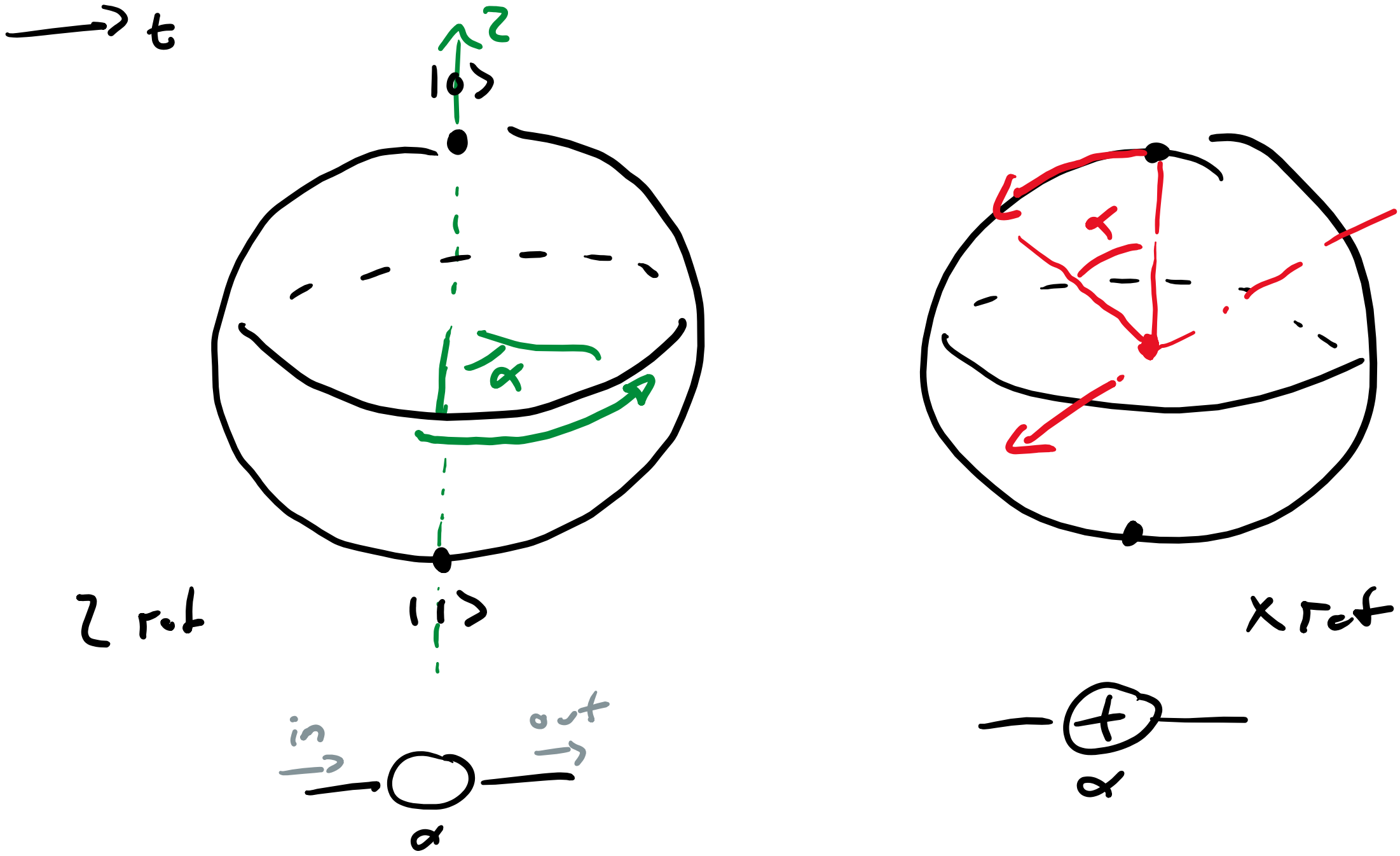
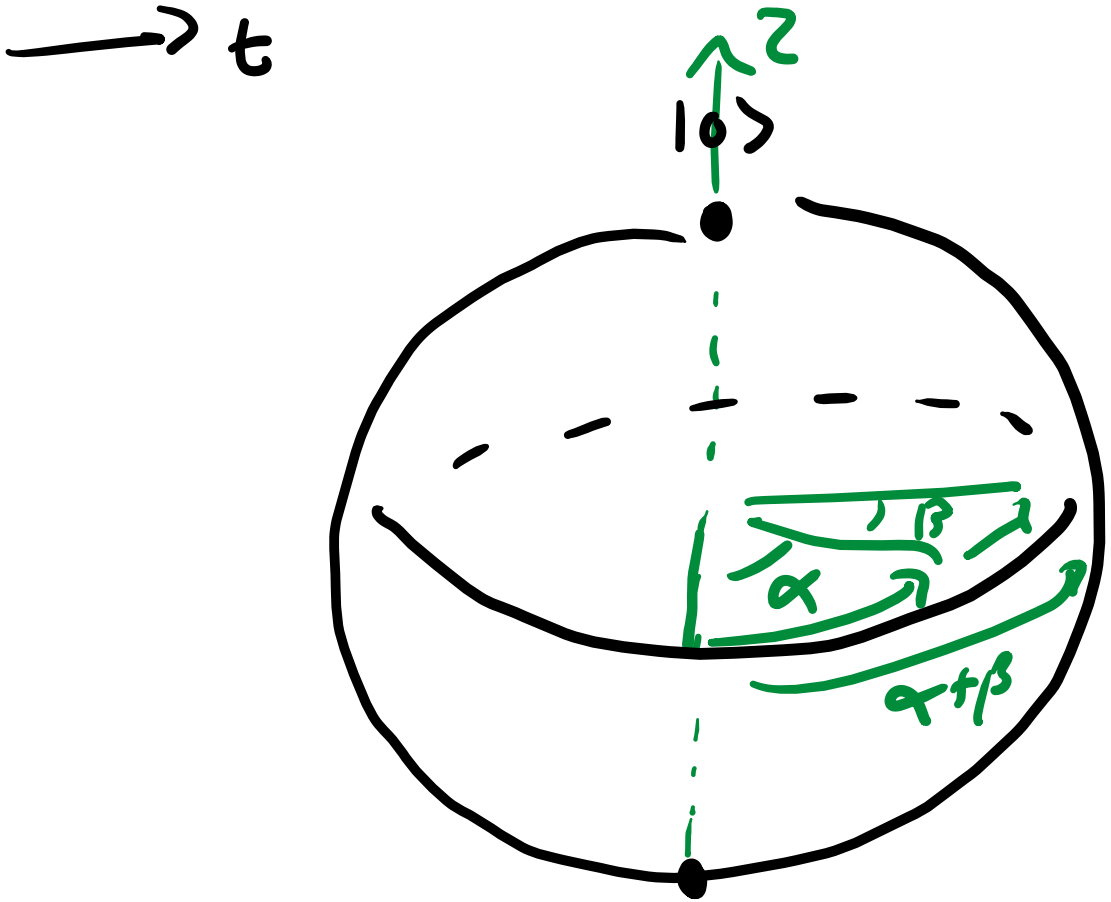
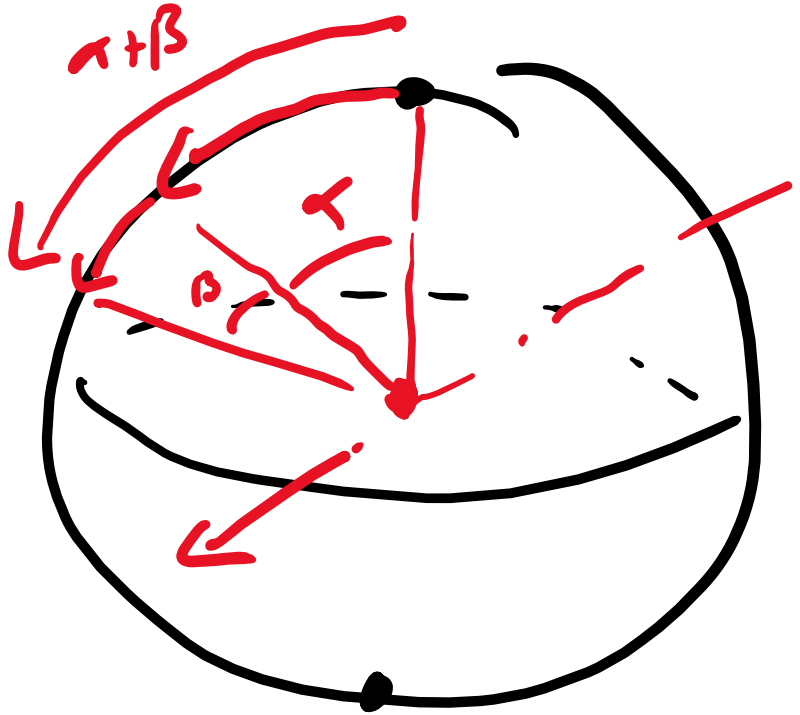
Quantum in Pictures Lecture Series

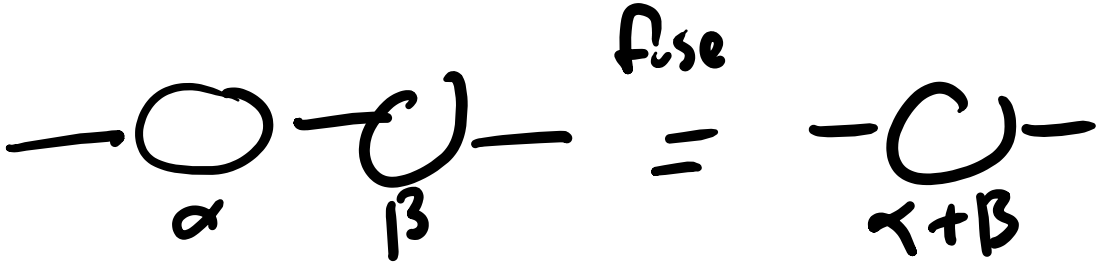
Lecturer: Stefano Gogioso

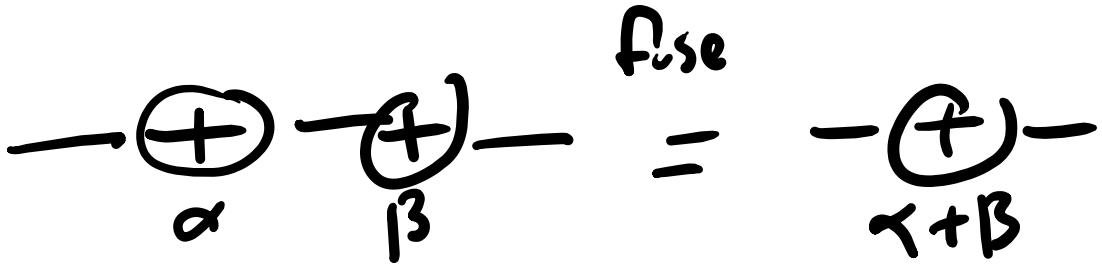
Tue 27 June 2023 – Morning Lecture


t
z
|0>
α
|1>
Z rot
X rot
in
out
α
α


t
z
|0>
α
β
α+β
|i>
Z rot

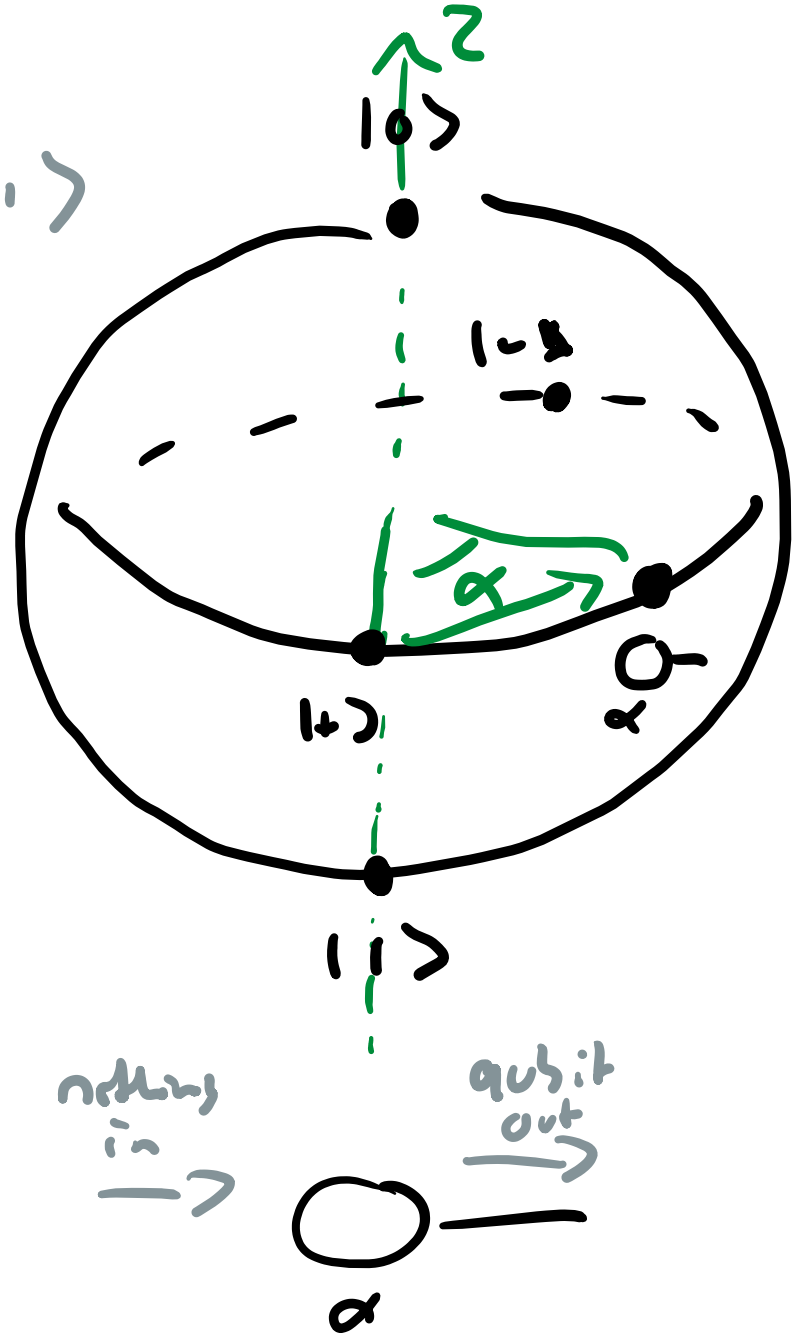

α+β
α
β
X rot


fuse
α
β
α+β


fuse
α
β
α+β

$\longrightarrow t$

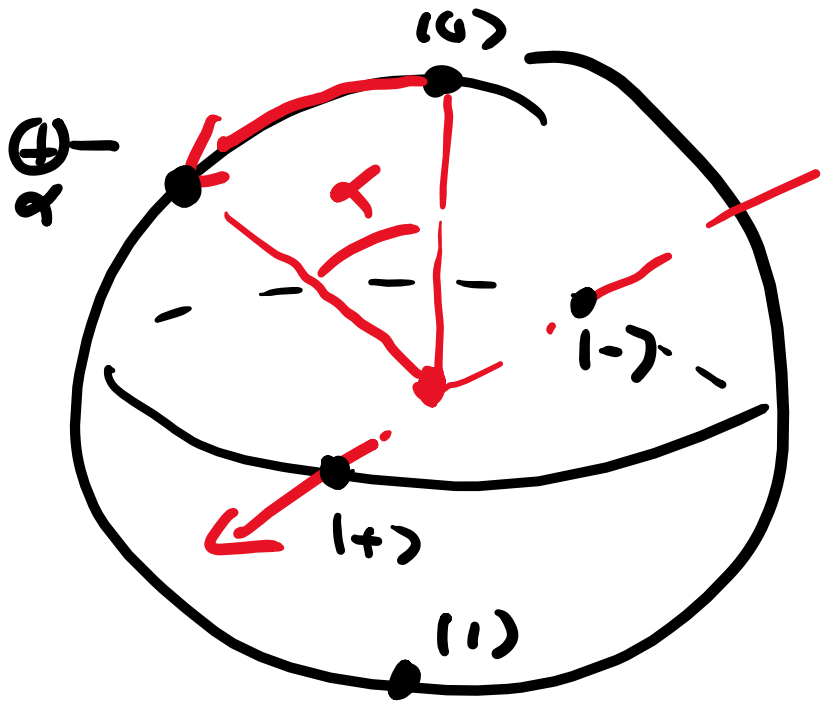
$|0\rangle + e^{i\varphi}|1\rangle$



$|+\rangle = \bigcirc\!\!-$

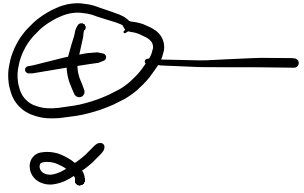
$|-\rangle = \bigcirc\!\!-_{\pi}$

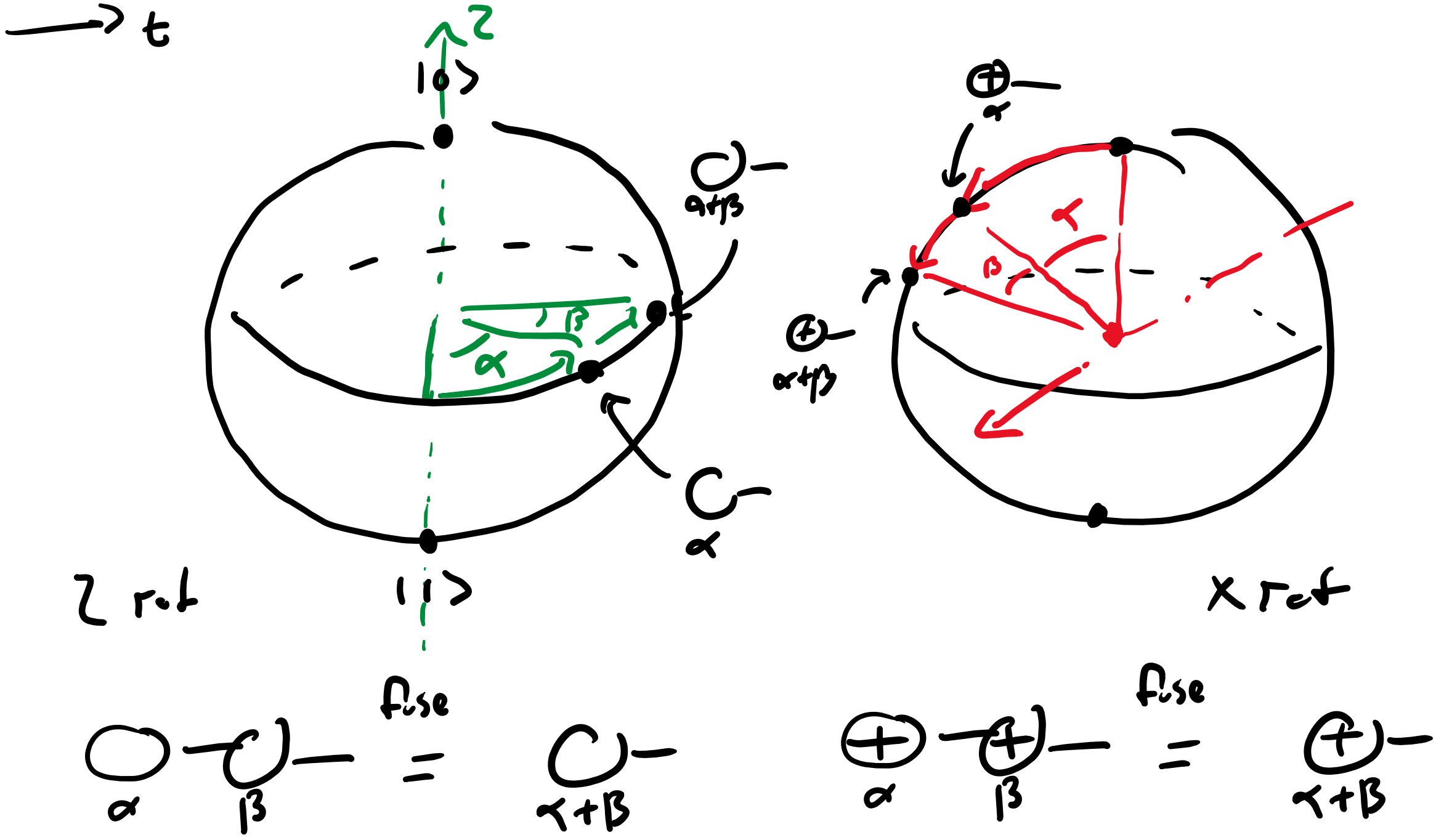
$|+\rangle + e^{i\alpha}|-\rangle$



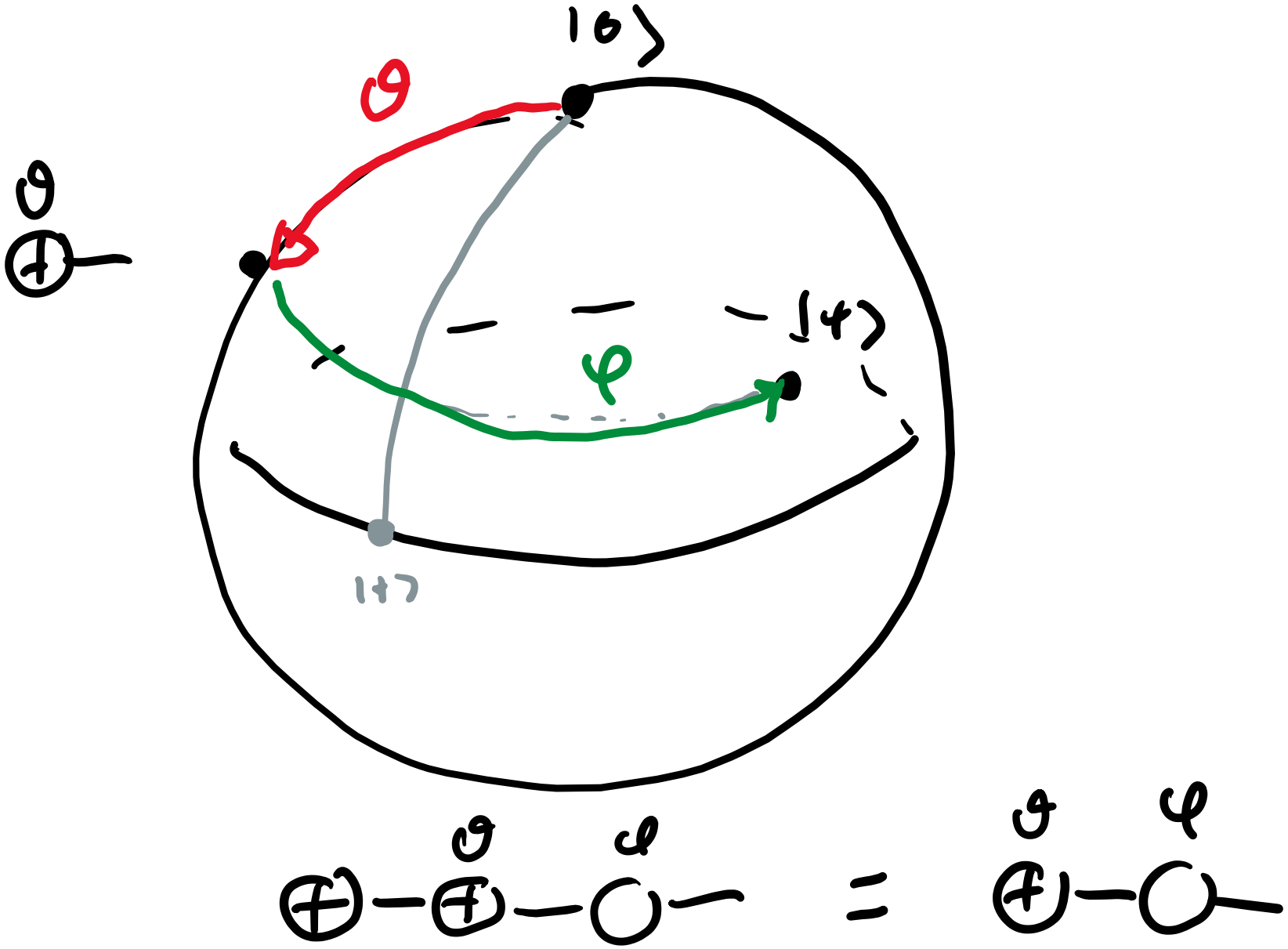
$|0\rangle = \oplus\!\!-$

$|1\rangle = \oplus\!\!-_{\pi}$

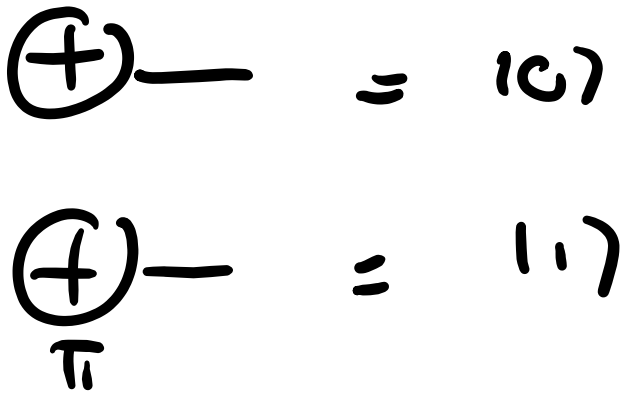


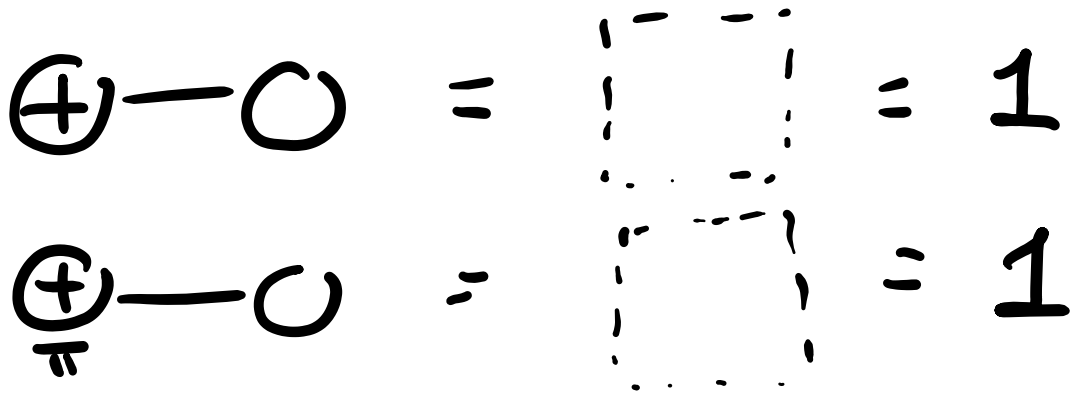


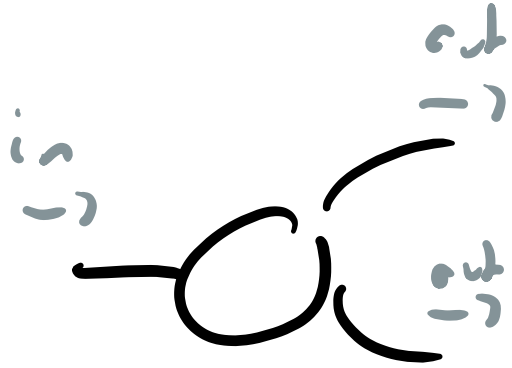
t
z
|0>
|1>
α
β
α+β
Z rot
X rot
fuse
α
β
α+β
fuse
α
β
α+β



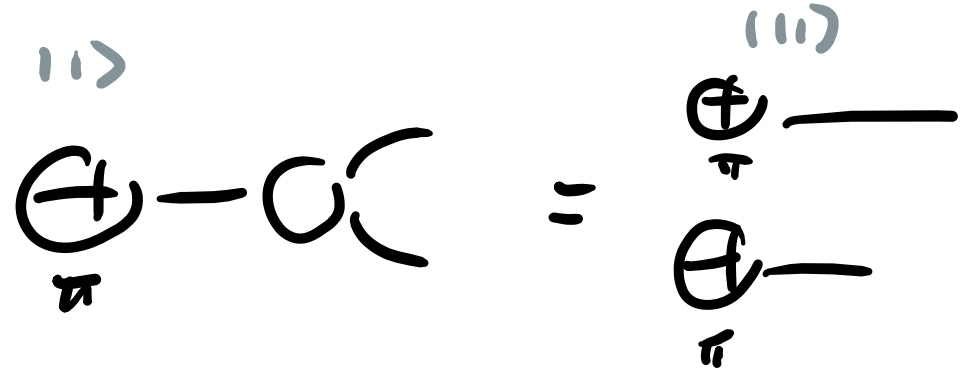
|0⟩
ϑ
ϑ
φ
|ψ⟩
|+⟩
ϑ
φ
=
ϑ
φ


= |0⟩
= |1⟩

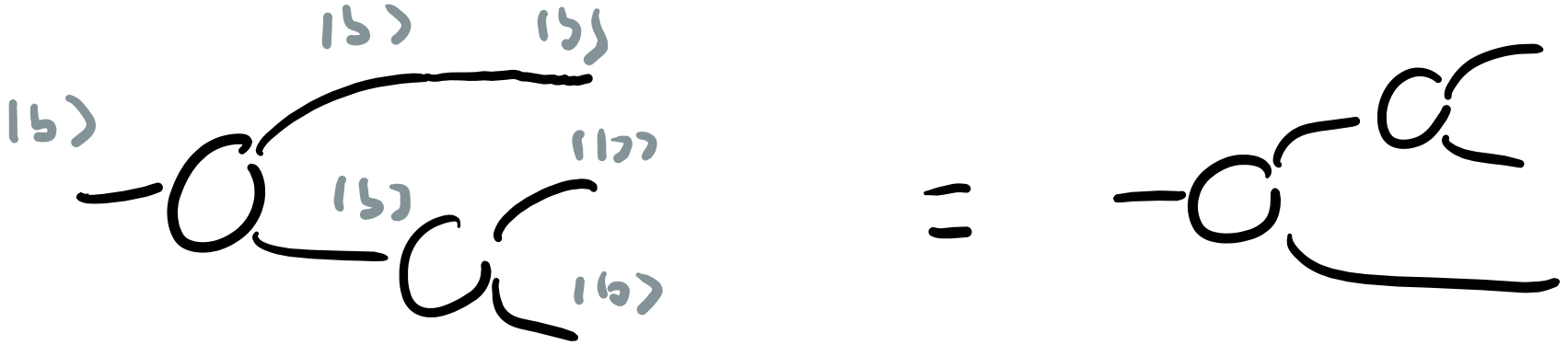

= 1
= 1

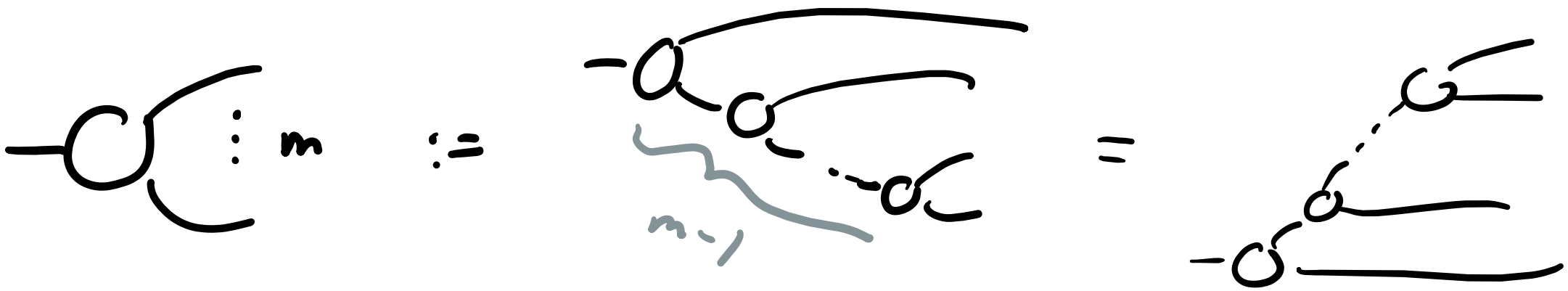


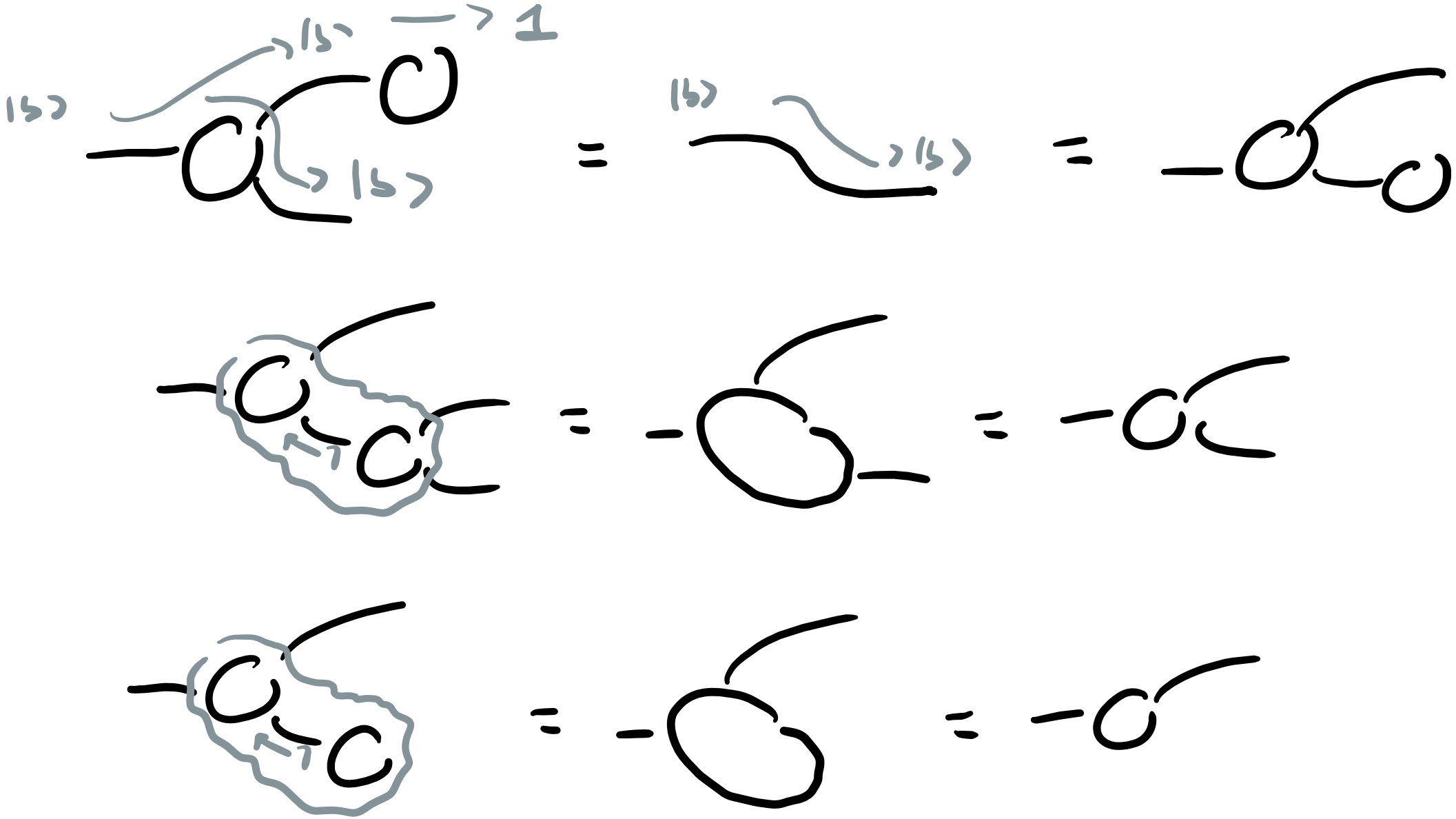
|0⟩
|00⟩
=


|1⟩
|11⟩
=

α
α
2 rotation
2 eq. str
2 copy
2 delete


|b⟩
|b⟩
|b⟩
|b⟩
|b⟩
|b⟩
=

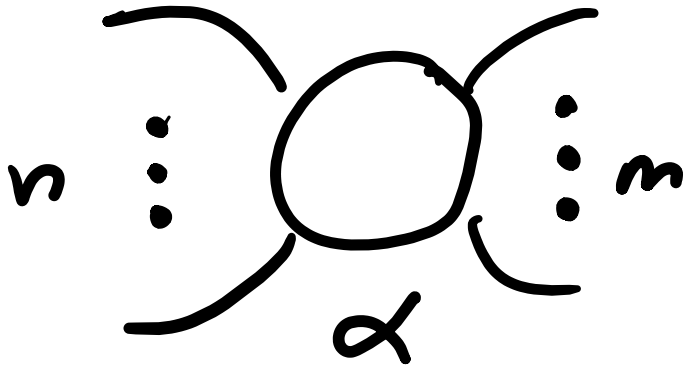

m
:=
m-1
=



$= \begin{matrix} |0\rangle \mapsto |00\rangle \\ |1\rangle \mapsto |11\rangle \end{matrix} = \sum_{b \in \{0,1\}} |bb\rangle\langle b|$

$= \begin{matrix} |0\rangle \mapsto 1 \\ |1\rangle \mapsto 1 \end{matrix} = (1\ 1) = \sqrt{2}\underbrace{\langle +|}_{(\frac{1}{\sqrt{2}}\ \frac{1}{\sqrt{2}})}$

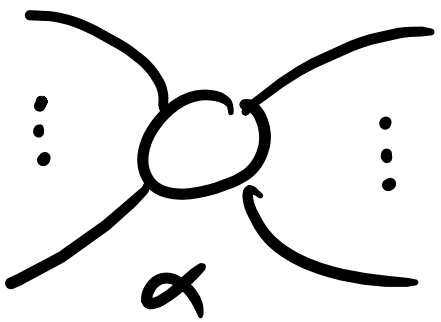
Z spider



$= \sum_{b \in \{0,1\}} |b \ldots b\rangle\, e^{ib\alpha} \langle b \ldots b|$

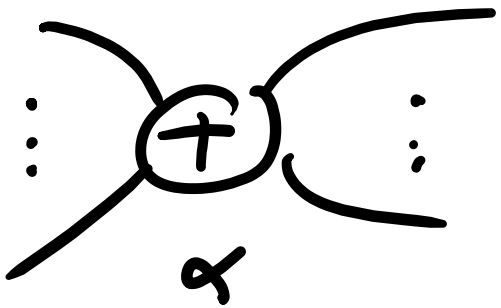
$= |0 \ldots 0\rangle\langle 0 \ldots 0| + e^{i\alpha} |1 \ldots 1\rangle\langle 1 \ldots 1|$

2 basis



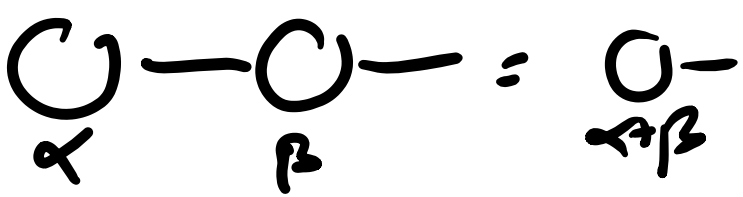
swap colours

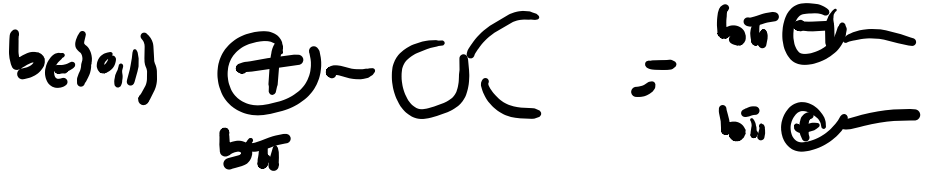
× spider

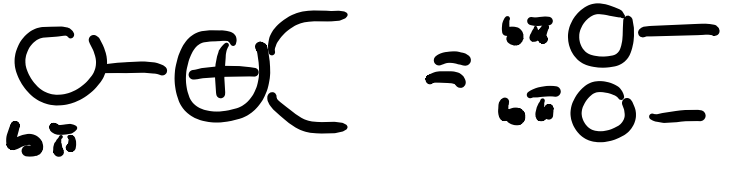


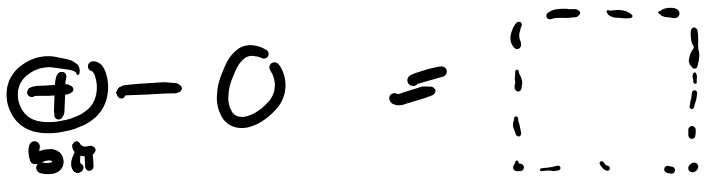
$|0\ldots0\rangle\langle 0\ldots 0| + e^{i\alpha}|1\ldots1\rangle\langle 1\ldots 1|$

$|+\ldots+\rangle\langle +\ldots+| + e^{i\alpha}|-\ldots-\rangle\langle -\ldots-|$

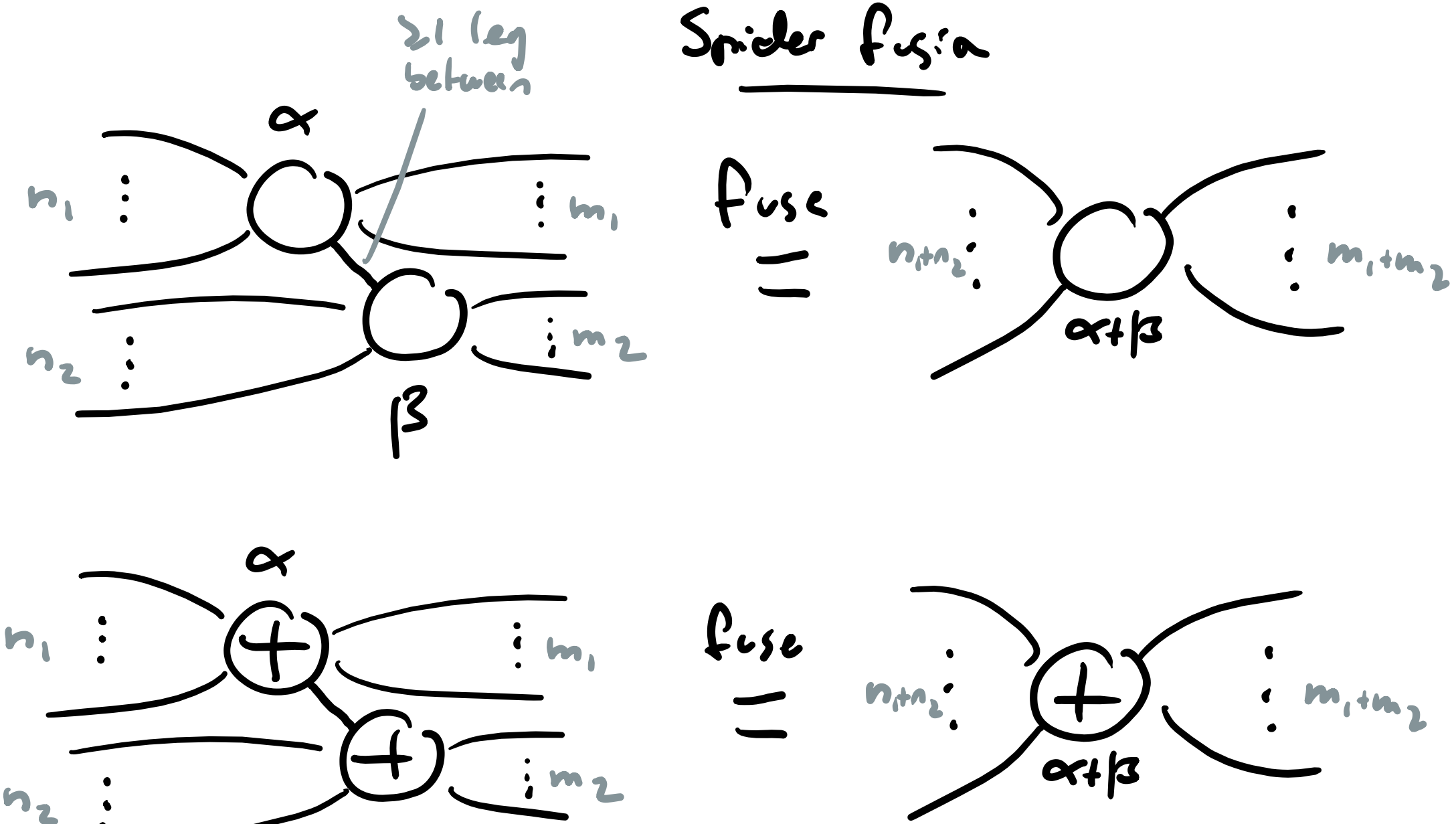


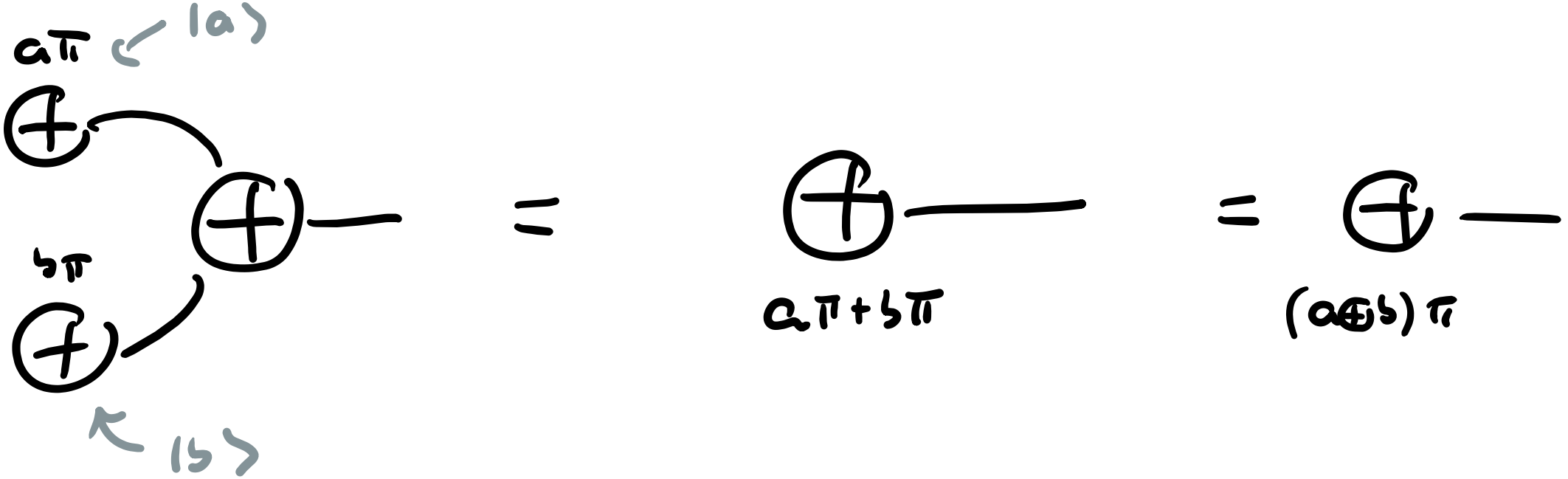




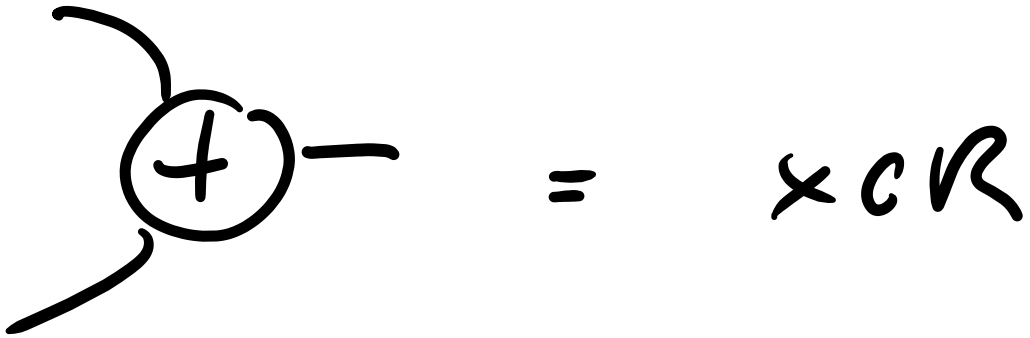


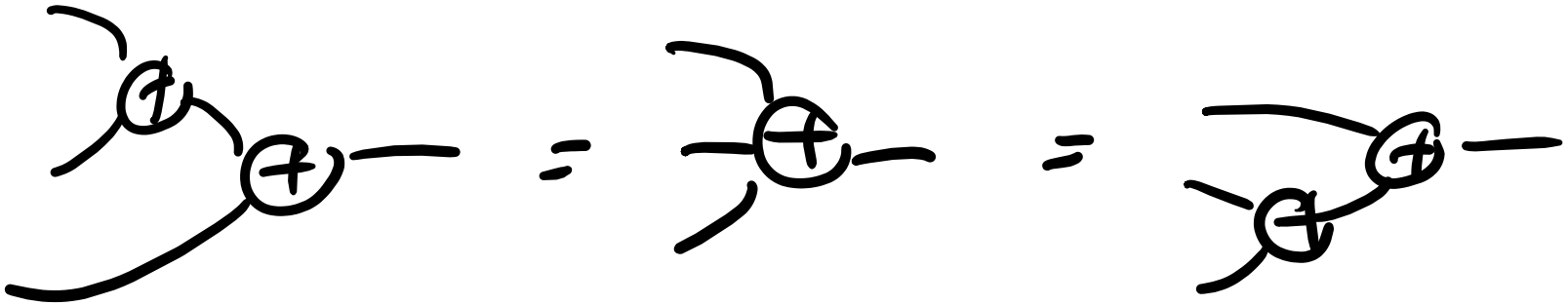
Spider fusion

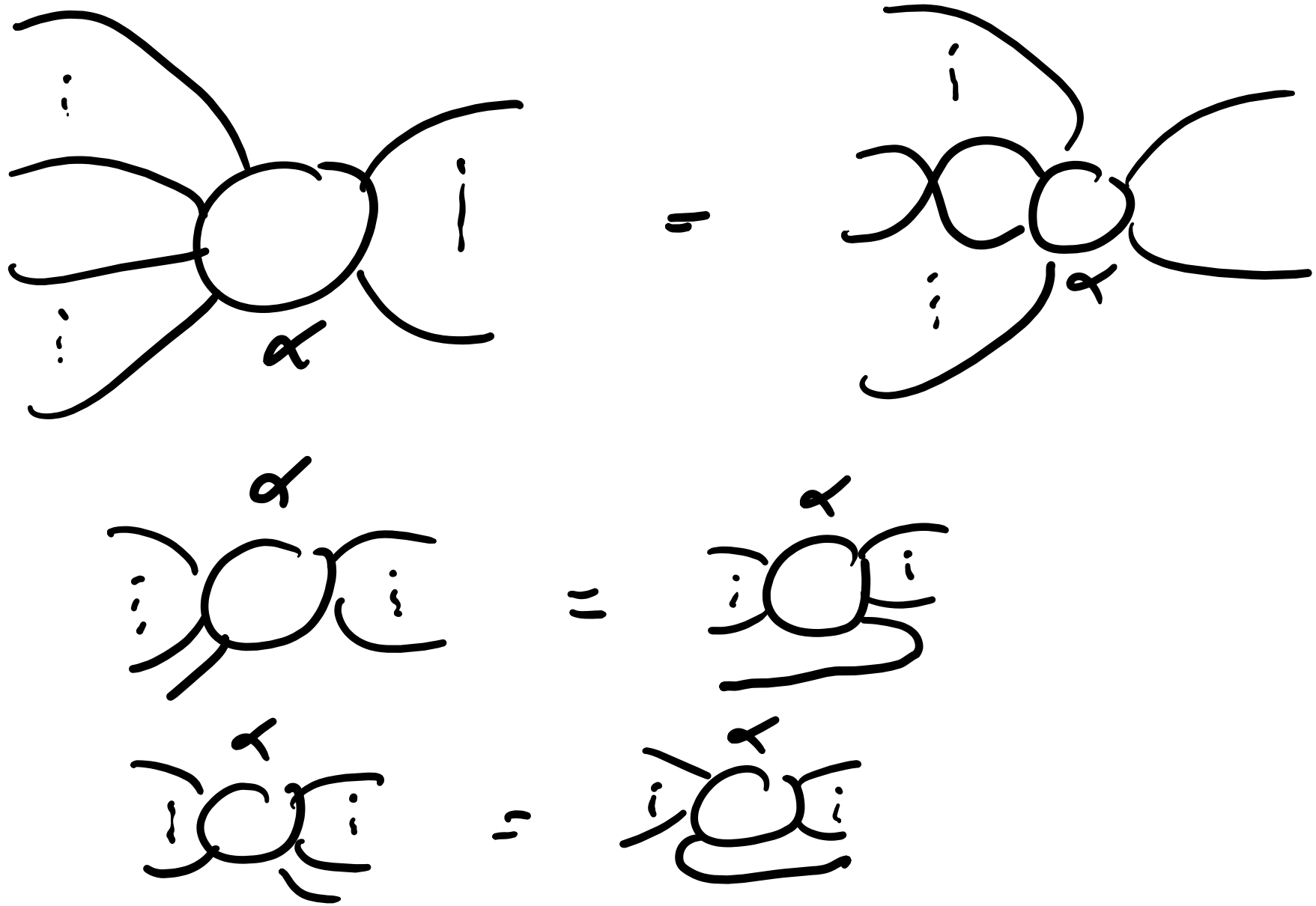




$a, b \in \{0, 1\}$






i
i
α
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i
i
α
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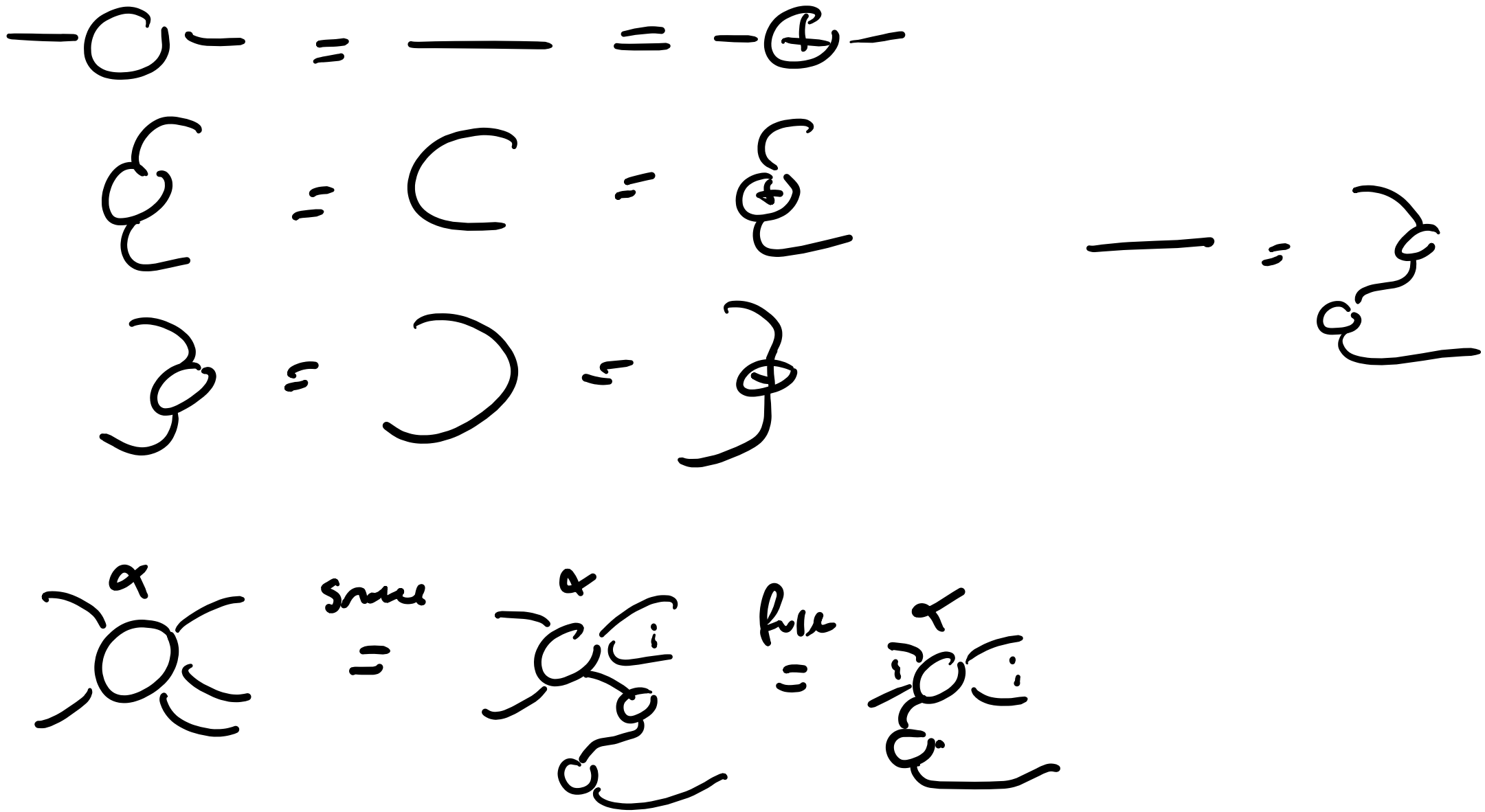
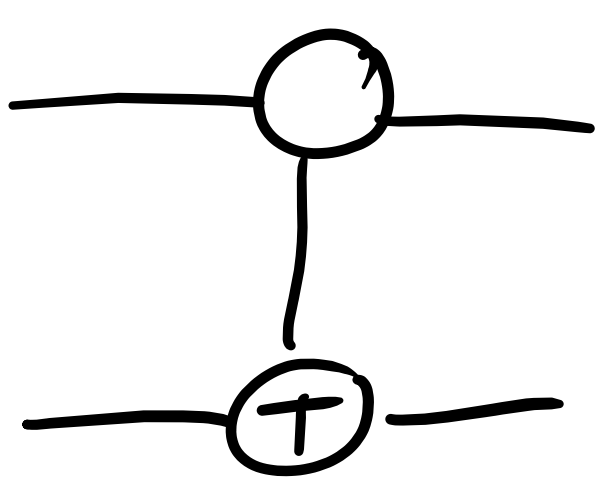
α
=


α
same
α
flip
α



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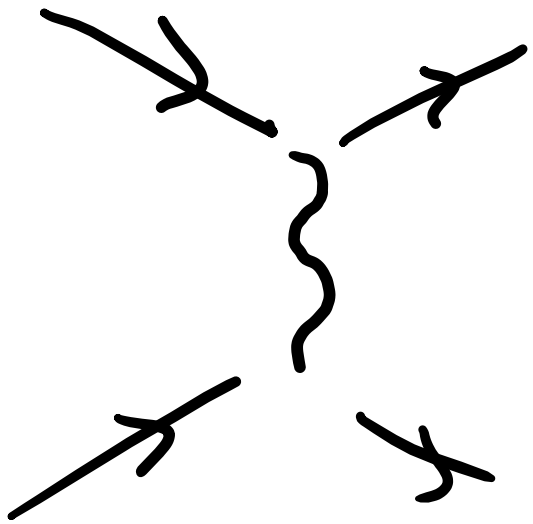
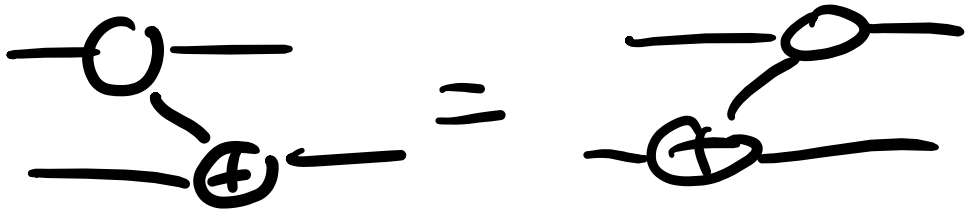
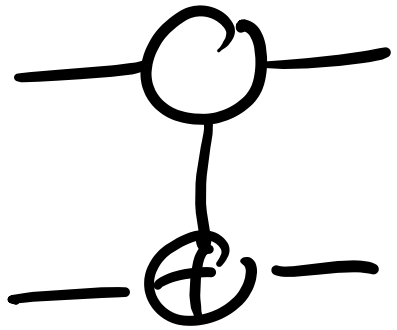
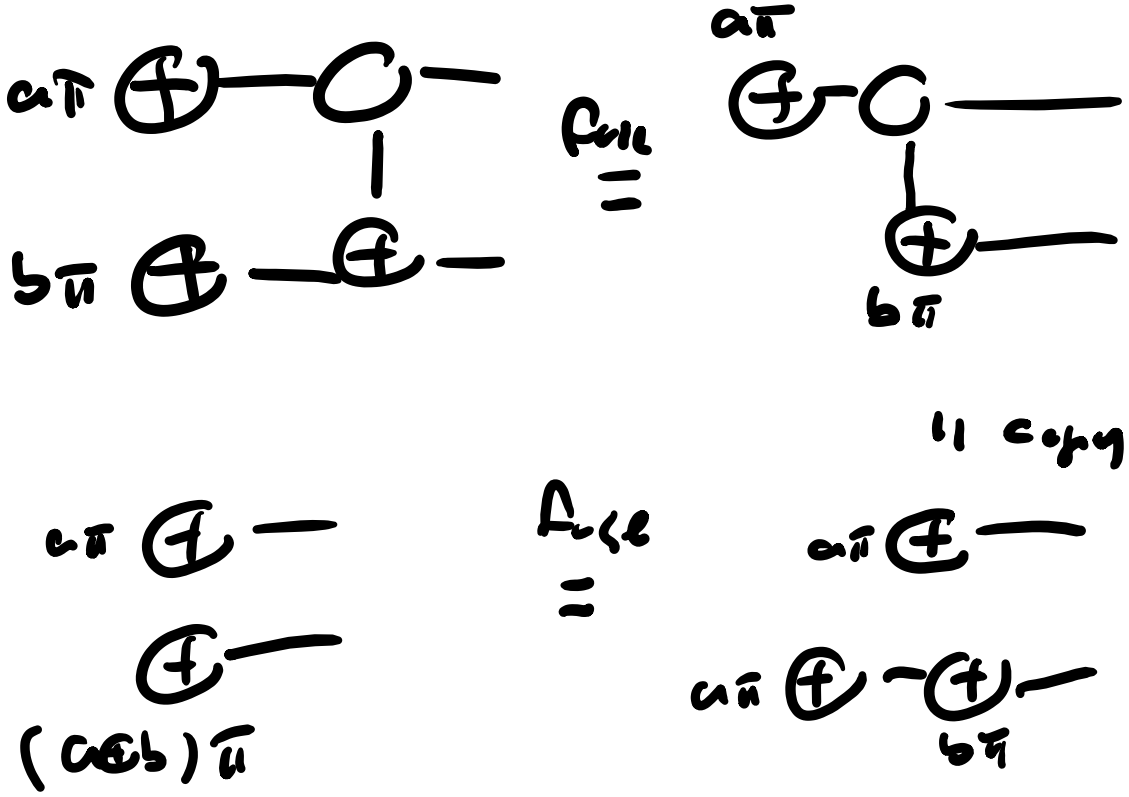
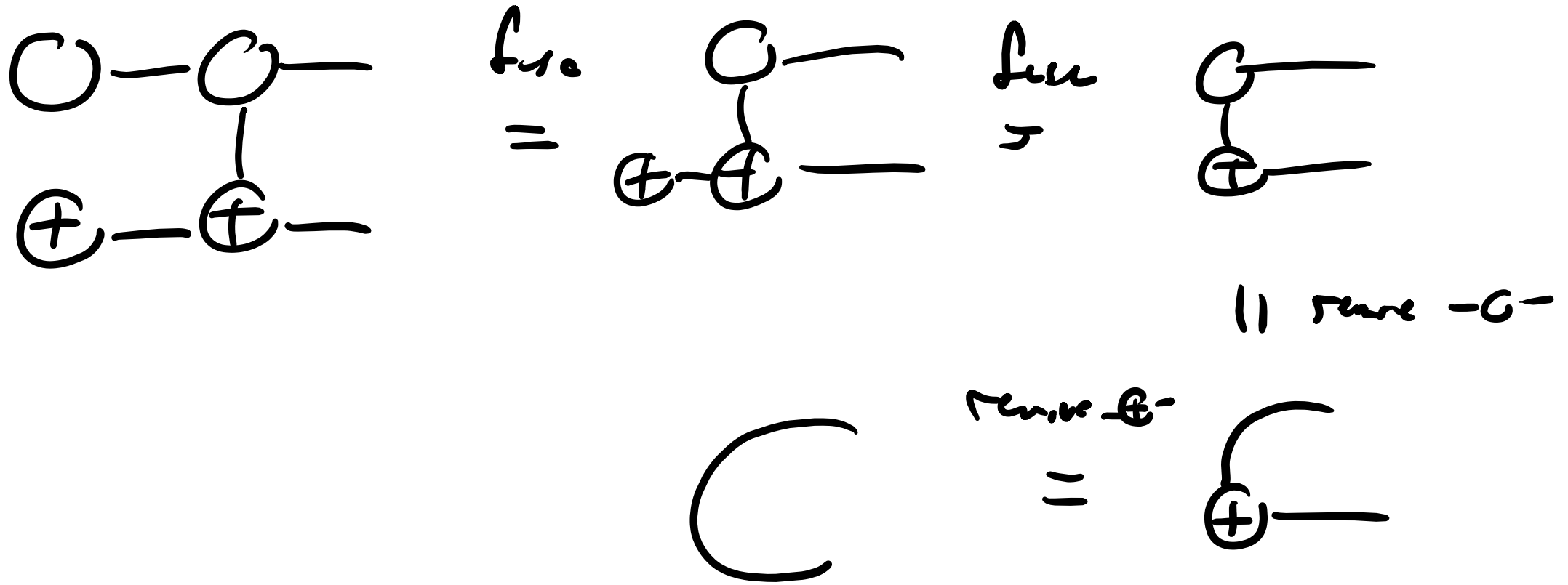
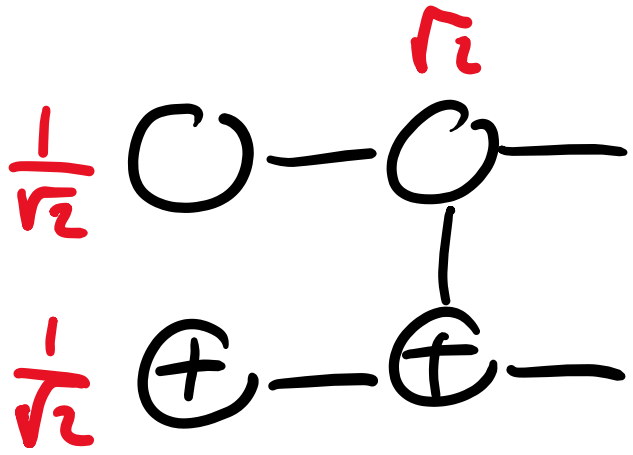
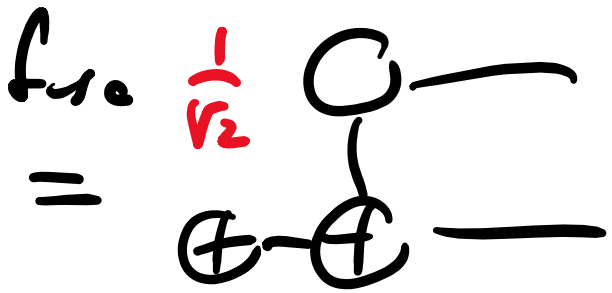
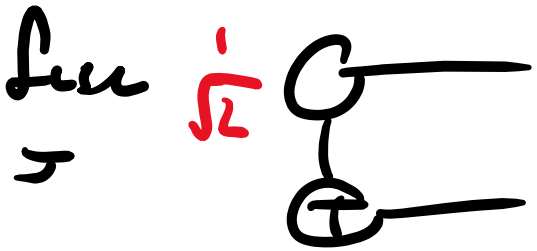
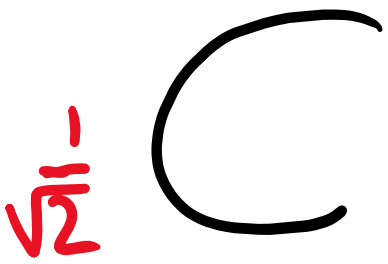
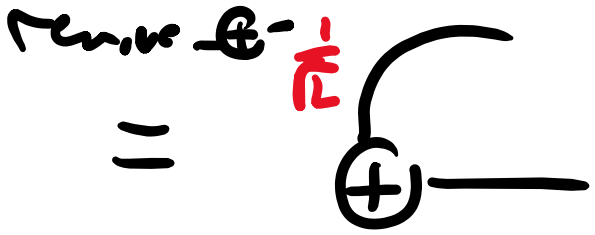




(for qubits)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