Minutes for the seminar at 1st Nov. 2017

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- $N_{tag} = 2N_{D^+D^-}\mathcal{B}_{tag}\varepsilon_{tag}$, is there double-counting event in the procedure?

  There is no double-counting event in this double-tag procedure. The selected events are originated from either $D^+ \to \bar{K}^0 e^+ \nu_e$, $D^- \to K^+\pi^-\pi^-$ or $D^+ \to K^-\pi^+\pi^+$, $D^- \to K^0 e^- \bar{\nu}_e$ events. There will be double-counting when using the $D^0 \to K^- e^+ \nu_e$, $\bar{D}^0 \to K^+\pi^-$ and $D^0 \to K^-\pi^+$, $\bar{D}^0 \to K^+ e^- \bar{\nu}_e$ to perform the measurement, because the doubly Cabibbo-suppressed decays $\bar{D}^0 \to K^-\pi^+$ and $D^0 \to K^+\pi^-$ are not the signal events but also can contribute.

- $$\frac{\varepsilon_{tag}}{\varepsilon_{tag,D^+\to Pe^+\nu_e}} \neq \varepsilon_{D^+\to Pe^+\nu_e}$$

  This is because the signal mode efficiency $\varepsilon_{D^+\to Pe^+\nu_e}$ is an ideal object. However, the ratio between the single-tag efficiency and the double-tag efficiency contains affects from the cross feed between signal decay and the single-tag decays. Nevertheless, this ratio is insensitive to most systematic effects associated with the single-tag decays, and the signal branching fraction obtained using this procedure is nearly independent of the single-tag efficiencies.

- Why using the criteria $CL_e > 0.1\%$ and $CL_e/(CL_e + CL_K + CL_\pi) > 0.8$?

  These two criteria is supposed to avoid identifying the low momentum K and π to be positron.

- Why require the unused photon to be $E_\gamma < 300$ MeV?

  This criteria is used to suppress the background in U_{miss} spectrum. Because the energy of real photon, which is mainly originated from the π^0 ($D^+ \to \pi^0 e^+ \nu_e$), is usually large.

- $$\frac{d\Gamma}{dq^2} = X\frac{G_F^2}{24\pi^3}|V_{cs(d)}|^2 p^3 |f_+^P(q^2)|^2$$

  - Why the $f_+^K(0)$ is different from $f_+^\pi(0)$?
  - What is the physical meaning of the form factor $f_+^P(0)$?

  The form factor of D^+ obtained from the leptonic decay is different from that of semi-leptonic decay by definition. In the leptonic decay, the c- and $\bar{d}$- quark of the D^+ particle will completely annihilated to a virtual W^+ boson and the hadronic dynamics is simply factorized into the decay constant f_D. While, at the quark level, the semi-leptonic decay is induced by the charm quark decay: $c \to q\ell\nu$, where $q = d, s$. The light d or s daughter quark is bound to the initial light quark of the charm meson by the strong interaction to form a new hadron. The amplitude of the semi-leptonic decay process depends both on the hadronic matrix element and the quark-mixing parameter V_{cq}, and the hadronic matrix element can further be decomposed into several form factors.

  The f_D and $f_+^P(0)$ are different objects. But both of them are used to factorize the strength of the strong interaction in corresponding processes.

- How to extract the $f_+(0)$ and $V_{cs(d)}$ respectively when you only know their product?

  There is other method to determine the magnitude of the CKM matrix elements. For example, the measurement of the decay of real W boson.