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**Characterization and measurement of the performance of
single-photon sources**

单光子源性能表征及测量方法

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Foreword

This document is in accordance with the provisions of GB/T 1.1-2020 "Guidelines for standardization work Part

1. Structure and drafting rules for standardization documents" Drafting. Please note that some of the contents of this document may involve patents. The issuing organization of this document does not assume the responsibility for identifying patents. This document was proposed and coordinated by the National Technical Committee on Quantum Computing and Measurement Standardization (SAC/TC578). This document was drafted by: China Institute of Metrology, University of Science and Technology of China, KUST Guodun Quantum Technology Co., Ltd., East China University of Science and Technology Normal University, Shanxi University, China Electronics Information Industry Group Co., Ltd.,

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1 Scope

China's national standard for characterising and measuring the performance of single-photon sources. A single-photon source emits exactly one photon at a time, and it is the fundamental component of quantum key distribution and photonic quantum computing. The property that defines it is the one hardest to measure: how confident one can be that a pulse contained one photon and not two. That matters absolutely in quantum cryptography, because a pulse containing two photons allows an eavesdropper to take one and leave the other, defeating the security proof entirely. It is quantified by the second-order correlation function measured in a Hanbury Brown and Twiss interferometer, where a value of zero would mean a perfect source. Alongside it the standard has to address the other performance measures - the emission rate, the collection efficiency, and the indistinguishability of successive photons, which is what interference-based schemes depend on.

This document describes the parameters and measurement methods that characterize the performance of single photon sources. This document applies to the performance evaluation and testing of single photon sources.

2 Normative references

The contents of the following documents constitute the essential clauses of this document through normative references in this document. For referenced documents without a date, only the version corresponding to that date applies to this document; for referenced documents without a date, the latest version (including all amendments) applies to This document.

GB/T 3102.6-1993 Quantities and units of light and related electromagnetic radiation

JJF1032-2005 Optical radiation measurement terms and definitions

3 Terms and definitions

The terms and definitions defined in GB/T 3102.6-1993 and JJF1032-2005 and the

following apply to this document.

3.1 Single-photon source A light source that emits a non-zero number of photons equal to 1 with a probability of 100% during the effective period of measurement or application.

Note. An ideal single-photon source is a light source that emits a photon with a probability of 100% equal to 1 during the effective period of measurement or application.

3.2 Photon flux The number of photons emitted, transmitted, or received per unit time interval.

Note. The unit is per second (s⁻¹).

3.3 The relative concentration of the photon flux (3.2) at different frequencies (or vacuum wavelengths).

3.4 The relative density of the photon flux (3.2) in space.

3.5 The relative density of the photon flux (3.2) in the time domain.

3.6 Photon emission rate photonemissionrate The number of photons emitted by a light source per unit time interval.