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Magnetically Controlled Quantum Teleportation Using the Bloch Catalyst

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Abstract

Quantum teleportation is at its advanced research stage and has attracted more novel discoveries in recent time. The Bloch NMR was used to highlight the specification for the construction of a virtual Magnetic-Not (M-Not) gate to analyze a two trans-sectional multiple arbitrary states. A new version of quantum manipulation for entanglement and disentanglement of particles was introduced. A new quantity known as the particle filter was discovered. The particle-filter acts like a catalyst via the use of transverse and longitudinal relaxations to speed-up teleportation of single qubit state from the sender to the intermediary and then to the receiver. The efficiency of the M-Not gates to filter both noise and excited qubit state during teleportation was shown.

Keywords: *Bloch NMR, Magnetic-Not gate, quantum teleportation, longitudinal magnetization*

1. Introduction

The Bloch NMR has shown much prospect than its original design. Its physics is flexible to fit into different concepts and disciplines e.g. Bio-physics, Solid state physics e.t.c. Earlier, the Bloch NMR was used as an investigative tool. For example, Wigner [1] used the Bloch NMR to investigate thermodynamic properties of solids; Awojoyogbe [2] used it to investigate the blood flow rate and physiological properties of living tissue; Uno and Emetere [3] used the Bloch NMR to investigate the London penetration depth in superconducting materials; Emetere used the Bloch NMR to investigate the Rashba energy features in spintronics device [4], worked out the energy levels of nuclei using the Bloch NMR [5, 6], furthered the Bloch NMR to re-enforce the Arrhenius law [7], introduced complexities of compounds via their kind of relaxations [8], used to enact a new concept in condensed matter physics i.e. Bloch inspired spin orbit interactions [9], introduced the magnetic excitation of single spin dynamics process for quantum information [10].

In this paper, the Bloch NMR was used as the basics for inventing a virtual Magnetic-Not gate which was extensively used for an improved quantum teleportation scheme. The Quantum teleportation scheme was first presented by Bennett et al [11]. He worked on teleportation of unknown single qubit state from a sender to a receiver. After then, vast studies (experimental and theoretical) have been done to improve the quantum teleportation scheme [12-15]. Among notable transitions of the quantum teleportation scheme were the use of quantum controlled teleportation scheme [16, 17] and quantum secret sharing scheme [18]. Recently, Shi et al [16] came up with an idea- using the Controller-Not gate to teleport multi-qubit from multiple senders to a single receiver. He did not account for the presence of noise and excited qubit state from the multiple senders. In this paper, the multi-qubit was teleported from multiple senders to specific locations of large receivers by a two trans-sectional scheme comprising of the sender, intermediary and receiver. The presence of noise and excited qubit states were discovered in a large quantum teleportation scheme. The Virtual Magnetic –Not (M-Not) gate was proposed to eliminate the noise and qubit states.

2. Research Method

In this section, a mathematical algorithm to describe in detail the translational mechanical properties of the Bloch NMR equation was developed. Sample of the atomic crystal

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structure was analyzed in the rotating frame of magnetization given by the ab-initio Bloch NMR equations [3-10].

$$\frac{dM_x}{dt} = \Delta\omega M_y - \frac{M_x}{T_2} \quad (1)$$

$$\frac{dM_y}{dt} = -\Delta\omega M_x + \omega_1 M_z - \frac{M_y}{T_2} \quad (2)$$

$$\frac{dM_z}{dt} = -\omega_1 M_y - \frac{(M_z - M_o)}{T_1} \quad (3)$$

Where $\Delta\omega = \omega_1 - \omega_o$ is the frequency difference between Larmor frequency and the frame of reference, $\omega_1 = -\gamma B_1$ is the Rabi frequency, $\omega_o = -\gamma B_o$ is the Larmor frequency, M_x, M_y are the transverse magnetization, M_z is the longitudinal magnetization, M_o is the equilibrium magnetization. The particles is assumed to move at a velocity V_e and V_h through distances L_h & L_e from the source to its destination. We introduce the parameters

$$\frac{dM_x}{dL_h}\frac{dL_h}{dt} = \frac{dM_x}{dt} \quad (4)$$

$$\frac{dM_y}{dL_e}\frac{dL_e}{dt} = \frac{dM_y}{dt} \quad (5)$$

$$\frac{dM_z}{dL_h}\frac{dL_h}{dt} = \frac{dM_z}{dt} \quad (6)$$

Where $\frac{dL_h}{dt} = v_h$ and $\frac{dL_e}{dt} = v_e$

The objective of the terms in equation (4-6) was to introduce the particle velocity into the ab-initio Bloch NMR equations. Therefore the translational time-independent mechanical properties of the new Bloch NMR equations were developed as shown in equation (7-9).

$$\frac{dM_x}{dL_h} = \frac{\Delta\omega}{v_h} M_y - \frac{M_x}{v_h T_2} \quad (7)$$

$$\frac{dM_y}{dL_e} = \frac{-\Delta\omega M_x}{v_e} + \frac{\omega_1 M_z}{v_e} - \frac{M_y}{v_e T_2} \quad (8)$$

$$\frac{dM_z}{dL_h} = \frac{-\omega_1 M_y}{v_h} - \frac{(M_z - M_o)}{v_h T_1} \quad (9)$$

Experimentally, the frequency ω_1 is adjusted slowly to attain resonance. This process is known as the steady Bloch state. The steady state occurs when the rate of change of magnetization along the axes x, y and z is constant in the rotating frame. Here, $\frac{dM_z}{dL_h}$ or $\frac{dM_y}{dL_e}$ or $\frac{dM_x}{dL_h}$ are prototypes of static spin susceptibility which we assumed to be zero when the system is at its steady state.

$$0 = \frac{\Delta\omega}{v_h} M_y - \frac{M_x}{v_h T_2} \quad (10)$$

$$0 = \frac{-\Delta\omega M_x}{v_e} + \frac{\omega_1 M_z}{v_e} - \frac{M_y}{v_e T_2} \quad (11)$$

$$0 = \frac{-\omega_1 M_y}{v_h} - \frac{(M_z - M_o)}{v_h T_1} \quad (12)$$

The solution of the above equations can be arranged in matrix form and solved using the matrix algebra as shown below:

$$\begin{bmatrix} -1 & \Delta\omega T_2 & 0 \\ -\Delta\omega T_2 & -1 & T_2\omega_1 \\ 0 & -T_1\omega_1 & -1 \end{bmatrix} \begin{bmatrix} M_x \\ M_y \\ M_z \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ -M_o \end{bmatrix} \tag{13}$$

The inverse matrix of the coefficients of M_x, M_y and M_z were constructed being mindful of the signs of cofactors and transposing later to get the adjoint matrix. The steady state solutions of the Bloch equations in the rotating frame of reference are:

$$M_x = \frac{\omega_1 \Delta\omega {T_2}^2 M_0}{1+\omega_1^2 T_1 T_2 - \Delta\omega^2 {T_2}^2} \tag{13b}$$

$$M_y = \frac{\omega_1 T_2 M_o}{1+\omega_1^2 T_1 T_2 - \Delta\omega^2 {T_2}^2} \tag{13c}$$

$$M_z = \frac{(1+\Delta\omega^2 {T_2}^2) M_o}{1+\omega_1^2 T_1 T_2 - \Delta\omega^2 {T_2}^2} \tag{13d}$$

These solutions directly give the frequency response of the magnetization and the measured signals of a spin system i.e. characterized by the longitudinal and transverse relaxation times T_1 and T_2. The first approach towards solving the remodeled Bloch NMR signal is to assume a laboratory framework where the signals are not in fractions for a many-body system i.e. $\omega_1^2 T_1 T_2 - \Delta\omega^2 {T_2}^2 \gg 1$ and $\Delta\omega^2 {T_2}^2 \gg 1$. The new steady state solution of the Bloch equation is written as:

$$M_x = \frac{\omega_1 \Delta\omega T_2 M_0}{\omega_1^2 T_1 - \Delta\omega^2 T_2} \tag{14}$$

$$M_y = \frac{\omega_1 M_o}{\omega_1^2 T_1 - \Delta\omega^2 T_2} \tag{15}$$

$$M_z = \frac{\Delta\omega^2 T_2 M_o}{\omega_1^2 T_1 - \Delta\omega^2 T_2} \tag{16}$$

These solutions directly give the frequency response of the magnetization. This idea gives the possibilities of quantitatively calculating the measured signal if a spin system is characterized by relaxation times T_1 and T_2. We can recover the usual longitudinal magnetization on the assumption $\Delta\omega^2 T_2 \gg 1$. The term $\omega_1^2 T_1$ is proportional to the radio frequency power P. At the state of no saturation i.e. for low power P, this term ($\omega_1^2 T_1$) is small i.e. $\omega_1^2 T_1 \ll 1$.

$$M_z = -M_o \tag{17}$$

An alternative measure was adopted i.e. reducing the longitudinal magnetization without any assumptions.

$$M_z = \frac{\Delta\omega^2 T_2 M_o}{-\omega_1^2 T_1 - \Delta\omega^2 T_2} \tag{18}$$

We shall introduce the velocity parameters to analyse the dynamics of the relaxation times on the qubit transfer between two known equations.

$$M_z = \frac{\Delta\omega^2 T_2 M_o}{-\omega_1^2 T_1 - \Delta\omega^2 T_2} \times \frac{v_z}{v_z} \tag{18b}$$

Recall that the magnitude of $\omega_1^2 T_1$ is very small, therefore, $\omega_1^2 T_1 \approx v_z \omega_1^2 T_1$. The time rate of change of the longitudinal magnetization is important experimentally to estimate the multiple quantum coherence and the dynamics of the quantum entanglement.

$$\frac{dM_z}{dt} = \frac{-\Delta\omega^2 a_z(t) T_2 M_o}{-\omega_1^2 T_1 - \Delta\omega^2 a_z(t) T_2} \tag{19}$$

$a_s(t)$ is the acceleration of the particles which shall be applied to the teleportation to enhance the efficiency of the virtual Magnetic-Not gate. For solids, the multiple quantum (MQ) spin dynamics is described as $\frac{dM_z}{dt}$ and defined by the Liouville-Von Neuman as:

$$\frac{dM_z}{dt} = -i[H_T, M_z(t)] \quad (20)$$

At thermal equilibrium, the solution of the above equation becomes:

$$M_z(t) = e^{-iHt} M_z(0) e^{iHt} \quad (21)$$

Where $M_z(0) = -M_o$ as shown in equation (17), H is the generic Hamiltonian given as:

$$H_T = H_n + H_s(t)$$
(21b)

$M_z(0)$ is expressed on the spin basis product states as $|00\rangle$, $|01\rangle$, $|10\rangle$ and $|11\rangle$. Therefore the matrix describing the equilibrium magnetization can be written as:

$$M_z(0) = \begin{bmatrix} -M_o & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & M_o \end{bmatrix} \quad (22)$$

From Equation (21), the full expression of the longitudinal magnetization can be given as:

$$M_z(t) = \alpha \begin{bmatrix} M_o cos\theta(t) & 0 & 0 & isin\theta(t) \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ -isin\theta(t) & 0 & 0 & -M_o cos\theta(t) \end{bmatrix} \quad (23)$$

$\alpha = \frac{\Delta\omega^2 a_s(t) T_2}{\omega_1^2 T_1 + \Delta\omega^2 a_s(t) T_2}$ is known as the particle filter, $\theta(t)$ is the rate of change of the phase angle.

Before Equation (23) is applied, a comprehensive unit of eight-party case is investigated in two trans-sections. The first section is made up of four-party comprising the senders (particle 1&2) and the intermediaries (particle 3&4). The second section is made up of six-party i.e. two intermediaries (now acting as the secondary senders i.e. 3 & 4) and four receivers (6, 7, 8, 9). The unknown arbitrary multi-qubit states for the two primary senders are $|\Phi\rangle_x$ and $|\Phi\rangle_y$. Here, the multi-qubit states are described mathematically as:

$$\left.\begin{aligned} |\Phi\rangle_x &= |\Phi\rangle_{x1} + |\Phi\rangle_{x2} \\ |\Phi\rangle_{x1} &= a_1|0\rangle_{x1} + b_1|1\rangle_{x1} \\ |\Phi\rangle_{x2} &= a_2|0\rangle_{x2} + b_2|1\rangle_{x2} \end{aligned}\right\} \quad (24)$$

$$\begin{aligned} |\Phi\rangle_y &= |\Phi\rangle_{y1} + |\Phi\rangle_{y2} \\ |\Phi\rangle_{y1} &= c_1|0\rangle_{y1} + d_1|1\rangle_{y1} \\ |\Phi\rangle_{y2} &= c_2|0\rangle_{y2} + d_2|1\rangle_{y2} \end{aligned} \quad (25)$$

a_1, b_1, c_1, d_1, a_2, b_2, c_2 and d_2 are complex numbers which satisfy the normalization conditions.

$$\left.\begin{aligned} |a_1|^2 + |b_1|^2 &= 1 \\ |a_2|^2 + |b_2|^2 &= 1 \\ |c_1|^2 + |d_1|^2 &= 1 \\ |c_2|^2 + |d_2|^2 &= 1 \end{aligned}\right\} \quad (26)$$

Equation (23) is expressed in equation (27) as the vector of the state i.e. with respect to the communication between the direct senders (1&2 particles) and intermediaries (3&4 particles) as shown in Figure 1.

$$\left.\begin{aligned}|\psi\rangle_{13} &= \alpha M_o e^{i\frac{\pi}{4}} \cos\left(\frac{\theta(t)}{2}\right)|00\rangle + \alpha M_o e^{-i\frac{\pi}{4}} \sin\left(\frac{\theta(t)}{2}\right)|11\rangle \\ |\psi\rangle_{24} &= \alpha M_o e^{i\frac{\pi}{4}} \cos\left(\frac{\theta(t)}{2}\right)|01\rangle + \alpha M_o e^{-i\frac{\pi}{4}} \sin\left(\frac{\theta(t)}{2}\right)|10\rangle\end{aligned}\right\} \quad (27)$$

To perform the Bell measurement, Equation (27) is transformed into the Bell state by making $\theta(t) = \frac{\pi}{2}$ in order to satisfy the usual five particle entanglement state i.e. $|\phi\rangle_{12345}$ used by Bennett *et al.* [11] The sender-intermediary pair was adopted i.e. (1,3) and (2,4).

$$\left.\begin{aligned}|\psi\rangle_{13} &= \frac{\alpha M_o}{2}(|00\rangle + |11\rangle) \\ |\psi\rangle_{24} &= \frac{\alpha M_o}{2}(|01\rangle + |10\rangle)\end{aligned}\right\} \quad (28)$$

Unlike the Controlled-Not (C-Not) gate, the Magnetic-Not (M-Not) does not change the control particle because of the changing transverse and longitudinal relaxations during operation. The M-Not gate behaves like the C-Not gate when two M-Not gates are used within the operational setting. To understand the arrangement of the particle-filter, the Hadamard transformation H which represents particle 5 and 10 is written as:

$$H_1|0\rangle = \frac{1}{\alpha\sqrt{2}}(|0\rangle + |1\rangle) \quad (29)$$

$$H_2|0\rangle = \frac{\alpha}{\sqrt{2}}(|0\rangle + |1\rangle) \quad (29b)$$

Thus, the initial states of the particles are:

$$\begin{aligned}|\phi\rangle_{12345} &= \frac{\alpha M_o}{2}(|00\rangle + |11\rangle)_{13} \otimes \frac{\alpha M_o}{2}(|01\rangle + |10\rangle)_{24} \otimes \frac{1}{\alpha\sqrt{2}}(|0\rangle + |1\rangle)_5 \\ &= \frac{\alpha M_o{}^2}{4\sqrt{2}}\begin{pmatrix}|00010\rangle + |00011\rangle + |00100\rangle + |00101\rangle + |11010\rangle + |11011\rangle \\ +|11100\rangle + |11101\rangle\end{pmatrix}_{13245}\end{aligned} \quad (30)$$

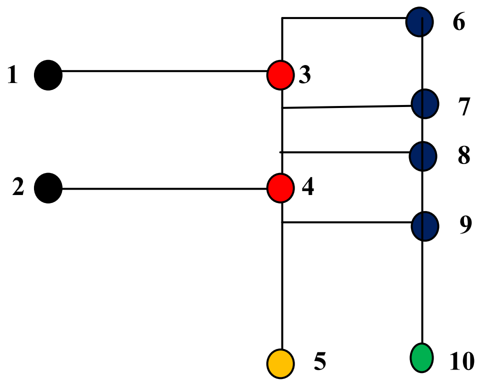

Figure 1. Eight party controlled teleportation

The secure quantum channels on both point 3 and point 4 can be written respectively as:

$$\left.\begin{aligned}|\varphi\rangle_1 &= |\Phi\rangle_{x1} \otimes |\Phi\rangle_{y1} \otimes |\phi\rangle_{13245} \\ |\varphi\rangle_2 &= |\Phi\rangle_{x2} \otimes |\Phi\rangle_{y2} \otimes |\phi\rangle_{13245}\end{aligned}\right\} \quad (31)$$

This can be simplified as:

$$|\varphi\rangle_1 = (a_1|0\rangle + b_1|1\rangle)_{x1} \otimes (a_2|0\rangle + b_2|1\rangle)_{y1} \otimes |\phi\rangle_{13245} \quad (32)$$

$$|\varphi\rangle_1 = (a_1a_2|00\rangle + a_1b_2|01\rangle + b_1a_2|10\rangle + b_1b_2|11\rangle)_{x1y1} \otimes (\frac{\alpha M_o{}^2}{4\sqrt{2}}(|00010\rangle + |00011\rangle + |00100\rangle + |00101\rangle + |11010\rangle + |11011\rangle + |11100\rangle + |11101\rangle)_{13245}) \quad (32b)$$

$$|\varphi\rangle_2 = (c_1|0\rangle + d_1|1\rangle)_{x2} \otimes (c_2|0\rangle + d_2|1\rangle)_{y2} \otimes |\phi\rangle_{13245} \quad (33)$$

$$|\varphi\rangle_2 = (c_1c_2|00\rangle + c_1d_2|01\rangle + d_1c_2|10\rangle + d_1d_2|11\rangle)_{x2y2} \otimes (\frac{\alpha M_o{}^2}{4\sqrt{2}}(|00010\rangle + |00011\rangle + |00100\rangle + |00101\rangle + |11010\rangle + |11011\rangle + |11100\rangle + |11101\rangle)_{13245}) \quad (33b)$$

Point 10 is made up of the second M-Not gate which allows for the change of target particle. The intermediary- receiver pair i.e. (3,6), (3,7), (4,8) and (4,9) makes-up the second section. The pair is in conformity with the Einstein-Podolsky-Rosen (EPR) pair

$$\left.\begin{aligned} |\psi\rangle_{36} &= \tfrac{1}{\sqrt{2}}(|01\rangle + |10\rangle) \\ |\psi\rangle_{37} &= \tfrac{1}{\sqrt{2}}(|00\rangle + |11\rangle) \\ |\psi\rangle_{48} &= \tfrac{1}{\sqrt{2}}(|01\rangle + |10\rangle) \\ |\psi\rangle_{49} &= \tfrac{1}{\sqrt{2}}(|00\rangle + |11\rangle) \end{aligned}\right\} \quad (34)$$

Thus, the final states of the particles are:

$$|\phi\rangle_{363710} = \tfrac{1}{\sqrt{2}}(|01\rangle + |10\rangle)_{36} \otimes \tfrac{1}{\sqrt{2}}(|00\rangle + |11\rangle)_{37} \otimes \tfrac{1}{\sqrt{2}}(|0\rangle + |1\rangle)_{10} = \tfrac{1}{2\sqrt{2}}(|00100\rangle + |00111\rangle + |01000\rangle + |01011\rangle + |10100\rangle + |10111\rangle + |11000\rangle + |11011\rangle)_{363710} \quad (35)$$

We apply the remodeled Hadamard transformations to Equation (35) to simplify the first section,

$$= \frac{1}{2\sqrt{2}}\begin{pmatrix} |00100\rangle + |01011\rangle + |01000\rangle + |00111\rangle + |10100\rangle + |11011\rangle + |11000\rangle \\ +|10111\rangle \end{pmatrix}_{336710} \quad (36)$$

Also, the same process is applied to the second section i.e. Equation (37).

$$|\phi\rangle_{484910} = \tfrac{1}{\sqrt{2}}(|01\rangle + |10\rangle)_{48} \otimes \tfrac{1}{\sqrt{2}}(|00\rangle + |11\rangle)_{49} \otimes \tfrac{1}{\sqrt{2}}(|0\rangle + |1\rangle)_{10} = \tfrac{1}{2\sqrt{2}}(|00100\rangle + |00111\rangle + |01000\rangle + |01011\rangle + |10100\rangle + |10111\rangle + |11000\rangle + |11011\rangle)_{484910} \quad (37)$$

$$= \tfrac{1}{2\sqrt{2}}(|00100\rangle + |01011\rangle + |01000\rangle + |00111\rangle + |10100\rangle + |11011\rangle + |11000\rangle + |10111\rangle)_{448910} \quad (38)$$

Without loss of generality, the secure quantum channel is written as:

$$|\varphi\rangle_1 = (a_1a_2|00\rangle + a_1b_2|01\rangle + b_1a_2|10\rangle + b_1b_2|11\rangle)_{x1y1} \otimes (\frac{\alpha M_o^2}{4\sqrt{2}}(|00010\rangle + |00011\rangle + |00100\rangle + |00101\rangle + |11010\rangle + |11011\rangle + |11100\rangle + |11101\rangle)_{13245}) \otimes \frac{1}{2\sqrt{2}}(|00100\rangle + |01011\rangle + |01000\rangle + |00111\rangle + |10100\rangle + |11011\rangle + |11000\rangle + |10111\rangle)_{336710} \quad (39)$$

The entanglement ($3,3,6,7,10$) of the first section was disentangled by collapsing the given state into three particles i.e. 6, 7 and 10. Equation (36) can be written as:

$$|\phi\rangle_{132456710} = \frac{1}{4\sqrt{2}}(a_1a_2|000\rangle + a_1a_2|111\rangle + a_1b_2|010\rangle + a_1b_2|101\rangle + b_1a_2|100\rangle + b_1a_2|011\rangle + b_1b_2|110\rangle + b_1b_2|011\rangle)_{6,7,10} \otimes (\frac{\alpha M_o^2}{4\sqrt{2}}(|00010\rangle + |00011\rangle + |00100\rangle + |00101\rangle + |11010\rangle + |11011\rangle + |11100\rangle + |11101\rangle)_{13245}) \quad (40)$$

The entanglement ($4,4,8,9,10$) of the second section was also disentangled by collapsing the given state into three particles i.e. 8, 9 and 10. The secured quantum channel is written as:

$$|\phi\rangle_{132458910} = \frac{1}{4\sqrt{2}}(c_1c_2|000\rangle + c_1c_2|111\rangle + c_1d_2|010\rangle + c_1d_2|101\rangle + d_1c_2|100\rangle + d_1c_2|011\rangle + c_1c_2|110\rangle + c_1c_2|011\rangle)_{8,9,10} \otimes (\frac{\alpha M_o^2}{4\sqrt{2}}(|00010\rangle + |00011\rangle + |00100\rangle + |00101\rangle + |11010\rangle + |11011\rangle + |11100\rangle + |11101\rangle)_{13245}) \quad (41)$$

Both particles 6 and 7 receive the target particle in the form of Equation (40) and are filtered by α into its respective location using a magnetic re-ordering of signal. Equation (40) can be written in the form [19].

$$|\phi\rangle_{132456710} = \frac{1}{4\sqrt{2}}(a_1a_2|000\rangle + a_1a_2|111\rangle + a_1b_2|010\rangle + a_1b_2|101\rangle + b_1a_2|100\rangle + b_1a_2|011\rangle + b_1b_2|110\rangle + b_1b_2|011\rangle)_{6,7,10} \otimes (\frac{\alpha M_o^2}{4\sqrt{2}}(|00010\rangle + |00011\rangle + |00100\rangle + |00101\rangle + |11010\rangle + |11011\rangle + |11100\rangle + |11101\rangle)_{13245}) \quad (42)$$

The second M-Not gate decouples Equation (42) in the format shown below:

$$\left.\begin{array}{c} A_xA_y|000\rangle \otimes |00010\rangle = A_xA_y|10\rangle \\ A_xA_y|000\rangle \otimes |00110\rangle = 0 \\ A_xB_y|000\rangle \otimes |00010\rangle = 0 \\ A_xA_y|110\rangle \otimes |11011\rangle = A_xA_y|11\rangle \end{array}\right\} \quad (43)$$

$$|\phi\rangle_{67} = \frac{\alpha M_o^2}{32}(a_1a_2(|10\rangle + |11\rangle) + b_1b_2(|10\rangle + |11\rangle))$$
$$|\phi\rangle_{67} = \frac{\alpha M_o^2}{32}(a_1|1\rangle a_2(|0\rangle + |1\rangle) + b_1|1\rangle b_2(|0\rangle + |1\rangle)) \quad (44)$$

When $\alpha = 0$, the $a_1|1\rangle$ and $b_1|1\rangle$ vanishes, likewise $\frac{M_o^2}{32}$. $(|0\rangle + |1\rangle$ is preserved because it is the qubit ground state. Therefore:

$$|\phi\rangle_{67} = a_2|0\rangle + a_2|1\rangle + b_2|0\rangle + b_2|1\rangle$$
$$|\phi\rangle_{67} = (a_2|1\rangle + b_2|0\rangle) + (a_2|0\rangle + b_2|1\rangle)$$

The point 6 and 7 receives the signal as either:

$$\left.\begin{array}{c} |\phi\rangle_6 = a_2|1\rangle + b_2|0\rangle \\ |\phi\rangle_7 = a_2|0\rangle + b_2|1\rangle \end{array}\right\} \quad (45)$$

$$\left.\begin{array}{l}|\phi\rangle_6 = a_1|0\rangle + b_1|1\rangle \\ |\phi\rangle_7 = a_1|1\rangle + b_1|0\rangle\end{array}\right\} \quad (46)$$

The strange qubit states $a_2|1\rangle + b_2|0\rangle$ and $a_1|1\rangle + b_1|0\rangle$ are received at both point 6&7 in the form of noise. Likewise, Equation (41) is concluded as

$$\left.\begin{array}{l}|\phi\rangle_8 = c_2|1\rangle + d_2|0\rangle \\ |\phi\rangle_9 = c_2|0\rangle + d_2|1\rangle\end{array}\right\} \quad (47)$$

$$\left.\begin{array}{l}|\phi\rangle_8 = c_1|0\rangle + d_1|1\rangle \\ |\phi\rangle_9 = c_1|1\rangle + d_1|0\rangle\end{array}\right\} \quad (48)$$

The strange qubit states $c_2|1\rangle + d_2|0\rangle$ and $c_1|1\rangle + d_1|0\rangle$ are received at point 8 and 9 in the form of noise. When $\alpha = 1$, the $a_1|1\rangle$ and $b_1|1\rangle$ are preserved like $\frac{M_o^2}{32}$. $(|0\rangle + |1\rangle$ vanishes because it has ascended into an excited state. Therefore, the excited state could be written as:

$$\left.\begin{array}{l}a_1|1\rangle + b_1|1\rangle = |\phi^+\rangle \\ a_2|1\rangle + b_2|1\rangle = |\phi^-\rangle \\ c_1|1\rangle + d_1|1\rangle = |\psi^+\rangle \\ c_2|1\rangle + d_2|1\rangle = |\psi^-\rangle\end{array}\right\} \quad (49)$$

3. Results and Analysis

The particle filter (α) – known as the Bloch catalyst vanishes for either $\alpha = 0$ or $\alpha = 1$. This result shows the general characteristics of catalyst i.e. they speed-up reactions and do not act as a mixture. The catalytic nature of the particle filter (α) was proved mathematically by its definition in Equation (23). For example, at the receiver (6, 7, 8, 9) the specific single qubit states are devoid of the α term. Therefore it is affirmed that the particle filter acts like a catalyst-meant to speed-up the rate of quantum teleportation. Unlike the Reference [16], the virtual Magnetic-Not gate has proven to be applicable - in two or more trans-sectional quantum teleportation of multiple arbitrary states from multiple senders to a large number of receivers with 100% recovery on a secured quantum channel. Unlike the C-Not gate [16, 17], the M-Not gate is a more sensitive device which is able to filter noise and excited qubit states from the original arbitrary states as shown by the red lines in Equation (45-48). Like C-Not gates, M-Not gates work on the principle that the particle of the first controller is the control particle. This occurrence satisfies the validity of the mathematical procedure used in this paper [16-18]. A new mathematical technique was propounded i.e. Equation (41) represents a new quantum manipulation for disentangling quantum channels at the receivers-end. This is a major achievement because the receivers-end are usually problematic as security of the information and the clarity of the message received.

4. Conclusion

The M-Not gate has shown more reliability and sensitivity in separating either noise or excited qubit states from ordinary arbitrary states sent from multiple senders to a large number of receivers within a secured quantum channel. Also the introduction of two trans-sectional quantum teleportation is an improvement on the set-up reported by Shi et al [16]. Beyond teleportation of qubit state, we have presented the particle filter which acts like a catalyst to speed-up the rate of teleportation. The presence of the longitudinal and transverse relaxations also aids the intermediaries to resist complex quantum entanglement.

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