K-State attosecond research could aid Homeland Security

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Building a new laser-like X-ray source powerful and quick enough to capture fast motion in the atomic world is a big job. But Zenghu Chang, Kansas State University professor of physics, and his team of physicists and engineers think their efforts will be worth it.

Possible applications of this attosecond laser technology include identifying elements. This means a laser pulse could be beamed into a suspicious package, for example, to quickly determine if it in fact did contain dangerous chemicals.

Chang is the principal investigator on a grant from the Department of Defense for research to improve attosecond sources and exploit the technology breakthrough for applications. The award is $1.25 million per year for three years with a possible two-year extension. Other team member institutions are Texas A&M University and the University of Ottawa.

Attosecond pulses are a special kind of X-ray; they can identify what molecules are in something.

"Just like each person has his or her unique fingerprints, molecules can be identified by their unique features too," Chang said. "As an example, different molecules absorb light differently. That is why we see things with different colors. We can tell which one is made of gold and which one is made of silver just by looking at their colors."

Attosecond pulses are extremely fast flashes of light, which Chang likens to a camera flash.

"This is very similar to taking pictures of a moving body with a camera," he said. "One has to reduce the exposure time using the shutter of the camera for a fast-moving object otherwise the image is blurred."

For their research on attoseconds, Chang and colleagues need a short-pulse, high-power laser. They are developing the technique to control the phase of a laser pulse and then amplify it.

Other possible uses for this short-pulse, high-power technology include machining. Most of the time when cutting with a high-power laser, more than what is necessary is cut, due to its extra heat. But with short pulses, the laser is much more precise.

"The technology is very new and we're still looking at possible applications," Chang said.

Source: Kansas State University