Dicke state using only a UV pulse train to drive the nonlinear crystal directly[3]. Because the SPDC process is very weak, the field enhancement provided by the fsEC has allowed Krischek *et al.* to generate the six-photon Dicke state at a count rate of nearly two orders of magnitude over previous studies. Because acquisition times for these experiments can be several hours (largely due to the weak output of desired states), the increased flux can greatly aid state analysis and may prove to be an important tool for future applications that rely on quantum communication protocols.

Although this 13-fold power build-up in the UV fsEC is relatively modest, the impact on the production rate of entangled states is significant. Further increases in the intracavity power should be possible if the linear intracavity loss (2.7%) is further reduced and the intracavity GDD is minimized by incorporating dispersion-compensating dielectric mirrors. However, further power scaling may be of limited value because the increase in background noise from higher-order emissions reduces the fidelity of the generated entangled states. Nevertheless, this work demonstrates an important application of UV fsECs to linear optics quantum information experiments, and has other potential applications in ultrafast nonlinear optics. ❐

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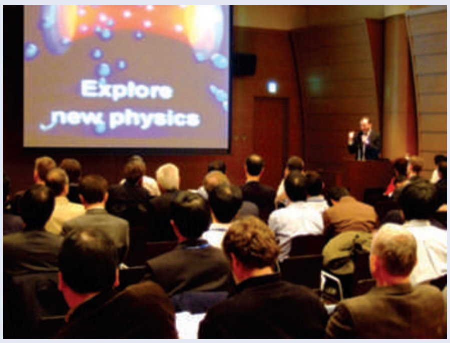
TERAHERTZ TECHNOLOGY

Endless applications

Thanks to the emergence of powerful light sources and highly sensitive detectors operating in the terahertz (THz) spectral region, the frequency gap between electronics and photonics is shrinking fast. Today, THz technology is used in many areas spanning from applications in the food, medical care and security sectors to studies of fundamental physics and cultural heritage.

“It is time to pave the way for the applications of THz waves.” This was the message that *Nature Photonics* took from the 2nd International Workshop on Terahertz Technology, held in Osaka, Japan, from 30 November – 3 December 2009.



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The event saw the conference rooms of Osaka University Nakanoshima Center packed with around 200 participants from all over the world. In total, 44 invited researchers presented their recent results on various topics within THz science and technology.

It is clear that weak THz waves are a thing of the past. Rupert Huber from the University of Konstantz in Germany described a table-top THz wave source that provides peak electric fields of up to 108 MV cm^{-1}, intensities of 15 TW cm^{-2}, energies as high as 19 μJ and centre frequencies tunable in the range of 1–107 THz. Such intense THz pulses are being used to investigate interesting effects in solid-state physics such as the coherent control of paraexcitons in CuO_2 and the coherent control of spin in NiO.

A severe drawback of THz waves is that they are highly absorbed by the moisture in air, making THz sensing usually limited to enclosed spaces filled with dry air. An interesting topic, therefore, discussed by Xi-Cheng Zhang of the Rensselaer Polytechnic Institute in New York, USA, was a scheme for sensing THz waves in air using the ionization of gas plasma. Zhang’s idea is to generate a plasma by focusing a femtosecond pulse at 800 nm and its second-harmonic at 400 nm into nitrogen gas. The THz waves then modulate the intensity of the fluorescence in the plasma, which enables their indirect detection. “By observing the time-delayed amplitude of the ultraviolet fluorescence (357 nm) altered by the THz wave, we can detect a coherent THz wave at a distance of ten metres,” he said.

Terahertz wave spectroscopy and imaging is also proving valuable for art conservation and the study of historical and cultural heritage. For example, Kaori Fukunaga of the NICT in Japan reported using THz spectroscopy to image various paintings. She explains that the advantage of using THz waves for art conservation is their deep penetration through many layers of paint and varnish, which are often an obstacle for infrared analysis. “Transmission and reflection spectra in the THz region show characteristic features, allowing the elements of pigments and binders to be easily identified by THz spectroscopy,” Fukunaga explained. Indeed, when Fukunaga obtained a THz reflection image of Giotto’s “Polittico di Badia” from the Uffizi Gallery in Italy, she discovered the presence of gold foil and cracks that were invisible from the surface. It seems that the versatility of THz waves shows no bounds.

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