Single-Photon Source by Means of Four-Wave Mixing Inside a Dispersion-Shifted Optical Fiber

Paulo Antunes[1,3], P. S. André[1,3], Armando Nolasco Pinto[2,3]
[1] *Department of Physics, University of Aveiro, 3810-193 Aveiro, Portugal*
[2] *Dept. of Electronics, Telecommunications and Informatics, University of Aveiro, 3810-193 Aveiro, Portugal*
[3] *Institute of Telecommunications, 3810-193 Aveiro, Portugal*
pantunes@av.it.pt

Abstract: We show how an inexpensive and versatile single photon source can be built using four-wave mixing inside a dispersion-shifted optical fiber. The average number of generated photons per pulse agrees well with theoretical predictions.

OCIS codes: (060.4370) Nonlinear optics, fibers; (190.4380) Nonlinear optics, four-wave mixing.

1. Introduction

The purpose of this work was to develop a single photon source which allows us to produce an average number of photons per pulse lower than one. The method used in this work provides an inexpensive and easy to implement alternative to the traditional methods of attenuated laser beams and it has the advantage of generate correlated photons at optical communication wavelengths, making them readily compatible with standard optical fiber technologies [1]. We use two optical signals, with constant average optical power, at wavelengths λ_1 and λ_2. λ_2 was kept constant at 1550.7 nm and we increased de offset between pump signals decreasing λ_1, see figure 1-(a). The conversion efficiency of the four-wave-mixing process is strongly dependent of the offset between pump signals, controlling the wavelength offset we can control the number of photons generated at wavelength $\lambda_{FWM} = 2\lambda_2 - \lambda_1$. The signal at the wavelength λ_1 was externally modulated in order to produce pulses with a temporal full-width half maximum of 1.6ns, with a repetition rate of 607kHz, the signal at λ_2 was kept in continuous mode. The photon generation occurs inside a dispersion-shifted optical fiber with length of 8.8km and zero dispersion wavelength at 1547nm. From the output of the dispersion-shifted fiber, where we measured the average optical power generated at λ_{FWM}, to the entrance of the single photon detector module, where the average number of photons were measured, we induce an attenuation factor of 22.48dB.

2. Results

The first graph, fig. 1-(a), shows the comparison between experimental and theoretical results in terms of optical power. The second graph, fig. 1-(b), shows a comparison between measured average number of photons per pulse and theoretical predictions.

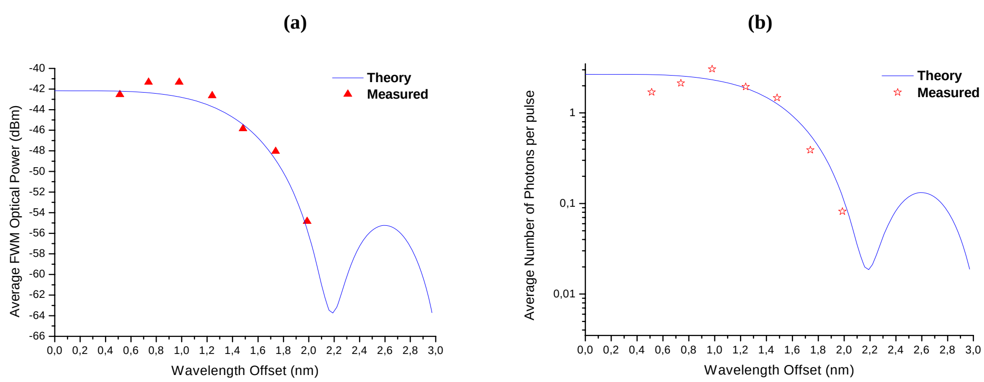

Figure 1. (a) Optical power for the generated FWM signal, experimental data and theoretical results. (b) Average number of photons generated per pulse, experimental data and theoretical results.

3. References

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