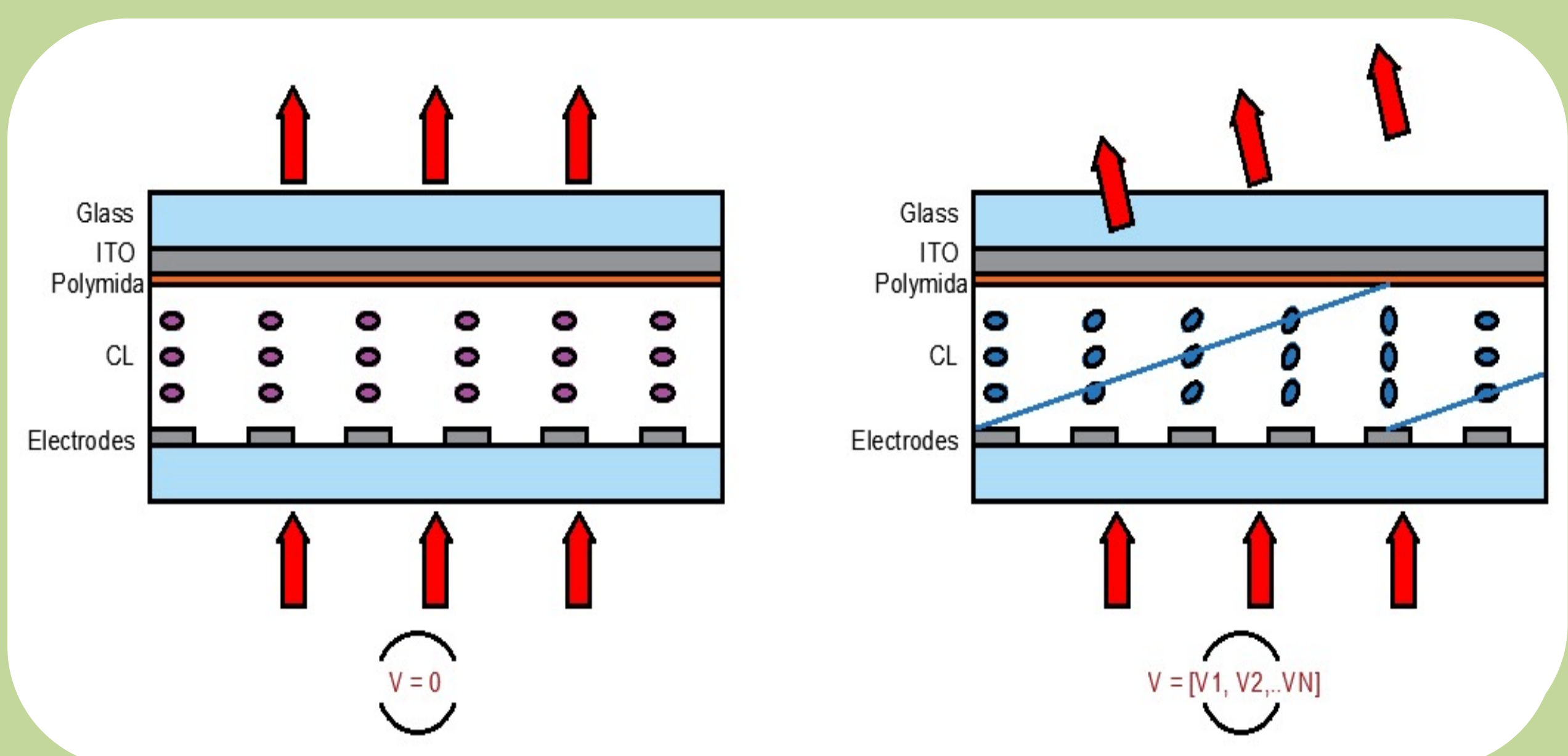
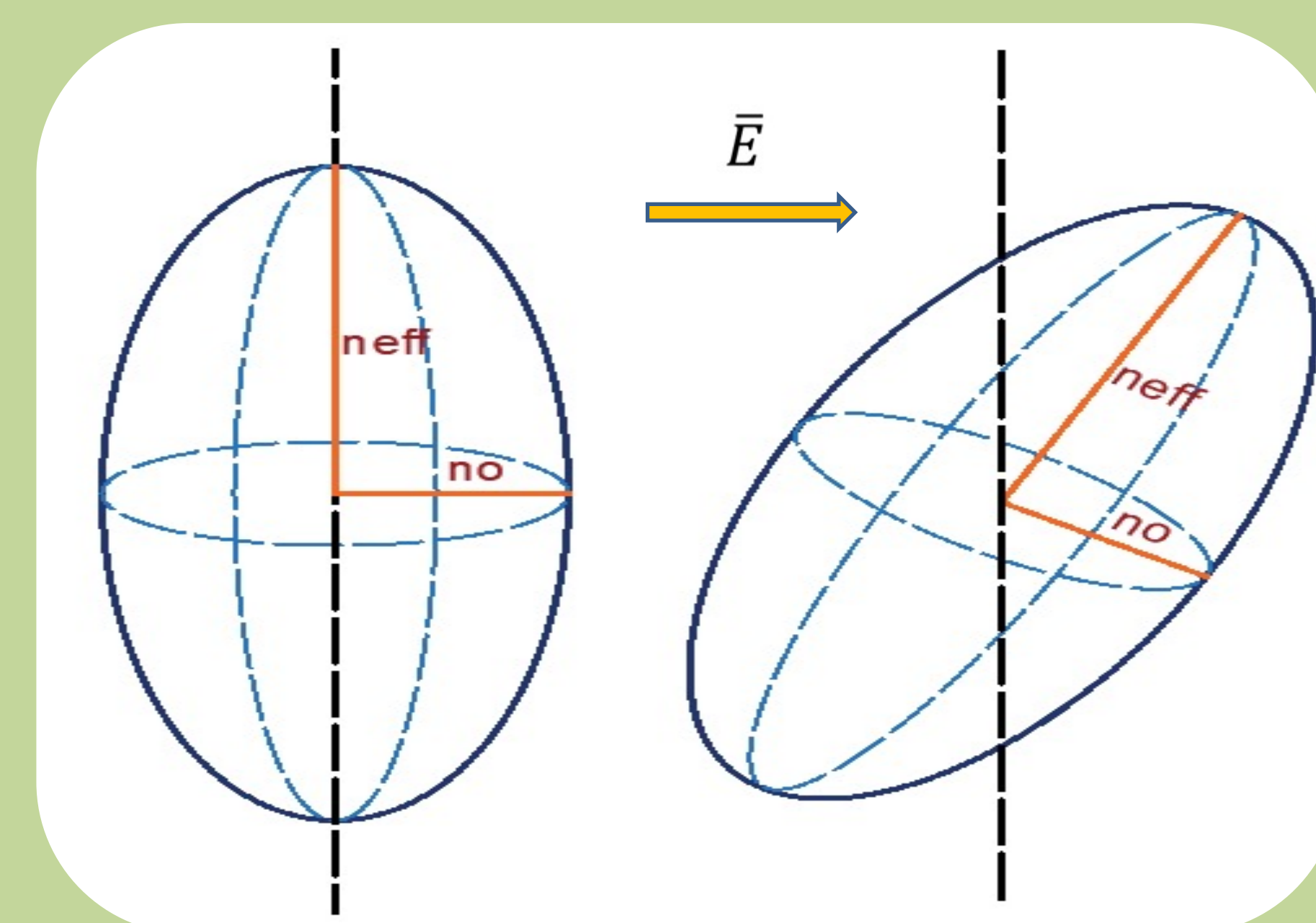
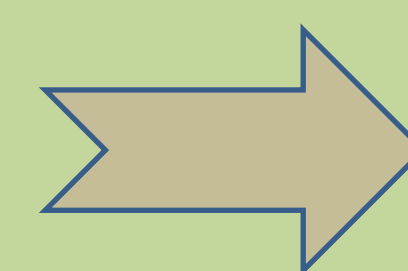


# WHAT DO WE RESEARCH? LIQUID CRYSTALS

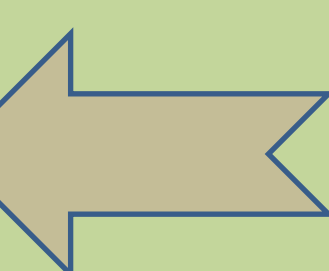
## LIQUID CRYSTALS

Liquid crystal is an electro-optical material capable of varying the orientation of its molecules when under the influence of an electric field. These molecules have the characteristic of being anisotropic, which means that they have two polarization axes, with different refractive indices ( $n_{eff}$  and  $n_o$ ). When light passes through liquid crystal, its phase is delayed depending on the orientation of both refractive axes.



## LIQUID CRYSTALS CELLS

Liquid crystal is introduced into a cell that is made up of two glass substrates (with a thin layer of a conductive metal, ITO, deposited on one side). Using a UV laser, a designed pattern of electrodes is printed on this metal layer. By striking a beam on the liquid crystal cell and varying the voltage applied to each electrode, it is possible to cause a tunable phase delay in the incident beam (due to the phenomenon of diffraction).



## APPLICATIONS

### AUTOMOTIVE



Source: PARC

### GADGETS



Source: Xataka

### AEROSPACE



Source: BBC

### CAMERAS



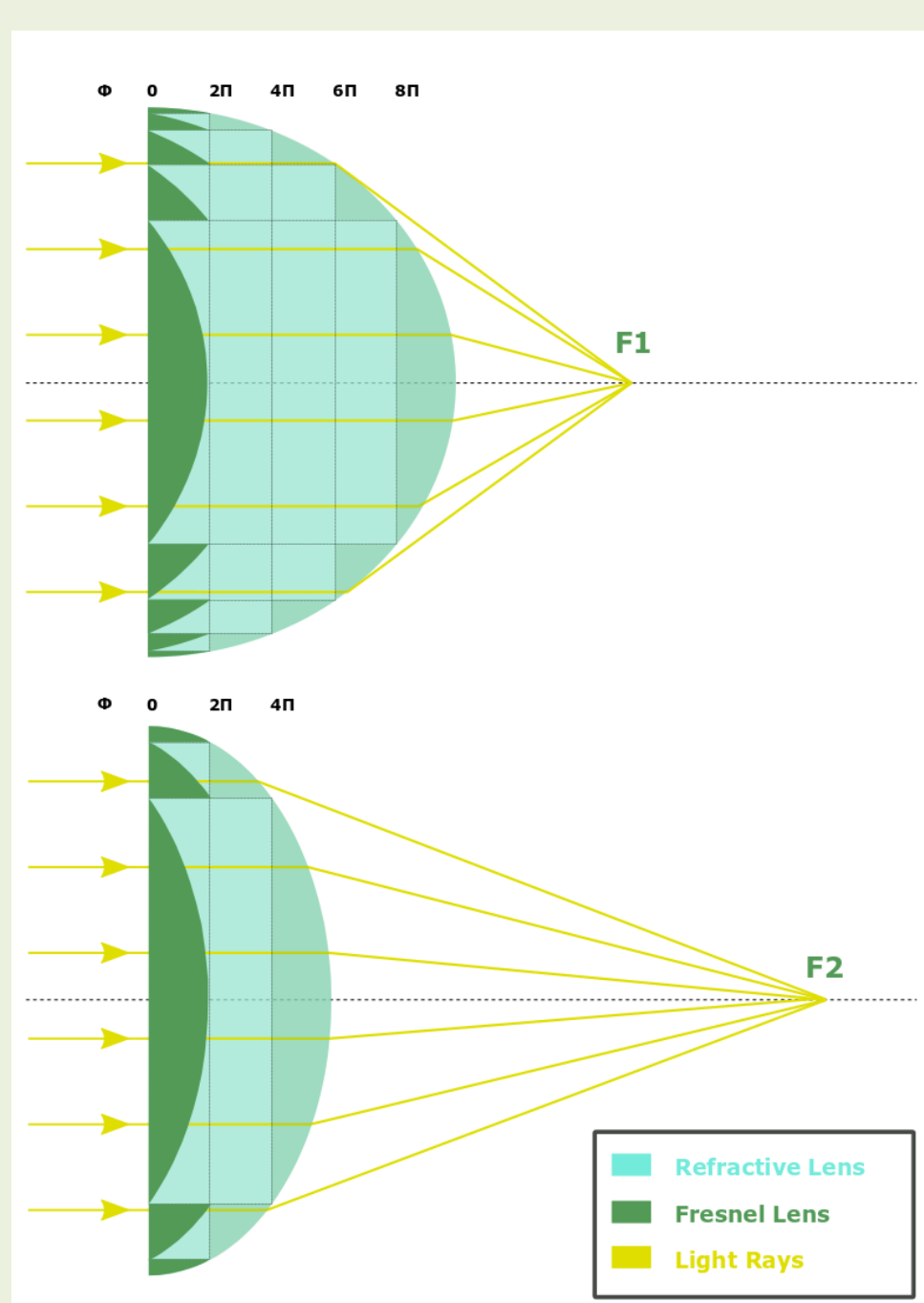
Source: GoPro

## RESEARCH LINES

### LENSES

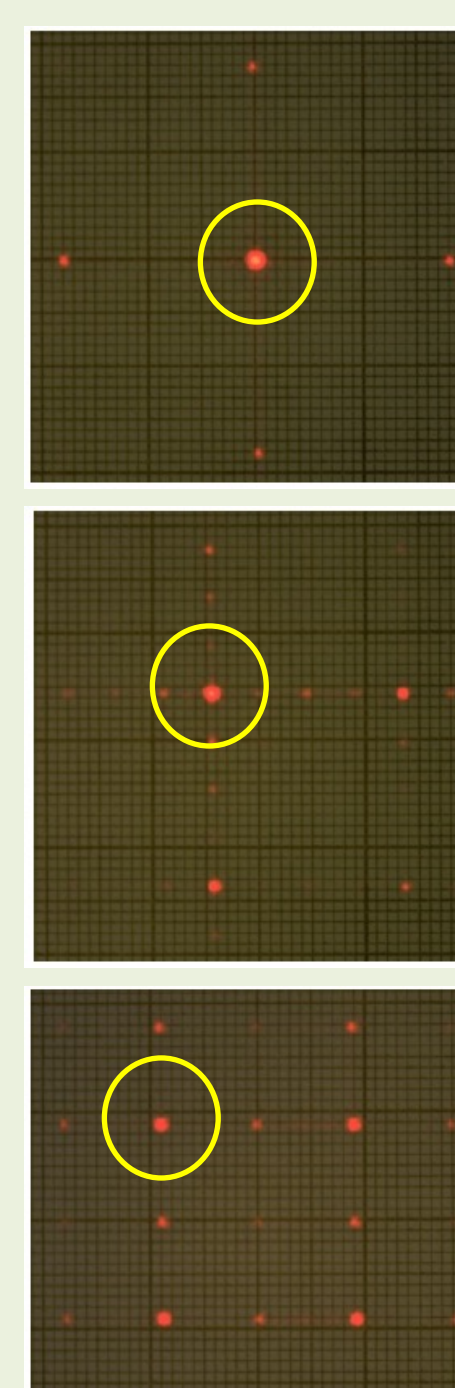
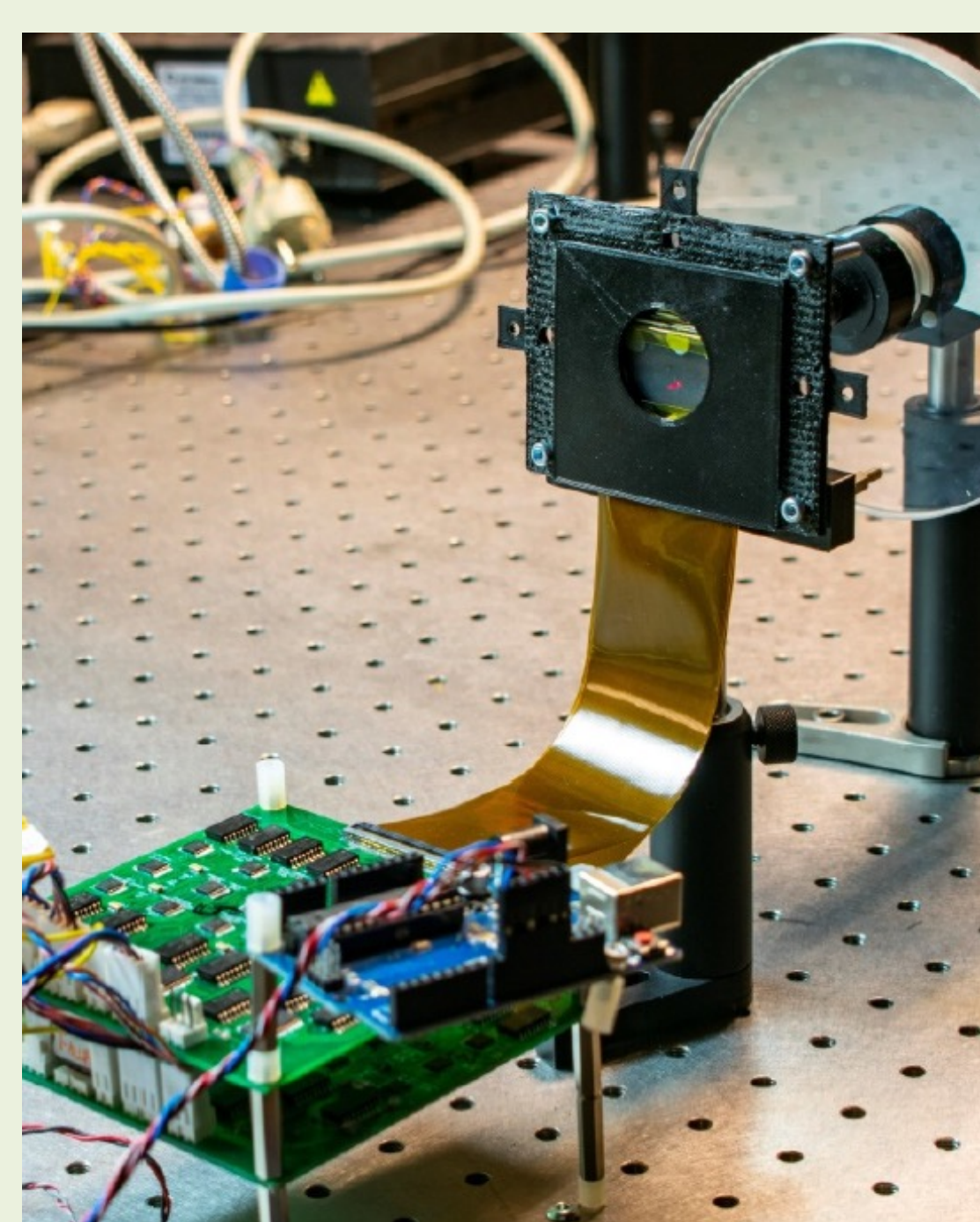
One of the fundamental principles of optics is that the direction of propagation of light does not change within a medium. Therefore, lenses bend light rays on surfaces due to the difference in refractive index between the lens material and the surrounding medium.

A Fresnel lens with an adjustable focal length can be realized using a liquid crystal cell. In this way, taking advantage of the anisotropy of the material, the "curvature" of the lens could be controlled through the voltage applied to the electrodes.



### BEAM DIRECTOR

A beam director is a device capable of deflecting an incident light beam at a specific angle. By connecting two LC cells it is possible to deflect the incident beam in the 2D plane, controlling the voltage applied to the electrodes.



### ELECTRONIC CONTROLLER

The hardware necessary to independently control each of the CL cell electrodes is developed in our laboratory (electronic design and PCB manufacturing). The software developed will be in charge of communication between the different systems.

