

## 8.15: GHZ Math Appendix

This appendix shows another way of "doing the math" in the GHZ experiment.

$$\begin{array}{l}
 \Psi_{yyx} = \frac{1}{\sqrt{2}}(H_1 H_2 H_3 + V_1 V_2 V_3) \left| \begin{array}{l}
 \text{substitute, } H_1 = \frac{1}{\sqrt{2}}(R_1 + L_1) \\
 \text{substitute, } H_2 = \frac{1}{\sqrt{2}}(R_2 + L_2) \\
 \text{substitute, } H_3 = \frac{1}{\sqrt{2}}(H'_3 + V'_3) \\
 \text{substitute, } V_1 = \frac{i}{\sqrt{2}}(L_1 - R_1) \\
 \text{substitute, } V_2 = \frac{i}{\sqrt{2}}(L_2 - R_2) \\
 \text{substitute, } V_3 = \frac{1}{\sqrt{2}}(H'_3 - V'_3) \\
 \text{simplify} \\
 + \frac{1}{2} L_1 R_2 H'_3 + \frac{1}{2} L_1 L_2 V'_3
 \end{array} \right. \rightarrow \Psi_{yyx} = \frac{1}{2} R_1 R_2 V'_3 + \frac{1}{2} R_1 L_2 H'_3
 \end{array}$$
  

$$\begin{array}{l}
 \Psi_{xyy} = \frac{1}{\sqrt{2}}(H_1 H_2 H_3 + V_1 V_2 V_3) \left| \begin{array}{l}
 \text{substitute, } H_1 = \frac{R_1 + L_1}{\sqrt{2}} \\
 \text{substitute, } H_2 = \frac{(H'_2 + V'_2)}{\sqrt{2}} \\
 \text{substitute, } H_3 = \frac{R_3 + L_3}{\sqrt{2}} \\
 \text{substitute, } V_1 = \frac{i}{\sqrt{2}}(L_1 - R_1) \\
 \text{substitute, } V_2 = \frac{H'_2 - V'_2}{\sqrt{2}} \\
 \text{substitute, } V_3 = \frac{i(L_3 - R_3)}{\sqrt{2}} \\
 \text{simplify} \\
 + \frac{1}{2} L_1 V'_2 L_3
 \end{array} \right. \rightarrow \Psi_{xyy} = \frac{1}{2} R_1 H'_2 L_3 + \frac{1}{2} R_1 V'_2 R_3 + \frac{1}{2} L_1 H'_2 R_3
 \end{array}$$
  

$$\begin{array}{l}
 \Psi_{xyy} = \frac{1}{\sqrt{2}}(H_1 H_2 H_3 + V_1 V_2 V_3) \left| \begin{array}{l}
 \text{substitute, } H_1 = \frac{H'_1 + V'_1}{\sqrt{2}} \\
 \text{substitute, } H_2 = \frac{R_2 + L_2}{\sqrt{2}} \\
 \text{substitute, } H_3 = \frac{R_3 + L_3}{\sqrt{2}} \\
 \text{substitute, } V_1 = \frac{H'_1 - V'_1}{\sqrt{2}} \\
 \text{substitute, } V_2 = \frac{i(L_2 - R_2)}{\sqrt{2}} \\
 \text{substitute, } V_3 = \frac{i(L_3 - R_3)}{\sqrt{2}} \\
 \text{simplify} \\
 + \frac{1}{2} V'_1 L_2 L_3
 \end{array} \right. \rightarrow \Psi_{xyy} = \frac{1}{2} H'_1 R_2 L_3 + \frac{1}{2} H'_1 L_2 R_3 + \frac{1}{2} V'_1 R_2 R_3
 \end{array}$$

$$\Psi_{xxx} = \frac{1}{\sqrt{2}}(H_1 H_2 H_3 + V_1 V_2 V_3) \left| \begin{array}{l} \text{substitute, } H_1 = \frac{H'_1 + V'_1}{\sqrt{2}} \\ \text{substitute, } H_2 = \frac{H'_2 + V'_2}{\sqrt{2}} \\ \text{substitute, } H_3 = \frac{H'_3 + V'_3}{\sqrt{2}} \\ \text{substitute, } V_1 = \frac{H'_1 - V'_1}{\sqrt{2}} \\ \text{substitute, } V_2 = \frac{H'_2 - V'_2}{\sqrt{2}} \\ \text{substitute, } V_3 = \frac{H'_3 - V'_3}{\sqrt{2}} \\ \text{simplify} \end{array} \right. \rightarrow \Psi_{xxx} = \frac{1}{2} H'_1 H'_2 H'_3 + \frac{1}{2} H'_1 V'_2 V'_3 + \frac{1}{2} V'_1 H'_2 V'_3 + \frac{1}{2} V'_1 V'_2 H'_3$$

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