Abstract

The power of quantum computation and information processing is based on two im- portant phenomenon: first, "superposition" which allows the quantum computer to compute the large number of calculation simultaneously and second, "entanglement" which has got wide range of application specially in quantum teleportation and in quantum cryptography. These both phenomenon have no anologous in classical com- puter. The experimental realization of quantum computation and information processing has already been seen in many different system like trapped ions, polarised photon lasers, cavity quantum electrodynamics and quantum dots etc. NMR has proven to be the most successful system for the application of quantum computation and even for going to the higher qubit sytem. In this thesis, I have started with the basic concepts on NMR describing about the nu- clear spins, interaction of nuclear spins with static magnetic field and radio frequency, relaxation theory of nuclear spins and signal detection. Since, in NMR, we deal with an ensemble of identical spin system which at room temperature are in a mixed state following the Boltzmann distribution but for the application of quantum computation, we require initial state should be pure which is not directly accessible. Therefore, to get pure state we need either very low temperature or very high magnetic field but this is also practically not possible. To get rid of this problem, we have di erent schemes to create initial state which can mimic pure state called "Pseudopure State". In this work, we describe the different schemes available mainly spatial averaging, temporal averaging and using controlled-transfer gate and also the experimental im- plementation of these schemes for the preparation of pseudopure States. By comparing these schemes qualitatively and quantitatively, I will conclude which scheme is best. The next part of my thesis will be dealing with the evolution of qubit system. Any quantum state when left undisturbed, it inevitably interact with their surrounding environment which results in a relaxation of quantum state back to a thermal equilib- rium due to the loss of coherence and energy. Therefore, to study the dynamics of the quantum states exposed to noisy environment is an important area in order to devise ways such that the system can be protected from the noisy effects of the environment. In this study we have considered three quantum channel to describe the noise: phase damping, depolarising and generalised amplitude damping channel and how the set of random pure states behave under these channel. Then we will describe about the relaxation of random pure states created in NMR through the quantum channels and characterize which damping channel is dominant.