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Single photon detectors for telecommunications wavelengths

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Practically speaking, single photon detection has not been something pursued very heavily at the wavelengths used for telecommunication signals. Part of the problem is that performance of single photon detectors are rather constrained at such long wavelengths. But, says Robert Thew, a scientist at the University of Geneva, the time is coming when single photon detectors may be needed in telecommunications.

“Up until now,” Thew tells *PhysOrg.com*, “classical communication has not done too badly with the detectors available now. But now they are getting pushed to the limit as optical communications explodes. Single photon detectors are becoming more important.”

In order to improve the ability of a single photon detector to work with signals with telecommunications wavelengths (about 1550 nanometers), Thew and his colleagues at the University of Geneva, Zbinden and Gisin, suggest a scheme that involves upconverting these signals using a tunable pump source to a silicon detector. Their work is published in *Applied Physics Letters*: “Tunable upconversion photon detector.”

“Photon detection in general is a key enabling field of research,” Thew explains. “And it is improving all the time. Photon detection is used for quantum cryptography and computing as well as for metrology and telecommunications. Our experiment is one that shows how telecom wavelength photons can be converted into the regime of silicon detectors.”

These Silicon detectors, Thew explains, are useful because they offer a high temporal resolution. While experiments have been done showing upconversion of silicon detectors, this Geneva group has added another element: tunability.

Usually, upconversion experiments do not feature a simple and practical method of controlling wavelengths. "These systems are dedicated at well-defined wavelengths," Thew says. "This works well for some things, but sometimes you want to be able to change the wavelength. That is what we are working on." Of those that do seek for tunability, they can rely on temperature control to change the wavelength or use the nonlinear phase matching scheme with different poling periods. Thew and his peers decided to make a tunable photon detector using laser tuning.

"All upconversion schemes rely on mixing two lasers to generate a third with the desired wavelength by a nonlinear process," Thew explains. "Our practicality comes from the choice of components. The precision comes from the choice of silicon detector. The tunability comes from being able to tune one of these lasers that are initially mixed."
Not only is this detector tunable, but it is also compact and more cost efficient than similar photon detectors. And, as telecommunications continues to advance, this could be a good way to continue the improvements seen in the last few years. "[F]aster communication systems necessarily have to work with lower intensities (fewer photons) and it is here that the single photon detection technologies will be needed," Thew explains. "This offers practicality and low cost. The idea is that we keep simplicity, but gain the advantage of tuning wavelengths."

"Things are improving all the time in this area of study," Thew continues. "Having tunable photon detectors would be helpful for many experiments and applications. We are taking advantage of being able to do this with a silicon detector. What we have done offers a huge advantage for this type of approach.”