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报告

红外单光子频率上转换探测

Single-photon Frequency Up-conversion Detection in the Infrared

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讲者介绍 Biography

武愕，女，1979 年生，华东师范大学与法国加香高师联合培养于 2007 年获博士学位，并同年晋升为华东师大副教授，2013 年，晋升为研究员。2011 年 5 月-2016 年 8 月，任华东师范大学精密光谱科学与技术国家重点实验室副主任。2016 年 8 月起，任华东师范大学物理与材料科学学院副院长。入选国家自然科学基金优秀青年、上海市科技启明星、上海市曙光学者等人才项目。武愕在单光子产生、单光子频率操控及应用等方面取得了多项研究成果，至今发表 SCI 论文 100 余篇，他引共 1000 次，H-index 为 24，曾获饶毓泰基础光学奖优秀奖、上海市研究生优秀成果奖(博士学位论文)、上海市技术发明奖二等奖(第四完成人)等，被国家自然科学基金委中德科学中心遴选作为优秀青年学者代表赴德国林岛参加与诺贝尔奖得主交流大会。

报告摘要 Abstract

Single-photon detection has been well developed and extensively used for various interesting applications in astronomy, imaging, metrology, ultrasensitive spectroscopy, and quantum key distribution (QKD). As a new single-photon detection technique for the infrared, single-photon frequency upconversion detection has attracted a lot of research interest, which uses Si-APDs to counting the visible sum-frequency replicas of the infrared single photons, avoiding the drawbacks of the InGaAs-InP avalanched photodiodes (APDs). According to the theory of quantum frequency conversion, the unity single-photon upconversion could be realized by means of sum-frequency generation (SFG) under a strong pump in a quadratic nonlinear medium with a large effective nonlinear coefficient. Periodically poled lithium niobate (PPLN) devices are typically used to attain quasi-phase-matched (QPM) nonlinear interaction with a large effective nonlinear coefficient. As for the strong pump field for the nonlinear interaction, researchers have developed the external cavity or intracavity enhancement methods to enhance the circulating pump power in PPLN. Pulsed excitation is another solution since the pulse energy is concentrated with a very narrow time window to produce an intensive peak power.

Here, we report on the synchronized single-photon frequency upconversion detection with a pulsed pump source. The infrared single photons at 1.56 □m were from an attenuated Er-doped mode-locked fiber laser (master laser) which was synchronized to an Yb-doped mode-locked fiber laser (slave laser) by the cross phase modulation induced nonlinear polarization rotation effect in the fiber cavity. One part of the master laser output after amplification was used as a trigger to start up the mode-locking of the slave laser, and the other part was used as the single photon source. Each single photon from the master laser was synchronized to one pump pulse from the slave laser. Such a stable single-photon upconversion system has shown a high conversion efficiency and a low background noise. With this system, few photon imaging and photon-number resolving detection were achieved. Moreover, a quantum interface for the infrared photons carrying orbital angular momentum was realized.