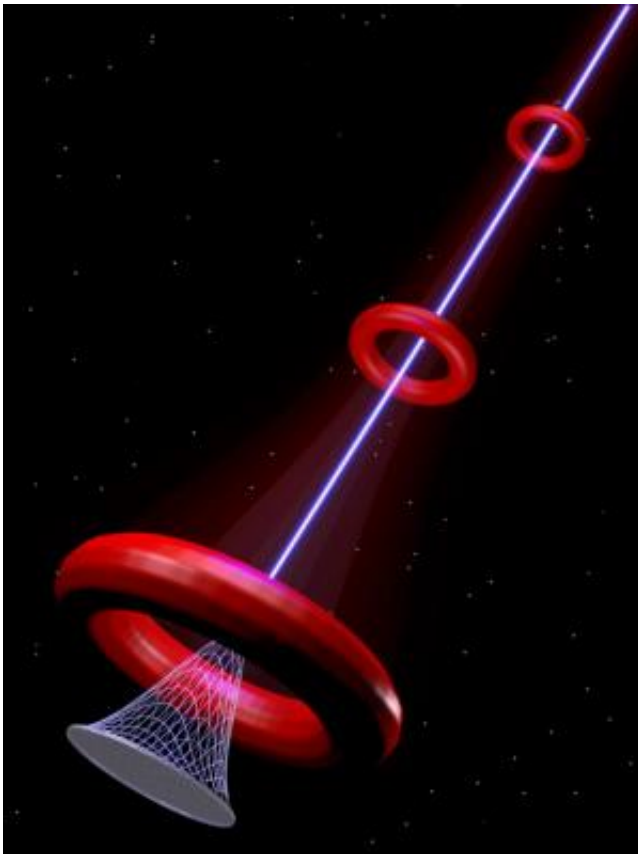


'Dressed' laser aimed at clouds may be key to inducing rain, lightning

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This is an illustration of the dressed filament that fuels the high-intensity laser to travel farther. Credit: Courtesy of University of Central Florida College of Optics and Photonics

The adage "Everyone complains about the weather but nobody does anything about it," may one day be obsolete if researchers at the

University of Central Florida's College of Optics & Photonics and the University of Arizona further develop a new technique to aim a high-energy laser beam into clouds to make it rain or trigger lightning.

The solution? Surround the beam with a second beam to act as an energy reservoir, sustaining the central beam to greater distances than previously possible. The secondary "dress" beam refuels and helps prevent the dissipation of the high-intensity primary beam, which on its own would break down quickly. A report on the project, "Externally refueled optical filaments," was recently published in *Nature Photonics*.

Water condensation and lightning activity in clouds are linked to large amounts of static charged particles. Stimulating those particles with the right kind of laser holds the key to possibly one day summoning a shower when and where it is needed.

Lasers can already travel great distances but "when a [laser beam](#) becomes intense enough, it behaves differently than usual – it collapses inward on itself," said Matthew Mills, a graduate student in the Center for Research and Education in Optics and Lasers (CREOL). "The collapse becomes so intense that electrons in the air's oxygen and nitrogen are ripped off creating plasma – basically a soup of electrons."

At that point, the plasma immediately tries to spread the beam back out, causing a struggle between the spreading and collapsing of an ultra-short laser pulse. This struggle is called filamentation, and creates a filament or "light string" that only propagates for a while until the properties of air make the beam disperse.

"Because a filament creates excited electrons in its wake as it moves, it artificially seeds the conditions necessary for rain and lightning to occur," Mills said. Other researchers have caused "electrical events" in clouds, but not [lightning strikes](#).

But how do you get close enough to direct the beam into the cloud without being blasted to smithereens by lightning?

"What would be nice is to have a sneaky way which allows us to produce an arbitrary long 'filament extension cable.' It turns out that if you wrap a large, low intensity, doughnut-like 'dress' [beam](#) around the filament and slowly move it inward, you can provide this arbitrary extension," Mills said.

"Since we have control over the length of a filament with our method, one could seed the conditions needed for a rainstorm from afar. Ultimately, you could artificially control the rain and lightning over a large expanse with such ideas."

So far, Mills and fellow graduate student Ali Miri have been able to extend the pulse from 10 inches to about 7 feet. And they're working to extend the filament even farther.

"This work could ultimately lead to ultra-long optically induced filaments or plasma channels that are otherwise impossible to establish under normal conditions," said professor Demetrios Christodoulides, who is working with the graduate students on the project.

"In principle such dressed filaments could propagate for more than 50 meters or so, thus enabling a number of applications. This family of optical filaments may one day be used to selectively guide microwave signals along very long plasma channels, perhaps for hundreds of meters."

Other possible uses of this technique could be used in long-distance sensors and spectrometers to identify chemical makeup. Development of the technology was supported by a \$7.5 million grant from the Department of Defense.

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