Claims:

1. A method, executed by one or more hardware processors, for executing a one-time program comprising at least one instruction operating on at least one input value (a, b) and returning at least one output value (O), for each instruction of the one-time program comprising the following steps:

providing by a program sending device at least one elementary quantum system in a pre-defined state;

encoding by the program sending device at least one instruction of a classical program onto the pre-defined state of the at least one elementary quantum system according to a pre-defined program-encoding scheme;

transmitting, by the one or more hardware processors, a resulting state of the at least one elementary quantum system via a computer network from the program sending device to a program receiving device, wherein the program receiving device is separate from the program sending device for execution;

receiving by the program receiving device, via the computer network the at least one elementary quantum system, wherein the resulting state of the at least one elementary quantum system represents the at least one instruction according to the pre-defined program-encoding scheme;

encoding by the program receiving device the at least one input value (a, b) onto a quantum gate according to a pre-defined input-encoding scheme;

applying the quantum gate to the at least one elementary quantum system;

making a measurement of the resulting state of the at least one elementary quantum system after the quantum gate; and

determining the at least one output value (O) from a result of the measurement,

wherein the at least one instruction is represented by a predetermined polarization state ($\Phi_i^A\rangle, \Phi_j^B\rangle$) of at least one single photon (A, B), the quantum gate operating on the predetermined polarization state ($\Phi_i^A\rangle, \Phi_j^B\rangle$), the measurement comprising detection of direction of the predetermined polarization state of the at least one single photon (A, B), the at least one

output value (O) being determined based on the detected direction.

2. The method according to claim 1, wherein the one-time program comprises at least two instructions, wherein the method further comprises executing the one-time program sequentially.

3. The method according to claim 2, wherein the method further comprises encoding the at least one input value (a, b) of a second instruction onto the quantum gate after determining the at least one output value (O) of a first instruction.

4. The method according to claim 3, wherein the at least one input value (a, b) of a second instruction depends on the at least one output value (O) of the first instruction.

5. The method according to claim 4, wherein the at least one elementary quantum system is at least one ensemble of weakly coherent photons or the at least one single photon (A, B).

6. The method according to claim 1, wherein the quantum gate is implemented by at least one phase retarder, wherein the input-encoding scheme determines the setting of the phase retarder(s) corresponding to the at least one input value (a, b).

7. The method according to claim 6, wherein each instruction is represented by at least two elementary quantum systems.

8. The method according to claim 7, wherein the at least one output value (O) is determined from the result of the measurement of the resulting states of the at least two elementary quantum systems using at least one logical exclusive-or gate or at least one logical exclusive-not-or gate, together with one or more of the at least one input value (a, b).

9. The method according to claim 8, wherein the quantum gates are chosen from a set of quantum gates defined such that for each possible pair of quantum gates picked from the set the two quantum gates of the pair are non-commuting.

10. The method according to claim 9, wherein the quantum gate is formed by a half-wave plate and a quarter-wave plate.

11. The method according to claim 1, wherein determining the at least one output value (O) from a result of the measurement~~,~~ comprises modifying the result depending on a clearance value received over a classical channel after confirming the safe reception of the at least one elementary quantum system.

12. The method according to claim 1, wherein the at least one instruction is encoded onto two or more elementary quantum systems, wherein during encoding each elementary quantum system is manipulated separately and contributes only a specific partial representation of the at least one instruction.

13. The method according to claim 12 for preparing the one-time program based on the classical program comprising at least two instructions, wherein following a sequence of the at least two instructions in the classical program and encoding each instruction sequentially.

14. The method according to claim 13, wherein, after transmission of a first elementary quantum system, preparing the encoding of a second elementary quantum system.

15. The method according to claim 14 wherein the at least one elementary quantum system is at least one ensemble of weakly coherent photons or at least one single photon (A, B), and wherein

the at least one ensemble of weakly coherent photons or the at least one single photon (A, B) is provided having a predetermined polarization state, and

the at least one instruction of the classical program is encoded on the predetermined polarization state of the at least one ensemble of weakly coherent photons or the at least one single photon (A, B).

16. The method according to claim 15, wherein a clearance value is randomly generated, the encoding of the at least one

instruction of the conventional program onto the state of the at least one elementary quantum system being modified according to the clearance value, the clearance value being transmitted only after safe reception of the at least one elementary quantum system for execution has been confirmed.

17. A system, executed by one or more hardware processors, for executing a one-time program comprising at least one instruction operating on at least one input value (a, b) and returning at least one output value (O), comprising:

a sender device, comprising:

a photon source configured to emit at least one single photon having a predetermined polarized state; and

a preparation unit comprising at least one configurable phase retarder for preparing the predetermined polarization state of the at least one photon emitted by the photon source; and

a program encoding unit,

wherein the photon source and the preparation unit are connected to the program encoding unit, which is configured to control the at least one phase retarder of the preparation unit depending on at least one instruction of a provided classical program using a predefined program-encoding scheme; and

a receiver device for receiving the at least one photon representing the at least one instruction of a provided classical program according to a pre-defined program-encoding scheme;

an input encoder for encoding the at least one input value (a, b) onto a quantum gate according to a pre-defined input-encoding scheme;

a quantum device connected to the input encoder and configured to apply the quantum gate to the at least one photon;

a measurement unit making a measurement of a resulting state of the at least one photon exiting the quantum device; and

a hardware post-processor connected to the measurement unit and configured to determine the at least one output value (O) from a result of the measurement,

wherein the at least one instruction is represented by the predetermined polarization state ($\Phi_i^A\rangle, \Phi_j^B\rangle$) of the at least one single photon (A, B), the quantum gate operating on the predetermined polarization state ($\Phi_i^A\rangle, \Phi_j^B\rangle$), the measurement comprising detection of direction of the predetermined polarization state of the at least one single photon (A, B), the at least one output value (O) being determined based on the detected direction.

18. The system according to claim 17, wherein the measurement unit or the post-processor is connected to the input encoder over an internal trigger channel and configured to notify the input encoder of the reception of the at least one elementary quantum system or the at least one instruction.

19. The system according to claim 17, wherein the quantum device comprises at least one configurable phase retarder connected to the input encoder, such that setting of the phase retarder is controlled depending on the at least one input value (a, b), the measurement unit comprising at least one detector capable of detecting a single photon.

20. The system according to claim 17, wherein the program-encoding unit is configured to receive a notification of the emission of the single photon by the photon source and to proceed to a next instruction of the provided program upon reception of the notification.