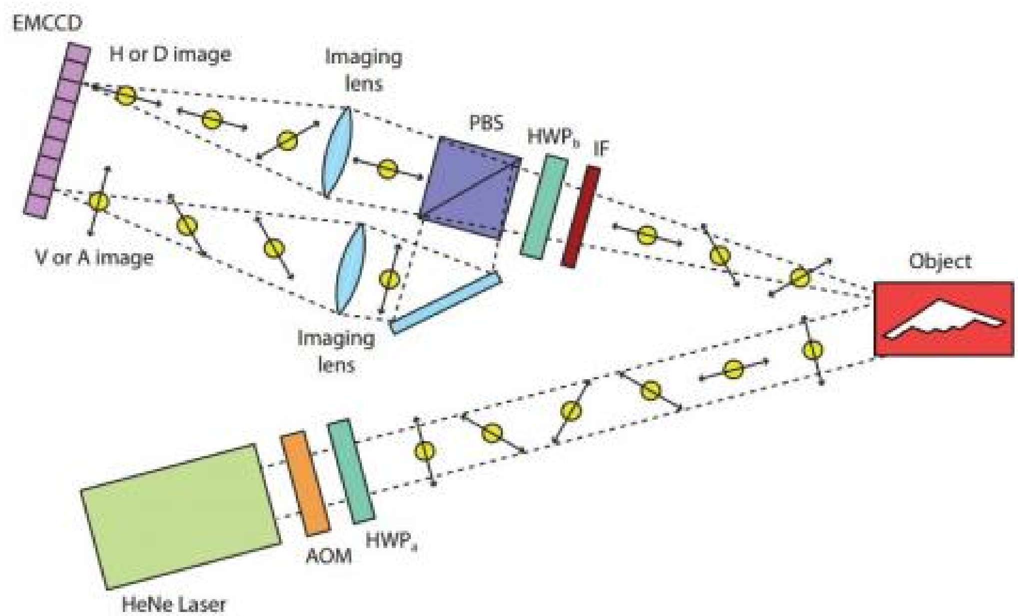
Researchers use quantum properties to create jammer-proof radar

December 17 2012, by Bob Yirka



Schematic of our quantum-secured imaging experiment. Polarized single-photon pulses from a HeNe laser are reflected from the object and imaged onto an electron-multiplying camera (EMCCD) through an interference filter (IF). A half-wave plate (HWP) and a polarizing beamsplitter (PBS) are used to make the appropriate polarization basis measurement. Four images corresponding to the four measured polarizations are obtained. The angle of reflection is exaggerated in the figure for clarity but is less than 5 deg. in reality. The object consists of a reflective stealth aircraft silhouette. Credit: arXiv:1212.2605 [quant-ph]

(Phys.org)—A trio of researchers from the University of Rochester in

New York, has created a radar system based on polarized photons that they describe as jam-proof. The new system relies on the fact, the team writes in their paper uploaded to the preprint server *arXiv*, that any changes made to such a photon stream would be recognized as false by the system.

Traditional radar systems work by shooting photons at a target and then measuring the reflections that occur as a result. Images of objects constructed using such a system can help discern the difference between a large bird and a small plane, for example. But, researchers have also developed ways to circumvent such systems, e.g. using flak, or generating false photon streams. This new system is an attempt to confound the latter.

Quantum theory suggests that because of the unique nature of quantum particles, measuring them causes them to be changed. Thus, if a pilot in a war plane responds to radar signals by trying to send back a false pattern, he or she (their equipment actually) would have to know what the original photons looked like, which means they would have to be observed – a form of measurement. Doing so would cause them to be changed. Because of that, the photon stream that is sent back in reply would be obvious to the recipient because it would no longer match the properties of the stream that was sent.

In their trial system, the researchers sent out a photon stream that had been polarized in one direction, then measured the photons as they were reflected back. They found an error rate of less than 1 percent. But when they set up a system to modify the photons before sending them back, the error rate jumped to close to 50 percent. This they say is more than enough to indicate that someone was attempting to jam their radar.

The researchers acknowledge that more testing is needed, particularly in a real-world environment where it's possible that natural elements might interfere with the polarization of photons, negating their results. Also, they note, there's the problem of systems with multiple photon streams allowing for siphoning off of photons that go undetected by the system. On a more positive note, they also point out that technology currently exists to implement such a system in the real-world, and because of that, those that wish to, could build one right away if they chose to do so.

More information: Quantum-secured imaging, arXiv:1212.2605 [quant-ph] arxiv.org/abs/1212.2605

Abstract
We have built an imaging system that uses a photon's position or time-of-flight information to image an object, while using the photon's polarization for security. This ability allows us to obtain an image which is secure against an attack in which the object being imaged intercepts and resends the imaging photons with modified information. Popularly known as "jamming," this type of attack is commonly directed at active imaging systems such as radar. In order to jam our imaging system, the object must disturb the delicate quantum state of the imaging photons, thus introducing statistical errors that reveal its activity.

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