An optical lens is a device with a stunningly long history. Its design was first driven by evolution, then by the human brain, and now by computers.

### Topology Optimization

Topology optimization is a computational method used in various branches of engineering to tackle the inverse design problem. The material layout is optimized within the design domain to achieve the desired performance.

Relaxing the original task, a convex optimization problem can be formulated, giving an upper bound to all topology realizations. This upper bound is not reachable but is used as a performance measure of results found by topology optimization.

### State-of-the-art classical lenses

State-of-the-art classical lenses were brought to perfection. (Large Synoptic Survey Telescope, 2018)

Today, computer-aided design is looking for nontraditional lenses offering, for example, near-field focusing. There, the conventional design rules developed for millennia fail. (Yage Zhao, et al., ACS Nano, 2022)

### Lenses behind our first explorations of the celestial system

The simplicity and great utility of lenses attracted many bright minds that used them for research or developed them further. (Galileo Galilei, 1609)

The eye of vertebrates developed before the evolution of hard body parts hundreds of millions of years ago. It already contained a lens. (Isaac Newton, “Optics”, 1740)

The initialization of fire was, for a long time, the primary task for lenses, giving them the name “burning glass.” (Ibn Sahl, “On Burning Mirrors and Lenses”, 984)

### Fundamental Bound

The first human-made lenses were used as decorative pieces, magnifying glasses, or tools for initializing fire. (Assyria, 750 BC)

The material gradient in order to improve your design. A bright color (positive value) means add material, a dark color (negative value) means remove material.

Get inspired by the material gradient in order to improve your design. A bright color (positive value) means add material, a dark color (negative value) means remove material.

The histogram showing the performance of the designed lenses. Can you beat our topology optimization powered by a computer and approach the fundamental bound on performance?

### Now, it is your turn to design a lens.

The main design window is accessible through a web application. Each pixel represents a small piece of Teflon. See how the actual design focuses the electric field of the incident the Gaussian beam. Is the output beam pointing to the desired point?

Reach as high as possible averaged electric field density at this point.

See how the actual design focuses the electric field of the incident the Gaussian beam. Is the output beam pointing to the desired point?

The main design window is accessible through a web application. Each pixel represents a small piece of Teflon. Scan the QR code and design your lens. See the performance on the screen in real-time!

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