Laser triggers electrical activity in thunderstorm for the first time

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A team of European scientists has deliberately triggered electrical activity in thunderclouds for the first time, according to a new paper in the latest issue of *Optics Express*, the Optical Society's (OSA) open-access journal. They did this by aiming high-power pulses of laser light into a thunderstorm.

At the top of South Baldy Peak in New Mexico during two passing thunderstorms, the researchers used laser pulses to create plasma filaments that could conduct electricity akin to Benjamin Franklin's silk kite string. No air-to-ground lightning was triggered because the filaments were too short-lived, but the laser pulses generated discharges in the thunderclouds themselves.

"This was an important first step toward triggering lightning strikes with laser beams," says Jérôme Kasparian of the University of Lyon in France. "It was the first time we generated lighting precursors in a thundercloud." The next step of generating full-blown lightning strikes may come, he adds, after the team reprograms their lasers to use more sophisticated pulse sequences that will make longer-lived filaments to further conduct the lightning during storms.

Triggering lightning strikes is an important tool for basic and applied research because it enables researchers to study the mechanisms underlying lightning strikes. Moreover, triggered lightning strikes will allow engineers to evaluate and test the lightning-sensitivity of airplanes and critical infrastructure such as power lines.

Pulsed lasers represent a potentially very powerful technology for triggering lightning because they can form a large number of plasma filaments – ionized channels of molecules in the air that act like conducting wires extending into the thundercloud. This is such a simple concept that the idea of using lasers to trigger lightning strikes was first suggested more than 30 years ago. But scientists have not been able to accomplish this to date because previous lasers have not been powerful enough to generate long plasma channels. The current generation of more powerful lasers, like the one developed by Kasparian's team, may change that.

Kasparian and his colleagues involved in the Teramobile project, an international program initiated by National Center for Scientific Research (CNRS) in France and the German Research Foundation (DFG), built a powerful mobile laser capable of generating long plasma channels by firing ultrashort laser pulses. They chose to test their laser at the Langmuir Laboratory in New Mexico, which is equipped to measure atmospheric electrical discharges. Sitting at the top of 10,500-foot South Baldy Peak, this laboratory is in an ideal location because its altitude places it close to the high thunderclouds.

During the tests, the research team quantified the electrical activity in the clouds after discharging laser pulses. Statistical analysis showed that their laser pulses indeed enhanced the electrical activity in the thundercloud where it was aimed—in effect they generated small local discharges located at the position of the plasma channels.

The limitation of the experiment, though, was that they could not generate plasma channels that lived long enough to conduct lightning all the way to the ground. The plasma channels dissipated before the lightning could travel more than a few meters along them. The team is currently looking to increase the power of the laser pulses by a factor of 10 and use bursts of pulses to generate the plasmas much more

efficiently.

Lightning strikes have been the subject of scientific investigation dating back to the time of Benjamin Franklin, but despite this, remain not fully understood. Although scientists have been able to trigger lightning strikes since the 1970s by shooting small rockets into thunderclouds that spool long wires connected to the ground, typically only 50 percent of rocket launches actually trigger a lightning strike. The use of laser technology would make the process quicker, more efficient and cost-effective and would be expected to open a number of new applications.

Source: Optical Society of America