Quasi-gated source for superconducting nanowire single-photon detector

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Superconducting nanowire single-photon detectors (SNSPDs) are attractive because of their wide response band, low noise and high reception rate in practical applications.However, the superconducting nanowire may latch in a permanent resistive state because of the backscattering problem, which may prevent it from detecting targeted photons. This study developed a quasi-gated source for SNSPD. The programmed source switches the SNSPD off at low lever, and switches it on at high lever. Such an on-off switching process enable the SNSPD to recover automatically from latching through compulsory initialization in each period, therefore resolving the problem caused by strong backscatterings in laser ranging systems.

I.Backscattering problem

The backscattering problem may prevent SNSPD from detecting targeted objects, such as fighters , satellites and so on.

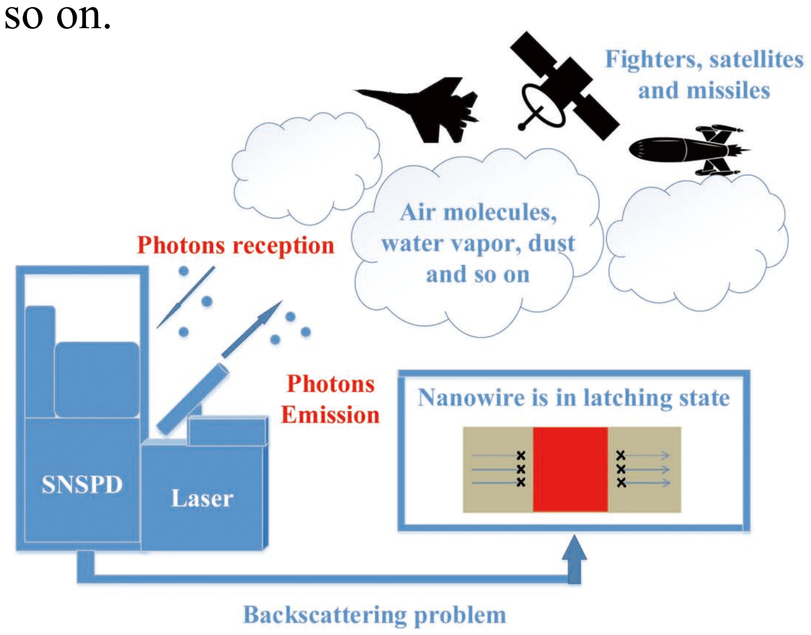

Fig.1. the principle of backscattering problem.

II. Design of system

The quasi-gated sourse system diagram is shown as follow.

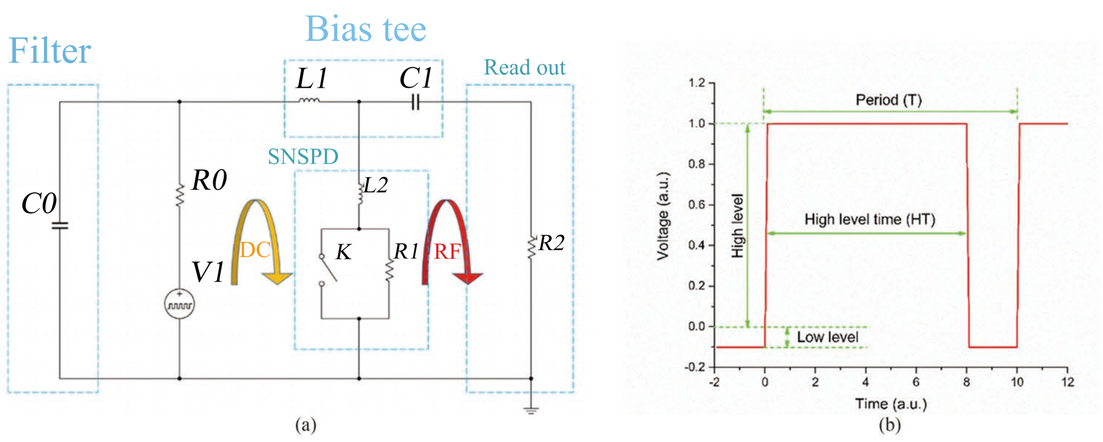

Fig.2. the equipment circuit (a) and the schematics of quasi-gated bias signal (b).

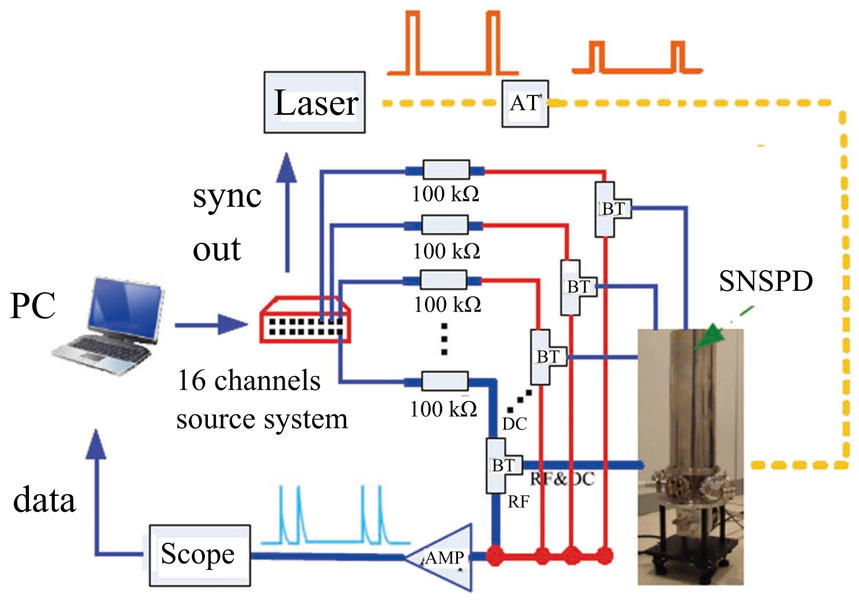

Fig.3. the system schematics of 16 channels' setting.

III. Testing and analysis of results

Rise time and bias current of the source system.

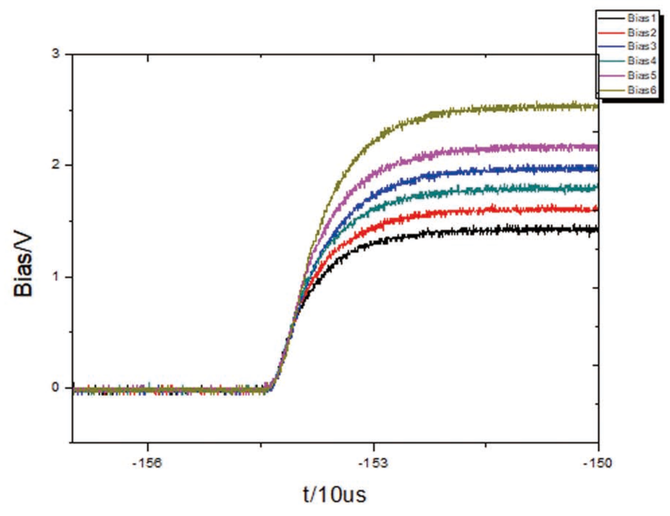

Fig.4. rise time of the gated voltage.

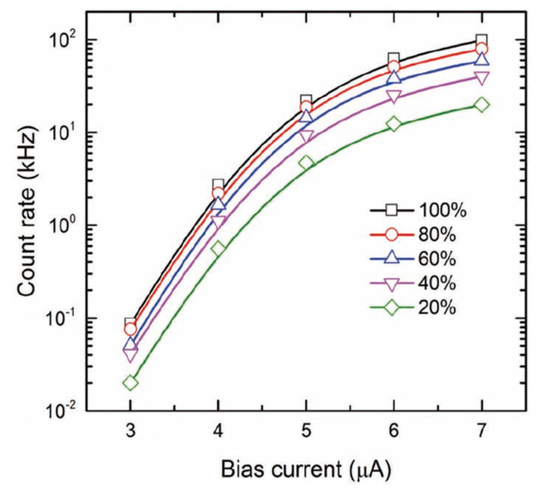

Fig.5. count rate of different duty cycle.

Results show that the photon response signal is displayed normally when the gated voltage is high while the photon response signal is effectively suppressed when the gated voltage is low.

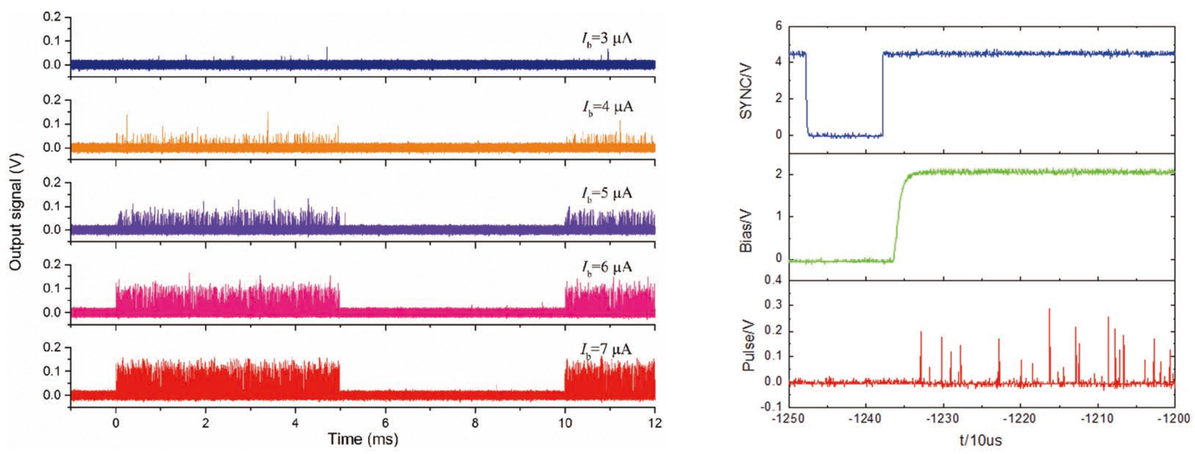

Fig.6. output signals of SNSPD with fixed low lever and different high levers, 0.3,0.4,0.5,0.6 and 0.7 V, corresponding to bias currents of 3,4,5,6 and 7 μA.

IV. Conclusions

Experiments shows that the 16 channels of the quasi-gated source system can output 0 V~3 V bias voltage independently and the duty cycle can be adjusted so that the backscattering photons within 1.5 km~75 km can be effectively shielded.

In the near future, SNSPDs will have a far-reaching impact on quantum radars and lidar area once the free detection function in atmospheric envirommment is achieved.

References

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