Foundation of GVB-BCCC formula derivation

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September 3, 2019

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A block has 16 states: $P_0, P_1, P_2, P_3, P_4, P_5, P_6, P_7, P_8, P_9, P_{10}, P_{11}, P_{12}, P_{13}, P_{14}, P_{15}$.

Each state corresponds to a functor in essence:

0: $\hat{0}^+_\alpha \hat{0}^+_\beta$

1: $\hat{1}^+_\alpha \hat{1}^+_\beta$

2: $\hat{0}^+_\alpha \hat{1}^+_\beta$

3: $\hat{0}^+_\beta \hat{1}^+_\alpha$

4: $\hat{0}^+_\alpha \hat{1}^+_\alpha$

5: $\hat{0}^+_\beta \hat{1}^+_\beta$

6:

7: $\hat{0}^+_\alpha$

8: $\hat{1}^+_\alpha$

9: $\hat{0}^+_\beta$

10: $\hat{1}^+_\beta$

11: $\hat{0}^+_\alpha \hat{0}^+_\beta \hat{1}^+_\alpha$

12: $\hat{0}^+_\alpha \hat{1}^+_\alpha \hat{1}^+_\beta$

13: $\hat{0}^+_\alpha \hat{0}^+_\beta \hat{1}^+_\beta$

14: $\hat{0}^+_\beta \hat{1}^+_\alpha \hat{1}^+_\beta$

15: $\hat{0}^+_\alpha \hat{0}^+_\beta \hat{1}^+_\alpha \hat{1}^+_\beta$

However, a functor is often expressed as a linear combination of a number of states:

0: $\hat{0}^+_\alpha \hat{0}^+_\beta = inv_{0,0} P_0 + inv_{0,1} P_1$

1: $\hat{1}^+_\alpha \hat{1}^+_\beta = inv_{1,0} P_0 + inv_{1,1} P_1$

2: $\hat{0}^+_\alpha \hat{1}^+_\beta = inv_{2,2} P_2 + inv_{2,3} P_3$

3: $\hat{0}^+_\beta \hat{1}^+_\alpha = inv_{3,2} P_2 + inv_{3,3} P_3$

4: $\hat{0}^+_\alpha \hat{1}^+_\alpha = 1 P_4$

5: $\hat{0}^+_\beta \hat{1}^+_\beta = 1 P_5$

6: $= 1 P_6$

7: $\hat{0}^+_\alpha = 1 P_7$

8: $\hat{1}^+_\alpha = 1 P_8$

9: $\hat{0}^+_\beta = 1P_9$

10: $\hat{1}^+_\beta = 1P_{10}$

11: $\hat{0}^+_\alpha \hat{0}^+_\beta \hat{1}^+_\alpha = 1P_{11}$

12: $\hat{0}^+_\alpha \hat{1}^+_\alpha \hat{1}^+_\beta = 1P_{12}$

13: $\hat{0}^+_\alpha \hat{0}^+_\beta \hat{1}^+_\beta = 1P_{13}$

14: $\hat{0}^+_\beta \hat{1}^+_\alpha \hat{1}^+_\beta = 1P_{14}$

15: $\hat{0}^+_\alpha \hat{0}^+_\beta \hat{1}^+_\alpha \hat{1}^+_\beta = 1P_{15}$

Therefore, the composition of each state can be written:

$P_0 = ci_{0,0}\hat{0}^+_\alpha \hat{0}^+_\beta + ci_{0,1}\hat{1}^+_\alpha \hat{1}^+_\beta \quad |vac\rangle$

$P_1 = ci_{1,0}\hat{0}^+_\alpha \hat{0}^+_\beta + ci_{1,1}\hat{1}^+_\alpha \hat{1}^+_\beta \quad |vac\rangle$

$P_2 = ci_{2,2}\hat{0}^+_\alpha \hat{1}^+_\beta + ci_{2,3}\hat{0}^+_\beta \hat{1}^+_\alpha \quad |vac\rangle$

$P_3 = ci_{3,2}\hat{0}^+_\alpha \hat{1}^+_\beta + ci_{3,3}\hat{0}^+_\beta \hat{1}^+_\alpha \quad |vac\rangle$

$P_4 = 1\hat{0}^+_\alpha \hat{1}^+_\alpha \quad |vac\rangle$

$P_5 = 1\hat{0}^+_\beta \hat{1}^+_\beta \quad |vac\rangle$

$P_6 = 1 \quad |vac\rangle$

$P_7 = 1\hat{0}^+_\alpha \quad |vac\rangle$

$P_8 = 1\hat{1}^+_\alpha \quad |vac\rangle$

$P_9 = 1\hat{0}^+_\beta \quad |vac\rangle$

$P_{10} = 1\hat{1}^+_\beta \quad |vac\rangle$

$P_{11} = 1\hat{0}^+_\alpha \hat{0}^+_\beta \hat{1}^+_\alpha \quad |vac\rangle$

$P_{12} = 1\hat{0}^+_\alpha \hat{1}^+_\alpha \hat{1}^+_\beta \quad |vac\rangle$

$P_{13} = 1\hat{0}^+_\alpha \hat{0}^+_\beta \hat{1}^+_\beta \quad |vac\rangle$

$P_{14} = 1\hat{0}^+_\beta \hat{1}^+_\alpha \hat{1}^+_\beta \quad |vac\rangle$

$P_{15} = 1\hat{0}^+_\alpha \hat{0}^+_\beta \hat{1}^+_\alpha \hat{1}^+_\beta \quad |vac\rangle$