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[Photonics Technology] Taiwan Physicists Control Optical Light Fields, Develop Optical Waveform Synthesizer

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Academia Sinica Newsletter (2011/01/25) A team of Taiwan-based scientists has demonstrated, for the first time, control of optical light fields in a manner similar in sophistication to that possible for microwaves and radio waves. This achievement marks a large step towards the creation of the as-yet elusive "all-optical waveform synthesizer". The study, led by Dr. Andy KUNG, a Research Fellow of the Institute of Atomic and Molecular Sciences at Academia Sinica and Director of the Institute of Photonics Technologies at National Tsing Hua University, was published online in the express edition of the top international journal Science on January 20, 2011 (US Eastern Time).

Function generators are pieces of electronic equipment or software that are used to generate waveforms. They can produce sine, sawtooth, square, triangular and even sophisticated arbitrary signals, and are important pieces of electronic testing equipment that are used in many scientific experiments and instrumentation development. However, they can only generate waveforms in the microwave to radio wave range. Current function generators utilize electrical circuit to generate waveforms, a method that can not be used on optical waveforms as electrons move more slowly than light. The development of a similar piece of equipment for the optical range has been a major challenge. The development of an optical waveform synthesizer, an "optical function generator", is much sought after in the world of physics as it would be an essential piece of testing equipment in the development of ultrahigh speed electronics, telecommunication, nanoelectronics and nanomaterials.

Previous studies on the synthesis of optical waveforms have focused on synthesizing the envelope of the electric field. In this study, Professor KUNG and his associates employed molecular modulation to manipulate the phase and amplitude of five discrete harmonics spanning from the blue to mid-infrared frequencies to produce instantaneous optical fields, which resulted in the production of periodic sawtooth, square, or sub-cycle cosine and sine pulses.

Their investigation further showed that these fields can be retrieved using a technique called shaper-assisted linear cross correlation (which the team gives a synonym SALC2), which in turn verified the success of the study's synthesis.

This project was jointly funded by the National Science Council of Taiwan and Academia Sinica. The article entitled "Synthesis and Measurement of Ultrafast Waveforms from Five Discrete Optical Harmonics" is available at the journal's website at: http://www.sciencemag.org/content/early/2011/01/19/science.1198397.

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Further Information:
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