Development of integrated quantum key distribution system

Min-Soo Lee, Min Ki Woo, Byung Kwon Park, Il Young Kim,
Osung Kwon, Yong-Su Kim, Sang-Wook Han, and Sung Moon*

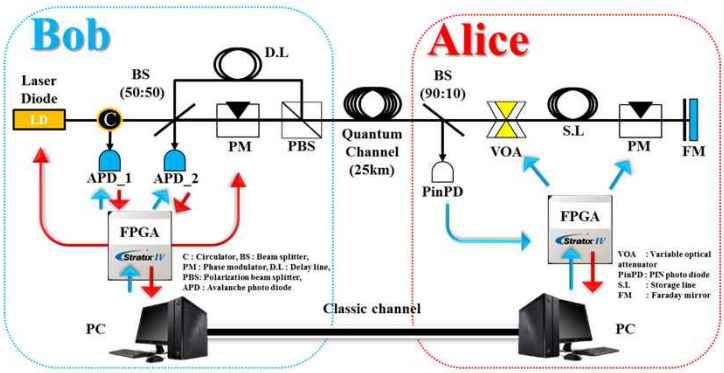
Center for Nano & Quantum Information, Korea Institute of Science and Technology, Republic of Korea

s.moon@kist.re.kr

Introduction

Block diagram of QKD system

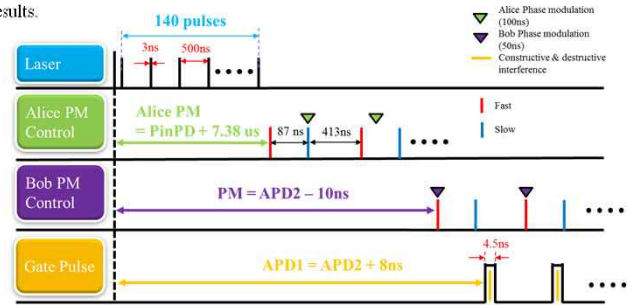
- ✓ Plug & Play quantum cryptography system
- ✓ Phase encoding BB84 protocol



Quantum key distribution system

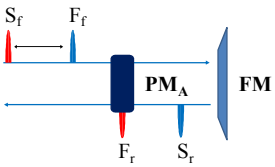
Timing control of QKD system

- ✓ Alice and Bob randomly modulate phase of laser pulse through PM controller.
- ✓ FPGA at Alice and Bob save modulated phase values and single photon detection results.



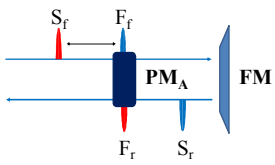
Phase modulator operation

✓ 1 time phase modulation method

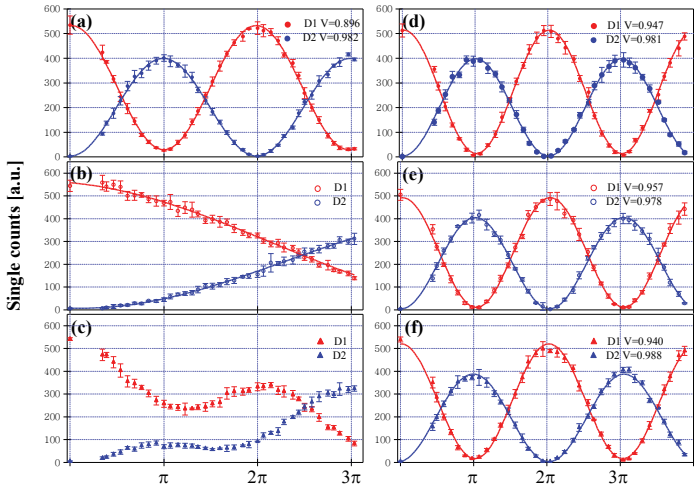


S_f = Slow pulse forward FM
S_r = Slow pulse after reflect from FM

✓ 2 times phase modulation method



F_f = Fast pulse forward FM
F_r = Fast pulse after reflect from FM

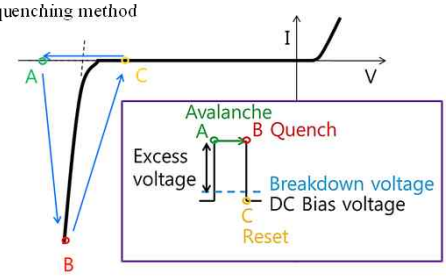


(a) 1 time vertical polarization pulse
(b) 1 time horizontal polarization pulse
(c) 1 time 45 degree polarization pulse
(d) 2 times vertical polarization pulse
(e) 2 times horizontal polarization pulse
(f) 2 times 45 degree polarization pulse

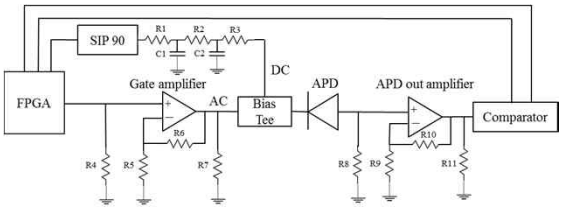
Single photon detection system

Geiger mode APD

- ✓ InGaAs/InP APD (Avalanche Photo Diode) : Geiger mode operation
- ✓ Gated quenching method

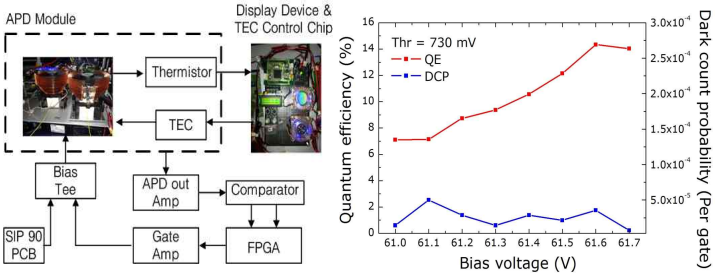


Single photon detection scheme based on APD



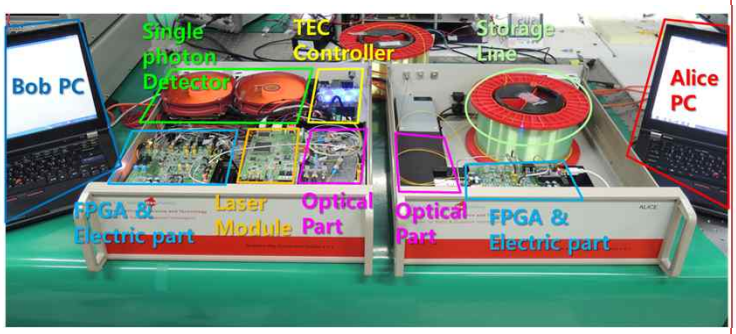
Implementation & measurement results

- ✓ Continuous APD temperature control & display
- ✓ QE : 15 %, dark count probability : 5×10^{-5} per gate (5ns)



Quantum key distribution system development

- **Laboratory developed QKD system over 25 km**
- **Sifted key rate : 1kbps**
- **QBER : < 5 %, 3 % on average**



Future works

- **Improvement of key rate & distance**
- **Development of post processing algorithm**
- **Implementation with decoy method**

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