrum

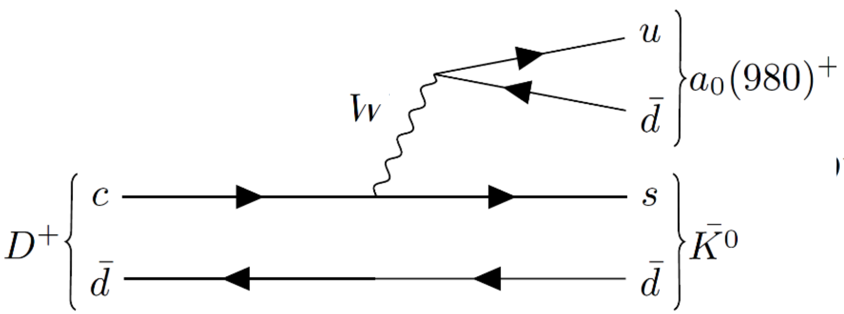
Amplitude analysis of $D^+ \to K_S^0\pi^+\eta$

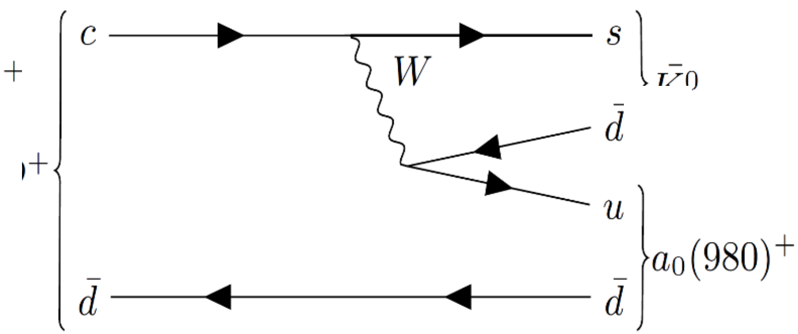
PRL 132, 131903 (2024)

Observe W-annihilation-free decay $D^+ \to K_S^0 a_0(980)^+$

Provide sensitive constraints in the extraction of contributions from external and internal W-emission diagrams of $D \to SP$

$2.93\text{fb}^{-1}@\boldsymbol{E_{cm}} = 3.773\text{GeV}$ 1113 candidates with 98% purity

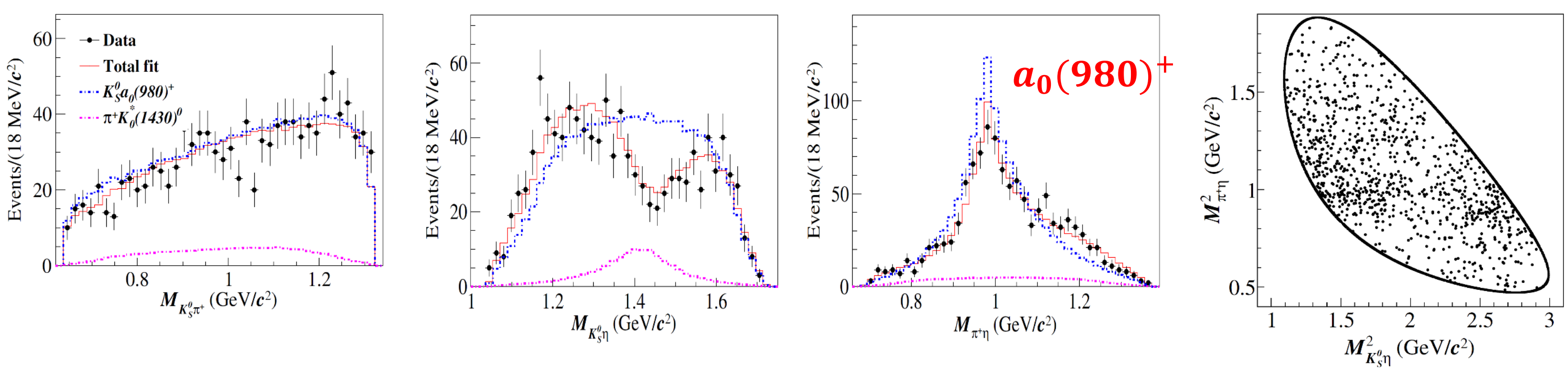




$$\mathcal{B}(D^+ \to K_S^0 a_0(980)^+, a_0(980)^+ \to \pi^+\eta) = (1.33 \pm 0.05_{\text{stat}} \pm 0.04_{\text{syst}})\%$$

$$\mathcal{B}(D^+ \to \bar{K}_0^*(1430)^0\pi^+,\ \bar{K}_0^*(1430)^0 \to K_S^0\eta) = (0.14 \pm 0.02_{\text{stat}} \pm 0.02_{\text{syst}})\%$$

$$\mathcal{B}(D^+ \to K_S^0\pi^+\eta) = (1.27 \pm 0.04_{\text{stat}} \pm 0.03_{\text{syst}})\%$$



Amplitude analysis of $D^0 \to \pi^+\pi^-\eta$, $D^+ \to \pi^+\pi^0\eta$

- **Observe $D \to a_0(980)\pi$**

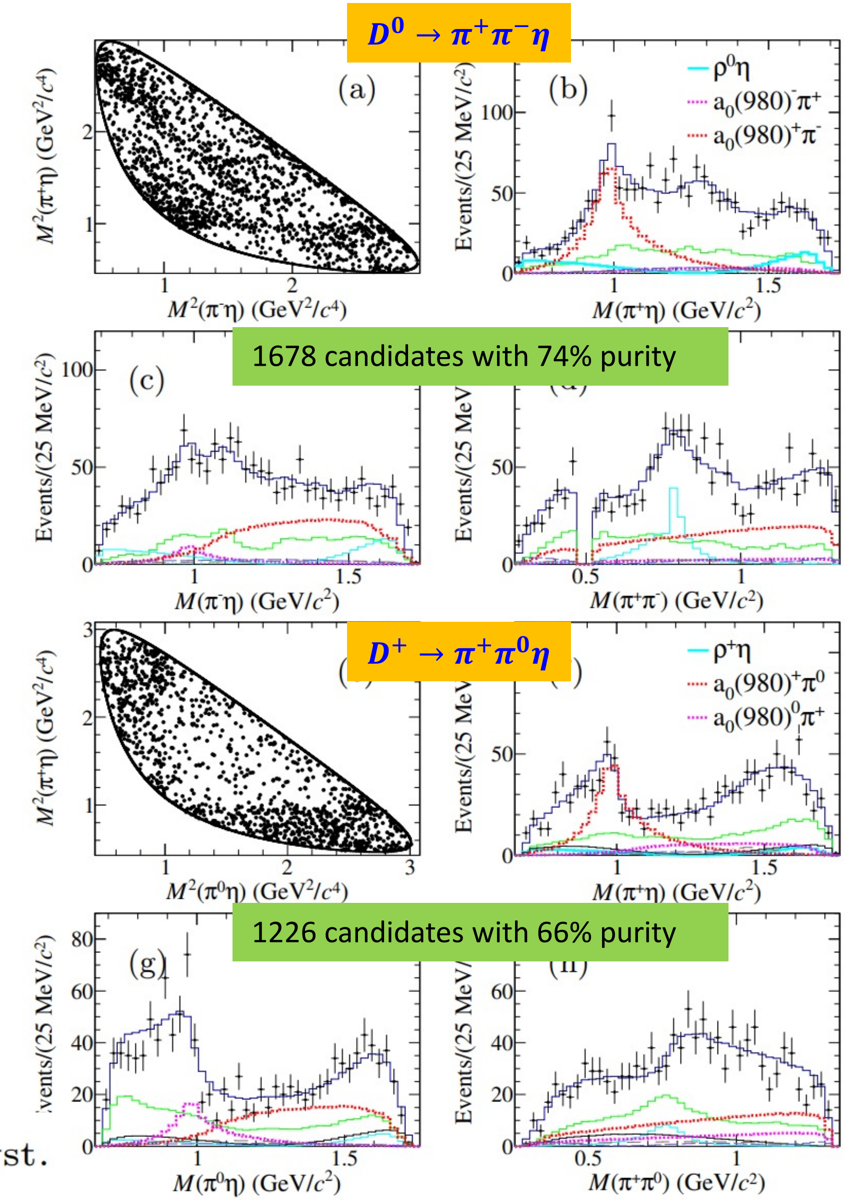
$7.9\ \mathrm{fb}^{-1}@E_{cm} = 3.773\mathrm{GeV}$

Submitted to PRL (arXiv:2404.09219)

Amplitude	Phase (in unit rad)	BF ($\times 10^{-3}$)
$D^0 \to \rho^0\eta$	0 (fixed)	$0.19 \pm 0.02 \pm 0.01$
$D^0 \to a_0(980)^-\pi^+$	$0.06 \pm 0.16 \pm 0.12$	$0.07 \pm 0.02 \pm 0.01$
$D^0 \to a_0(980)^+\pi^-$	$-1.06 \pm 0.12 \pm 0.10$	$0.55 \pm 0.05 \pm 0.07$
$D^0 \to a_2(1320)^+\pi^-$	$-1.16 \pm 0.25 \pm 0.23$	$0.03 \pm 0.01 \pm 0.01$
$D^0 \to a_2(1700)^+\pi^-$	$0.08 \pm 0.17 \pm 0.23$	$0.07 \pm 0.02 \pm 0.03$
$D^0 \to (\pi^+\pi^-)_{S-\mathrm{wave}}\eta$	$-0.92 \pm 0.29 \pm 0.14$	$0.05 \pm 0.02 \pm 0.03$
$D^+ \to \rho^+\eta$	$-4.03 \pm 0.19 \pm 0.13$	$0.20 \pm 0.07 \pm 0.05$
$D^+ \to (\pi^+\pi^0)_V\eta$	$-0.64 \pm 0.22 \pm 0.19$	$0.34 \pm 0.11 \pm 0.11$
$D^+ \to a_0(980)^+\pi^0$	0 (fixed)	$0.95 \pm 0.12 \pm 0.05$
$D^+ \to a_0(980)^0\pi^+$	$2.44 \pm 0.20 \pm 0.10$	$0.37 \pm 0.10 \pm 0.04$
$D^+ \to a_2(1700)^+\pi^0$	$0.92 \pm 0.20 \pm 0.14$	$0.09 \pm 0.05 \pm 0.02$
$D^+ \to a_0(1450)^+\pi^0$	$0.63 \pm 0.41 \pm 0.30$	$0.15 \pm 0.06 \pm 0.02$

$$\mathcal{B}(D^0 \to a_0(980)^+\pi^-)/\mathcal{B}(D^0 \to a_0(980)^-\pi^+)$$
$$7.5^{+2.5}_{-0.8\,\mathrm{stat.}} \pm 1.7_{\mathrm{syst.}}$$

$$\mathcal{B}(D^+ \to a_0(980)^+\pi^0)/\mathcal{B}(D^+ \to a_0(980)^0\pi^+)$$
$$2.6 \pm 0.6_{\mathrm{stat.}} \pm 0.3_{\mathrm{syst.}}$$



→ Disagrees with theoretical predictions by orders of magnitude.

Amplitude analysis of $D_s^+ \to \pi^+\pi^+\pi^-\pi^0$

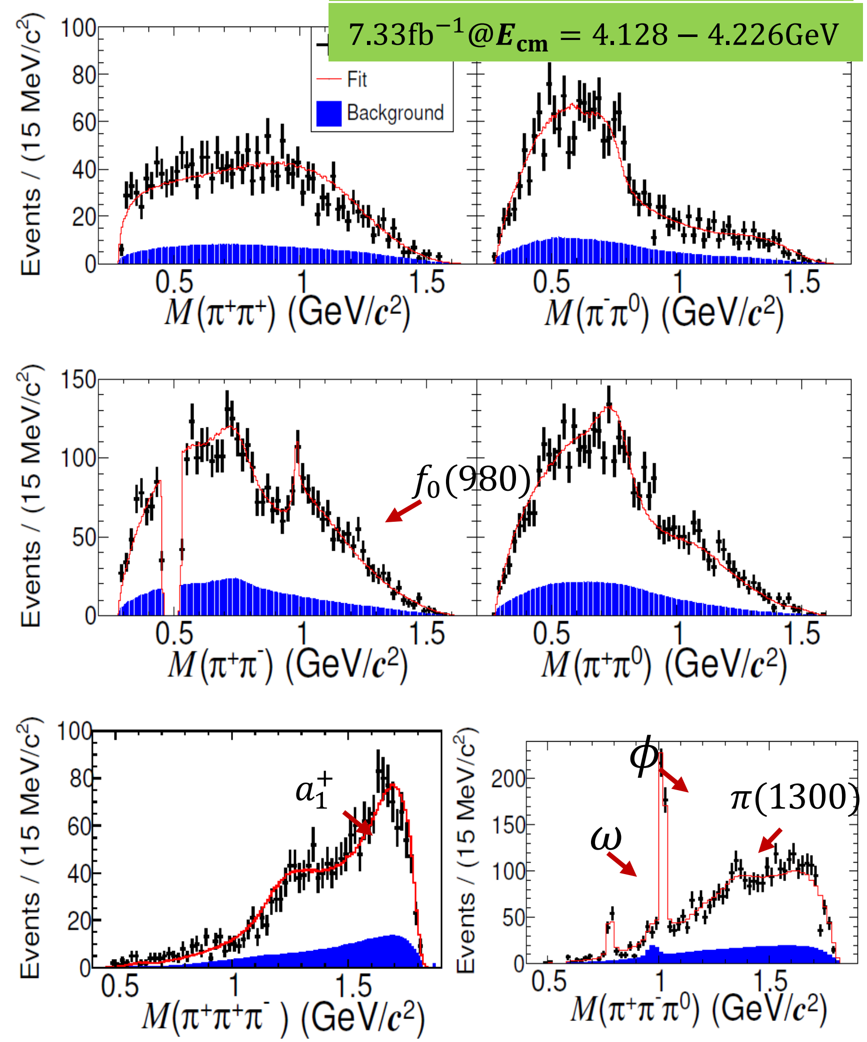
Submitted to PRL (arXiv:2406.17452)

1552 candidates with >75% purity

$7.33\text{fb}^{-1}@E_{\text{cm}} = 4.128 - 4.226\text{GeV}$

Observation of $D_s^+ \to f_0(980)\rho(770)^+$

Component	Phase (rad)	BF (10^{-3})
$f_0(1370)\rho^+$	0.0(fixed)	$5.08 \pm 0.80 \pm 0.43$
$f_0(980)\rho^+$	$3.99 \pm 0.13 \pm 0.07$	$2.57 \pm 0.44 \pm 0.20$
$f_2(1270)\rho^+$	$1.11 \pm 0.10 \pm 0.10$	$1.94 \pm 0.36 \pm 0.12$
$(\rho^+\rho^0)_S$	$1.10 \pm 0.18 \pm 0.10$	$0.71 \pm 0.25 \pm 0.12$
$(\rho(1450)^+\rho^0)_S$	$0.43 \pm 0.18 \pm 0.17$	$0.94 \pm 0.27 \pm 0.16$
$(\rho^+\rho(1450)^0)_P$	$4.58 \pm 0.16 \pm 0.09$	$1.75 \pm 0.27 \pm 0.08$
$\phi((\rho\pi) \to \pi^+\pi^-\pi^0)\pi^+$	$2.90 \pm 0.15 \pm 0.18$	$5.08 \pm 0.32 \pm 0.10$
$\omega((\rho\pi) \to \pi^+\pi^-\pi^0)\pi^+$	$3.22 \pm 0.21 \pm 0.09$	$1.41 \pm 0.17 \pm 0.06$
$a_1^+(\rho^0\pi^+)_S\pi^0$	$3.78 \pm 0.16 \pm 0.12$	$2.55 \pm 0.34 \pm 0.20$
$a_1^0((\rho\pi)_S \to \pi^+\pi^-\pi^0)\pi^+$	$4.82 \pm 0.15 \pm 0.12$	$1.29 \pm 0.39 \pm 0.24$
$\pi(1300)^0((\rho\pi)_P \to \pi^+\pi^-\pi^0)\pi^+$	$2.22 \pm 0.14 \pm 0.08$	$2.39 \pm 0.48 \pm 0.45$



$$\mathcal{B}(D_s^+ \to \eta\pi^+) = (1.56 \pm 0.09_{\text{stat.}} \pm 0.04_{\text{syst.}})\%$$

$$\frac{\mathcal{B}(\phi(1020) \to \pi^+\pi^-\pi^0)}{\mathcal{B}(\phi(1020) \to K^+K^-)} = 0.230 \pm 0.014_{\text{stat.}} \pm 0.010_{\text{syst.}}$$

Taking from $D_s^+ \to K^+K^-\pi^+$
BESIII, PRD 104, 012016 (2021)

deviates from PDG value (0.313±0.010) by >4σ

$$\mathcal{B}(D_s^+ \to \pi^+\pi^+\pi^-\pi^0|_{\text{non}-\eta}) = (2.04 \pm 0.08_{\text{stat.}} \pm 0.05_{\text{syst.}})\%$$

Amplitude analyses of D_s decays

$D^0 \to K^-\pi^+\pi^+\pi^-$ PRD95, 072010 (2017)
$D^0 \to K^-\pi^+\pi^0\pi^0$ PRD99, 092008 (2019)
$D^+ \to K_S^0\pi^+\pi^+\pi^-$ PRD100, 072008(2019)
$D^+ \to K_S^0\pi^+\pi^0\pi^0$ JHEP 09, 077 (2023)
$D^0 \to \pi^+\pi^-\pi^+\pi^-$,
$\pi^+\pi^-\pi^0\pi^0$ CPC 48,083001(2024)

$D_s^{\pm}$ Amplitude analyses

$D_s^+ \to K^+K^-\pi^+$ partial wave analyses	Phys. Rev. D **104** (2021) 012016
$D_s^+ \to K^+K_S\pi^0$ partial wave analyses	Phys. Rev. Lett. **129** (2022) 182001
$D_s^+ \to 2\,\pi^+\pi^-$ partial wave analyses	Phys. Rev. D **106** (2022) 112006
$D_s^+ \to 2\,\pi^+\pi^-\eta$ partial wave analyses	Phys. Rev. D **104** (2021) L071101
$D_s^+ \to \pi^+\pi^0\eta'$ partial wave analyses.	JHEP 04 (2022) 058
$D_s^+ \to \pi^+2\,\pi^0$ partial wave analyses.	JHEP 01 (2022) 052
$D_s^+ \to K^+\pi^+\pi^-$ partial wave analyses	JHEP 08 (2022) 196
$D_s^+ \to K^+\pi^+\pi^-\pi^0$ partial wave analyses	JHEP 09 (2022) 242
$D_s^+ \to 2\,K_S^0\,\pi^+$ partial wave analyses	Phys. Rev. D **105** (2022) L051103
$D_s^+ \to K_S^0\,K^-2\,\pi^+$ partial wave analyses	Phys. Rev. D **103** (2021) 092006
$D_s^+ \to K^-K^+\pi^+\pi^0$ partial wave analyses	Phys. Rev. D **104** (2021) 032011
$D_s^+ \to K^-K^+2\,\pi^+\pi^-$ partial wave analyses	JHEP 07 (2022) 051
Amplitude analysis of $D_s^+ \to K_S^0\pi^+\pi^0$	JHEP 06 (2021) 181
Amplitude analysis of $D_s^+ \to \pi^+\pi^0\eta$	Phys. Rev. Lett. **123** (2019) 112001
$D_s^+ \to \pi^+\,\pi^+\,\pi^-\,\pi^0$.	(arXiv:2406.17452)

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Observation of the DCSD $D^+ \to K^+\pi^+\pi^-\pi^0$

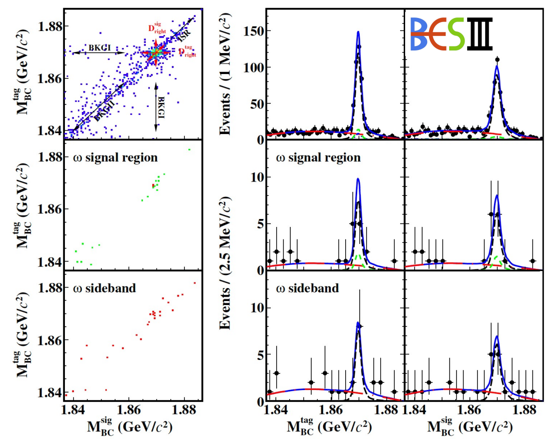
Use hadronic tags. 350 signal events

$$\mathcal{B}(D^+ \to K^+\pi^+\pi^-\pi^0) = (1.13 \pm 0.08 \pm 0.03) \times 10^{-3}$$

$$\frac{\mathcal{B}(D^+ \to K^+\pi^+\pi^-\pi^0)}{\mathcal{B}(D^+ \to K^-\pi^+\pi^+\pi^0)} = (1.81 \pm 0.15)\%$$

Corresponding to $(6.28 \pm 0.52)\ tan^4\theta_C$

One order larger than normal

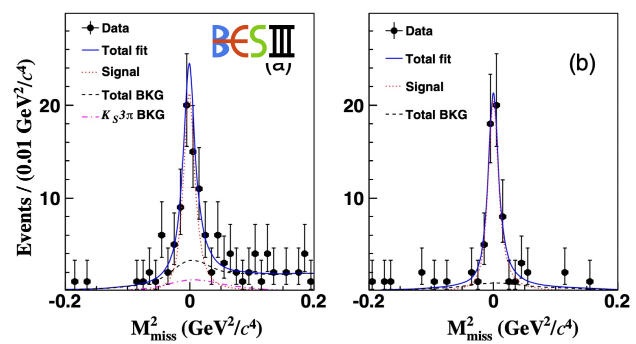


PRL 125, 141802 (2020)

Use semileptonic tags. 112 signal events

$$\mathcal{B}(D^+ \to K^+\pi^+\pi^-\pi^0) = (1.03 \pm 0.12 \pm 0.06) \times 10^{-3}$$

First try of semileptonic tag at BESIII



PRD 104, 072005 (2021)

$D^+ \to K^+\pi^0\pi^0$ and $D^+ \to K^+\pi^0\eta$

$\mathcal{B}(D^+ \to K^+\pi^0\pi^0) = (2.1 \pm 0.4 \pm 0.1)\times10^{-4}$

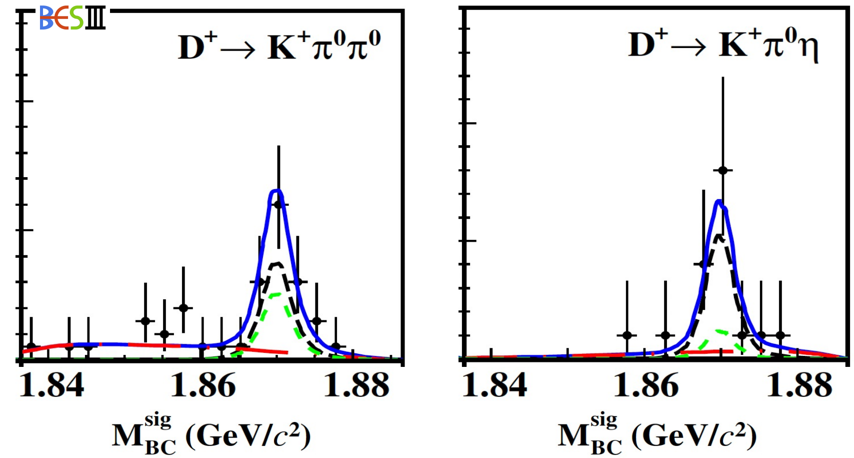
$\mathcal{B}(D^+ \to K^+\pi^0\eta) = (2.1 \pm 0.5 \pm 0.1)\times10^{-4}$

$$\frac{\mathcal{B}(D^+ \to K^+\pi^0\pi^0)}{\mathcal{B}(D^+ \to K^-\pi^+\pi^+)} = (2.24 \pm 0.40)\times10^{-3}$$

$(0.77 \pm 0.14)\ tan^4\theta_C$

$$\frac{\mathcal{B}(D^+ \to K^+\pi^0\eta)}{\mathcal{B}(D^+ \to \overline{K^0}\pi^+\eta)} = (8.01 \pm 1.97)\times10^{-3}$$

$(2.64 \pm 0.68)\ tan^4\theta_C$



JHEP 09 (2022) 107

$D^0 \to K^+\pi^-\pi^0$ and $D^0 \to K^+\pi^-\pi^0\pi^0$

Can not distinguish D^0 and $\overline{D}^0$ in DCSD measurements with hadronic tag

$\mathcal{B}(D^0 \to K^+\pi^-\pi^0 = (3.13^{+0.60}_{-0.56} \pm 0.09)\times10^{-4}$

$\mathcal{B}(D^0 \to K^+\pi^-\pi^0\pi^0) < 3.6\times10^{-4}$

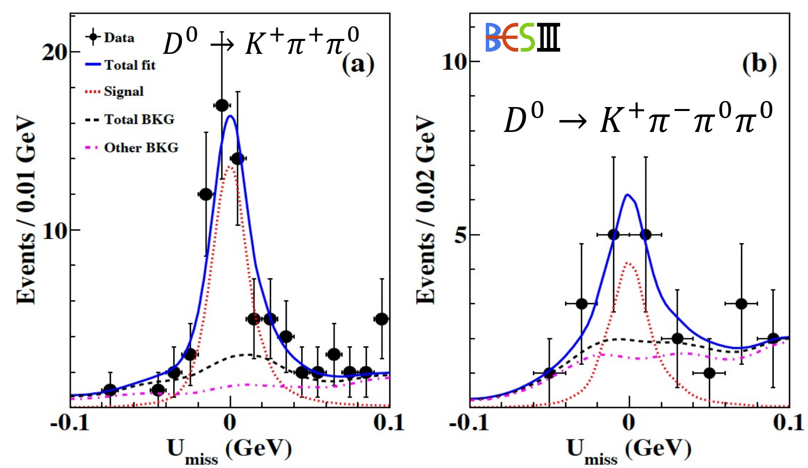
at the 90% C.L.

$$\frac{\mathcal{B}(D^0 \to K^+\pi^-\pi^0)}{\mathcal{B}(D^0 \to K^-\pi^+\pi^0)} = (0.22 \pm 0.44)\%$$

$(0.75 \pm 0.14) tan^4\theta_C$

$$\frac{\mathcal{B}(D^0 \to K^+\pi^-\pi^0\pi^0)}{\mathcal{B}(D^0 \to K^-\pi^+\pi^0\pi^0)} < 0.40\%$$

$< 1.37\times tan^4\theta_C$



PRD105, 112001 (2022)

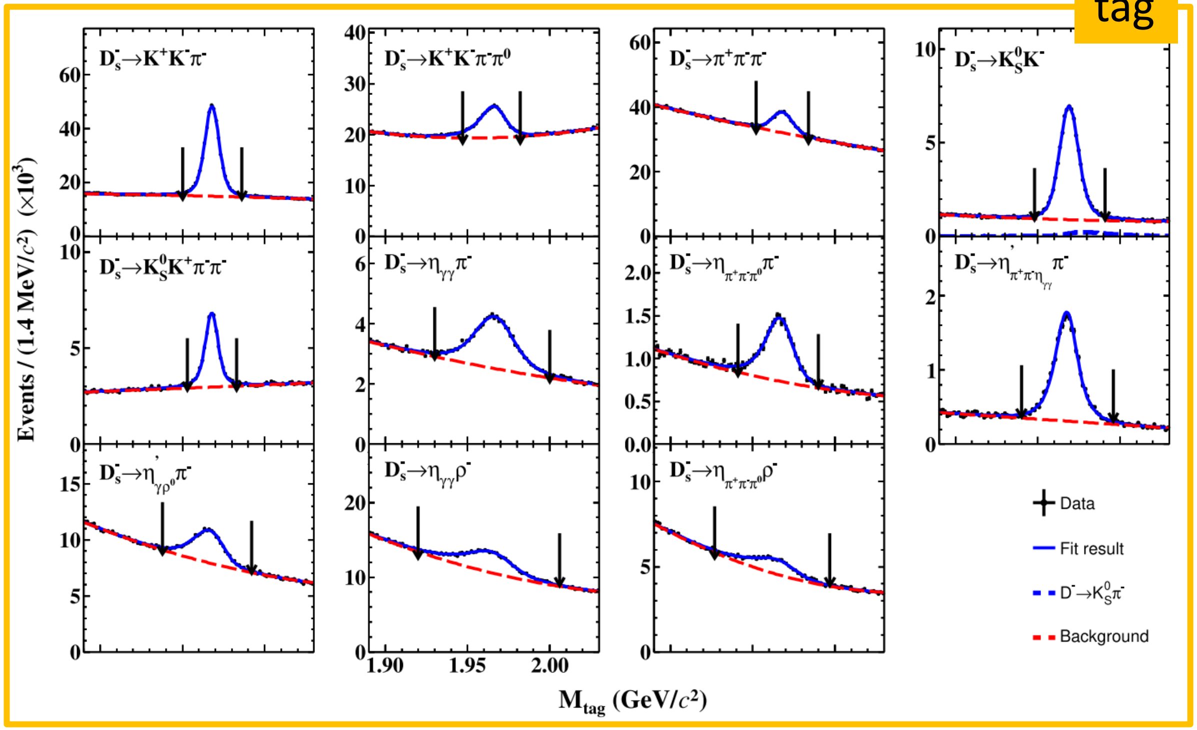
$D_s^+ \to K^+K^+\pi^-(\pi^0)$

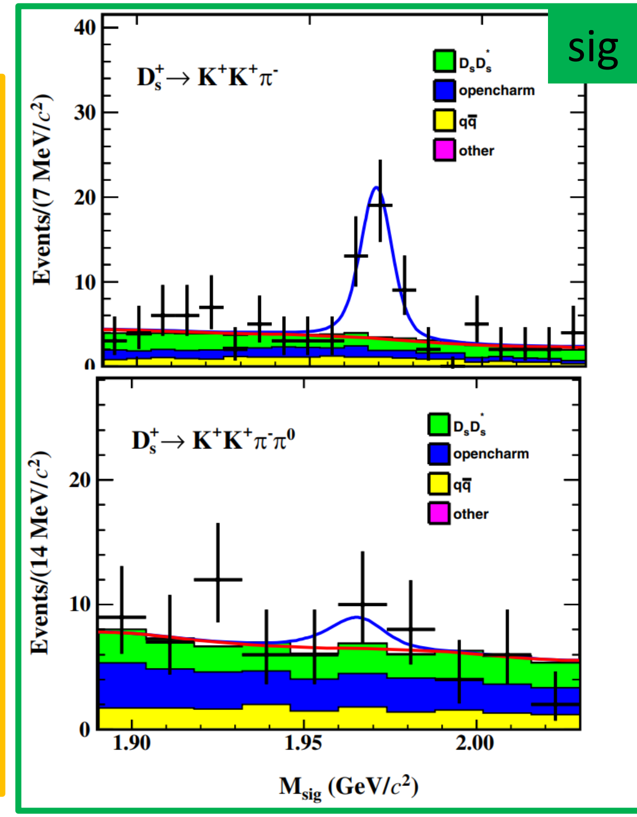
Phys. Rev. D 109, 032011 (2024)

Method: Double Tag

Data: 7.33 fb^{-1} 4.128 - 4.226 GeV

--Doubly Cabibbo-suppressed (DCS) decays





DCS decay	$\mathcal{B}_{DCS}^{this\ work}$ ($\times 10^{-4}$)	CF decay	$\mathcal{B}_{CF}^{PDG}$ ($\times 10^{-2}$)	$\mathcal{B}_{DCS}^{this\ work}/\mathcal{B}_{CF}^{PDG}$ ($\times 10^{-3}$)	$\times \tan^4\theta_C$
$D_s^+ \to K^+K^+\pi^-$	$1.24^{+0.28}_{-0.26} \pm 0.06$	$D_s^+ \to K^+K^-\pi^+$	5.37 ± 0.10	$2.31^{+0.52}_{-0.48}$	$0.80^{+0.18}_{-0.16}$
$D_s^+ \to K^+K^+\pi^-\pi^0$	< 1.7	$D_s^+ \to K^+K^-\pi^+\pi^0$	5.50 ± 0.24	< 3.09	< 1.07

No significant deviation from native expectation of (0.5−2.0)$\times tan^4\theta_C$ is found.

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总结

- 利用在阈值附近采集的粲介子样本，开展强子衰变研究，对
  - 检验并刻度理论计算非微扰效应的参数化方法和唯象模型，
  - 理解粲强子弱衰变机制，
  - 检验SU(3)味对称性和提高粲强子CP破坏的理论预言，

  具有重要意义

- BESIII开展了粲介子强子衰变的精密测量工作，成果丰富。

- 20fb^{-1} $\psi(3770)$数据和相应inclusive MC样本(40x数据)已发布。预期有更多重要的BESIII粲物理成果发表。

谢谢！