준열광원을 이용한 고스트 이미징

Ghost imaging with pseudo-thermal light

조영욱*, 김윤호
포항공과대학교 물리학과
*e-mail: soullio@postech.ac.kr

After the correlated two-photon imaging, so-called 'ghost imaging', with entangled photons from spontaneous parametric down conversion is observed[1], many experimental and theoretical studies of ghost imaging with classical light sources have been done in recent years[2,3]. In this study, we report an experimental study of ghost imaging with pseudo-thermal light at high intensity regime.

A schematic of the experimental setup is shown in Fig. 1. The chaotic pseudo-thermal light source consists of a diode laser and a rotating ground glass. The incident pseudo-thermal beam splits into two optical paths. In the path A, the transverse plane is scanned by a point detector, which is made up of a detector and 62.5 μm core mutimode optical fiber so that the pixel size is defined by 62.5 μm. In the path B, a double slit (1 mm separation, 0.2 mm width) is placed at a distance of 100 mm from the source and a bucket detector including a short focal length lens (25 mm) is placed after the object. The photo-current signal of each detector is digitized and saved to the computer.

It is well known that the cross correlation of the intensity fluctuation of two beams provides a

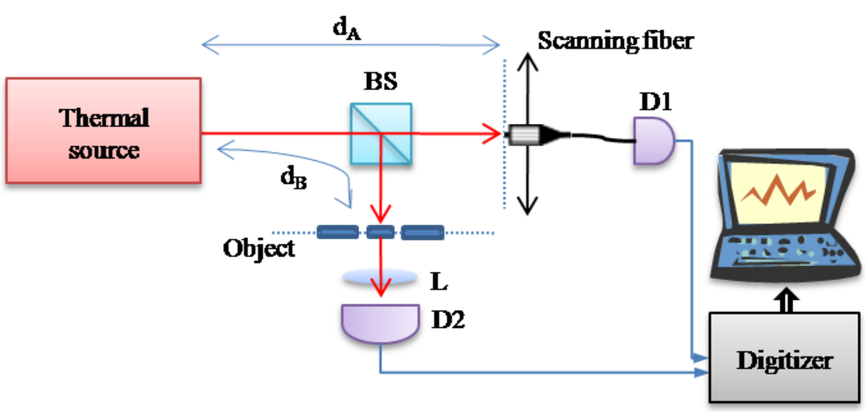

Fig. 1. Experimental Setup.

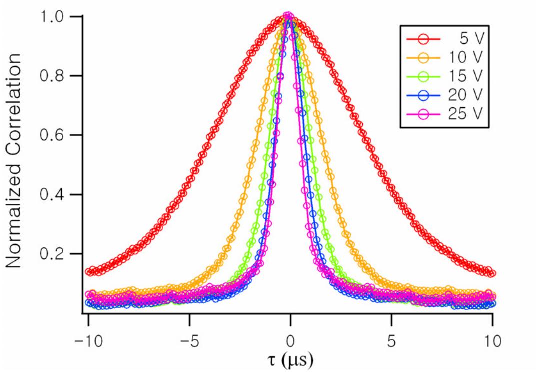

Fig.2. Normalized temporal correlation of the intensity fluctuation vs. time difference. The inset indicates the applied voltage to the rotating motor.

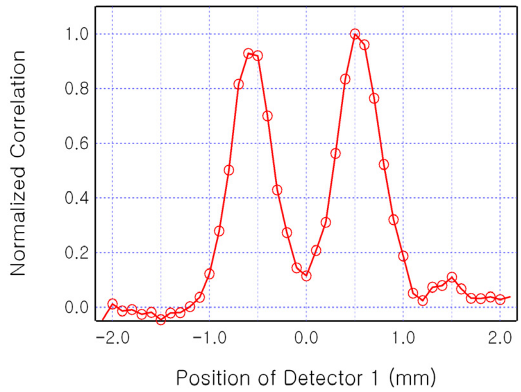

Fig.3. Ghost image : Normalized correlation of the intensity fluctuation at τ=0 vs. transverse position of scanning fiber.

measurement of the degree of second-order correlation for the input beam : $\langle \Delta I_1(t_1)\Delta I_2(t_2)\rangle = G^{(2)}(\tau = t_1 - t_2) - \overline{I_1}\,\overline{I_2}$. For that purpose, the DC components of the digitized photo-current signals are eliminated and the cross correlation function of the two AC components of the photo-current signals is obtained. Fig. 2 shows the normalized cross correlation of intensity fluctuation as a function of time. With this setup, we can measure both temporal and spatial correlation. By changing the rotation speed of the ground glass, the coherence time of our thermal-like source is easily engineered.

When $d_A = d_B$, the ghost image is obtained as shown in Fig. 3. The point to point spatial correlation is confirmed with an equal size image. Since any classical spatial correlation is washed out by the bucket detector, the ghost imaging with correlation measurement of intensity fluctuation can be understood as a two-photon correlation effect.[3]

In summary, we will present the experimental observation of ghost imaging with a classical light source at high intensity regime.

Reference

1. T.B. Pittman *et al.*, Phys. Rev. A. **52**, R3429 (1995)
2. A. Valencia *et al.*, Phys. Rev. Lett. **94**, 063601 (2005)
3. G. Scarcelli *et al.* Phys. Rev. Lett. **96**, 063602 (2006)