Study of $D_s^+ \rightarrow K^{(*)0} e^+\nu_e$ at BESIII

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Signal Events of $D_s^+ \rightarrow K^{(*)0} e^+\nu_e$

- To find the best photon candidate for the $D_s^+$ candidate, all the residual photons are looped and constrained to the nominal mass of $D_s^+$ under the hypothesis that photon comes from the tag side, i.e. $D_s^+$ or the signal side, i.e. $D_s^+$. The combination with low $\chi^2$ is kept.

Introduction

- $D_s^+ \rightarrow K^{(*)0} e^+\nu_e$ are Cabibbo-suppressed processes.
- Current branching fractions (BFs) of these decays are limited to the statistics. Significant improvement is expected with the dataset collected with BESIII.

BESIII and BEPCII

- The Beijing Spectrometer (BESIII) detects $e^+e^-$ collisions in the double-ring collider Beijing Electron Positron Collider (BEPCII).
- $D_s^+$ dataset is accumulated in 2016, based on $D_s^- D_s^+$ $\rightarrow \pi^+ \pi^0 D_s^0$ production at $\sqrt{s} = 4.180$ GeV. The luminosity is about $L = 3.18$ fb$^{-1}$, so about 6M $D_s^+$ events are produced.

Analysis Method

- A double tag (DT) analysis method is employed, where a single tag (ST) $D^+_s$ is reconstructed with the hadronic decays, as the tag side, while the SL candidates could be reconstructed in the signal side.
- The hadronic form factor $F_{\gamma}$ is determined to be $f_1(0) = 0.720 \pm 0.084 \pm 0.011$ for $D_s^+ \rightarrow K^{(*)0} e^+\nu_e$ by fixing the partial decay ratio. The form factor ratios $r_1$ and $r_2$ for the decay $D_s^+ \rightarrow K^{(*)0} e^+\nu_e$ are measured to be $r_1 = 2.83 \pm 0.34 \pm 0.16$ and $r_2 = 0.77 \pm 0.29 \pm 0.07$, respectively. Here, the first errors are statistical and the second systematic.

Table 1: ST yields in data

<table>
<thead>
<tr>
<th>Decay</th>
<th>$\sigma^{D_s^+ \rightarrow K^{(*)0} e^+\nu_e}_T$</th>
<th>$\sigma^{D_s^+ \rightarrow K^{(*)0} e^+\nu_e}_S$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$D_s^+ \rightarrow K^+ e^+\nu_e$</td>
<td>0.68 \pm 0.41 \pm 0.06</td>
<td>0.68 \pm 0.41 \pm 0.06</td>
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<tr>
<td>$D_s^+ \rightarrow K^0 e^+\nu_e$</td>
<td>0.71 \pm 0.44 \pm 0.07</td>
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<tr>
<td>$D_s^+ \rightarrow K^{*+} e^+\nu_e$</td>
<td>0.73 \pm 0.46 \pm 0.08</td>
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<tr>
<td>$D_s^+ \rightarrow K^{*0} e^+\nu_e$</td>
<td>0.75 \pm 0.48 \pm 0.09</td>
<td>0.75 \pm 0.48 \pm 0.09</td>
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References


Acknowledgements

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