CLAIMS:

1. A QKD transmitter system comprising:

a plurality of pulse signal sources, at least one of which configured to generate pulse signals which voltage polarity is opposite to a voltage polarity of pulse signals of at least another one of said plurality of signal pulse sources;

a plurality of signal manipulating units, each configured to controllably adjust at least one of amplitude and delay time of at least some of the pulse signals generated by said plurality of pulse signal sources; and

a plurality of analog combiner units configured to combine the adjusted and non-adjusted pulse signals and generate therefrom a light-modulating signal that is substantially proportional to a summation of the adjusted and non-adjusted pulse signals for modulating quantum communication states in light generated by a light source.

2. The QKD transmitter of claim 1 comprising an output tuneable gain unit configured to controllably adjust the light-modulating signal before modulating the quantum communication states.

3. The QKD transmitter of claim 2 comprising three pulse signal sources, respective three signal manipulating units, and two analog combiner units.

4. The QKD transmitter of claim 3 configured such that the pulse signals generated by the pulse signal source configured to generate the pulse signals with the opposite voltage polarity are not combined with pulse signals from the other pulse signal sources for generation of at least one main quantum state of the quantum communication states.

5. The QKD transmitter of claim 3 or 4 configured either such that:

a first analog combiner (Σ_1) of the two analog combiners is configured to combine pulse signals generated by second and third pulse signal sources (P_1 and P_2) of the three pulse signal sources having the opposite voltage polarities, and a second analog combiner (Σ_0) of said two analog combiners is configured to combine signals produced by said first analog combiner (Σ_1) with pulse signals generated by a first pulse signal source (P_0) of the three pulse signal sources; or

a single analog combiner is configured to combine the first, second and third, pulse signal sources (P_0, P_1 and P_2).

6. The QKD transmitter of claim 5 configured for at least one of the following:

to cause the respective signal manipulating unit of the first pulse signal source (P_0) and the output tuneable gain unit (G_m) to adjust amplitudes of signals thereby received such that

power/intensity *I* of the modulated light responsive to pulse signals generated by the first pulse signal source (P_0) is attenuated by a predefined upper-level intensity setting factor α to about $\alpha \cdot I$, wherein $0.95 \leq \alpha < 1$;

to cause the respective signal manipulating unit of the second pulse signal source (P_1) to adjust amplitudes of signals thereby received such that power/intensity of the modulated light *I* responsive to pulse signals generated by the first pulse signal source (P_0) is attenuated by a predefined mid-intensity level setting factor β to about $\beta \cdot I$, wherein $\beta < \alpha$;

to cause the respective signal manipulating unit of the first pulse signal source (P_0) to adjust amplitude of signals thereby received such that power/intensity of the modulated light *I* responsive to pulse signals generated by said first and second pulse signal sources (P_0 and P_1) is attenuated by an upper-mid-level intensity setting factor γ to an upper-mid-level power/intensity I_β, wherein $\beta < \gamma < \alpha$;

to cause the respective signal manipulating unit of the third pulse signal source (P_2) to adjust amplitude of signals thereby received such that power/intensity of the modulated light *I* responsive to pulse signals generated by the first, second and third, pulse signal sources (P_0, P_1 and P_2) is attenuated to the upper-mid-level power/intensity I_β;

to cause the respective signal manipulating unit of the third pulse signal source (P_2) to adjust amplitude of signals thereby received such that power/intensity of the modulated light *I* responsive to pulse signals generated by the second and third pulse signal sources (P_1 and P_2) is attenuated to about half of the upper-mid-level power/intensity I_β;

to cause the respective signal manipulating unit of the first and/or second pulse signal sources (P_0 and/or P_1) to adjust time delay of signals thereby received such that power/intensity of the modulated light *I* responsive to pulse signals generated by said first and second pulse signal sources is minimized;

to cause the respective signal manipulating unit of the third pulse signal source (P_2) to adjust time delay of signals thereby received such that power/intensity of the modulated light *I* responsive to pulse signals generated by the second and third pulse signal sources is minimized.

7. The QKD transmitter of any one of claims 1 to 3 comprising two pairs of the pulse signal sources, respective four signal manipulating units each coupled to one of said pulse signal sources, and three analog combiner units, wherein the pulse signal sources of each pair of the pulse signal sources are configured to generate pulse signals of opposite voltage polarities,

wherein one pair of the pulse signals sources is configured to generate main quantum states of the quantum communication states, and the other pair of the pulse signals sources is configured to generate decoy states of said quantum communication states.

8. The QKD transmitter of claim 7 having one of the following configurations:

a first analog combiner (Σ_2) of the three analog combiners is configured to combine pulse signals generated by fourth and third pulse signal sources (P_3 and P_2) forming one of the pairs of the pulse signal sources, a second analog combiner (Σ_1) of said three analog combiners is configured to combine signals produced by said first analog combiner (Σ_2) with pulse signals generated by a second pulse signal source (P_1) of the four pulse signal sources, and a third analog combiner (Σ_0) of said three analog combiners is configured to combine signals produced by said second analog combiner (Σ_1) with pulse signals generated by a first pulse signal source (P_0) of the four pulse signal sources, said first and second pulse signal sources (P_0 and P_0) are forming the other pair of pulse signal sources;

a single analog combiner is used to combine the first, second, third and fourth, pulse signal sources (P_0, P_1,P_2 and P_3);

the QKD transmitter is configured to cause the respective signal manipulating unit of the first pulse signal source (P_0) and the output tuneable gain unit (G_m) to adjust amplitudes of signals thereby received such that power/intensity *I* responsive to pulse signals generated by the first pulse signal source (P_0) of the modulated light is attenuated by a predefined upper-level intensity setting factor α to an upper-level power/intensity $I_{pattern1}=\alpha \cdot I$, wherein $0.95 \leq \alpha < 1$;

the QKD transmitter is configured to cause the respective signal manipulating unit of the second pulse signal source (P_1) to adjust amplitudes of signals thereby received such that power/intensity of the modulated light *I* responsive to pulse signals generated by the second pulse signal source (P_1) is attenuated to a mid-intensity level $I_{pattern2}$ of about $\beta \cdot I_{pattern1}$, wherein $\beta < \alpha$ is predefined mid-intensity level setting factor;

the QKD transmitter is configured to cause the respective signal manipulating unit of the second pulse signal source (P_1) to adjust amplitudes of signals thereby received such that power/intensity of the modulated light *I* responsive to pulse signals generated by the first and second pulse signal sources (P_0 and P_1) is attenuated to a fine-tuned-intensity level $I_{pattern3}$ of about $I_{pattern2}$;

the QKD transmitter is configured to cause the respective signal manipulating unit of the third pulse signal source (P_2) to adjust amplitudes of signals thereby received such that power/intensity of the modulated light *I* responsive to pulse signals generated by the third pulse

signal source (P_2) is attenuated to about $\frac{\mu_d}{\mu}\cdot I_{pattern1}$, wherein μ and μ_d are predefined uniform average number of photons for main and decoy quantum states respectively;

the QKD transmitter is configured to cause the respective signal manipulating unit of the fourth pulse signal source (P_3) to adjust amplitudes of signals thereby received such that power/intensity of the modulated light *I* responsive to pulse signals generated by the fourth pulse signal source (P_3) is attenuated to a mid-decoy level $I_{pattern2d}=\beta\cdot I_{pattern1}$, wherein $\beta<\alpha$ is predefined mid-intensity level setting factor;

the QKD transmitter is configured to cause the respective signal manipulating unit of the fourth pulse signal source (P_3) to adjust amplitudes of signals thereby received such that power/intensity of the modulated light *I* responsive to pulse signals generated the third and fourth pulse signal source (P_2 and P_3) is attenuated to the mid-decoy level $I_{pattern2d}$;

the QKD transmitter is configured to cause the respective signal manipulating unit of the first and/or second pulse signal sources (P_0 and/or P_1) to adjust time delay of signals thereby received such that power/intensity of the modulated light *I* responsive to pulse signals generated by said first and second pulse signal sources is minimized;

the QKD transmitter is configured to cause the respective signal manipulating unit of the third pulse signal sources (P_2) to adjust time delay of signals thereby received such that power/intensity of the modulated light *I* responsive to pulse signals generated by the second and third pulse signal sources (P_1 and P_2) is minimized;

the QKD transmitter is configured to cause the respective signal manipulating unit of the fourth pulse signal sources (P_3) to adjust time delay of signals thereby received such that power/intensity of the modulated light *I* responsive to pulse signals generated by the third and fourth pulse signal sources (P_2 and P_3) is minimized.

9. The QKD transmitter of any one of the preceding claims wherein the quantum communication states comprise four main quantum states, four decoy states, and one vacuum state.

10. The QKD transmitter of any one of claims 3 to 6 wherein the quantum communication states comprise four main quantum states, any number of decoy states, and one vacuum state.

11. The QKD transmitter of any one of the preceding claims comprising a power meter configured to measure optical output power/intensity of the modulated light signals and generate measurement data/signals indicative thereof, and a control unit configured and operable to adjust at least one of the plurality of signal manipulating units and/or the output tuneable gain unit based on said measurement data/signals.

12. The system of any one of the preceding claims configured to receive feedback data/signals indicative of interference visibility obtained in response to transmitted optical signals, and wherein the control unit is configured adjust at least one of a frequency of a clock unit thereof and pulse time difference of the pulse signals based on said feedback data/signals.

13. A QKD transmitter's calibration method comprising: generating a plurality of pulse signals, voltage polarity of at least one of said plurality of pulse signals is opposite to a voltage polarity of at least another one of said plurality of pulse signals; combining said plurality of pulse signals and generating therefrom a light-modulating signal; modulating light signal by said light-modulating signal; measuring said modulated light signals and generating measurement data indicative thereof; and adjusting at least one of amplitude and delay time of at least some of said plurality of pulse signals to obtain a desired quantum communication state.

14. The method of claim 13 comprising one or more of the following: combining first, second and third, pulse signals to generate the light-modulating signal, wherein said second pulse signal (P_1) having the opposite voltage polarity;

generating at least one main quantum state by the pulse signal source configured to generate the pulse signals with the opposite voltage polarity without combining it with the other pulse signals;

adjusting amplitudes of the first pulse signal and of the light-modulating signal such that power/intensity *I* of the modulated light signals responsive to said first pulse signal is attenuated by a predefined upper-level intensity setting factor α to about $\alpha \cdot I$, wherein $0.95 \leq \alpha < 1$;

adjusting amplitude of the second pulse signal (P_1) such that power/intensity of the modulated light signals *I* responsive to the first pulse signal (P_0) is attenuated by a predefined mid-intensity level setting factor β to about $\beta \cdot I$, wherein $\beta < \alpha$;

adjusting the first pulse signal (P_0) such that power/intensity of the modulated light signals *I* responsive to the first and second pulse signals (P_0 and P_1) is attenuated by an upper-mid-level intensity setting factor γ to an upper-mid-level power/intensity I_β, wherein $\beta < \gamma < \alpha$;

adjusting amplitude of the third pulse signal (P_2) such that power/intensity of the modulated light signals *I* responsive to the first, second and third, pulse signals (P_0, P_1 and P_2) is attenuated to the upper-mid-level power/intensity I_β;

adjusting amplitudes of the third pulse signal (P_2) such that power/intensity of the modulated light signals *I* responsive to the second and third pulse signals (P_1 and P_2) is attenuated to about half of the upper-mid-level power/intensity I_β;

adjusting time delay of the first and/or second pulse signals (P_0 and/or P_1) such that power/intensity of the modulated light signals *I* responsive to said first and second pulse signals is minimized;

adjusting time delay of the third pulse signal source (P_2) such that power/intensity of the modulated light signals *I* responsive to the second and third pulse signals is minimized.

15. The method of claim 13 comprising generating the light modulating signal by combining two pairs of the pulse signals, wherein each of said pairs pulse signals are of opposite voltage polarities, and wherein the method comprising one or more of the following:

generating main quantum states from one pair of the pulse signals, and generating decoy states from the other pair pulse signals;

adjusting amplitudes of the first pulse signal (P_0) and of the light-modulating of signals such that power/intensity of the modulated light signals *I* responsive to the first pulse signal (P_0) is attenuated by a predefined upper-level intensity setting factor α to an upper-level power/intensity $I_{pattern1}=\alpha \cdot I$, wherein $0.95 \leq \alpha < 1$;

adjusting amplitude of the second pulse signal (P_1) such that power/intensity of the modulated light signal *I* responsive to the second pulse signal (P_1) is attenuated to a mid-intensity level $I_{pattern2}$ of about $\beta \cdot I_{pattern1}$, wherein $\beta<\alpha$ is predefined mid-intensity level setting factor;

adjusting amplitude of the second pulse signal (P_1) such that power/intensity of the modulated light signals *I* responsive to the first and second pulse signal (P_0 and P_1) is attenuated to a fine-tuned-intensity level $I_{pattern3}$ of about $I_{pattern2}$;

adjusting amplitude of the third pulse signal (P_2) such that power/intensity of the modulated light signals *I* responsive to the third pulse signal (P_2) is attenuated to about $\frac{\mu_d}{\mu} \cdot I_{pattern1}$, wherein μ and μ_d are predefined uniform average number of photons for main and decoy quantum states respectively;

adjusting amplitude of the fourth pulse signal (P_3) such that power/intensity of the modulated light signals *I* responsive to the fourth pulse signal (P_3) is attenuated to a mid-decoy level $I_{pattern2d}=\beta \cdot I_{pattern1}$, wherein $\beta<\alpha$ is predefined mid-intensity level setting factor;

adjusting amplitude of the fourth pulse signal (P_3) such that power/intensity of the modulated light signal *I* responsive to the third and fourth pulse signal (P_2 and P_3) is attenuated to the mid-decoy level $I_{pattern2d}$;

adjusting a time delay of the first and/or second pulse signal (P_0 and/or P_1) such that power/intensity of the modulated light signals *I* responsive to said first and second pulse signal is minimized;

adjusting time delay of the third pulse signal (P_2) such that power/intensity of the modulated light signals *I* responsive to the second and third pulse signal (P_1 and P_2) is minimized;

adjusting a time delay of the fourth pulse signal (P_3) such that power/intensity of the modulated light signals *I* responsive to the third and fourth pulse signal (P_2 and P_3) is minimized;

receiving feedback data/signals indicative of interference obtained in response to transmitted optical signals, and adjusting at least one of a frequency of a clock unit of the transmitter and pulse time difference of the pulse signals based on said feedback data/signals.