Motivation

Studies of the hadronic D decays are important to understand the weak decay mechanisms of D meson.

The $K_S^0 - K_L^0$ asymmetry is predicted to be 0.113 ± 0.001 for all possible processes of two-body non-leptonic D^0 decays.

Phys. Rev. D **95**, 073007

With the current world averaging result of the $D^0 - \overline{D}^0$ mixing parameter $y_D = (0.62 \pm 0.08)\%$ assuming no CP violation [3], we have

$$\begin{aligned} R(D^0 \to K^0_{S,L}\pi^0) &= R(D^0 \to K^0_{S,L}\eta) = R(D^0 \to K^0_{S,L}\eta') \\ &= R(D^0 \to K^0_{S,L}\rho^0) = R(D^0 \to K^0_{S,L}\omega) \\ &= R(D^0 \to K^0_{S,L}\phi) = 0.113 \pm 0.001, \end{aligned} \tag{32}$$

$$R(f) \equiv \frac{\Gamma(D \to K_S^0 f) - \Gamma(D \to K_L^0 f)}{\Gamma(D \to K_S^0 f) + \Gamma(D \to K_L^0 f)}.$$

Phys. Rev. D 78, 012001 (2008) (CLEO)	$Br_{(D^0 \to K_S^0 \omega)} = (1.12 \pm 0.04 \pm 0.05)\%$
Phys. Rev. D 105, 092010 (2022) (BESIII)	$Br_{(D^0 \to K_L^0 \omega)} = (1.164 \pm 0.022 \pm 0.028)\%$ $Br_{(D^0 \to K_L^0 \phi)} = (0.414 \pm 0.021 \pm 0.010)\%$
Phys. Rev. D 100, 072006 (BESIII)	$Br_{(D^0 \to K_S^0 \phi)} = (0.413 \pm 0.031)\%$
BAM-567	$Br_{(D^0 \to K_L^0 \omega)} = (1.09 \pm 0.06 \pm 0.03)\%$ $Br_{(D^0 \to K_S^0 \omega)} = (1.101 \pm 0.012)\%$

- $\Gamma_{D^0 \to K_S^0 \omega}/\Gamma_{total}$=$(1.11 \pm 0.06)\%$ (PDG)
- $\Gamma_{D^0 \to K_S^0 \omega, \omega \to \pi^+\pi^-\pi^0}/\Gamma_{total}$=$(9.9 \pm 0.06) \times 10^{-3}$ (PDG)

- Phys. Rev. D 78, 012001 (2008)   (CLEO)
- $\left|M_{\pi^+\pi^-} - M_{K_S^0}\right| \leq 7.5\ MeV/c^2$
- Vertex fit :decay length $L/\sigma_L > 2$
- $|M_{\pi^+\pi^-\pi^0} - M_{\omega}| < 20\ MeV/c^2$

Phys. Rev. D **86**, 112001(2012) (CLEO)
Sideband Subtraction in $M_{\pi^+\pi^-\pi^0}$ Spectrum, signal region are set as$(0.760, 0.805) GeV/c^2$,
the lower sideband region is $(0.600, 0.730) GeV/c^2$, the upper sideband region is $(0.830, 0.8525) GeV/c^2$
The limited range of the upper sideband is chosen to minimize the effect of $\rho^0 \to \pi^+\pi^-$ and $\rho^\pm \to \pi^\pm\pi^0$ decays

BAM-567

$0.115 < m_{\gamma\gamma} < 0.150\ \mathrm{GeV}/c^2$,kinematic fit

$0.750 < m_{\pi^+\pi^-\pi^0} < 0.820\ \mathrm{GeV}/c^2$

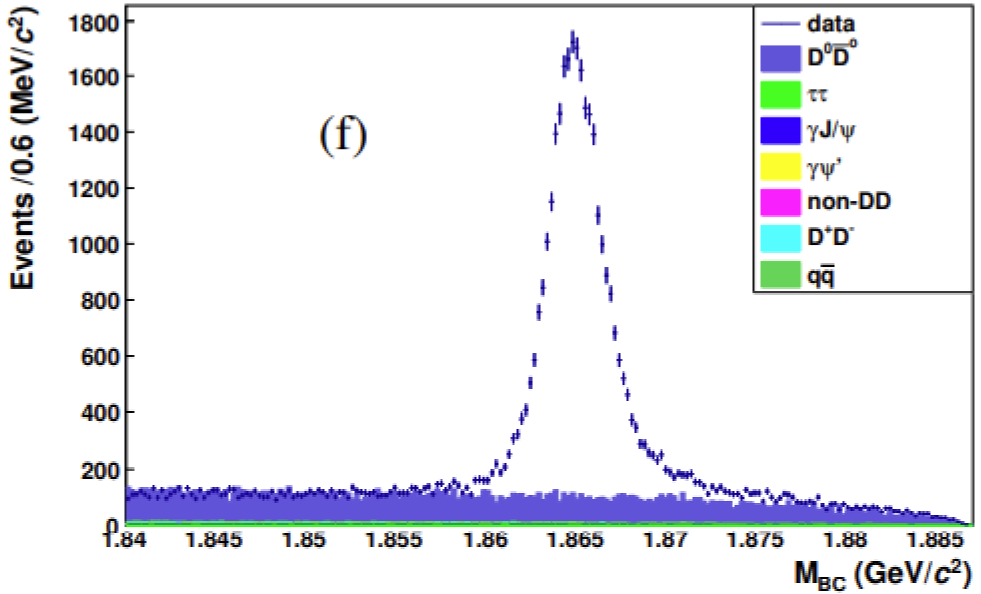
Vertex fit :decay length $L/\sigma_L > 2$

$0.487 < m_{\pi^+\pi^-} < 0.511\ \mathrm{GeV}/c^2$

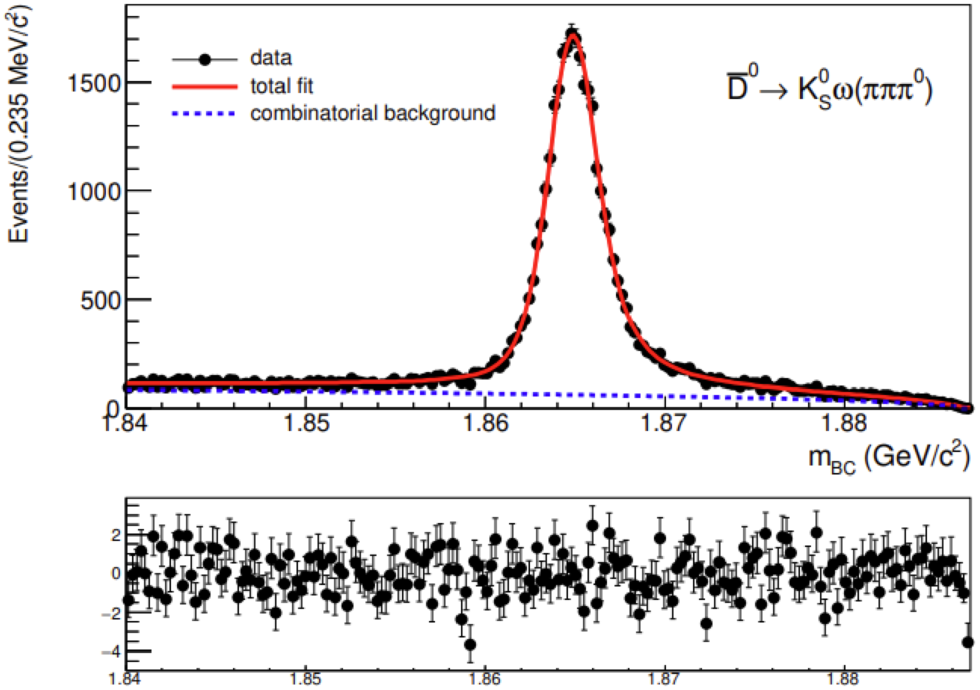
$\Delta E\ within \pm 3\sigma_{\Delta E}$

fit to M_{BC} distributions

The signal shape is a template taken from the corresponding signal MC, which is then convoluted with a Gaussian function. The amount and shape of the peaking background contributions are taken from inclusive MC simulation.



M_{BC} distributions of ST *CP*-odd modes for candidates in data, with MC-estimated background



Fits to M_{BC} distributions of ST candidates in data for the *CP*-odd

The single-tag yields from these fits are listed in Table 10, together with the efficiencies determined from MC. In order to provide a sanity check on these values the branching fraction for each tag mode T is determined from the following relation

$$\mathcal{B}(D^0 \to T) = \frac{N(T)}{2N_{D\bar{D}}\epsilon(T)}. \tag{16}$$

The value of $N_{D\bar{D}}$ is taken to be $(10,597 \pm 28 \pm 98) \times 10^3$, as reported in Ref. [29]. It can be seen

Table 10: Summary of single-tag yields and the selection efficiencies as determined from Monte Carlo simulation. The uncertainties are statistical only. Also shown is the branching fraction, determined from these values, again with the statistical uncertainty only, and the value of the branching fraction found in the PDG [18].

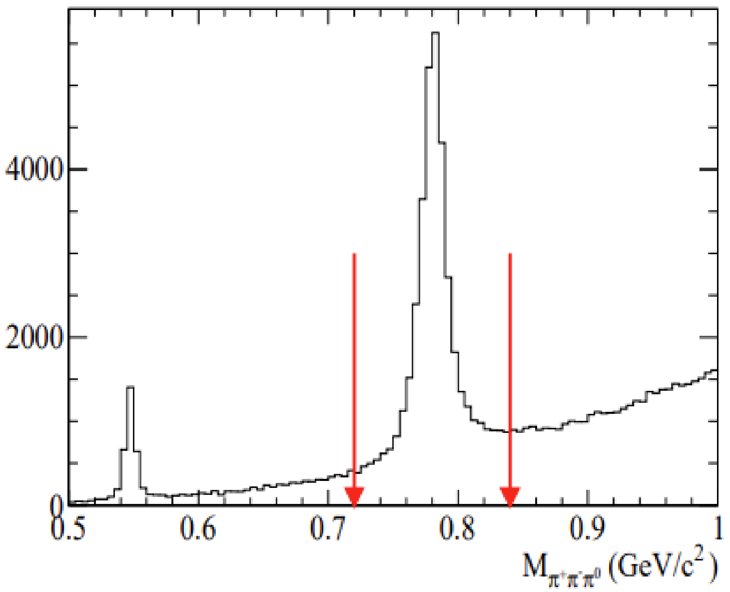
Tag	ΔE cut (MeV)	Yield	Efficiency (%)	$\mathcal{B}$ (%)	$\mathcal{B}_{\text{PDG}}$ (%)
K^+K^-	[-18, 18]	55,696 ± 256	63.01 ± 0.05	0.414 ± 0.002	0.408 ± 0.006
$\pi^+\pi^-$	[-25, 24]	20,403 ± 175	67.71 ± 0.08	0.141 ± 0.001	0.145 ± 0.002
$\pi^0\pi^0$	[-95, 55]	7,012 ± 179	40.69 ± 0.12	0.081 ± 0.002	0.083 ± 0.003
$\pi^+\pi^-\pi^0$	[-57, 43]	129,601 ± 717	44.34 ± 0.02	1.369 ± 0.008	1.49 ± 0.06
$K_S^0\pi^0\pi^0$	[-60, 44]	29,328 ± 265	21.33 ± 0.04	0.931 ± 0.008	0.91 ± 0.11
$K_S^0\pi^0$	[-69, 44]	72,632 ± 294	40.50 ± 0.04	1.214 ± 0.005	1.239 ± 0.022
$K_S^0\eta(\gamma\gamma)$	[-38, 34]	10,769 ± 131	36.11 ± 0.09	0.512 ± 0.006	0.508 ± 0.013
$K_S^0\eta(\pi\pi\pi^0)$	[-57, 43]	3,054 ± 67	17.76 ± 0.11	0.508 ± 0.011	0.508 ± 0.013
$K_S^0\eta'(\gamma\pi\pi)$	[-27, 23]	10,427 ± 136	24.55 ± 0.07	0.974 ± 0.013	0.949 ± 0.032
$K_S^0\eta'(\pi\pi\eta)$	[-27, 23]	3,723 ± 70	15.27 ± 0.07	0.985 ± 0.019	0.949 ± 0.032
$K_S^0\omega(\pi\pi\pi^0)$	[-38, 29]	25,794 ± 288	17.78 ± 0.03	1.101 ± 0.012	1.11 ± 0.06
$K_S^0\phi$	[-19, 16]	4,297 ± 69	11.20 ± 0.06	-	-

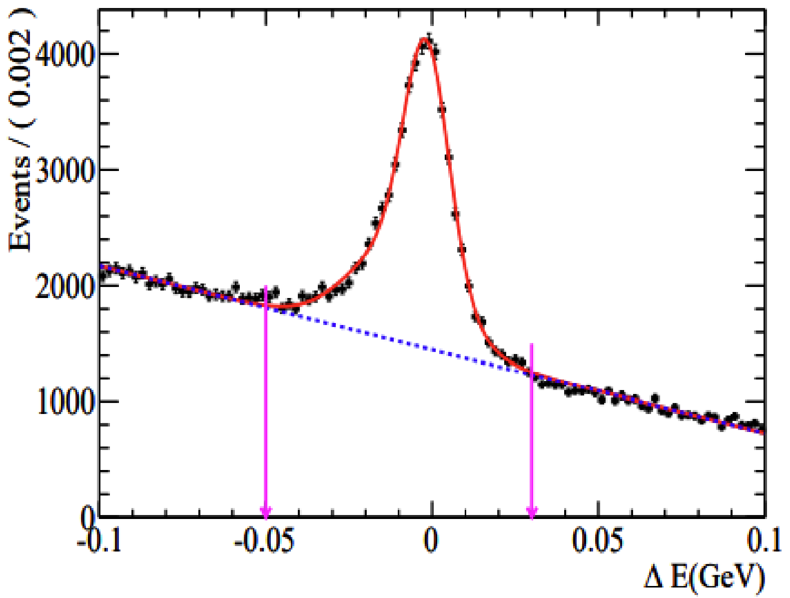
Phys. Lett. B 734, 227 (2014) Determination of the Strong Phase Difference in

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

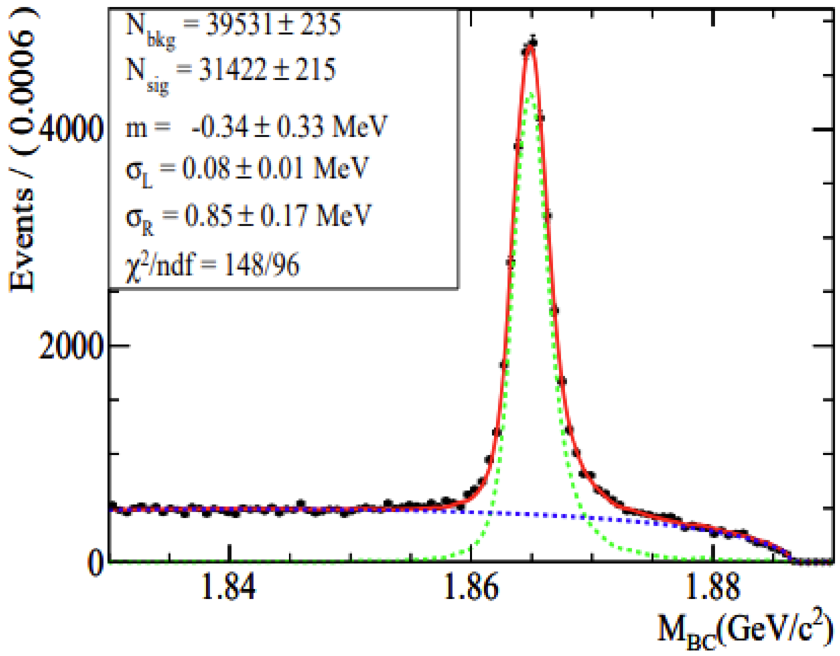
ω	$0.720 < m_{\pi^+\pi^-\pi^0} < 0.840\text{GeV}/\text{c}^2$
$K_S^0\omega$	$-0.050 < \Delta E < 0.030$

ΔE set at approximately 3 standard deviations
Modes with π^0 or η, which decay to two photons, have asymmetric limits for partially contained showers in the EMC (about −4/+3.5σ).





(d) $D \to K_S^0\omega$



(c) $CP-$: $K_S^0\omega$

Mode(CP)	ST Yield	Efficiency(%)
K^+K^-	56156 ± 261	62.99 ± 0.26
$\pi^+\pi^-$	20222 ± 187	65.58 ± 0.26
$K_S^0\pi^0\pi^0$	25156 ± 235	16.46 ± 0.07
$\pi^0\pi^0$	7610 ± 156	42.77 ± 0.21
$\rho\pi^0$	41117 ± 354	36.22 ± 0.21
$K_S^0\pi^0$	72710 ± 291	41.95 ± 0.21
$K_S^0\eta$	10046 ± 121	35.12 ± 0.20
$K_S^0\omega$	31422 ± 215	17.88 ± 0.10

We fit the M_{BC} distributions with a so-called "matched" signal shape derived from MC truth signal events (using ST MC) and a background ARGUS function[21]:

$$\sigma \bigotimes PDF_{MC-ST-signal} + BKG. \tag{34}$$

$$\mathcal{B}(D^0 \to T) = \frac{N(T)}{2N_{D\bar{D}}\epsilon(T)}.$$

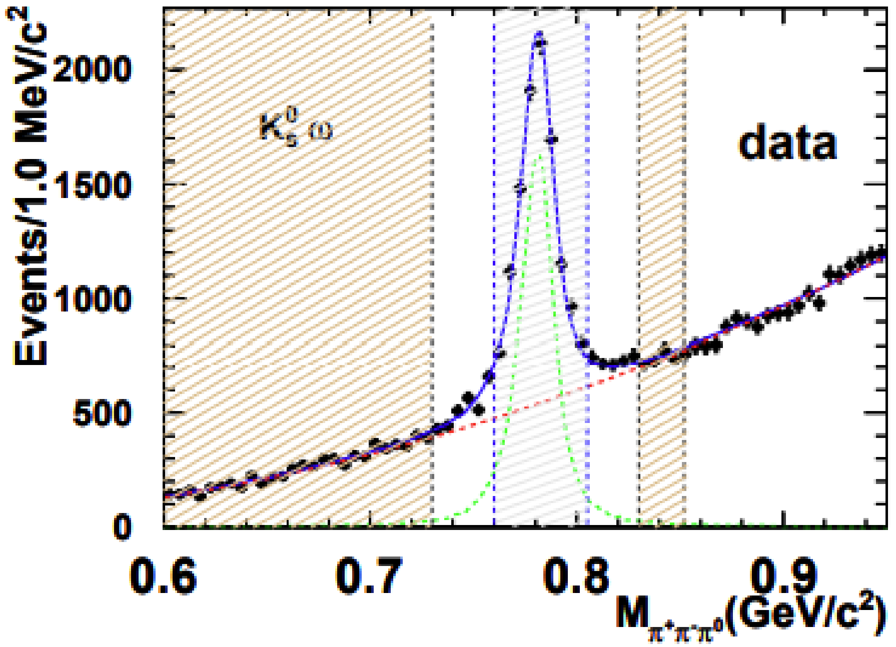
$$Br_{(D^0 \to K_S^0 \omega)} = (1.34 \pm 0.022)\%$$

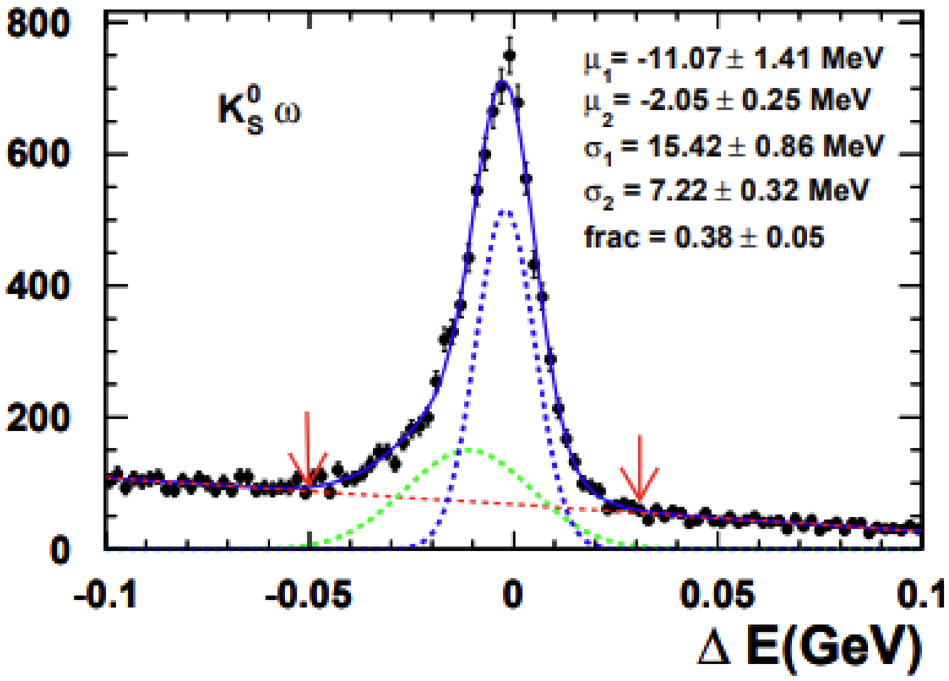
Phys. Lett. B 744, 339 (2015)

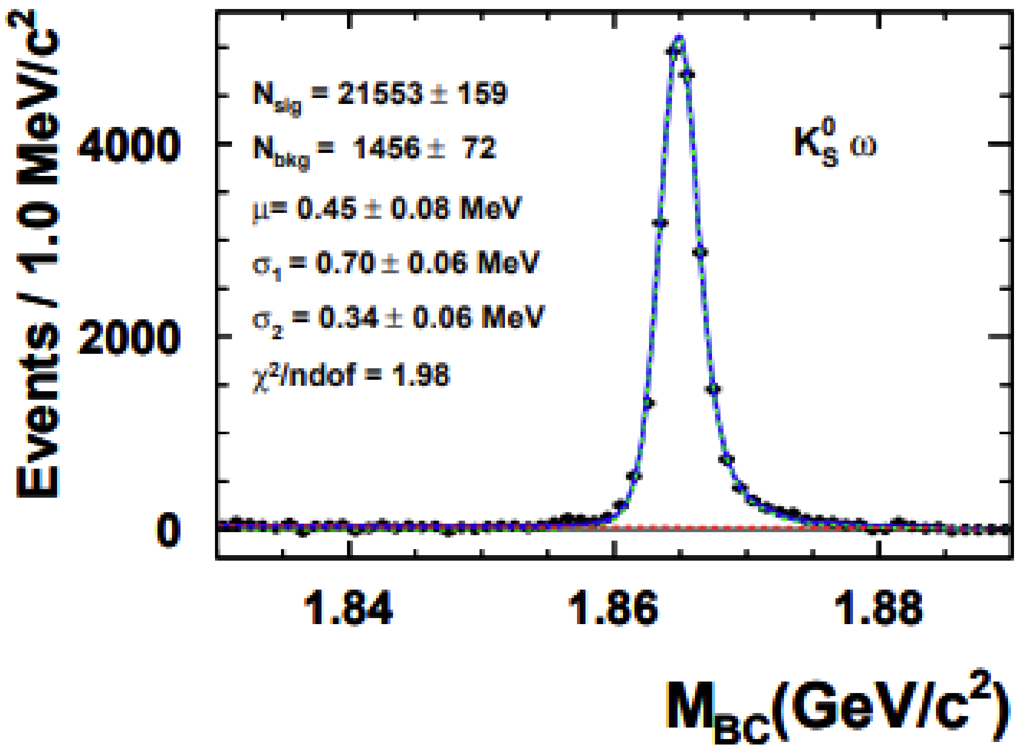
Measurement of y_{CP} in $D^0 - \overline{D}^0$ oscillation using quantum correlations in $e^+e^- \to D^0\overline{D}^0$ at $\sqrt{s} = 3.773\,\mathrm{GeV}$

Sideband Subtraction in $M_{\pi^+\pi^-\pi^0}$ Spectrum, signal region are set as$(0.760,0.805)GeV/c^2$, the lower sideband region is $(0.600,0.730)GeV/c^2$, the upper sideband region is $(0.830,0.8525)GeV/c^2$

ΔE between -5σ and +3σ for modes with π^0 due to the lowside tail caused by π^0 .







The signal is described by a double-guassian function and the background is described by polynomial.

Single Tag yields and efficiencies. All uncertainties are statistical only.

Modes	Yields(N_{tag})	Efficiency (ϵ_{tag})(%)
K^+K^-	54307 ± 252	61.32 ± 0.18
$\pi^+\pi^-$	19996 ± 177	64.09 ± 0.18
$K_S^0\pi^0\pi^0$	24369 ± 231	16.13 ± 0.08
$K_S^0\pi^0$	71419 ± 286	40.67 ± 0.14
$K_S^0\omega$	21249 ± 157	13.44 ± 0.07
$K_S^0\eta$	9897 ± 119	34.39 ± 0.13

$$\mathcal{B}(D^0 \to T) = \frac{N(T)}{2N_{D\bar{D}}\epsilon(T)}.$$

$$Br_{(D^0 \to K_S^0\omega)} = (1.208 \pm 0.025)\%$$