**CLAIMS:**

1. A photon state converter (32) comprising an imbalanced interferometer (23r), characterized in that

said imbalanced interferometer (23r) comprising a non-polarizing beam combiner (24) configured to combine optical pulse signals from short and long arms of said imbalanced interferometer (23r) to thereby generate the following three observable optical signal pulses responsive to time-bin and phase states encoded photons ($p_0$,$p_\tau$) received by said imbalanced interferometer:

(i) a first optical pulse signal ($St_0$) responsive to a first time-bin ($p_0$) of said time-bin and phase states encoded photon reaching said non-polarizing beam (24) combiner from the short arm ($Arm_s$) of said imbalanced interferometer;

(ii) a second optical pulse signal ($St_1$) responsive to an interference pattern between said first time-bin ($p_0$) reaching said non-polarizing beam combiner (24) from the long arm ($Arm_l$) of said imbalanced interferometer and a second time-bin ($p_\tau$) of said time-bin and phase states encoded photon reaching said non-polarizing beam combiner (24) from said short arm ($Arm_s$) of said imbalanced interferometer; and

(iii) a third optical pulse signal ($St_2$) responsive to said second time-bin ($p_\tau$) reaching said non-polarizing beam combiner (24) from the long arm ($Arm_l$) of said imbalanced interferometer; and

said photon state converter comprising at least one polarization orientation manipulating device configured to affect orthogonal polarization orientations to light components of said imbalanced interferometer (23r) and thereby convert said time-bin and phase states encoded photons ($p_0$,$p_\tau$) into hybrid time-bin and polarization states encoded photons ($St_0$,$St_1$,$St_2$).

2. The photon state converter of claim 1 comprising two polarization arms ($Arm_h$, $Arm_v$) optically coupled to the imbalanced interferometer (23r) and configured for generating the two orthogonally polarized optical signals.

3. The photon state converter of claim 2 comprising either a half wavelength phase retarder (24w) in one of the polarization arms ($Arm_h$, $Arm_v$), or a respective polarization orientation manipulating device (24h,24v) in each one of the polarization arms ($Arm_h$, $Arm_v$).

4. The photon state converter of claim 1 configured for one of the following: the time-bin and phase states encoded photons ($p_0$,$p_\tau$) have a defined linear polarization orientation, and wherein said photon state converter comprises a half wavelength phase retarder (23w) in one

of the arms ($Arm_s$,$Arm_l$) of the imbalanced interferometer (23r); the time-bin and phase states encoded photons ($p_0$,$p_\tau$) have a defined diagonal polarization orientation, and wherein said photon state converter comprises a half wavelength phase retarder (23w) in one of the arms of the imbalanced interferometer and a polarizing beam splitter (23") for transmitting said time-bin and phase states encoded photons into the long and short arms ($Arm_s$,$Arm_l$) of the imbalanced interferometer (23r'); the time-bin and phase states encoded photons ($p_0$,$p_\tau$) have a defined linear polarization orientation, and wherein said photon state converter comprises a half wavelength phase retarder (23w) in one of the arms of the imbalanced interferometer and a polarizing beam combiner (24") for combining optical signals from the long and short arms ($Arm_s$,$Arm_l$) of the imbalanced interferometer (23r').

5. A quantum communication system (10) comprising transmitter (12) and receiver systems (11) configured to communicate over a free space medium (10q), said transmitter system (12) comprising a quantum transmitter (12p) configured to generate time-bin and phase states modulated photons ($p_0$,$p_\tau$), and the photon state converter (12t) of any one of the preceding claims optically coupled said quantum transmitter (12p) for converting the time-bin and phase states encoded photons thereby generated into the hybrid time-bin and polarization states encoded photons ($St_0$,$St_1$,$St_2$) for transmission to the receiver system (11) over said free space medium.

6. The quantum communication system of claim 5 wherein the quantum transmitter (12p) is mounted in a secure location (12u), and wherein the photon state converter (12t) is at a relatively remote and insecure location and optically coupled to said quantum transmitter by one or more optical fibers (12o), and/or wherein the receiver system comprises a quantum receiver (11p) optically coupled to a photon state converter (11t) configured to convert hybrid time-bin and polarization states photons ($St_0$,$St_1$,$St_2$) received over the free space medium (10q) into time-bin and phase states encoded photons ($p_0$,$p_\tau$).

7. The quantum communication system of claim 6, wherein the quantum receiver (11p) is mounted in a secure location (11u), and wherein the photon state converter (11t) in at a relatively remote and insecure location and optically coupled to said quantum receiver (11p) by one or more optical fibers (11o).

8. The quantum communication system of any one of claims 5 to 7, wherein the receiver system (11) is configured to carry out polarization plane alignment based on the first ($St_0$) and third ($St_2$) observable optical signal pulses.

9. A photon states encoder (36) comprising: a coherent light source (12c') of a defined linear polarization orientation; an interferometer (23r') optically coupled to said coherent light source and configured with a polarizing beam combiner (23') for combining optical signals from arms ($Arm_s$,$Arm_l$) of said interferometer; first and second modulators (IM1,IM2) configured to respectively modulate amplitude and phase of optical signals passing through said arms ($Arm_s$,$Arm_l$); and a polarization orientation manipulating device (23w) configured to shift polarization orientation of optical signals passing through one of said arms.

10. The photon states encoder of claim 9 comprising one of the following: separate amplitude and phase modulators (IM1,IM2) in each of the arms ($Arm_s$,$Arm_l$); a single intensity modulator ($Arm_s$,$Arm_l$) in each of the arms ($Arm_s$,$Arm_l$) configured to modulate both amplitude and phase of the optical signals.

11. A quantum communication system comprising transmitter (12) and receiver (11) systems configured to communicate over free space medium (10q) or optical fibers, said transmitter system comprising a quantum transmitter (12p) comprising the photon states encoder (12t) of claim 9 or 10.

12. A method of converting photon state, the method comprising

passing time-bin and phase states encoded photons ($p_0$,$p_\tau$) through an imbalanced interferometer (23r) comprising a non-polarizing beam combiner (24) configured to combine optical pulse signals from short and long arms ($Arm_s$,$Arm_l$) of said imbalanced interferometer (23r) to thereby generate the following three observable optical signal pulses:

(i) a first optical pulse signal ($St_0$) responsive to a first time-bin ($p_0$) of said time-bin and phase states encoded photon reaching said non-polarizing beam combiner (24) from the short arm ($Arm_s$) of said imbalanced interferometer;

(ii) a second optical pulse signal ($St_1$) responsive to an interference pattern between said first time-bin ($p_0$) reaching said non-polarizing beam combiner (24) from the long arm ($Arm_l$) of said imbalanced interferometer (23r) and a second time-bin ($p_\tau$) of said time-bin and phase states encoded photon reaching said non-polarizing beam combiner (24) from said short arm ($Arm_s$) of the imbalanced interferometer; and

(iii) a third optical pulse signal ($St_2$) responsive to said second time-bin ($p_\tau$) of said imbalanced interferometer (23r) from the long arm ($Arm_l$) of said imbalanced interferometer,

and setting orthogonal polarization orientations to light components from said imbalanced interferometer and thereby converting said time-bin and phase states encoded photons ($p_0$,$p_\tau$) into hybrid time-bin and polarization states encoded photons ($St_0$,$St_1$,$St_2$).

13. The method of claim 12 comprising setting one light components from the imbalanced interferometer into a horizontal orientation (24h) and another light component therefrom into a vertical polarization orientation (24v).

14. The method of claim 12 comprising applying a half wavelength phase shift (24w) to one the light components of the imbalanced interferometer.

15. The method of claim 12 wherein the time-bin and phase states encoded photons ($p_0$,$p_\tau$) have a defined linear polarization orientation, and wherein the method comprising applying a half wavelength phase shift (23w) to optical signals passing through one of the arms ($Arm_s$,$Arm_l$) of the imbalanced interferometer, or wherein the time-bin and phase states encoded photons ($p_0$,$p_\tau$) have a defined diagonal polarization orientation, and wherein the method comprising splitting (23") the time-bin and phase states encoded photons into orthogonally polarized light components into the long and short arms of the imbalanced interferometer and applying a half wavelength phase shift (23w) to optical signals passing through one of the arms ($Arm_s$,$Arm_l$) of the imbalanced interferometer, or wherein the time-bin and phase states encoded photons ($p_0$,$p_\tau$) have a defined linear polarization orientation, and wherein the method comprising applying a half wavelength phase shift (23w) to optical signals passing through one of the arms ($Arm_s$,$Arm_l$) of the imbalanced interferometer and combining (24") orthogonally polarized optical signals from the long and short arms ($Arm_s$,$Arm_l$) of the imbalanced interferometer.