

Supplemental material for the Letter “Search for D^0 meson decays to $\pi^+\pi^-e^+e^-$ and $K^+K^-e^+e^-$ final states”

The fit results for $D^0 \rightarrow K^-\pi^+[e^+e^-]_{\rho^0/\omega}$ decays are shown in Fig. 3 for candidates selected as normalization sample for measurement of the branching fraction of both $D^0 \rightarrow \pi^+\pi^-e^+e^-$ and $D^0 \rightarrow K^+K^-e^+e^-$ decays. The measured branching fractions in dielectron-mass regions for $D^0 \rightarrow \pi^+\pi^-e^+e^-$ and $D^0 \rightarrow K^+K^-e^+e^-$ decays are reported in Table 3 and Table 4, respectively. A summary of the systematic uncertainties is listed in Table 5. The correlation matrices for the measurements, including statistical and systematic uncertainties, are given in Tables 6 and 7.

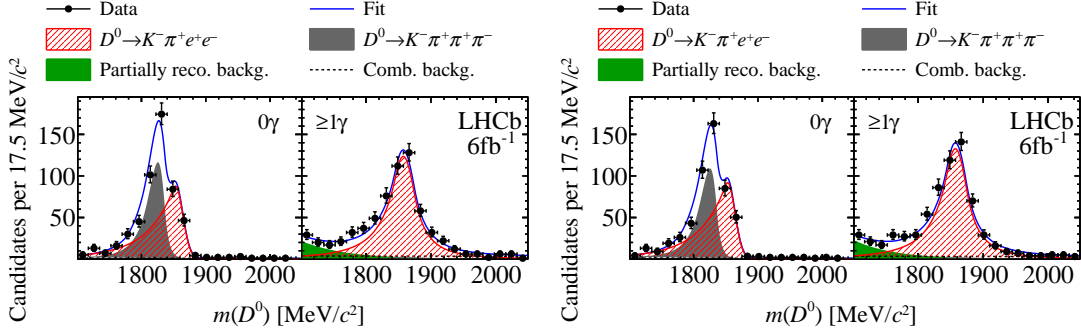


Figure 3: Distributions of $m(D^0)$ for selected $D^0 \rightarrow K^-\pi^+[e^+e^-]_{\rho^0/\omega}$ candidates in the dielectron-mass region between 675–875 MeV/c^2 split within no-brem and with-brem categories, with the selection optimized for (left) $D^0 \rightarrow \pi^+\pi^-e^+e^-$ and (right) $D^0 \rightarrow K^+K^-e^+e^-$ decays. Fit projections are also shown.

Table 3: Measured branching fractions of $D^0 \rightarrow \pi^+\pi^-e^+e^-$ decays in regions of the dielectron mass, which are used to compute the total branching fraction. The total uncertainty is reported, including the statistical, systematic and due to the limited knowledge of the normalization mode branching fraction uncertainties.

$m(e^+e^-)$ region	[MeV/c^2]	\mathcal{B} [10^{-7}]
$D^0 \rightarrow \pi^+\pi^-e^+e^-$		
Low mass	$2m_\mu$ –525	$2.8^{+1.2}_{-1.1}$
η	525–565	$1.0^{+0.7}_{-0.6}$
ρ^0/ω	565–950	4.5 ± 1.4
ϕ	950–1100	3.8 ± 0.9
High mass	> 1100	$1.1^{+0.5}_{-0.4}$

Table 4: Measured branching fractions of $D^0 \rightarrow K^+K^-e^+e^-$ decays in regions of dielectron mass. The total uncertainty is reported, including the statistical, systematic and due to the limited knowledge of the normalization mode branching fraction uncertainties.

$m(e^+e^-)$ region	[MeV/ c^2]	\mathcal{B} [10^{-8}]
$D^0 \rightarrow K^+K^-e^+e^-$		
Low mass	$2m_\mu$ –525	$0.9^{+4.3}_{-1.1}$
η	525–565	$0.1^{+1.7}_{-0.2}$
ρ^0/ω	> 565	$9.9^{+6.4}_{-5.1}$

Table 5: Summary of relative systematic uncertainties on ratio of yields ($\frac{\Delta R_\epsilon}{R_\epsilon}$) and ratio of efficiencies ($\frac{\Delta R_\epsilon}{R_\epsilon}$) for (top) $D^0 \rightarrow \pi^+\pi^-e^+e^-$ and (bottom) $D^0 \rightarrow K^+K^-e^+e^-$ decays in different ranges of dielectron mass. The last column shows the sum in quadrature of the contributions. The uncertainty due to the limited knowledge of the normalization mode branching fraction (13.7%) is not shown in this table.

$m(e^+e^-)$ region	[MeV/ c^2]	$\frac{\Delta R_N}{R_N}$ [%]	$\frac{\Delta R_\epsilon}{R_\epsilon}$ [%]	$\frac{\Delta \mathcal{B}}{\mathcal{B}}$ [%]
$D^0 \rightarrow \pi^+\pi^-e^+e^-$				
Low mass	$2m_\mu$ –525	8.1	10.1	12.9
η	525–565	11.7	16.9	20.6
ρ^0/ω	565–950	15.1	4.8	15.8
ϕ	950–1100	8.2	5.9	10.1
High mass	> 1100	11.9	13.0	17.6
$D^0 \rightarrow K^+K^-e^+e^-$				
Low mass	$2m_\mu$ –525	9.2	8.8	12.7
η	525–565	9.8	15.4	18.3
ρ^0/ω	> 565	10.3	5.5	11.7

Table 6: Correlation coefficients related to the statistical and systematic uncertainties of the branching fractions of $D^0 \rightarrow \pi^+\pi^-e^+e^-$ decays in different dilepton mass regions.

$m(e^+e^-)$ region [MeV/ c^2]	$2m_\mu$ –525	525–565	565–950	950–1100	>1100
$2m_\mu$ –525	1.00	0.14	0.33	0.34	0.22
525–565		1.00	0.25	0.25	0.17
565–950			1.00	0.54	0.37
950–1100				1.00	0.37
>1100					1.00

Table 7: Correlation coefficients related to the statistical and systematic uncertainties of the branching fractions of $D^0 \rightarrow K^+K^-e^+e^-$ decays in different dielectron mass regions.

$m(e^+e^-)$ region [MeV/ c^2]	$2m_\mu$ –525	525–565	> 565
$2m_\mu$ –525	1.00	0.05	0.02
525–565		1.00	0.17
> 565			1.00