Amplitude Analyses of multibody hadronic $D^{0/+}$ Decays at BESIII

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Outline

- **Data Sets and Analysis Strategy**
- **Amplitude Analyses**
- **Summary**

DataSets

- @ E_{cm}= 3.773 GeV
- Integrated luminosity ~ 8 fb^{-1} → **20 fb^{-1}**:
  - 2.93 fb^{-1} in 2011-2012
  - 4.97 fb^{-1} in 2021-2022
  - $\sigma(e^+e^- \to D^0\bar{D}^0)$ ~3.6 nb $\Longrightarrow$ 58 M D^0 produced
  - $\sigma(e^+e^- \to D^+D^-)$ ~2.9 nb $\Longrightarrow$ 46 M D^+ produced
- Pair production at threshold
- Fully reconstructed with low background
- Missing Track case

Tag Mode
$\bar{D}^0 \to K^+\pi^-$
$\bar{D}^0 \to K^+\pi^-\pi^0$
$\bar{D}^0 \to K^+\pi^-\pi^-\pi^+$
$D^- \to K^+\pi^-\pi^-$
$D^- \to K^+\pi^-\pi^-\pi^0$
$D^- \to K^0_S\pi^-$
$D^- \to K^0_S\pi^-\pi^0$
$D^- \to K^0_S\pi^+\pi^-\pi^-$
$D^- \to K^+K^-\pi^-$

Fully reconstructed

$$\Delta E = E_D - E_{beam}$$

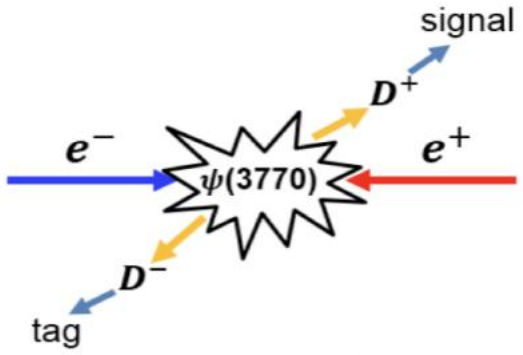
$$M_{BC} = \sqrt{E^2_{beam} - |\vec{p}_D|^2}$$

Partially reconstructed

$$E_{miss} = E_{beam} - \sum_i E_i,$$

$$\vec{p}_{miss} = -\hat{p}_{tag}\sqrt{E^2_{beam} - M^2_{D^0}} - \sum_i \vec{p}_i$$

For $Ke\nu$, use $U_{miss} = E_{miss} - |\vec{p}_{miss}|$
For K^0_L included modes, use $M^2_{miss} = E^2_{miss} - |\vec{p}_{miss}|^2$



Formalism

Unbinned maximum Likelihood Fit

- $A_{D^0}(p) = \sum_i a_i A_i(p)$

$a_i = \rho_i e^{i\Phi i}$: the complex coefficient
$A_i(p)$: the i^{th} partial wave amplitude

$$A_i(p) = B_{L_D}(p)[B_{L_{R_1}}(p)P_{R_1}(p)][B_{L_{R_2}}(p)P_{R_2}(p)]S_i(p)$$

- $P_{Ri}(p)$: propagators of intermediate resonances 1 and 2;
- $B_{Li}(p)$ and $B_{LD}(p)$: Blatte-Weisskopf barriers;
- $S_i(p)$: spin factor, describe the dynamic mechamism, angular distribution.

- $\mathcal{P}(p) = \frac{\epsilon(p)|A_{D^0}|^2 \, d\Phi(p)}{\int \epsilon(p)|A_{D^0}|^2 \, d\Phi(p)}$

MC Integration

- $\ln\mathcal{L} = \sum_i^{N_{data}} \ln\mathcal{P}(p_i) - \sum_j^{N_{bkg}} w_j \ln\mathcal{P}(p_j)$

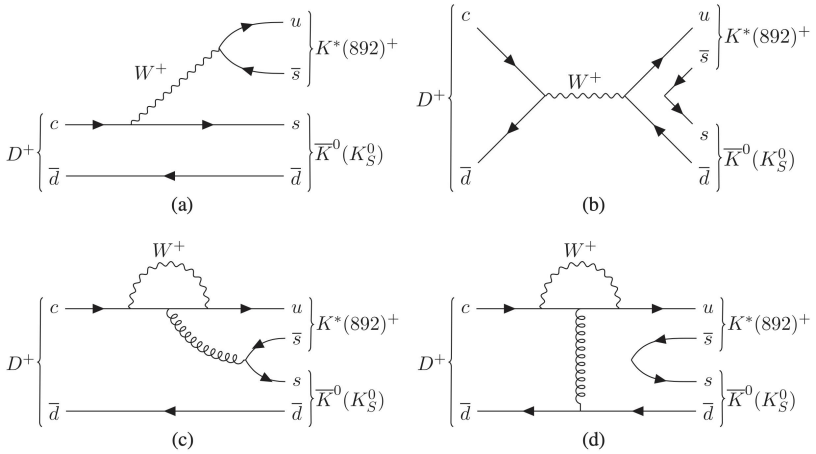
$$\ln\mathcal{L} = \sum_i^{N_{data}} \ln(w_s\mathcal{P}(p_i) + (1 - w_s)\mathcal{P}_B(p_i))$$

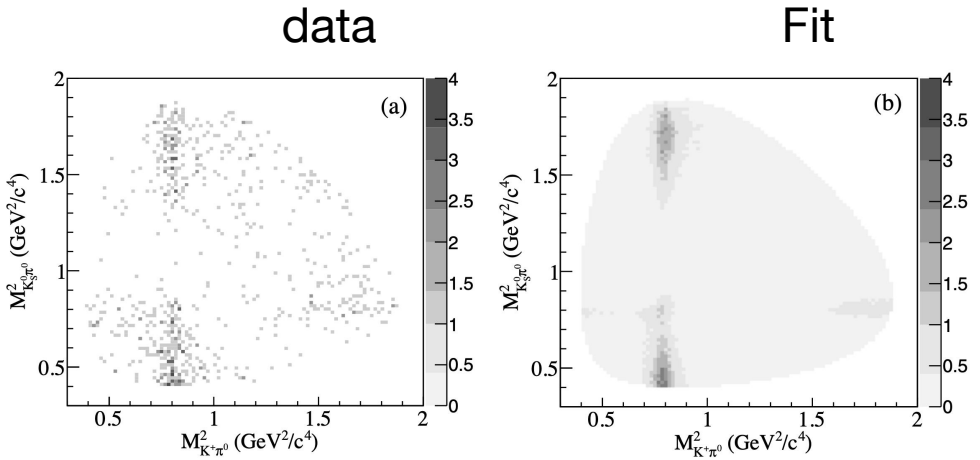
$D^+ \to K^0_S K^+ \pi^0$

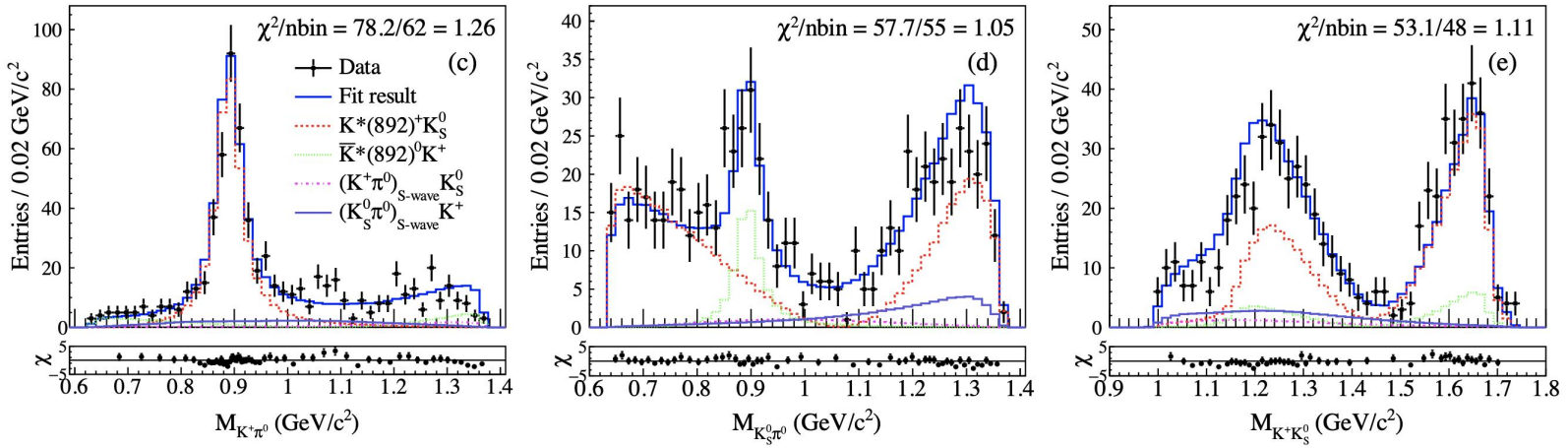
Phys. Rev. D 104, 012006 (2021)

- **Before theory calculation for SCS decay $K^*(892)^+ K^0_S$ is not consistent with experiment.**
- **692 DT events with 97.4% purity @ $\sqrt{s}$ = 3.773 GeV**
- **Dominant $K^*(892)^+ K^0_S$**

Topology diagrams for $D^+ \to K^*(892)^+ K^0_S$







$D^+ \to K^0_S K^+ \pi^0$

Phys. Rev. D 104, 012006 (2021)

- A factor of 4.6 improvement for B($D^+ \to K^0_S K^+ \pi^0$)
- Previse measurement of B($D^+ \to K^0_S K^+ \pi^0$) could provide a more stringent test of the theorical models and help to deepen our understanding of the dynamics of charmed meson decays

Amplitude	Magnitude	Phase ϕ (°)	FF (%)	Significance
$D^+ \to K^*(892)^+ K^0_S$	1.0 (fixed)	0.0 (fixed)	57.1 ± 2.6	$29.6\,\sigma$
$D^+ \to \bar{K}^*(892)^0 K^+$	0.41 ± 0.04	162 ± 10	10.2 ± 1.5	$11.6\,\sigma$
$D^+ \to (K^+\pi^0)_{\mathcal{S}-\text{wave}} K^0_S$	2.02 ± 0.37	140 ± 14	3.9 ± 1.5	$5.2\,\sigma$
$D^+ \to (K^0_S\pi^0)_{\mathcal{S}-\text{wave}} K^+$	3.14 ± 0.46	-173.7 ± 9.7	9.7 ± 2.6	$7.4\,\sigma$

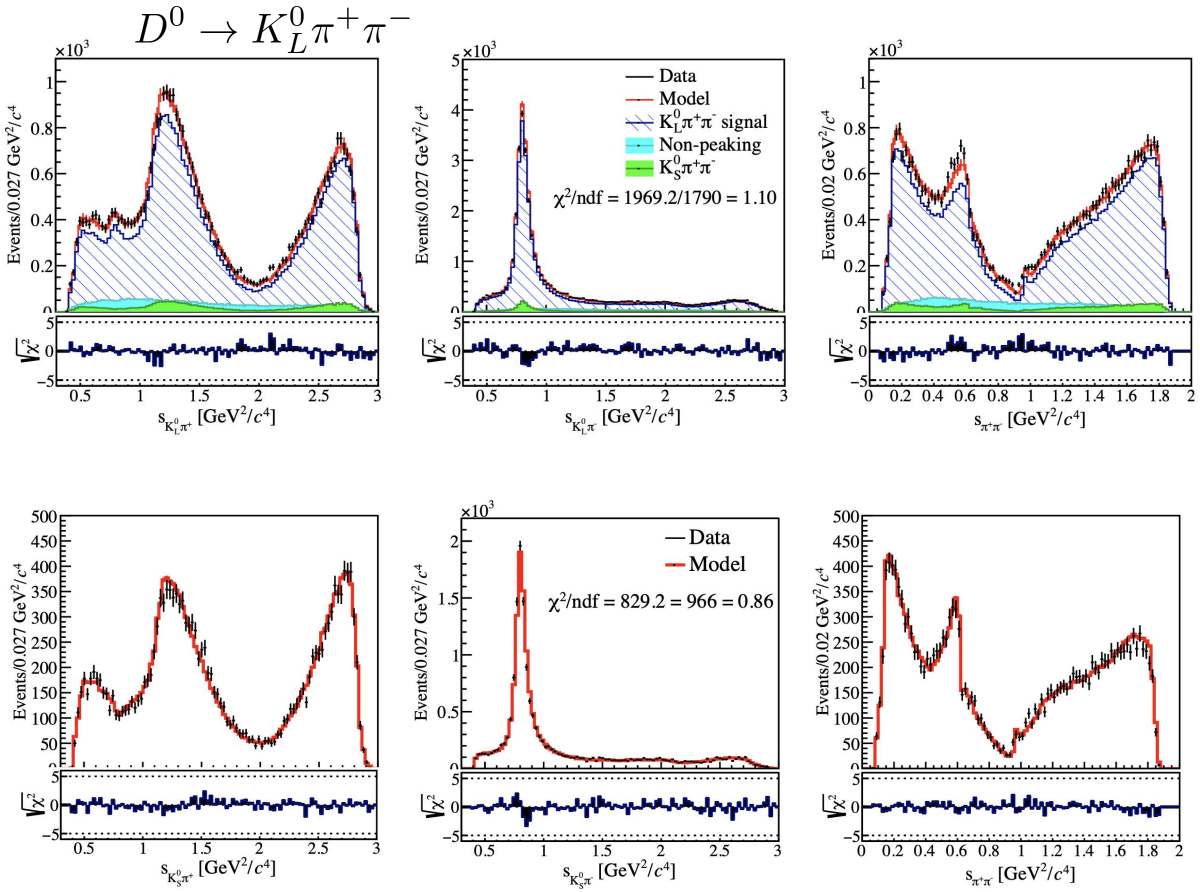
BF	This work	PDG
$\frac{\mathcal{B}(D^+ \to K^*(892)^+(K^+\pi^0)K^0_S)}{\mathcal{B}(D^+ \to K^+K^0_S\pi^0)}$	$(57.1 \pm 2.6_{\text{stat.}} \pm 4.2_{\text{syst.}})\%$	—
$\frac{\mathcal{B}(D^+ \to \bar{K}^*(892)^0(K^0_S\pi^0)K^+)}{\mathcal{B}(D^+ \to K^+K^0_S\pi^0)}$	$(10.2 \pm 1.5_{\text{stat.}} \pm 2.2_{\text{syst.}})\%$	—
$\mathcal{B}(D^+ \to K^*(892)^+ K^0_S)$	$(8.69 \pm 0.40_{\text{stat.}} \pm 0.64_{\text{syst.}} \pm 0.51_{\text{Br.}}) \times 10^{-3}$	$(17 \pm 8) \times 10^{-3}$
$\mathcal{B}(D^+ \to \bar{K}^*(892)^0 K^+)$	$(3.10 \pm 0.46_{\text{stat.}} \pm 0.68_{\text{syst.}} \pm 0.18_{\text{Br.}}) \times 10^{-3}$	$(3.74^{+0.12}_{-0.20}) \times 10^{-3}$

Model	$\mathcal{B}(D^+ \to K^*(892)^+ K^0_S)(\times 10^{-3})$
Pole	6.2 ± 1.2
FAT[mix]	5.5
TDA[tree]	5.02 ± 1.31
TDA[QCD-penguin]	4.90 ± 0.21
PDG	17 ± 8

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

arxiv: 2212.09048, submitted to JHEP

➢ Simultaneous Fit with two modes



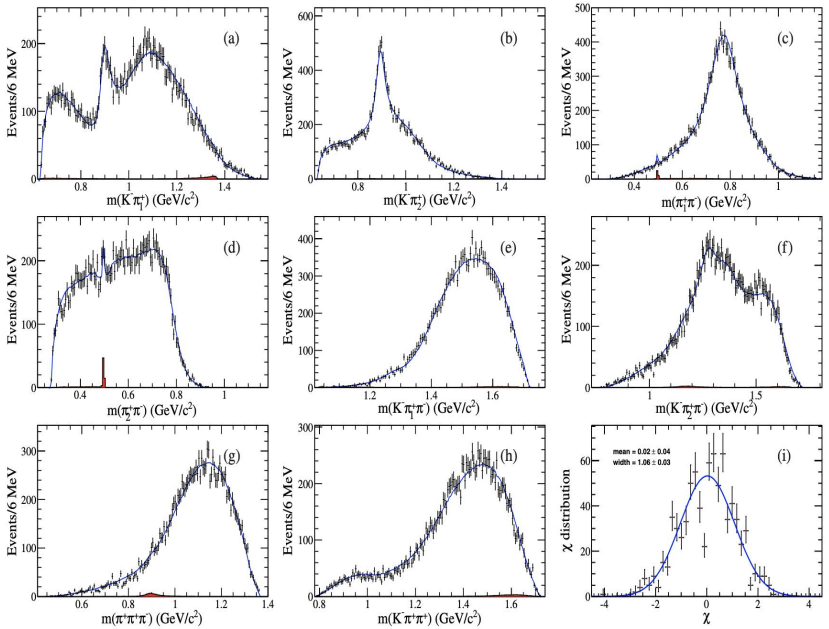
Resonance	$K^0_L\pi^+\pi^-$ FF_R [%]	$K^0_S\pi^+\pi^-$ FF_R [%]
$\rho(770)$	$18.16^{+0.53}_{-0.45} \pm 2.50$	$18.90 \pm 0.42 \pm 2.12$
$\omega(782)$	$0.06^{+0.03}_{-0.02} \pm 0.04$	$0.54 \pm 0.09 \pm 0.14$
$f_2(1270)$	$0.40 \pm 0.08 \pm 0.37$	$0.61^{+0.13}_{-0.11} \pm 0.29$
$\rho(1450)$	$0.42 \pm 0.08 \pm 0.53$	$0.21 \pm 0.10 \pm 0.40$
$K^*(892)^-$	$56.98^{+0.58}_{-0.56} \pm 3.10$	$62.18^{+0.55}_{-0.59} \pm 2.58$
$K^*_2(1430)^-$	$1.64^{+0.10}_{-0.09} \pm 0.48$	$1.79 \pm 0.09 \pm 0.47$
$K^*(1680)^-$	$0.25^{+0.06}_{-0.05} \pm 0.68$	$0.27 \pm 0.06 \pm 0.63$
$K^*(1410)^-$	$0.19 \pm 0.06 \pm 0.46$	$0.21 \pm 0.06 \pm 0.19$
$K^*(892)^+$	$0.45 \pm 0.05 \pm 0.14$	$0.49 \pm 0.05 \pm 0.35$
$K^*_2(1430)^+$	$0.05 \pm 0.02 \pm 0.04$	$0.05 \pm 0.02 \pm 0.03$
$K^*(1410)^+$	$0.04 \pm 0.02 \pm 0.03$	$0.05 \pm 0.02 \pm 0.02$
$K^*_0(1430)^-$	$6.84^{+0.24}_{-0.25} \pm 1.84$	$7.47 \pm 0.26 \pm 1.55$
$\pi\pi$ S-wave	$10.12^{+0.32}_{-0.33} \pm 0.96$	$10.24 \pm 0.23 \pm 1.62$
Total	$95.59^{+2.16}_{-2.07} \pm 11.17$	$103.02^{+2.11}_{-2.10} \pm 10.39$

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

Phys. Rev. D 95, 072010 (2017)

- **First publication of the amplitude analysis of four-body decay at Charm group**
- **Previous analysis only from MARKIII and E691**
- **Help to determine the absolute BFs, strong phase, benefit γ**

Component	Fit fraction (%)	Mark III's result	E691's result
$D^0 \to \bar{K}^{*0}\rho^0$	$12.3 \pm 0.4 \pm 0.5$	$14.2 \pm 1.6 \pm 5$	$13 \pm 2 \pm 2$
$D^0 \to K^- a_1^+(1260)(\rho^0\pi^+)$	$54.6 \pm 2.8 \pm 3.7$	$49.2 \pm 2.4 \pm 8$	$47 \pm 5 \pm 10$
$D^0 \to K_1^-(1270)(\bar{K}^{*0}\pi^-)\pi^+$	$0.8 \pm 0.2 \pm 0.2$	$6.6 \pm 1.9 \pm 3$	...
$D^0 \to K_1^-(1270)(K^-\rho^0)\pi^+$	$3.4 \pm 0.3 \pm 0.5$		
$D^0 \to K^-\pi^+\rho^0$	$8.4 \pm 1.1 \pm 2.5$	$8.4 \pm 2.2 \pm 4$	$5 \pm 3 \pm 2$
$D^0 \to \bar{K}^{*0}\pi^+\pi^-$	$7.0 \pm 0.4 \pm 0.5$	$14.0 \pm 1.8 \pm 4$	$11 \pm 2 \pm 3$
$D^0 \to K^-\pi^+\pi^+\pi^-$	$21.9 \pm 0.6 \pm 0.6$	$24.2 \pm 2.5 \pm 6$	$23 \pm 2 \pm 3$

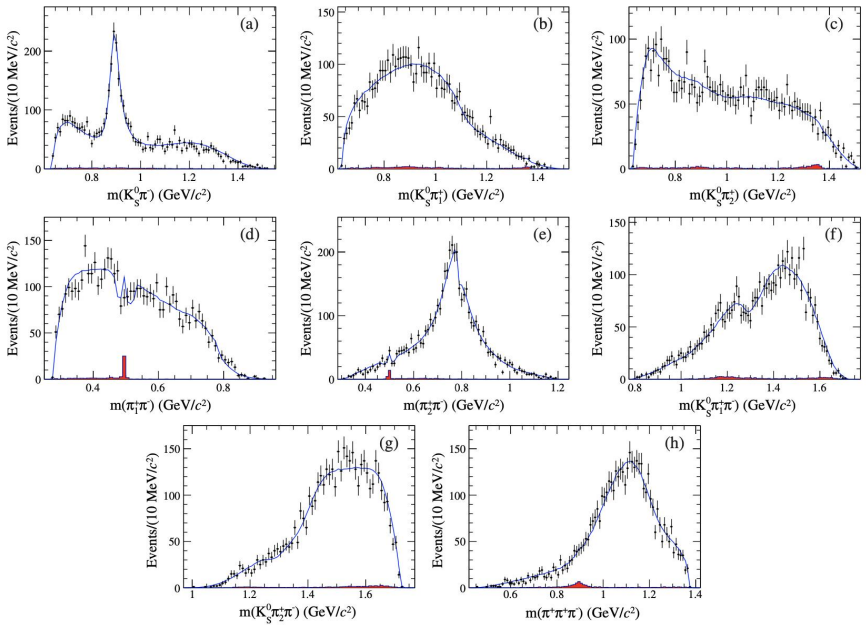


Amplitude	ϕ_i	Fit fraction (%)
$D^0[S] \to \bar{K}^*\rho^0$	$2.35 \pm 0.06 \pm 0.18$	$6.5 \pm 0.5 \pm 0.8$
$D^0[P] \to \bar{K}^*\rho^0$	$-2.25 \pm 0.08 \pm 0.15$	$2.3 \pm 0.2 \pm 0.1$
$D^0[D] \to \bar{K}^*\rho^0$	$2.49 \pm 0.06 \pm 0.11$	$7.9 \pm 0.4 \pm 0.7$
$D^0 \to K^- a_1^+(1260)$, $a_1^+(1260)[S] \to \rho^0\pi^+$	0(fixed)	$53.2 \pm 2.8 \pm 4.0$
$D^0 \to K^- a_1^+(1260)$, $a_1^+(1260)[D] \to \rho^0\pi^+$	$-2.11 \pm 0.15 \pm 0.21$	$0.3 \pm 0.1 \pm 0.1$
$D^0 \to K_1^-(1270)\pi^+$, $K_1^-(1270)[S] \to \bar{K}^{*0}\pi^-$	$1.48 \pm 0.21 \pm 0.24$	$0.1 \pm 0.1 \pm 0.1$
$D^0 \to K_1^-(1270)\pi^+$, $K_1^-(1270)[D] \to \bar{K}^{*0}\pi^-$	$3.00 \pm 0.09 \pm 0.15$	$0.7 \pm 0.2 \pm 0.2$
$D^0 \to K_1^-(1270)\pi^+$, $K_1^-(1270) \to K^-\rho^0$	$-2.46 \pm 0.06 \pm 0.21$	$3.4 \pm 0.3 \pm 0.5$
$D^0 \to (\rho^0 K^-)_A\pi^+$, $(\rho^0 K^-)_A[D] \to K^-\rho^0$	$-0.43 \pm 0.09 \pm 0.12$	$1.1 \pm 0.2 \pm 0.3$
$D^0 \to (K^-\rho^0)_P\pi^+$	$-0.14 \pm 0.11 \pm 0.10$	$7.4 \pm 1.6 \pm 5.7$
$D^0 \to (K^-\pi^+)_{S\text{-wave}}\rho^0$	$-2.45 \pm 0.19 \pm 0.47$	$2.0 \pm 0.7 \pm 1.9$
$D^0 \to (K^-\rho^0)_V\pi^+$	$-1.34 \pm 0.12 \pm 0.09$	$0.4 \pm 0.1 \pm 0.1$
$D^0 \to (\bar{K}^{*0}\pi^-)_P\pi^+$	$-2.09 \pm 0.12 \pm 0.22$	$2.4 \pm 0.5 \pm 0.5$
$D^0 \to \bar{K}^{*0}(\pi^+\pi^-)_S$	$-0.17 \pm 0.11 \pm 0.12$	$2.6 \pm 0.6 \pm 0.6$
$D^0 \to (\bar{K}^{*0}\pi^-)_V\pi^+$	$-2.13 \pm 0.10 \pm 0.11$	$0.8 \pm 0.1 \pm 0.1$
$D^0 \to ((K^-\pi^+)_{S\text{-wave}}\pi^-)_A\pi^+$	$-1.36 \pm 0.08 \pm 0.37$	$5.6 \pm 0.9 \pm 2.7$
$D^0 \to K^-((\pi^+\pi^-)_S\pi^+)_A$	$-2.23 \pm 0.08 \pm 0.22$	$13.1 \pm 1.9 \pm 2.2$
$D^0 \to (K^-\pi^+)_{S\text{-wave}}(\pi^+\pi^-)_S$	$-1.40 \pm 0.04 \pm 0.22$	$16.3 \pm 0.5 \pm 0.6$
$D^0[S] \to (K^-\pi^+)_V(\pi^+\pi^-)_V$	$1.59 \pm 0.13 \pm 0.41$	$5.4 \pm 1.2 \pm 1.9$
$D^0 \to (K^-\pi^+)_{S\text{-wave}}(\pi^+\pi^-)_V$	$-0.16 \pm 0.17 \pm 0.43$	$1.9 \pm 0.6 \pm 1.2$
$D^0 \to (K^-\pi^+)_V(\pi^+\pi^-)_S$	$2.58 \pm 0.08 \pm 0.25$	$2.9 \pm 0.5 \pm 1.7$
$D^0 \to (K^-\pi^+)_T(\pi^+\pi^-)_S$	$-2.92 \pm 0.14 \pm 0.12$	$0.3 \pm 0.1 \pm 0.1$
$D^0 \to (K^-\pi^+)_{S\text{-wave}}(\pi^+\pi^-)_T$	$2.45 \pm 0.12 \pm 0.37$	$0.5 \pm 0.1 \pm 0.1$

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

Phys. Rev. D 100, 072008 (2019)

Help to understand D→AP decay and the mixing between $K_1(1270)$ and $K_1(1400)$

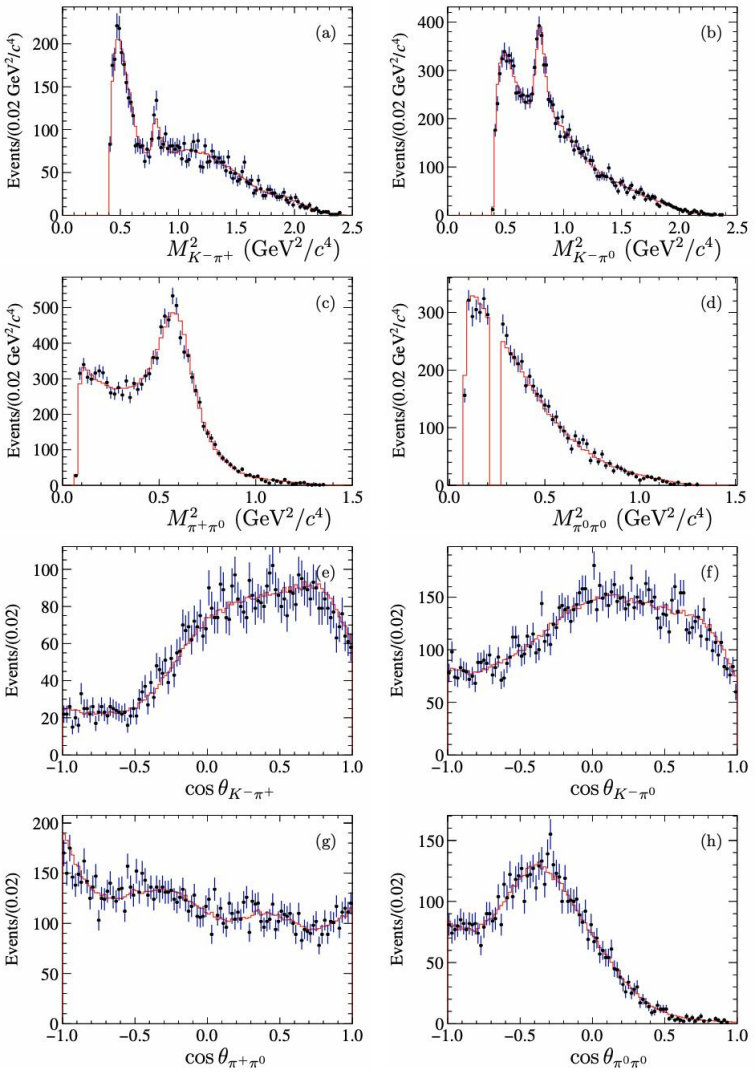


	Amplitude	Significance (σ)	Phase	FF
I	$D^+ \to K^0_S a_1(1260)^+(\rho^0\pi^+[S])$	>10	0.0 (fixed)	$0.384 \pm 0.021 \pm 0.041$
II	$D^+ \to K^0_S a_1(1260)^+(\rho^0\pi^+[D])$	4.3	$-1.55 \pm 0.16 \pm 0.22$	$0.004 \pm 0.002 \pm 0.001$
	$D^+ \to K^0_S a_1(1260)^+(\rho^0\pi^+)$	···	···	$0.403 \pm 0.021 \pm 0.041$
III	$D^+ \to K^0_S a_1(1260)^+(f_0(500)\pi^+)$	>10	$-1.82 \pm 0.08 \pm 0.10$	$0.055 \pm 0.007 \pm 0.018$
IV	$D^+ \to \bar{K}_1(1400)^0(K^{*-}\pi^+[S])\pi^+$	>10	$-2.68 \pm 0.05 \pm 0.07$	$0.221 \pm 0.012 \pm 0.016$
V	$D^+ \to \bar{K}_1(1400)^0(K^{*-}\pi^+[D])\pi^+$	>10	$-2.24 \pm 0.10 \pm 0.07$	$0.015 \pm 0.002 \pm 0.001$
	$D^+ \to \bar{K}_1(1400)^0(K^{*-}\pi^+)\pi^+$	···	···	$0.216 \pm 0.012 \pm 0.011$
VI	$D^+ \to \bar{K}_1(1270)^0(K^0_S\rho^0[S])\pi^+$	9.7	$-0.56 \pm 0.09 \pm 0.11$	$0.024 \pm 0.003 \pm 0.006$
XIII	$D^+ \to \bar{K}(1460)^0(K^{*-}\pi^+)\pi^+$	>10	$-2.50 \pm 0.07 \pm 0.06$	$0.068 \pm 0.006 \pm 0.010$
IX	$D^+ \to \bar{K}(1460)^0(K^0_S\rho^0)\pi^+$	6.1	$-2.65 \pm 0.18 \pm 0.25$	$0.008 \pm 0.002 \pm 0.005$
X	$D^+ \to \bar{K}_1(1650)^0(K^{*-}\pi^+[S])\pi^+$	6.5	$-0.95 \pm 0.14 \pm 0.22$	$0.016 \pm 0.004 \pm 0.014$
VII	$D^+ \to (K^0_S\rho^0[S])_A\pi^+$	>10	$-1.88 \pm 0.08 \pm 0.05$	$0.057 \pm 0.007 \pm 0.023$
VIII	$D^+ \to (K^0_S\rho^0[D])_A\pi^+$	7.0	$2.77 \pm 0.12 \pm 0.14$	$0.008 \pm 0.002 \pm 0.003$
	$D^+ \to (K^0_S\rho^0)_A\pi^+$	···	···	$0.064 \pm 0.007 \pm 0.034$
XI	$D^+ \to (K^0_S(\pi^+\pi^-)_S)_A\pi^+$	>10	$-3.08 \pm 0.06 \pm 0.04$	$0.064 \pm 0.005 \pm 0.007$
XII	$D^+ \to ((K^0_S\pi^+)_{S\text{-wave}}\pi^-)_P\pi^+$	>10	$2.10 \pm 0.08 \pm 0.28$	$0.017 \pm 0.003 \pm 0.005$
	$D^+ \to K^0_S\pi^+\pi^+\pi^-$ nonresonance	···	···	$0.081 \pm 0.006 \pm 0.009$

Component	Branching fraction (%)
$D^+ \to K^0_S a_1(1260)^+(\rho^0\pi^+)$	$1.197 \pm 0.062 \pm 0.120 \pm 0.044$
$D^+ \to K^0_S a_1(1260)^+(f_0(500)\pi^+)$	$0.163 \pm 0.021 \pm 0.053 \pm 0.006$
$D^+ \to \bar{K}_1(1400)^0(K^{*-}\pi^+)\pi^+$	$0.642 \pm 0.036 \pm 0.033 \pm 0.024$
$D^+ \to \bar{K}_1(1270)^0(K^0_S\rho^0)\pi^+$	$0.071 \pm 0.009 \pm 0.019 \pm 0.003$
$D^+ \to \bar{K}(1460)^0(K^{*-}\pi^+)\pi^+$	$0.202 \pm 0.018 \pm 0.031 \pm 0.007$
$D^+ \to \bar{K}(1460)^0(K^0_S\rho^0)\pi^+$	$0.024 \pm 0.006 \pm 0.015 \pm 0.009$
$D^+ \to \bar{K}_1(1650)^0(K^{*-}\pi^+)\pi^+$	$0.048 \pm 0.012 \pm 0.042 \pm 0.002$
$D^+ \to K^0_S\pi^+\rho^0$	$0.190 \pm 0.021 \pm 0.103 \pm 0.007$
$D^+ \to K^0_S\pi^+\pi^+\pi^-$	$0.241 \pm 0.018 \pm 0.026 \pm 0.009$

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

Phys. Rev. D 99, 092008 (2019)



First amplitude analysis of this decay

Amplitude mode	FF (%)	Phase (ϕ)	Significance (σ)
$D \to SS$			
$D \to (K^-\pi^+)_{S\text{-wave}}(\pi^0\pi^0)_S$	$6.92 \pm 1.44 \pm 2.86$	$-0.75 \pm 0.15 \pm 0.47$	> 10
$D \to (K^-\pi^0)_{S\text{-wave}}(\pi^+\pi^0)_S$	$4.18 \pm 1.02 \pm 1.77$	$-2.90 \pm 0.19 \pm 0.47$	6.0
$D \to AP, A \to VP$			
$D \to K^-a_1(1260)^+, \rho^+\pi^0[S]$	$28.36 \pm 2.50 \pm 3.53$	0 (fixed)	> 10
$D \to K^-a_1(1260)^+, \rho^+\pi^0[D]$	$0.68 \pm 0.29 \pm 0.30$	$-2.05 \pm 0.17 \pm 0.25$	6.1
$D \to K_1(1270)^-\pi^+, K^{*-}\pi^0[S]$	$0.15 \pm 0.09 \pm 0.15$	$1.84 \pm 0.34 \pm 0.43$	4.9
$D \to K_1(1270)^0\pi^0, K^{*0}\pi^0[S]$	$0.39 \pm 0.18 \pm 0.30$	$-1.55 \pm 0.20 \pm 0.26$	4.8
$D \to K_1(1270)^0\pi^0, K^{*0}\pi^0[D]$	$0.11 \pm 0.11 \pm 0.11$	$-1.35 \pm 0.43 \pm 0.48$	4.0
$D \to K_1(1270)^0\pi^0, K^-\rho^+[S]$	$2.71 \pm 0.38 \pm 0.29$	$-2.07 \pm 0.09 \pm 0.20$	> 10
$D \to (K^{*-}\pi^0)_A\pi^+, K^{*-}\pi^0[S]$	$1.85 \pm 0.62 \pm 1.11$	$1.93 \pm 0.10 \pm 0.15$	7.8
$D \to (K^{*0}\pi^0)_A\pi^0, K^{*0}\pi^0[S]$	$3.13 \pm 0.45 \pm 0.58$	$0.44 \pm 0.12 \pm 0.21$	> 10
$D \to (K^{*0}\pi^0)_A\pi^0, K^{*0}\pi^0[D]$	$0.46 \pm 0.17 \pm 0.29$	$-1.84 \pm 0.26 \pm 0.42$	5.9
$D \to (\rho^+K^-)_A\pi^0, K^-\rho^+[D]$	$0.75 \pm 0.40 \pm 0.60$	$0.64 \pm 0.36 \pm 0.53$	5.1
$D \to AP, A \to SP$			
$D \to ((K^-\pi^+)_{S\text{-wave}}\pi^0)_A\pi^0$	$1.99 \pm 1.08 \pm 1.55$	$-0.02 \pm 0.25 \pm 0.53$	7.0
$D \to VS$			
$D \to (K^-\pi^0)_{S\text{-wave}}\rho^+$	$14.63 \pm 1.70 \pm 2.41$	$-2.39 \pm 0.11 \pm 0.35$	> 10
$D \to K^{*-}(\pi^+\pi^0)_S$	$0.80 \pm 0.38 \pm 0.26$	$1.59 \pm 0.19 \pm 0.24$	4.1
$D \to K^{*0}(\pi^0\pi^0)_S$	$0.12 \pm 0.12 \pm 0.12$	$1.45 \pm 0.48 \pm 0.51$	4.1
$D \to VP, V \to VP$			
$D \to (K^{*-}\pi^+)_V\pi^0$	$2.25 \pm 0.43 \pm 0.45$	$0.52 \pm 0.12 \pm 0.17$	> 10
$D \to VV$			
$D \to K^{*-}\rho^+[S]$	$5.15 \pm 0.75 \pm 1.28$	$1.24 \pm 0.11 \pm 0.23$	> 10
$D \to K^{*-}\rho^+[P]$	$3.25 \pm 0.55 \pm 0.41$	$-2.89 \pm 0.10 \pm 0.18$	> 10
$D \to K^{*-}\rho^+[D]$	$10.90 \pm 1.53 \pm 2.36$	$2.41 \pm 0.08 \pm 0.16$	> 10
$D \to (K^-\pi^0)_V\rho^+[P]$	$0.36 \pm 0.19 \pm 0.27$	$-0.94 \pm 0.19 \pm 0.28$	5.7
$D \to (K^-\pi^0)_V\rho^+[D]$	$2.13 \pm 0.56 \pm 0.92$	$-1.93 \pm 0.22 \pm 0.25$	> 10
$D \to K^{*-}(\pi^+\pi^0)_V[D]$	$1.66 \pm 0.52 \pm 0.61$	$-1.17 \pm 0.20 \pm 0.39$	7.6
$D \to (K^-\pi^0)_V(\pi^+\pi^0)_V[S]$	$5.17 \pm 1.91 \pm 1.82$	$-1.74 \pm 0.20 \pm 0.31$	7.6
$D \to TS$			
$D \to (K^-\pi^+)_{S\text{-wave}}(\pi^0\pi^0)_T$	$0.30 \pm 0.21 \pm 0.30$	$-2.93 \pm 0.31 \pm 0.82$	5.8
$D \to (K^-\pi^0)_{S\text{-wave}}(\pi^+\pi^0)_T$	$0.14 \pm 0.12 \pm 0.10$	$2.23 \pm 0.38 \pm 0.65$	4.0
TOTAL	98.54		

B(D0 → K−π+π0π0) = (8.86 ± 0.13(stat) ± 0.19(syst))%.

Summary

- Amplitude Analyses of D hadronic decays with 2.93 fb^{-1} data @ E_{cm} = 3.773 GeV have been published.
- 8 fb^{-1} data now with more precison, totally 20 fb^{-1} in the future.
- Several amplitude analyses are ongoing, coming soon.

$D^+ \to K_S \pi^+ \eta$
$D^+ \to \pi^+ \pi^0 \pi^0$
$D^+ \to \pi^+ \pi^0 \eta$
$D^0 \to \pi^+ \pi^- \eta$
$D^0 \to K_S \pi^0 \eta$
$D^0 \to \pi^+ \pi^- \pi^{+(0)} \pi^{-(0)}$
$D^0 \to K^+ K^- \pi^+ \pi^-$
$D^0 \to K_S \pi^+ \pi^- \pi^0$
.....