The suggestion of preliminary experiment (single photon detection)

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1 The motivation of conducting this experiment

Our goal in this P1 activity is the examination of quantum mechanics. In our experiment, we are going to emit the laser ray onto a *nonlinear crystal* (such as BBO) in order to emit two photon in the opposite direction. However, unfortunately, the power of Ar^+ laser in Yabusaki lab. is not so strong, and thus the counting rate of photon will be only 20 (count/sec) or so. This is a very slight amount , and it is said that we require the equivalent technique to that of *single photon detection.*

Therefore, the purpose of this preliminary experiment is the *exercize of detection photons*, which will enable us to realize the problem of detecting photon in our main experiment.

2 The setup of the eperiment

Basically , I am going to have the same procedure as '*The Interference of Single Photon* ('97 SUMMER STUDENT). There are 2 light source available.

2.1 The use of LED (light emitting diode)

A light emitting diode is useful for obtaining a very weak light. In this case, the setup of the experiment is as follows. Since the light of LED has no cohelence unlike the laser beam , we put a slit and pinhole so that we can obtain the light only in the straightforward direction.

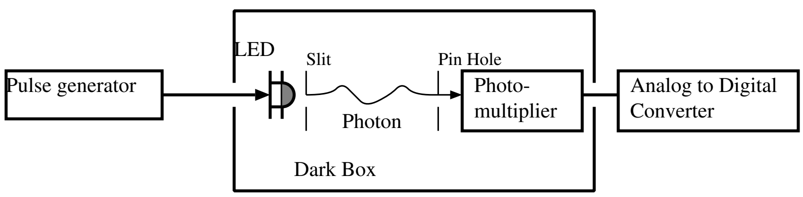

Figure 1: The experimental setup used in '97 Summer Student

In our main experiment, the wavelength of the pump light is 355 nm, so that the wavelength of the down-converted light is 710 nm. In order to be accused to the similar situation to the main experiment, we would like to use the *LED whose emitted light has 710nm of the wvelength.* A photomultiplier whose cathode is S-20 will realize the utmost quantum efficiency[1]

In this case, the signal will flow as is shown in the figure below. In order to obtain the *pulse emission* of LED, we associate the Pulse Genelator to the LED. And we open the GATE by means of the SYNCHRO OUT of the Pulse Generator , so that we can count the signal only when the LED is emitted.

2.2 The use of laser

It is impossible to weaken the strength of the laser beam by adjusting the voltage. But we can get a weak laser beam by *putting two polarizers* with the difference of the polarizing angle *90 degree* , where the strength of the laser beam reduces to only one-photon level. In order to get the pulse beam using a laser, we are require

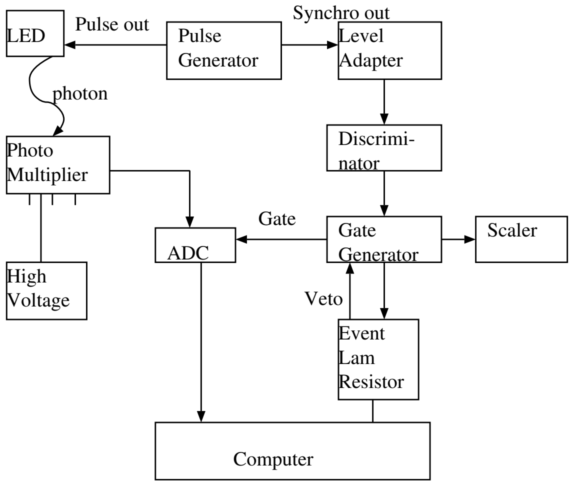

Figure 2: The flow of the signal

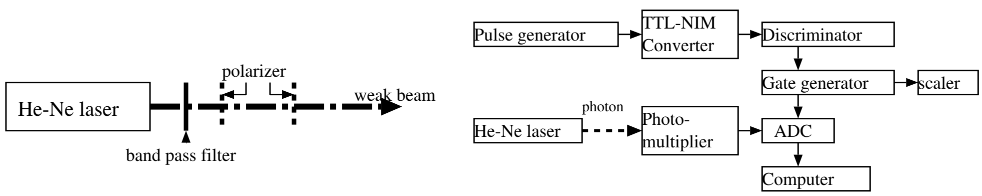

Figure 3: The setup for obtaining an extremely weak laser beam.

to design the gate in the following way. In this setup, the biggest difference from the case of LED is *that the opening of the gate is independent of the laser beam !*. Thus, we can count the photon only when the gate is open, so that we can realize the similar situation to that of LED.

Here also, *a laser of the wavelength 710nm* is desirable, considering the situation of the main experiment.

3 Apology

I am afraid you will frown at English writings. I am very sorry for making this handout in English, because on 12/13 the server of BIRD is completely destroyed. It is said that the disease of the computer system is so serious that it is extremely difficult to remedy it.

[1] Leo's textbook , p171 Table 8.1.