Physics 499 Outline of Summary

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August, 2018: I read Chapter 1, 2, and 4 of Neilson and Chung's *Quantum Computation and Quantum Information* and learned the basics about quantum circuits.

Week 1-3 (9/1-9/16): I read paper "Meassurement of SNC (Premakumar et al.)" and learned other supplement materials ("Decoherence Free Subspaces for 2 Qubits" and "Suggestion for a 2-Qubit Experiment"), and I tried to be familiar with IBM Q website used to construct quantum circuits.

Week 5-8 (9/24-10/21): With instructions, I constructed a gate sequence for Ramsey experiments on IBM Q website. To study how the distribution of four outcomes (00, 01, 10, 11) changes with respect to the waiting time, one of four bell states is prepared and n identity gates follows, given that one identity gate functions as one unit time as the website states. However, the exact time of "one unit time" is unknown yet. With the restriction of the number of gates, $n \leq 74$ for 00+11 state and $n \leq 71$ for 01+10 state. Then subsequent gates are prepared so the state could rotate back to the original direction in the Bloch sphere. For 00+11 state, I tabled the results of distributions for four outcomes and the calibration data (T1, T2). I fit the data with 2 functions: $C \exp(-\frac{t}{T_2^-})$ and $C \exp(-(\frac{t}{T_2^-})^2)$, where C is a constant. However, the error between the data and the fitting curve is large so I added constants to the fitting function to minimize the error.

Week 9-11 (10/22-11/11): I tabled 5 more groups of results for 00+11 state (8 groups in total). I fit these with new functions with extra constants: $C \exp(-\frac{t}{T_2^-}) + D$ and $C \exp(-(\frac{t}{T_2^-})^2 + D)$ and $kt + b$, where C, D, k and b are constants, and $T_2^- \approx 189.013$ is obtained from the first fitting. I also tabled two groups of outcomes for 01+10 state. I fit these with the above three functions, where T_2^- is replaced by T_2^+. $T_2^+ \approx 951.874$ is obtained from the first fitting.

Later (Week 13-): More outcomes for 01+10 state need to be tabled to get a better fitting. $T_2(1)$, $T_2(2)$, T_2^+, T_2^- are expected to be obtain to determine S_{12}. Also, the operating frequencies need to be checked. Also, four extra experiments with (a) 2 Hadamards on qubit 1 and (b) 2

Hadamards on qubit 2 and (c) two CNOTS with qubit 1 as the control and (d) two CNOTS with qubit 2 as the control, to examine how 00 probability changes in each case.