Exercises 2

Example

Draw a Feynman diagram for the weak decay $D^+ \rightarrow \phi\pi^+$

A) Identify the quarks (from tables) needed in the "initial" state:

D^+	$(c\bar{d})$

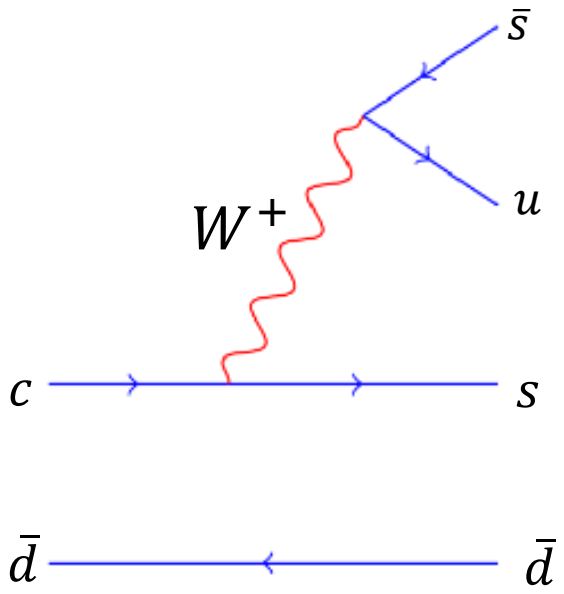
B) Identify the quarks (from tables) needed in "final" state:

ϕ	$(s\bar{s})$

π^+	$(u\bar{d})$

C) There is a $\bar{d}$ in both the initial and final state, so, good chance it's just a **spectator quark in the decay**

D) The charm quark does not appear in the final state, **so it MUST have decayed**!
Have the c-quark decay by emitting a W boson, and then the W boson decaying into a quark + antiquark.



- I need to get an "s" quark in the final state, so let me try c→sW$^+$ (Must be a W$^+$ by charge conservation)
- I have $s, \bar{d}$ in final state, just need to get an $\bar{s}$ and u !
- Can $W^+ \rightarrow \bar{s}\,u$?

We have all the quarks we need, but we need the $\bar{s}$ from W+ to combine with the s from charm decay. And u quark to combine with $\bar{d}$. How can we do that?

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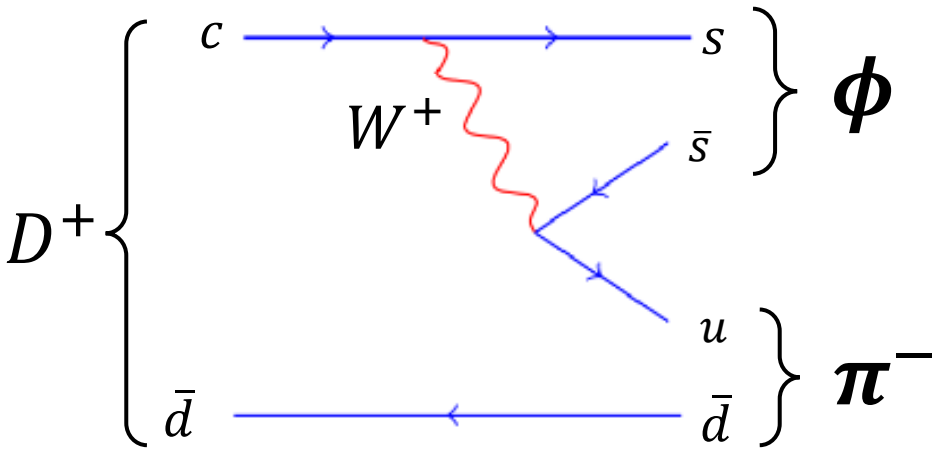

❑ Draw it as an internal W diagram!

Exercises with Feynman diagrams, Weak decays

Using the Table on the next page to draw the following Feynman diagrams

- Draw a Feynman diagram for the weak decay $\mathrm{B}^- \rightarrow D^0\pi^-$.
- Draw a Feynman diagram for the weak decay $D^0 \rightarrow K^+K^-$.
- Draw a Feynman diagram for the weak decay $D_s^+ \rightarrow \phi\pi^+$.
- Draw a Feynman diagram for the weak decay $K^+ \rightarrow \pi^+\pi^0$.
- Draw a Feynman diagram for the weak decay $\bar{B}^0 \rightarrow D^-\pi^+$.
- Draw a Feynman diagram for the weak decay $n \rightarrow p\,\pi^-$.
- Draw a Feynman diagram for the weak decay $\Lambda_b^0 \rightarrow \Lambda_c^+\,\pi^-$.

Some Mesons

Particle	Quarks
π^+	$(u\bar{d})$
π^-	$(\bar{u}d)$
π^0	$(u\bar{u}), or\ (d\bar{d})$
K^+	$(u\bar{s})$
K^-	$(\bar{u}s)$
K_S^0	$(s\bar{d})$ or $(\bar{s}d)$
D^+	$(c\bar{d})$
D^-	$(\bar{c}d)$
D^0	$(c\bar{u})$
$\bar{D}^0$	$(\bar{c}u)$
D_s^+	$(c\bar{s})$
D_s^-	$(\bar{c}s)$

Particle	Quarks
B^+	$(\bar{b}u)$
B^-	$(b\bar{u})$
B^0	$(\bar{b}d)$
$\bar{B}^0$	$(b\bar{d})$
B_s^0	$(\bar{b}s)$
$\bar{B}_s^0$	$(b\bar{s})$
ϕ	$(s\bar{s})$
J/ψ	$(c\bar{c})$
Υ	$(b\bar{b})$

Some Baryons

Particle	Quarks
p	uud
n	udd
Δ^-	ddd
Δ^0	udd
Δ^+	uud
Δ^{++}	uuu
Λ	sud
Λ_c^+	cud
Λ_b^0	bud

Quarks

Particle	Charge
d	$-1/3$
u	$+2/3$
s	$-1/3$
c	$+2/3$
b	$-1/3$
t	$+2/3$

Antiquarks have opposite charge to the quarks