The First Ghost Image Using Sun as a Light Source
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Ghost imaging was first demonstrated experimentally by Pittman et al. [1] in 1995 using entangled photon pairs as the light source. Later, using a chaotic radiation or pseudo-thermal light source, a 50% contrast ghost image of the object was observed in terms of coincidences between the CCD and a bucket detector that receives the scattered and reflected photons from the object [2]. In 2004, Gatti et al. demonstrated speckle-to-speckle classical correlation between two distant planes to image the speckles of the source onto both the object and ghost-image planes [3]. In 2005, Zhang et al. demonstrated an experiment of two-photon correlated imaging with true thermal light from a hollow cathode lamp [4]. In this paper, we wish to report first experimental demonstration on two-photon ghost imaging using the Sun as a light source for field imaging applications.

The setup of this experiment is inside the light-tight small black box shown in Fig. 1(a) and Fig. 1(b) shows the measured temporal correlation between two spatially separated detectors $D_1$ and $D_2$. The width of this measured correlation agrees with our expected results very well. Right now we are working on spatial correlation and very soon we will be able to observe the ghost image of an object mask with sunlight as a source.

This result can be interpreted as a nonlocal point-to-point image-forming correlation which is the result of interference between two-photon amplitudes, corresponding to different yet indistinguishable alternative ways of triggering a joint photodetection event. As a result of two-photon interference, ghost imaging has two peculiar features: (1) it is nonlocal and (2) its spatial resolution which is better from that of classical imaging. Consequently, ghost imaging using the sun as a light source could achieve spatial resolution equivalent to that of a classical imaging system taking pictures at a distance of 10 km with a 92 m-diameter lens.

In conclusion, this experimental demonstration of sunlight-based ghost imaging raises a fundamentally important question about whether the nonlocal ghost-imaging effect of classical thermal light is caused by quantum-mechanical two-photon interference.

References