

# Scientists find the only answer to laser chaos is quantum chaos



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In an effort to produce ultra-strong, stable lasers, an international research team has brought "quantum chaos" into the mix.

Far from science fiction, lasers are a fundamental component of semiconductor technology, which is often used in materials processing, biomedical imagination, and industrial research.

One of the biggest problems, however, is that the light they produce is affected by instabilities that make them "incoherent."

These instabilities are caused by chaotic light structures that move randomly and change over time, called optical filaments.

Attempting to eliminate these instabilities has been the focus of many physicists, but our best efforts to date have meant that we can choose between a high-performance, low-quality semiconductor laser or a coherent but much weaker laser.

Now an international team from Imperial College London (ICL), Yale University, Nanyang Technological University and Cardiff University have come up with a truly fantastic solution.

## Laser tornadoes

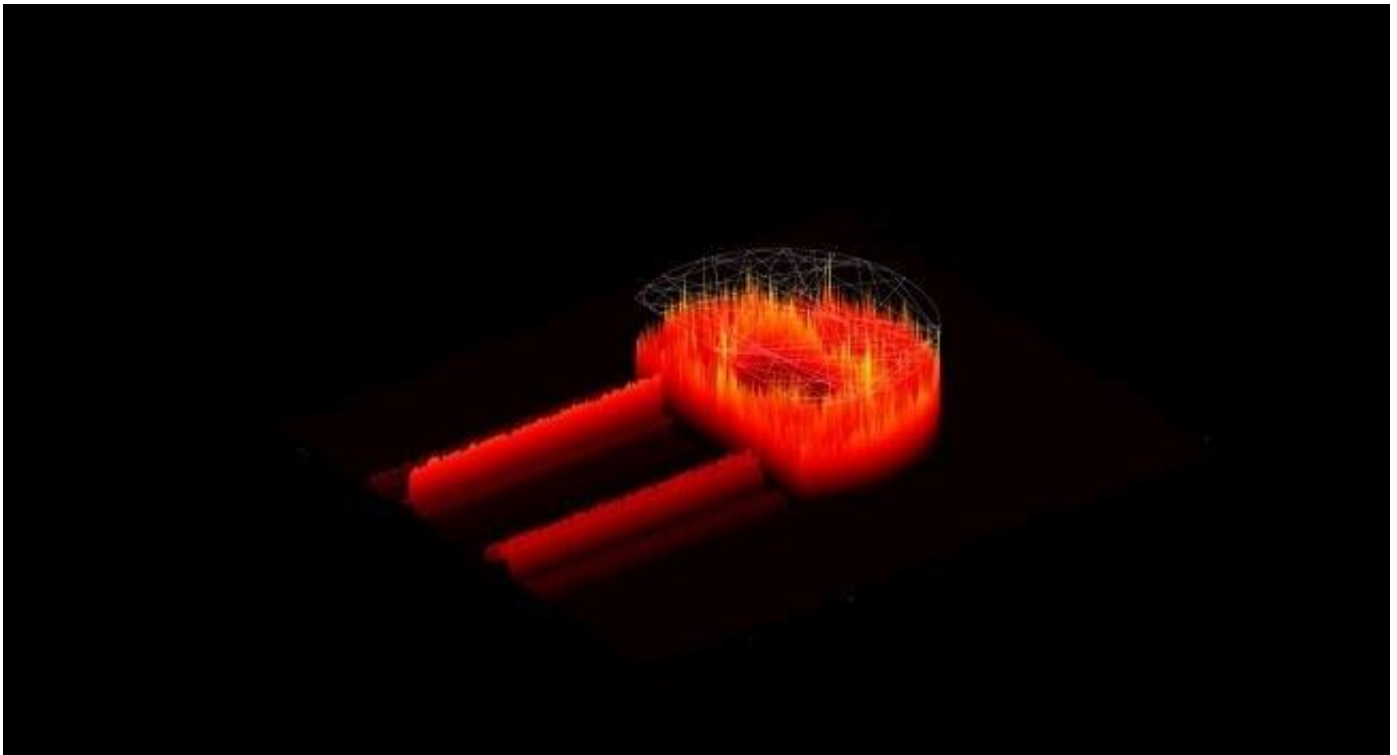
Publication of his results in *science*The team described how it can prevent laser filaments with a technique called "quantum chaos".

By overcoming laser chaos, scientists can create ultra-bright 3D laser cinemas or use them as elements in extremely bright laser systems used in nuclear fusion reactors.

Rather than being a new super villain, quantum chaos can be compared to the unpredictable and destructive behavior of tornadoes.

"Tornadoes tend to form and move over flat land," said Prof. Ortwin Hess of ICL.

"For example, in America they often form in beautiful Oklahoma, but not so often in hilly West Virginia, the hills seem to be a major difference, preventing tornadoes from forming or moving."



*The D-shaped cavity creates quantum chaos, resulting in a more stable laser. Picture: Bittner et al*

## Creating quantum chaos

Against this backdrop, researchers can prevent filaments from forming or out of control by using quantum chaos to create a "hilly" optical landscape in lasers.

To achieve quantum chaos, researchers had to change how a typical laser amplifies, jumping around a quad ridge.

The design of quantum chaos uses a D-shaped hollow to create these optical "hills" to disperse the optical "tornadoes".

Following the successful test of the Singapore-built laser system in the US, the team is now working to further investigate and adjust the light emission, such as improving the directionality of the laser.

In the meantime, the team's current work should allow semiconductor lasers to work with higher power and high emission quality, and the same idea could be applied to other types of lasers.