Charmed mesons whose decay generate the muon.

Table 1: Branching fraction of mesons producing the muon.

ID	Sample	BR $[10^{-3}]$	Notes
C1	$D^0 \to \mu X$	68 ± 6	PDG inclusive. Breakdown below is 59.4 ± 2.5 (tension 1.3σ).
C1.1	$K^- \mu^+ \nu$	34.1 ± 0.4	From PDG.
C1.2	$K^{*-} \mu^+ \nu$	18.9 ± 2.4	From PDG.
C1.3	$\pi^- \mu^+ \nu$	2.67 ± 0.12	From PDG.
C1.4	$\rho^- \mu^+ \nu$	1.50 ± 0.12	From PDG similar channel with electron (link).
C1.5	$K_1(1270)^- \mu^+ \nu$	0.76 ± 0.3	From PDG similar electron chgannel (link).
C1.6	$\overline{K}^0 \pi^- \mu^+ \nu$	0.77 ± 0.16	Non resonant. From electron paper.
C1.7	$K^- \pi^0 \mu^+ \nu$	0.39	Isospin from above.
C1.8	$K_2^{*-} \mu^+ \nu$	0.3 ± 0.3	In EvtGen but no trace elsewhere.
C2	$D^+ \to \mu^+ X$	176 ± 32	PDG inclusive. Breakdown below is 158.8 ± 2.7 (tension 0.5σ).
C2.1	$\overline{K}^0 \mu^+ \nu$	87.6 ± 1.9	From PDG Γ_{17}.
C2.2	$\overline{K}^{*0} \mu^+ \nu$	52.7 ± 1.5	From PDG Γ_{29}.
C2.3	$\pi^0 \mu^+ \nu$	3.5 ± 0.15	From PDG.
C2.4	$\overline{K}_1^0 \mu^+ \nu$	2.77 ± 0.40	From PDG Γ_{31}, smilar electron channel times BR.
C2.5	$\overline{K}_2^{*0} \mu^+ \nu$	1.0 ± 1.0	In EvtGen but no trace elsewhere.
C2.6	$\rho^0 \mu^+ \nu$	2.4 ± 0.4	From PDG.
C2.7	$\omega \mu^+ \nu$	1.69 ± 0.11	From PDG similar electron channel.
C2.8	$\eta \mu^+ \nu$	1.11 ± 0.07	From PDG similar electron channel.
C2.9	$\eta' \mu^+ \nu$	0.20 ± 0.04	From PDG similar electron channel.
C2.10	$\pi^- \pi^+ \mu^+ \nu$	2.45 ± 0.10	From PDG similar electron channel.
C2.11	$K^- \pi^+ \mu^+ \nu$	1.9 ± 0.5	Non resonant, from PDG Γ_{28}.
C2.12	$\overline{K}^0 \pi^0 \mu^+ \nu$	0.95	Isospin from above.
C2.13	$\mu^+ \nu$	0.37 ± 0.02	From PDG.
C2.14	$\tau^+ \nu$	0.20 ± 0.05	From PDG, includes $\tau \to \mu\nu\nu$.
C3	$D_s^+ \to \mu^+ X$	74.35 ± 8.68	From sum of below, not present in PDG.
C3.1	$\phi \mu^+ \nu$	19 ± 5	From PDG.
C3.2	$\eta \mu^+ \nu$	24 ± 5	From PDG.
C3.3	$\eta' \mu^+ \nu$	11 ± 5	From PDG.
C3.4	$\overline{K}^0 \mu^+ \nu$	3.4 ± 0.4	From PDG similar electron channel.
C3.5	$\overline{K}^{*0} \mu^+ \nu$	2.15 ± 0.28	From PDG similar electron channel.
C3.6	$\tau^+ \nu$	9.31 ± 0.39	From PDG, includes $\tau \to \mu\nu\nu$.
C3.7	$\mu^+ \nu$	5.49 ± 0.16	From PDG.

Decays to be included in the MC as part of the $B \to D^* H_c$ samples.
General useful facts:

- The probability of producing a B_s is ~ 5 times smaller than producing a B^0 (pythia Soft QCD non diffractive) and is not included in the BR below but should be considered when comparing the expected yield of B^0 and B_s channels.

Charge conjugation is implied. Generator efficiencies are estimated with PYTHIA and normalized to the one of $B^0 \to D^{*-}\mu^+\nu$ for which $\epsilon_\mu = (9.55 \pm 0.69) \cdot 10^{-3}$. Generator cuts applied are that the muon form the decays have $p_T > 6.7$ and $|\eta| < 1.6$.

Decays breakdown does not include the $H_c \to \mu X$ branching fraction but their sum does.

Table 2: Relevant processes.

ID	Sample	BR [10^{-3}]	$\epsilon_{gen}/\epsilon_\mu$	Notes
0.1	$B^0 \to D^{*-}\mu^+\nu$	50.5 ($\pm$1.4)	1	From PDG.
0.2	$B^0 \to D^{*-}\tau^+\nu$	2.67 ($\pm$0.15)	0.23 ± 0.07	From PDG, includes $\tau \to \mu\nu\nu$ (implicit in the following).
1	$B^0 \to D^{*-}D^0(\mu X)Y$	2.5 ± 0.1	-	Sum of below $37.0 \pm 2.0 \cdot 10^{-3}$ times [C1].
1.2	$D^{*-}D^0K^+$	2.47 ± 0.21	-	PDG Γ_{174}.
1.3	$D^{*-}D^0K^{*+}$	1.24	-	Half of above.
1.4	$D^{*-}D^{*0}K^+$	10.6 ± 0.9	-	PDG Γ_{175}.
1.5	$D^{*-}D^{*0}K^{*+}$	5.3	-	Half of above.
1.6	$D^{*-}D^{*+}(D^0\pi^+)K^0$	5.43 ± 0.47	-	PDG Γ_{178}, includes 0.67 from $D^{*+} \to D^0\pi^+$.
1.7	$D^{*-}D^{*+}(D^0\pi^+)K^{*0}$	2.7	-	Half of above.
1.8	$D^{*-}D^{*+}(D^0\pi^+)$	0.54 ± 0.04	-	PDG Γ_{168}, includes 0.67 from $D^{*+} \to D^0\pi^+$.
1.9	$D^{*-}(\overline{D}^0\pi^-)D^{*+}K^0$	5.43	-	Like [1.6] with swapped decays.
1.10	$D^{*-}(\overline{D}^0\pi^-)D^{*+}K^{*0}$	2.7	-	Like [1.7] with swapped decays.
1.11	$D^{*-}(\overline{D}^0\pi^-)D^{*+}$	0.54	-	Like [1.8] with swapped decays.
2	$B^0 \to D^{*-}D^+(\mu X)Y$	3.40 ± 0.18	-	Sum of below 19.4 ± 1.0 times [C2].
2.1	$D^{*-}D^+K^0$	3.2 ± 0.25	-	Half of PDG Γ_{177}.
2.2	$D^{*+}D^-K^0$	3.2 ± 0.25	-	Half of PDG Γ_{177}.
2.3	$D^{*-}D^+K^{*0}$	1.6	-	Half of [2.1].
2.4	$D^{*+}D^-K^{*0}$	1.6	-	Half of [2.2].
2.5	$D^{*-}D^{*+}(D^+X^0)K^0$	2.67 ± 0.23	-	PDG Γ_{178}, includes 0.33 from $D^{*+} \to D^+X^0$.
2.6	$D^{*-}D^{*+}(D^+X^0)K^{*0}$	1.33	-	Half of above.
2.7	$D^{*-}D^{*+}(D^+X^0)$	0.26 ± 0.02	-	PDG Γ_{168}, includes 0.33 from $D^{*+} \to D^+X^0$.
2.8	$D^{*-}(D^-X^0)D^{*+}K^0$	2.67	-	Like [2.5] with swapped decays.
2.9	$D^{*-}(D^-X^0)D^{*+}K^{*0}$	1.33	-	Like [2.6] with swapped decays.
2.10	$D^{*-}(D^-X^0)D^{*+}$	0.26	-	Like [2.7] with swapped decays.
2.11	$D^{*+}D^-$	0.61 ± 0.15	-	PDG Γ_{170}
2.12	$D^{*-}D^+$	0.61	-	CC of above.
3	$B^0 \to D^{*-}D_s^+(\mu X)Y$	1.96 ± 0.11	-	Sum of below 27.2 ± 1.5 times [C3].
3.1	$D^{*-}D_s^+$	8.0 ± 1.1	-	From PDG Γ_{85}.
3.2	$D^{*-}D_s^{*+}$	17.7 ± 0.14	-	From PDG Γ_{85}.
3.3	$D^{*-}D_{s0}^{*+}$	1.5 ± 1.0	-	Not measured, from EvtGen default.
4	$B^+ \to D^{*-}D^0(\mu X)Y$	1.59 ± 0.14	-	Sum of below 23.3 ± 2.0 times [C1].
4.1	$D^{*+}\overline{D}^0K^0$	3.8 ± 0.4	-	PDG Γ_{195}
4.2	$D^{*+}\overline{D}^0K^{*0}$	1.9	-	Half of above.
4.3	$D^{*+}\overline{D}^{*0}K^0$	9.2 ± 1.2	-	PDG Γ_{196}
4.4	$D^{*+}\overline{D}^{*0}K^{*0}$	4.6	-	Half of above.
4.5	$D^{*-}D^{*+}(D^0\pi^+)K^+$	0.88 ± 0.12	-	PDG Γ_{204}, includes 0.67 from $D^{*+} \to D^0\pi^+$
4.6	$D^{*-}D^{*+}(D^0\pi^+)K^{*+}$	0.44	-	Half of above.

ID	Sample	BR $[10^{-3}]$	$\epsilon_{gen}/\epsilon_{\mu}$	Notes
4.7	$D^{*-}(\overline{D}^0\pi^-)D^{*+}K^+$	0.88	-	Like [4.5] with swapped decays.
4.8	$D^{*-}(\overline{D}^0\pi^-)D^{*+}K^{*+}$	0.44	-	Like [4.6] with swapped decays.
4.9	$D^{*+}\overline{D}^0$	0.39 ± 0.05	-	PDG Γ_{190}
4.10	$D^{*+}\overline{D}^{*0}$	0.81 ± 0.17	-	PDG Γ_{188}
5	$B^+ \to D^{*-}D^+(\mu X)Y$	0.56 ± 0.05	-	Sum of below 2.11 ± 0.20 times [C2].
5.1	$D^{*-}D^+K^+$	0.60 ± 0.12	-	PDG Γ_{203}
5.2	$D^{*-}D^+K^{*+}$	0.3	-	Half of above.
5.3	$D^{*+}D^-K^+$	0.63 ± 0.11	-	PDG Γ_{202}
5.4	$D^{*+}D^-K^{*+}$	0.31	-	Half of above.
5.5	$D^{*-}D^{*+}(D^+X^0)K^+$	0.44 ± 0.06	-	PDG Γ_{204}, includes 0.33 from $D^{*+} \to D^+X^0$
5.6	$D^{*-}D^{*+}(D^+X^0)K^{*+}$	0.22	-	Half of above.
5.7	$D^{*-}(D^-X^0)D^{*+}K^+$	0.44	-	Like [5.5] with swapped decays.
5.8	$D^{*-}(D^-X^0)D^{*+}K^{*+}$	0.22	-	Like [5.6] with swapped decays.
6	$B_s^0 \to D^*D_s(\mu X)Y$	2.29 ± 2.0	-	Sum of below 30.9 times [C3] with some added 100% uncertainty.
6.1	$D^{*+}D_s^{*-}K^0$	15	-	Not observed, EvtGen default.
6.2	$D^{*+}D_s^{*-}K^{*0}$	5	-	Not observed, EvtGen default.
6.3	$D^{*+}D_s^-K^0$	5	-	Not observed, EvtGen default.
6.4	$D^{*+}D_s^-K^{*0}$	2.5	-	Not observed, EvtGen default.
6.5	$D^{*-}D_s^+$	1.7	-	Not observed, EvtGen default.
6.5	$D^{*-}D_s^{*+}$	1.7	-	Not observed, EvtGen default.

Additional uncertainties:

- Unmeasured mode with K^* will get 50% uncertainty correlated among the relevant decays.
- Each sample will have the corresponding $H_c \to \mu X$ applied.

Remarks:

- Uncertainty on [0.1] and [0.2] is irrelevant since in the fit those are freely floating.
- D^{*0} decays 100% in D^0 plus neutrals.
- Most of K^* modes are not measured but are present in EvtGen. Are estimated as half of the similar K mode as EvtGen does.
- Unspecified $D^{*\pm}$ decays are in the analysis final state $D(K\pi)\pi$
- D_s^* and D_{s0}^* decay completely in D_s
- It is not possible to chance sign/conjugate to the K because it is determined by the b quark.
- $D^{*-} \to D^- X^0$ includes a 0.31 $D^-\pi^0$ and 0.02 $D^-\gamma$