Laser lightning rod: Guiding bursts of electricity with a flash of light

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Image: Wikimedia Commons

Lightning is a fascinating but dangerous atmospheric phenomenon. New research reveals that brief bursts of intense laser light can redirect these high-power electrical discharges.

Using an experimental apparatus reminiscent of a classic Frankenstein movie, French researchers have coaxed laboratory-generated lightning into striking the same place, not just twice, but over and over. This feat of electrical reorientation used femtosecond (one quadrillionth of a second) pulses of laser light to create a virtual lightning rod out of a column of ionized gas. This is the first time that these laser-induced atmospheric filaments were able to redirect an electrical discharge away from its intended target and guide it to a normally less-attractive electrode.

The experiment demonstrates the potential of using laser-based lightning rods for research and protection. "The laser lightning rod would be a valuable alternative to lightning rockets," says Aurlien Houard, Ph.D., of the Laboratoire d'Optique Appliquée and co-author on a paper published in the American Institute of Physics' journal *AIP Advances*.

Previous experiments confirmed that femtosecond laser could produce ultrashort filaments of ionized gas that act like electrical guide wires. Further studies revealed that these filaments could function over long distances, potentially greater than 50 meters.

In a series of new experiments, the French research team sent a laser beam skimming past a spherical electrode to an oppositely charged planar electrode. The laser stripped away the outer electrons from the atoms along its path, creating a plasma filament that channeled an electrical discharge from the planar electrode to the spherical one. To determine if the filament had the ability to redirect an electrical discharge from its normal path, the researchers added a longer, pointed electrode to their experiment. Since lightning tends to follow the path of least resistance, it would preferentially strike the nearest object; in nature, that would be the tallest object.

Without the laser, the discharge obeyed this rule and always struck the taller, pointed electrode. With the laser, however, the discharge was redirected, following the filaments and striking the spherical electrode instead. This occurred even after the initial path of the discharge began to form.

More information: "Triggering, guiding and deviation of long air spark discharges with femtosecond laser filament" has been published in *AIP Advances.*