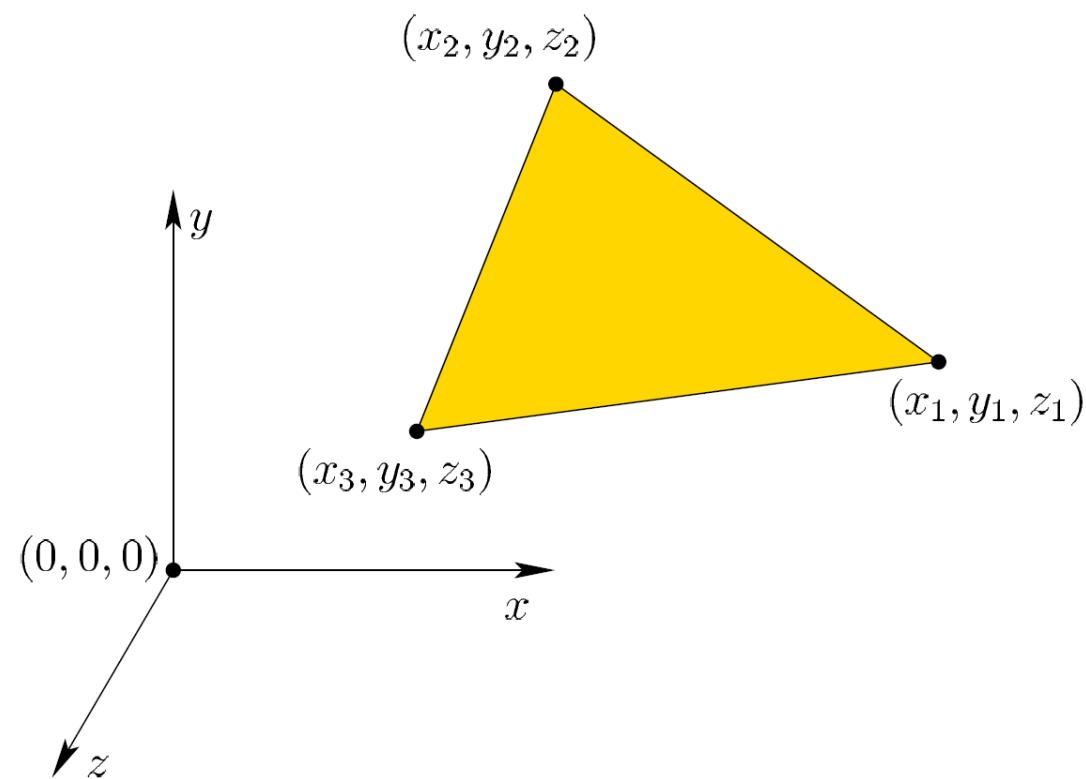
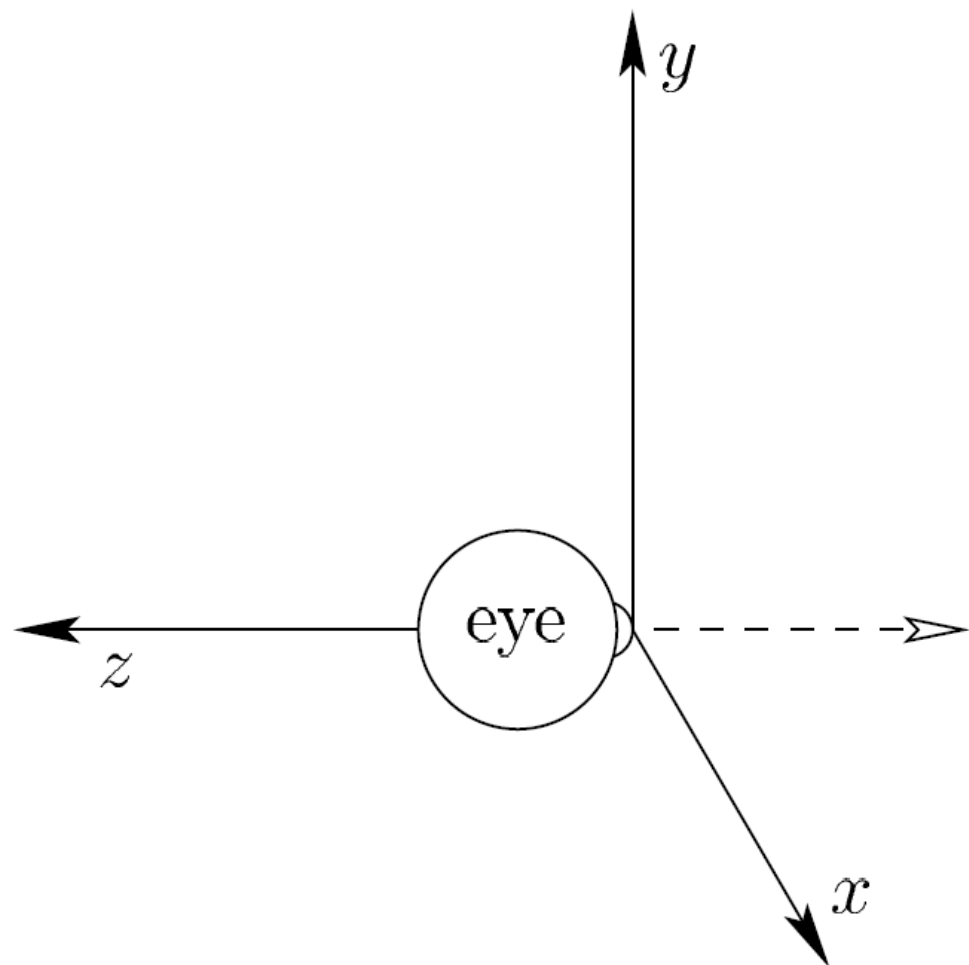
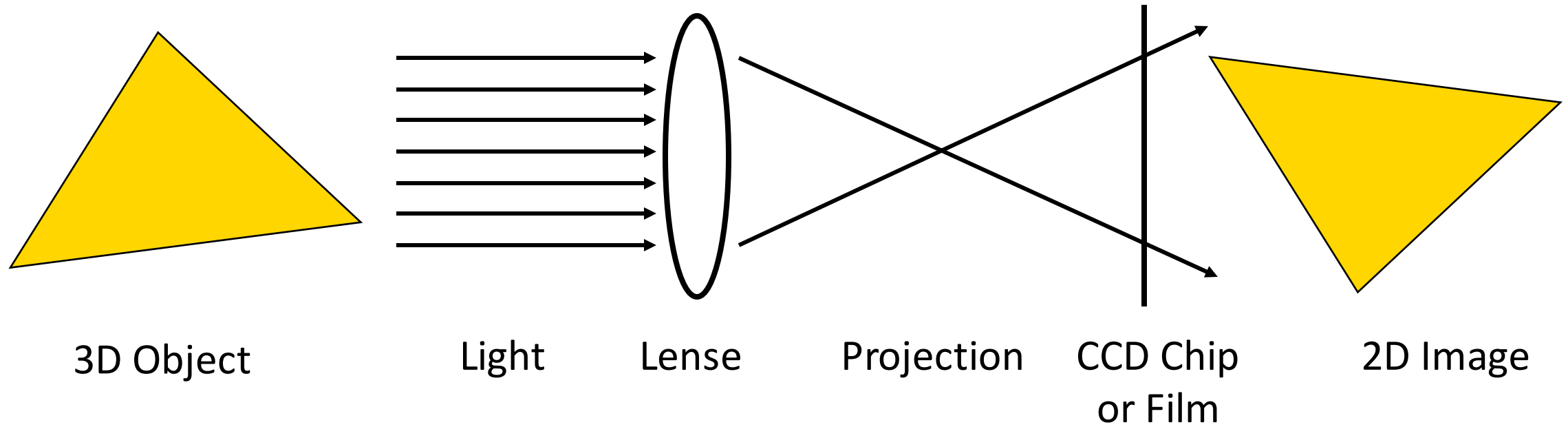


CSU44054/CS7GV4: ~~Augmented~~ Reality

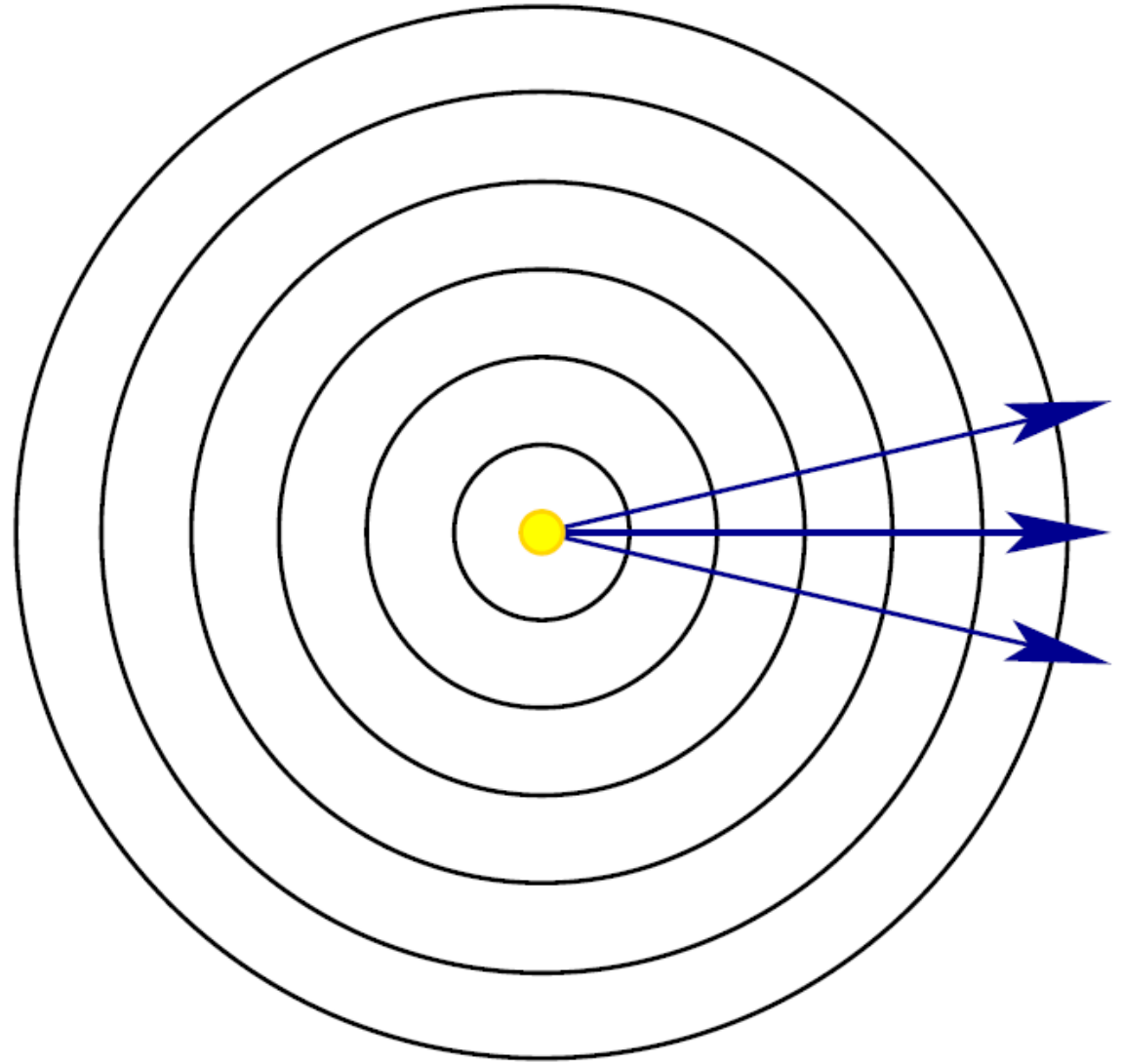
Gareth W. Young

extended



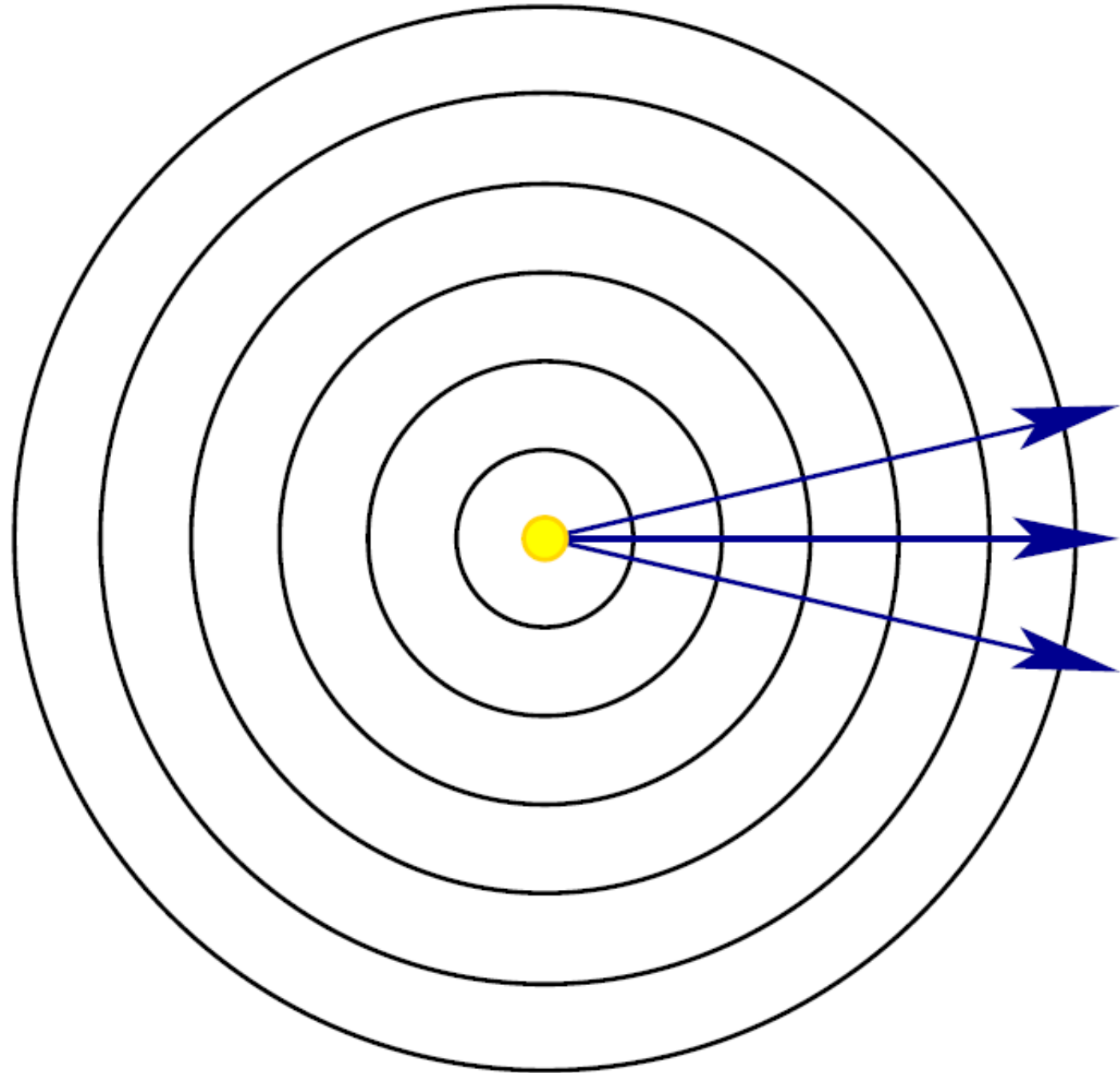


Light and Optics



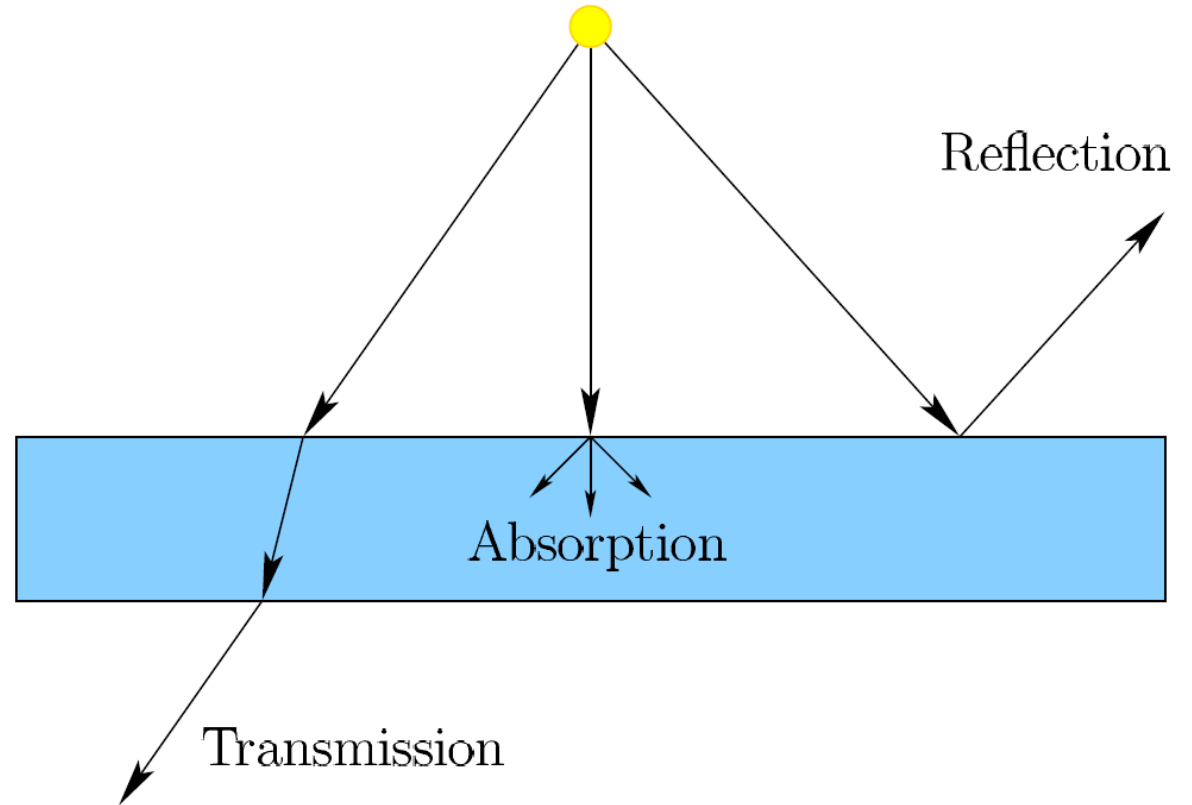
Basic Behavior of Light

- Photons
- Waves
- Rays

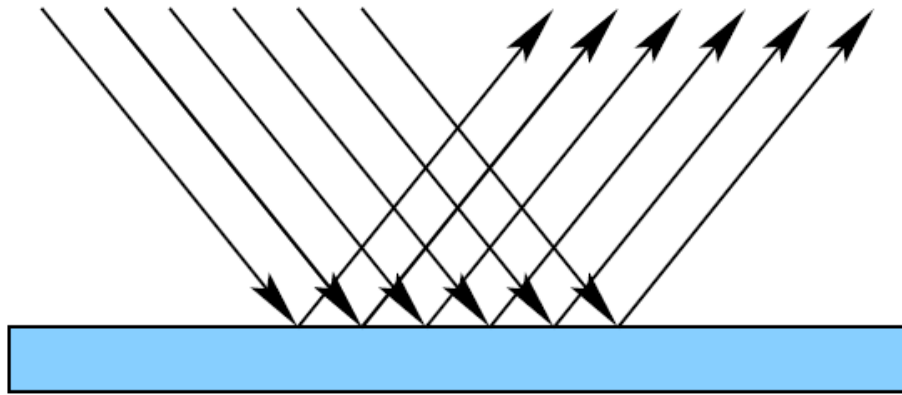


Interactions with materials

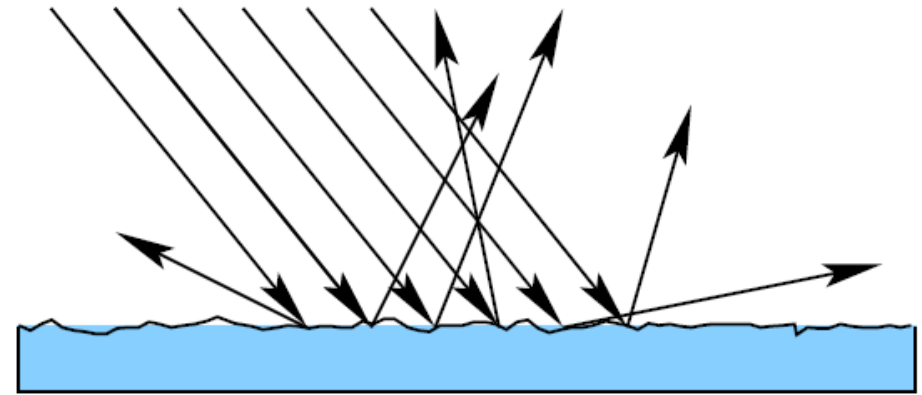
- Transmission
- Absorption
- Reflection



Reflection



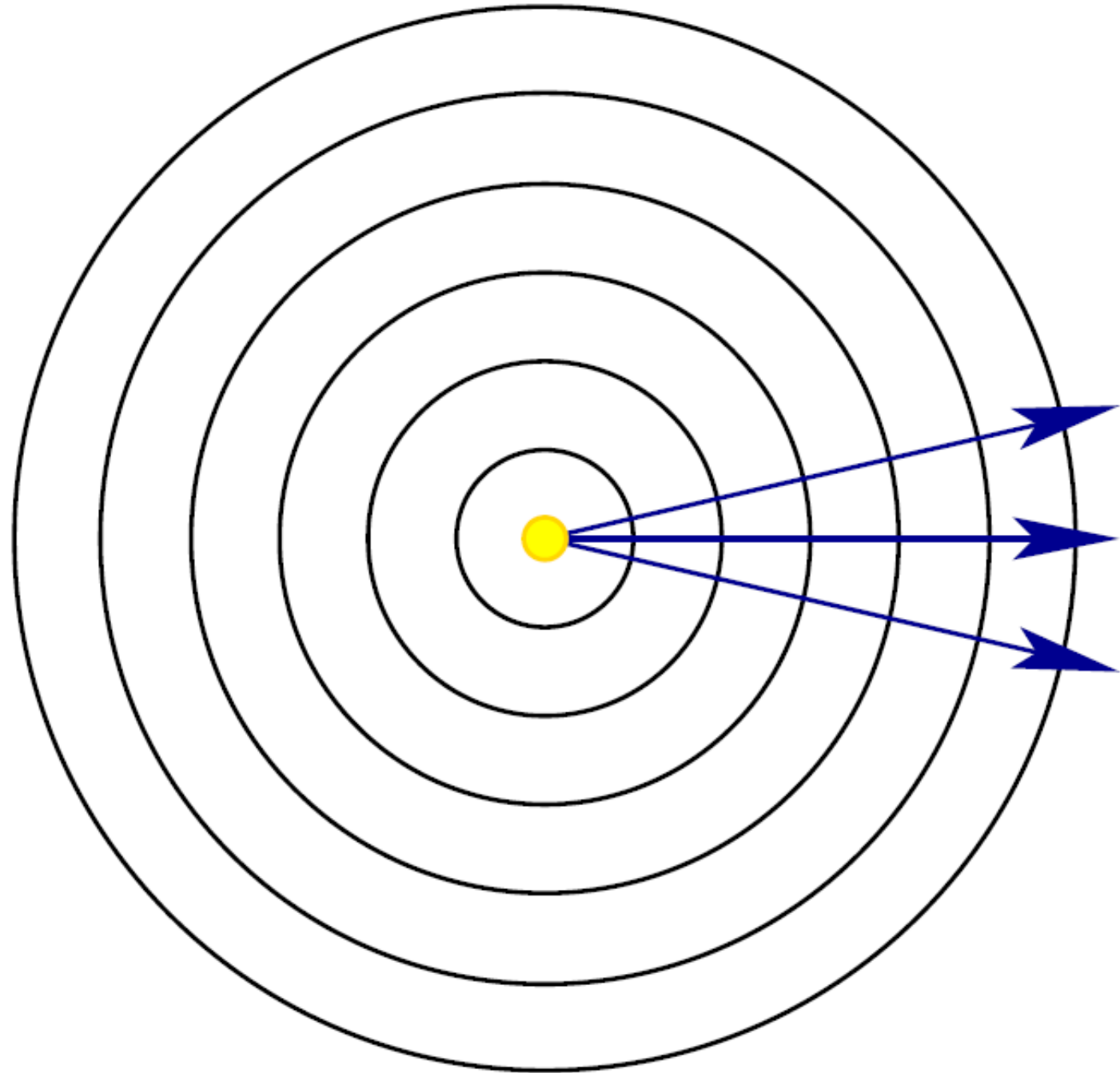
Specular



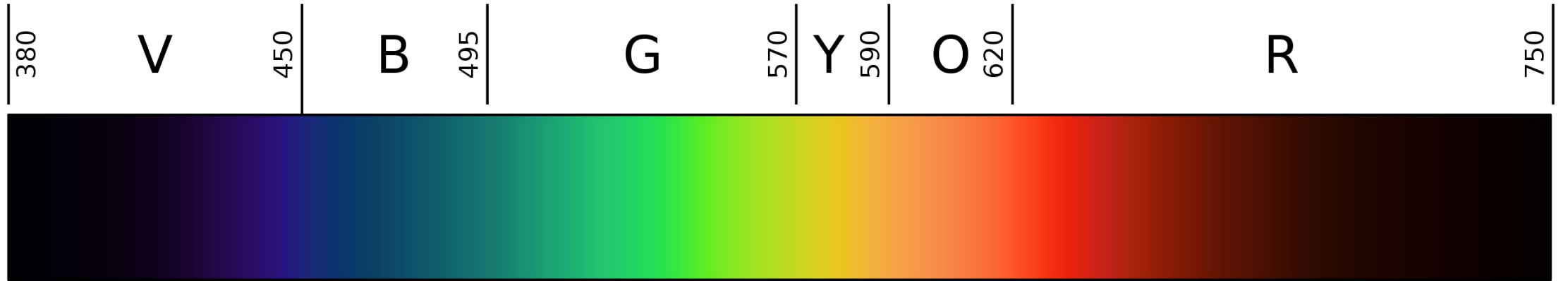
Diffuse

Basic Behavior of Light

- Light sources usually do not emit coherent light

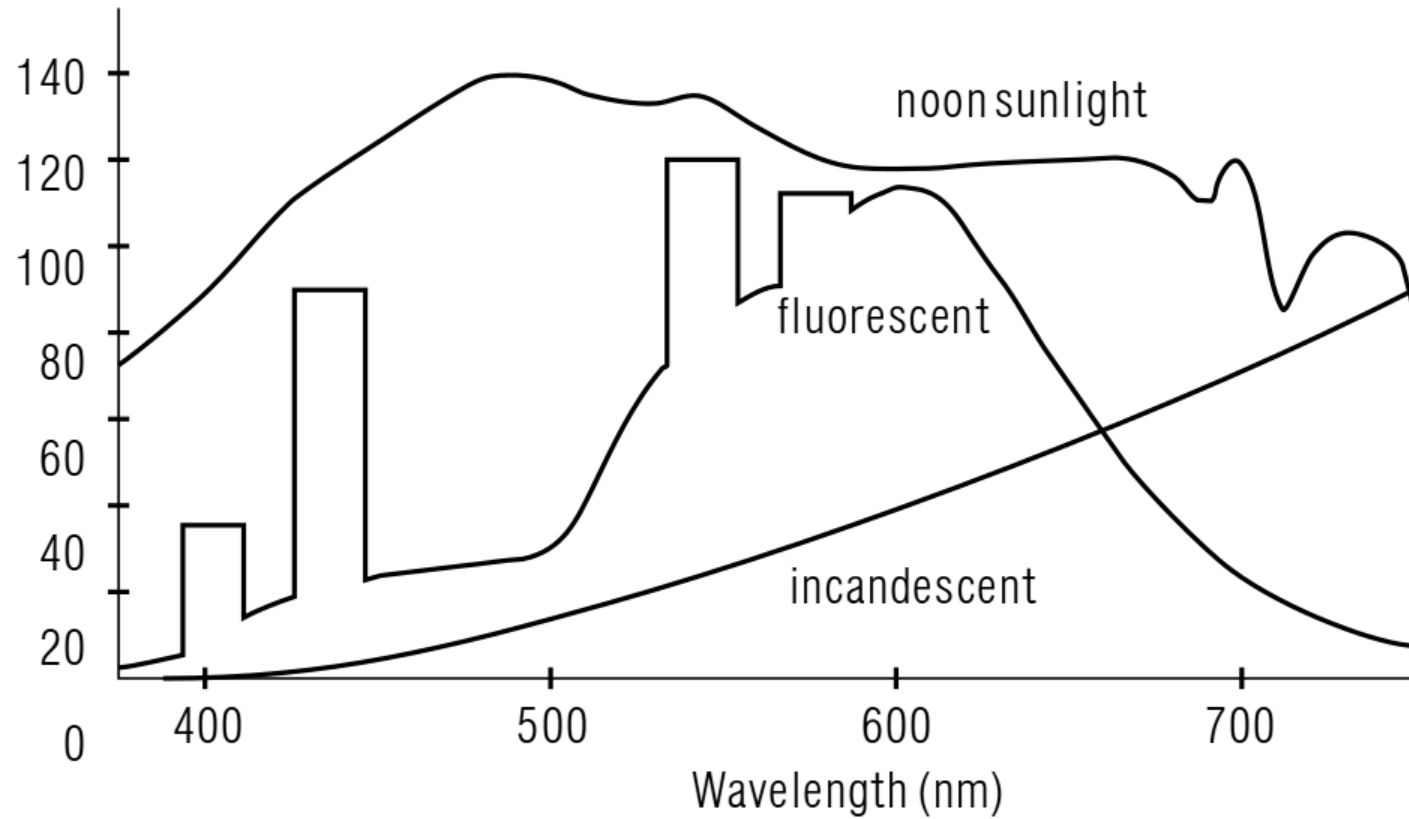


Visible light spectrum

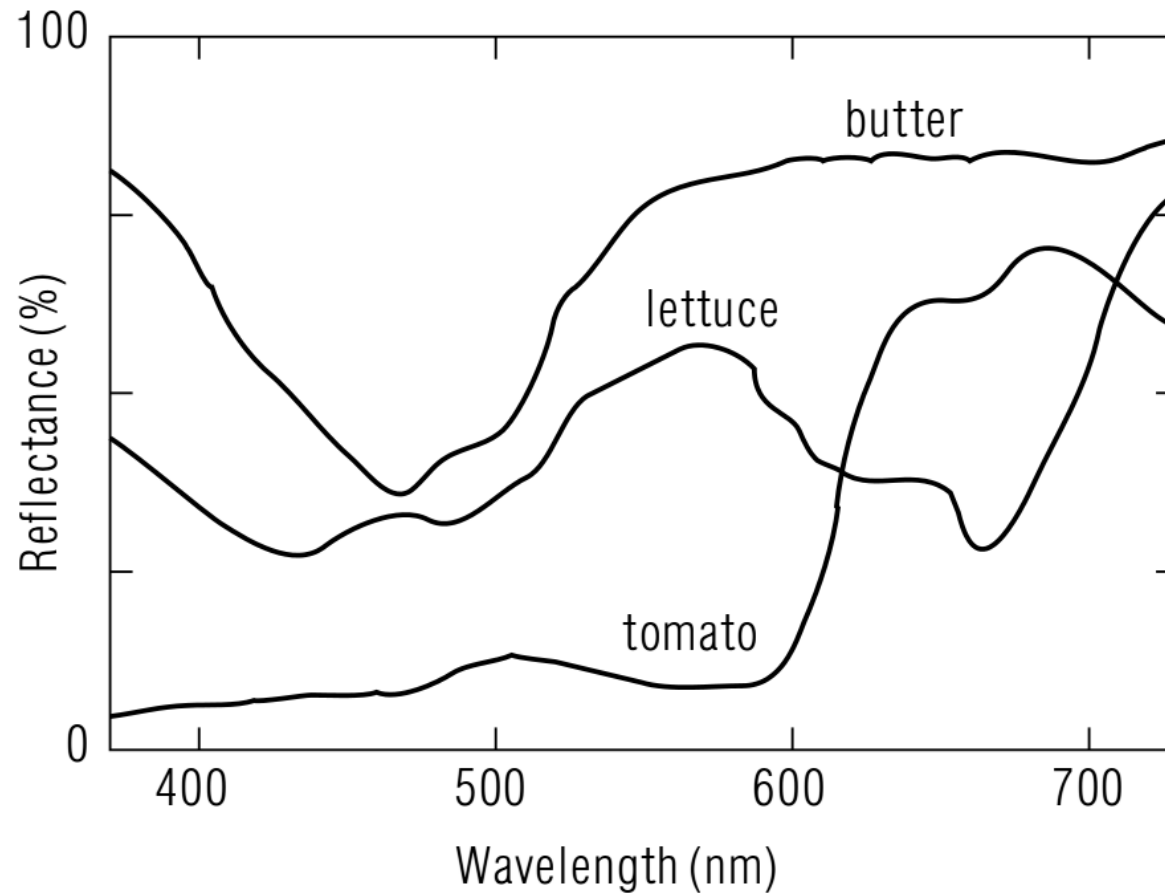


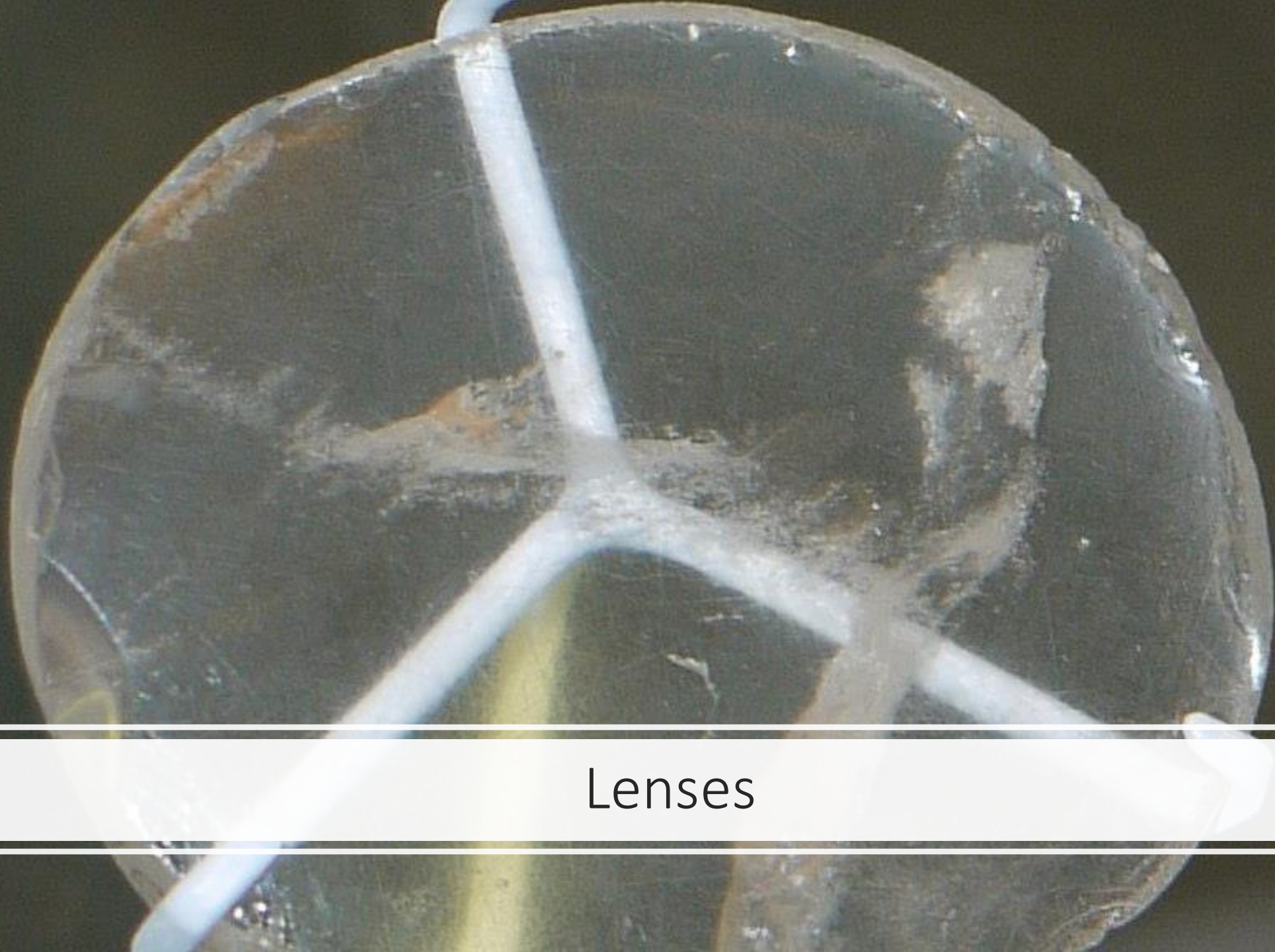
wavelengths that are visible to humans.

Spectral power distribution

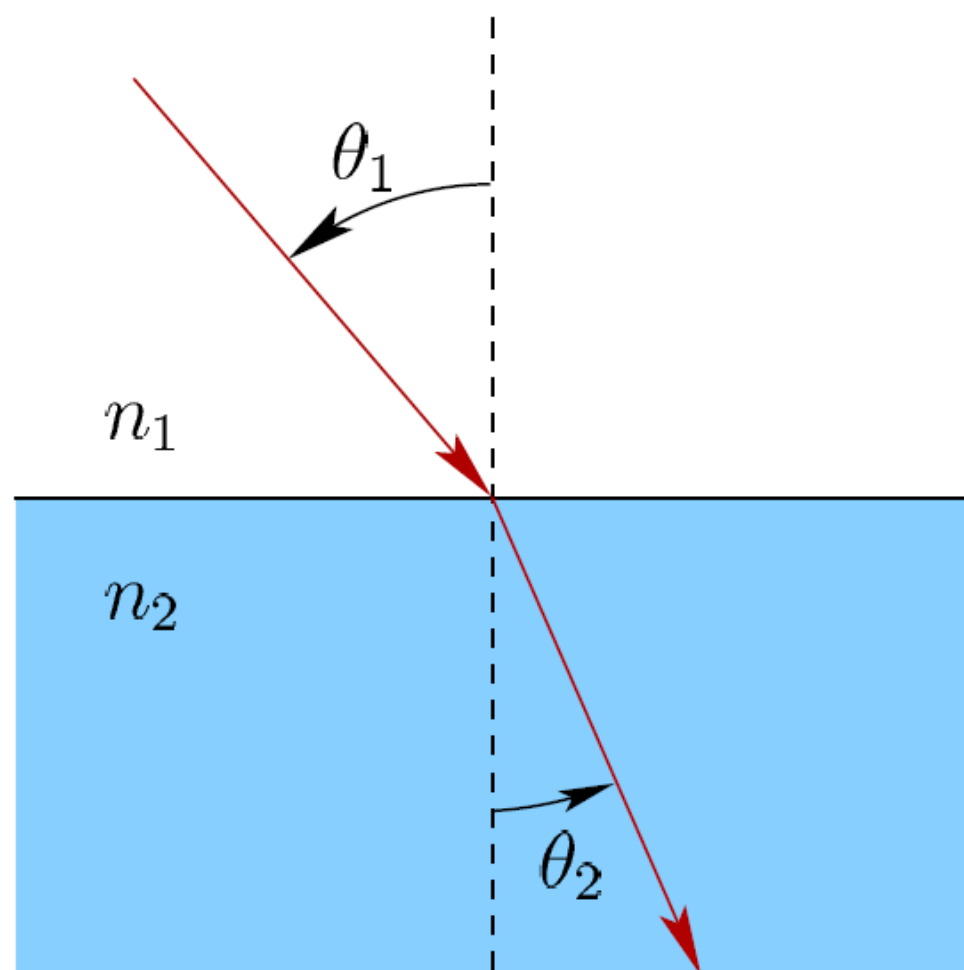
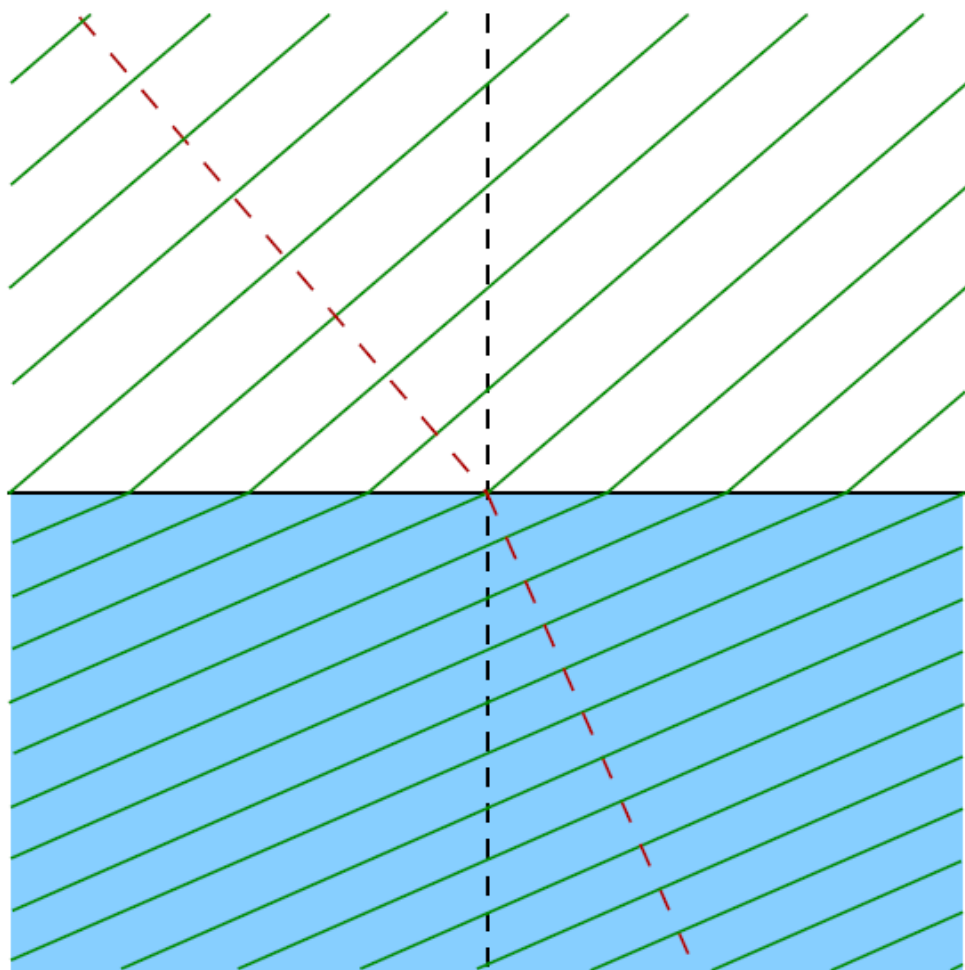


Spectral reflection function





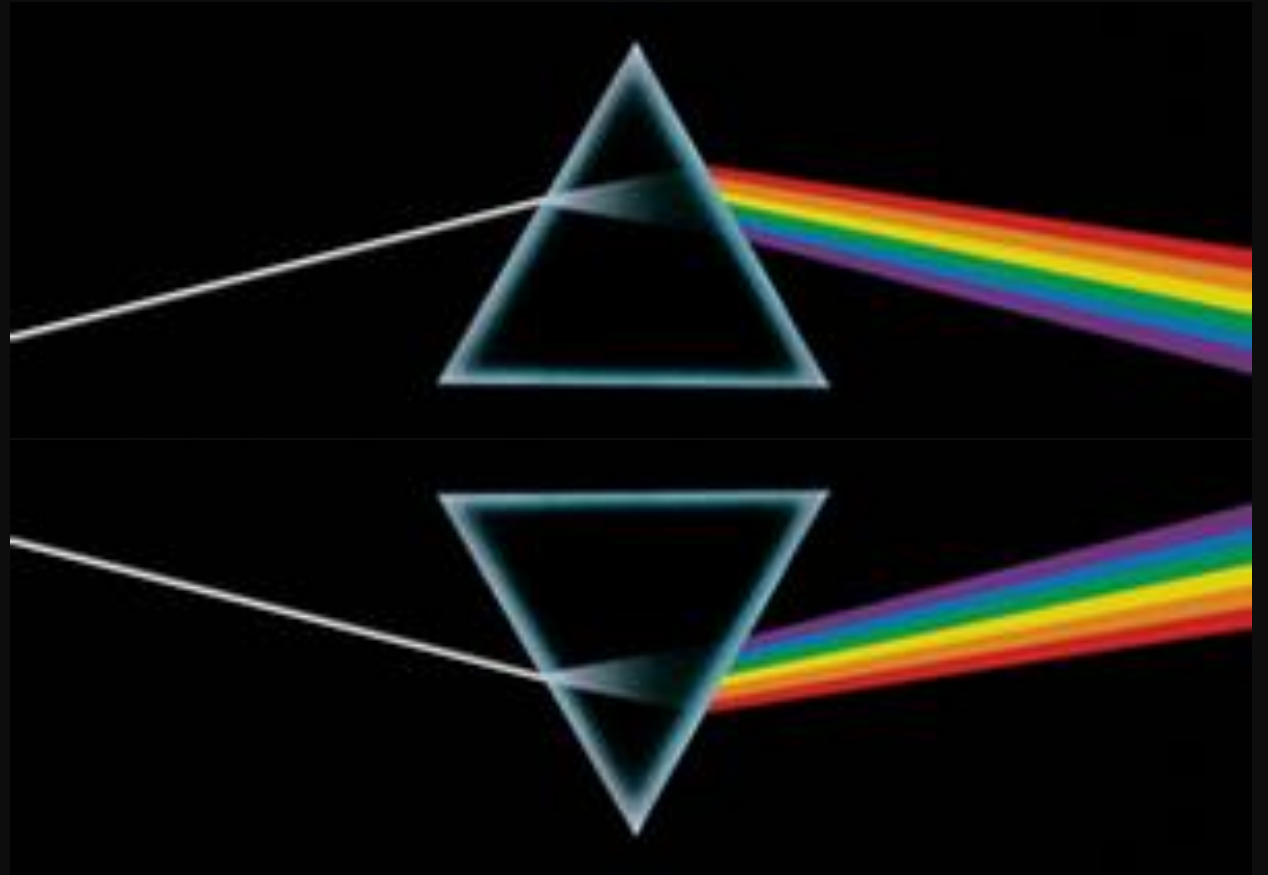
Lenses



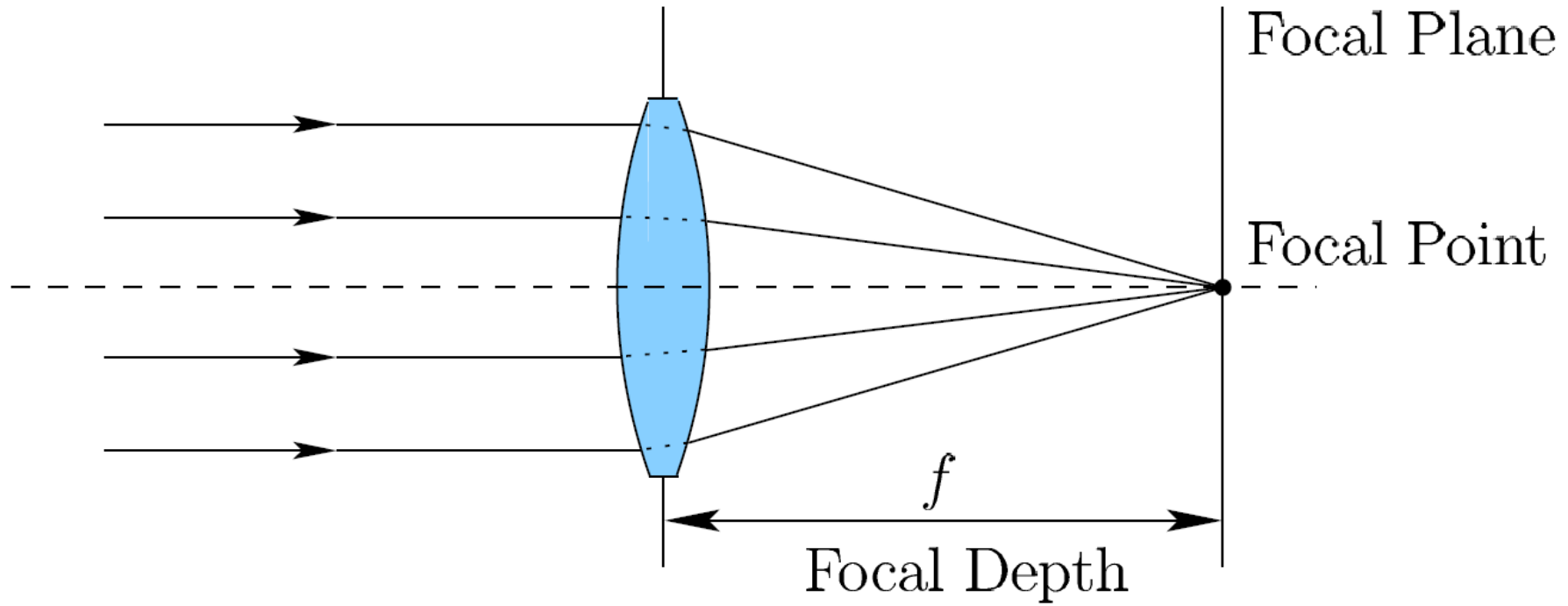
Snell's Law

Prisms

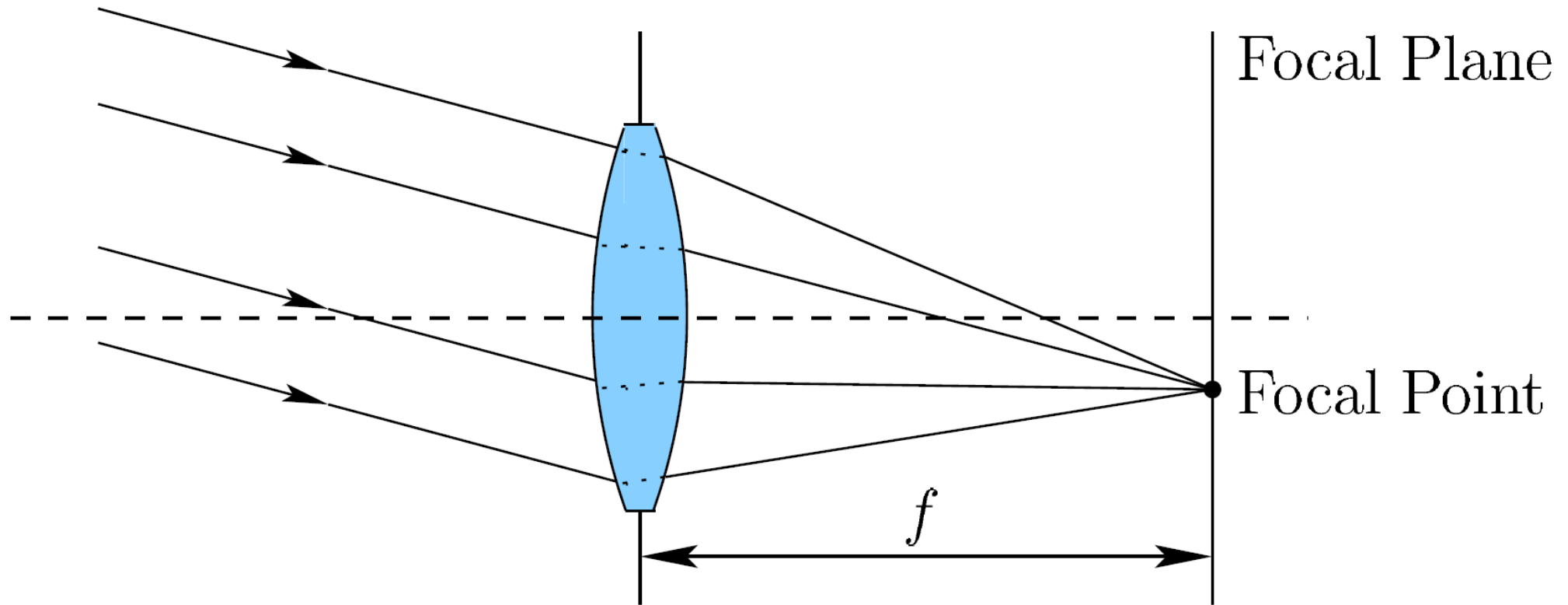
A simple prism bends ascending rays into descending rays



Simple convex lens

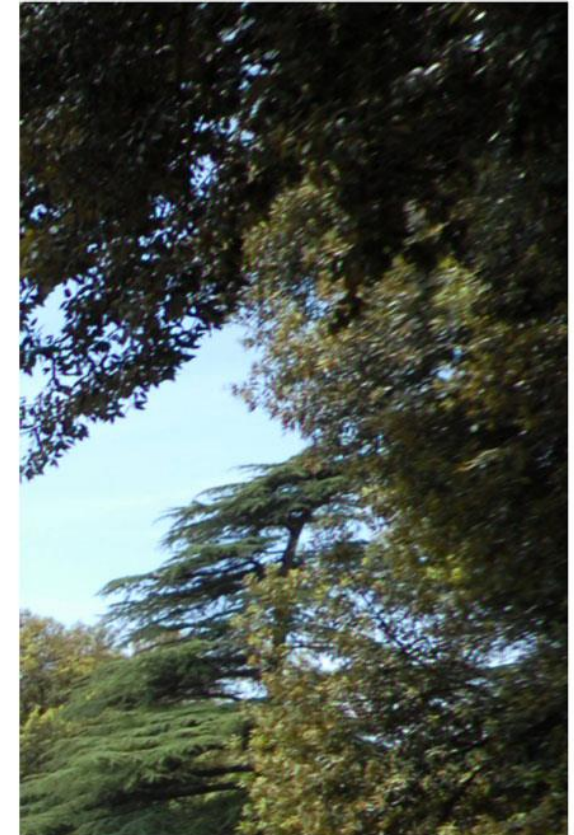


Simple convex lens



Optical Aberrations

- **Chromatic aberration**
- Spherical aberration
- Optical distortion
- Astigmatism
- Coma and flare



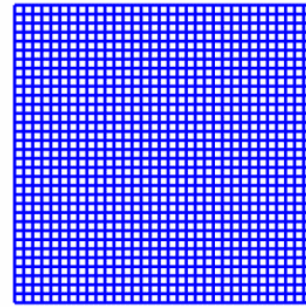
Optical Aberrations

- Chromatic aberration
- **Spherical aberration**
- Optical distortion
- Astigmatism
- Coma and flare

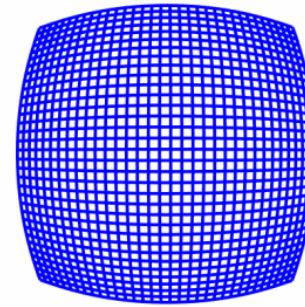


Optical Aberrations

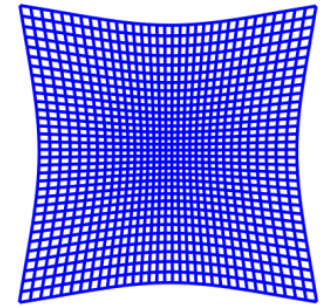
- Chromatic aberration
- Spherical aberration
- **Optical distortion**
- Astigmatism
- Coma and flare



INPUT GRID



BARREL DISTORTION



PINCUSHION DISTORTION

Optical Aberrations

- Chromatic aberration
- Spherical aberration
- Optical distortion
- **Astigmatism**
- Coma and flare

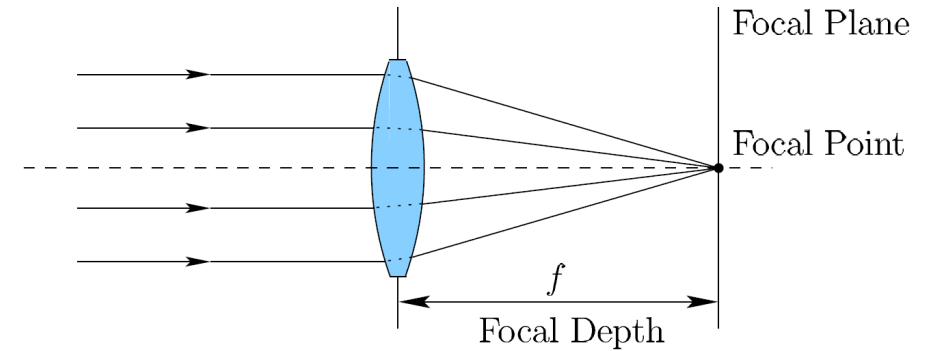
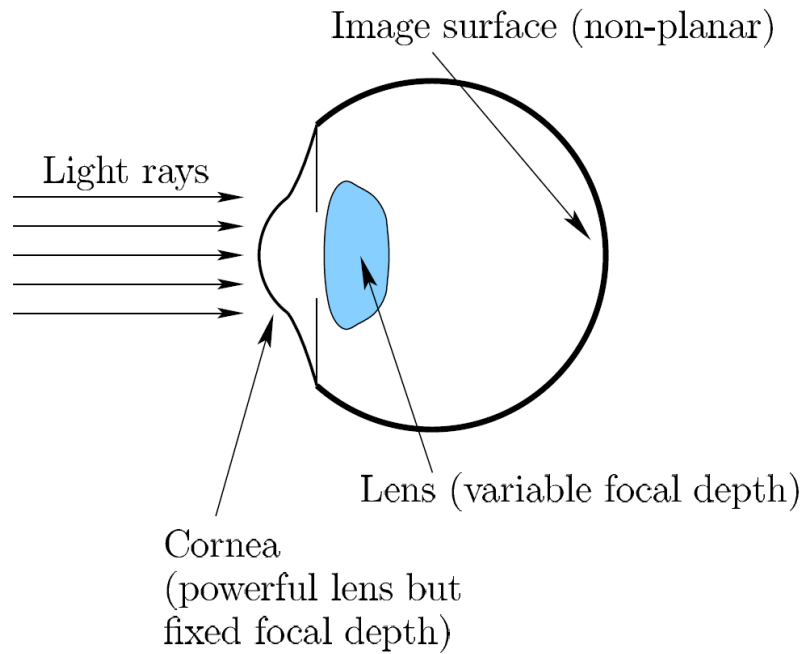


Optical Aberrations

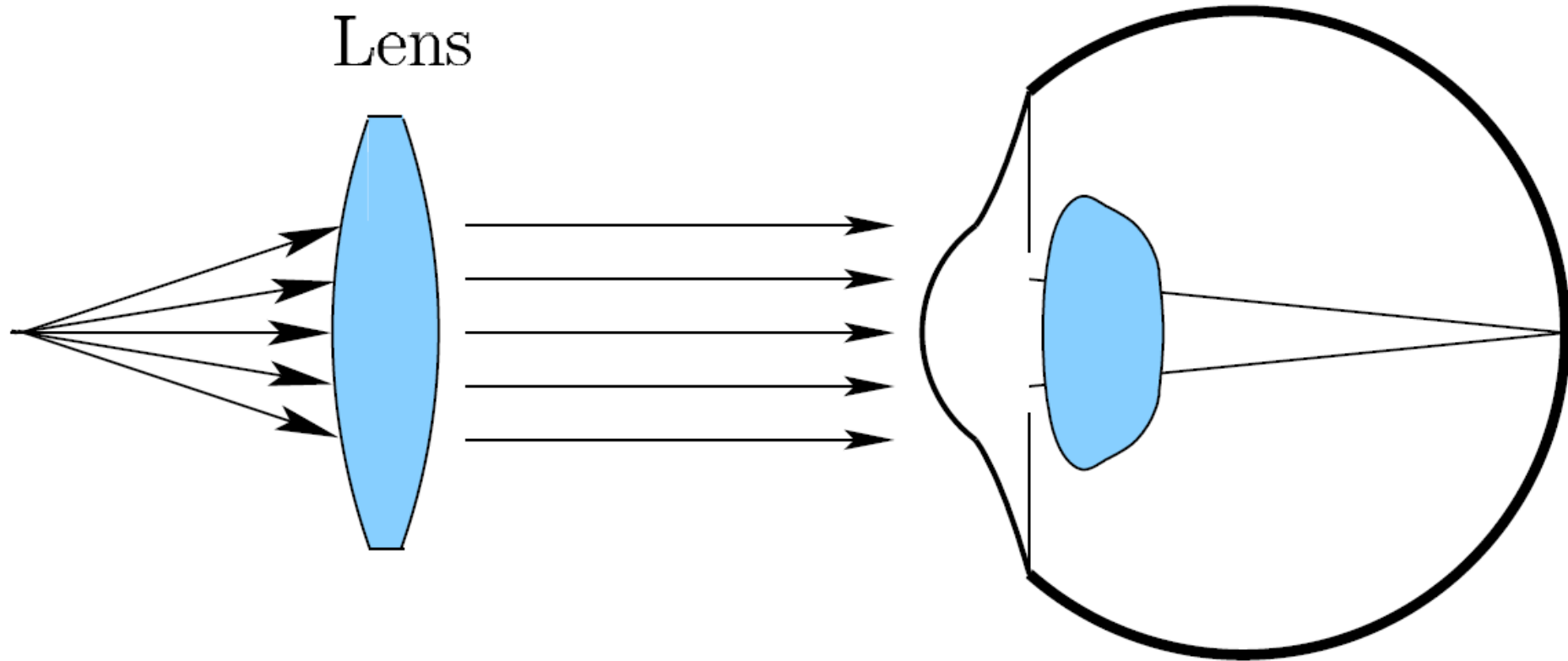
- Chromatic aberration
- Spherical aberration
- Optical distortion
- Astigmatism
- **Coma and flare**



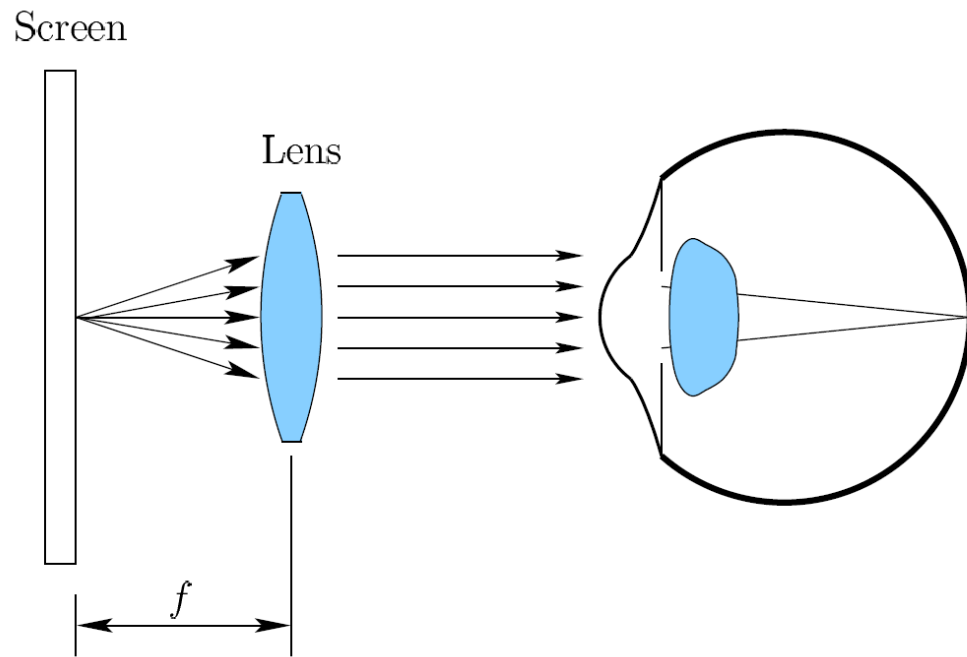
The Human Eye



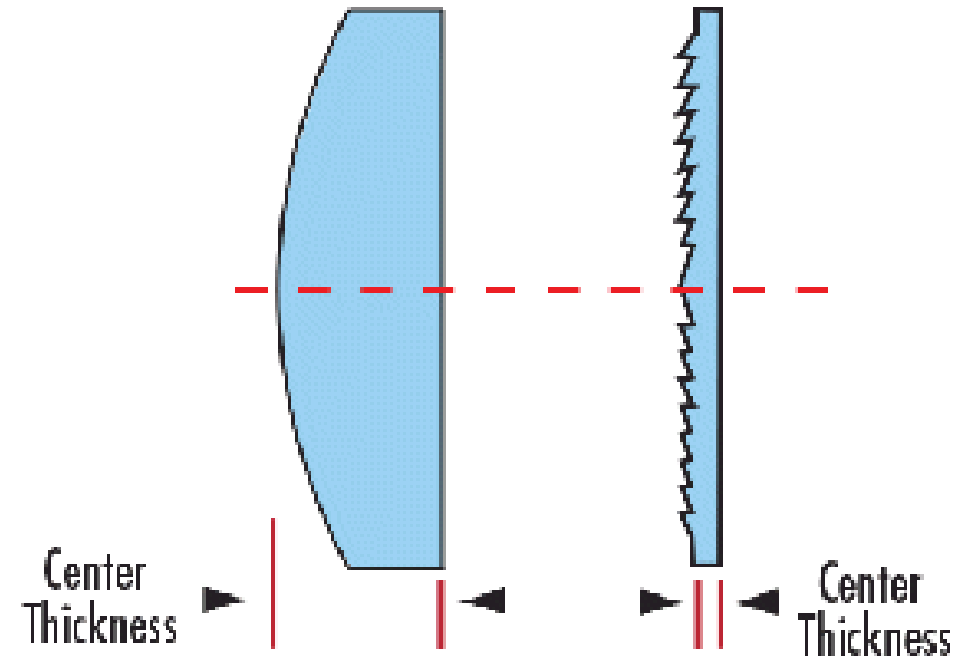
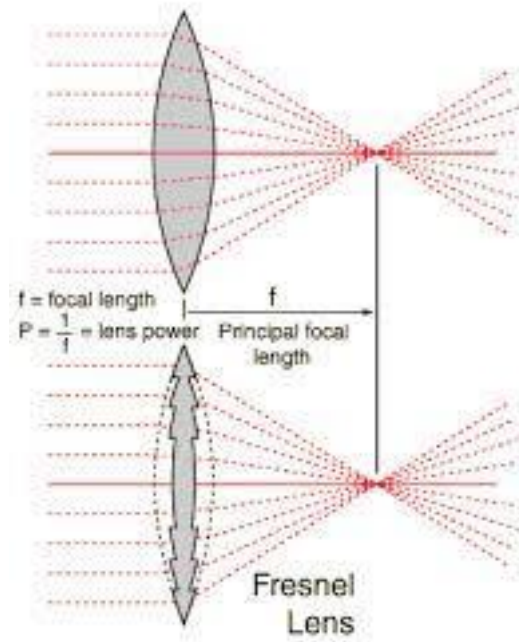
Combining



A simple HMD XR device

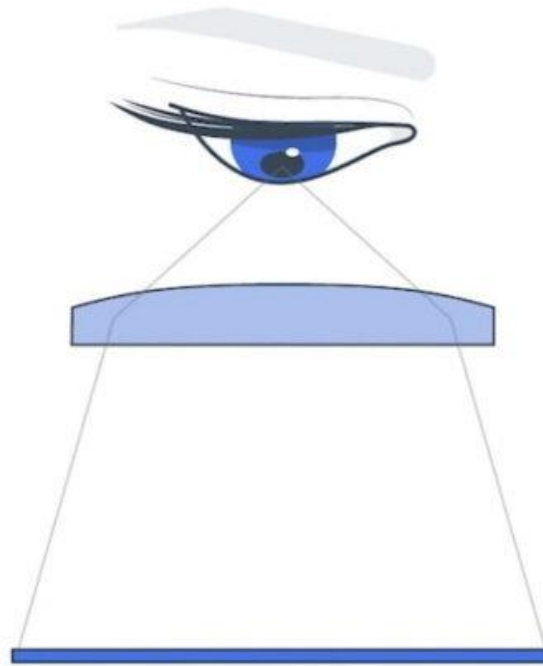


Fresnel lens

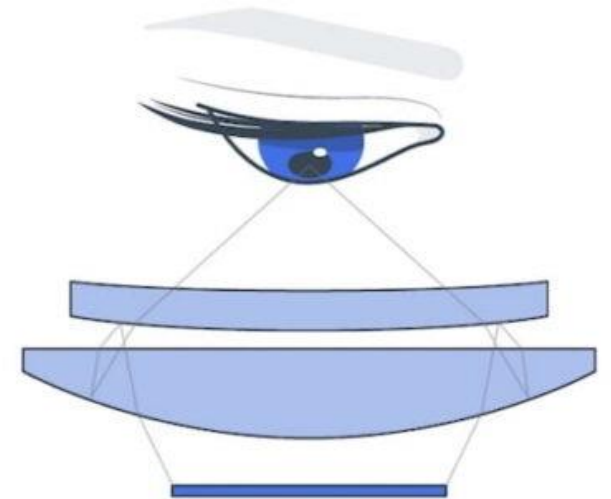


Pancake lens

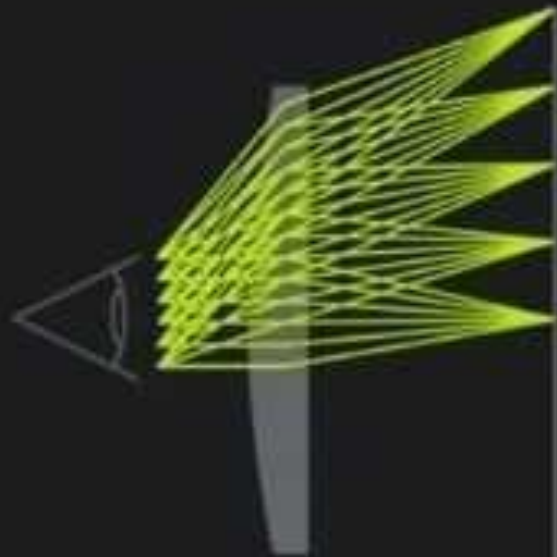
Refractive lens



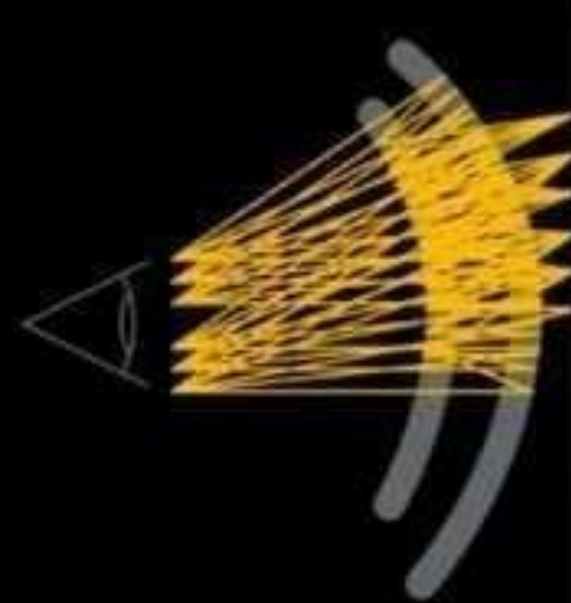
Pancake lens

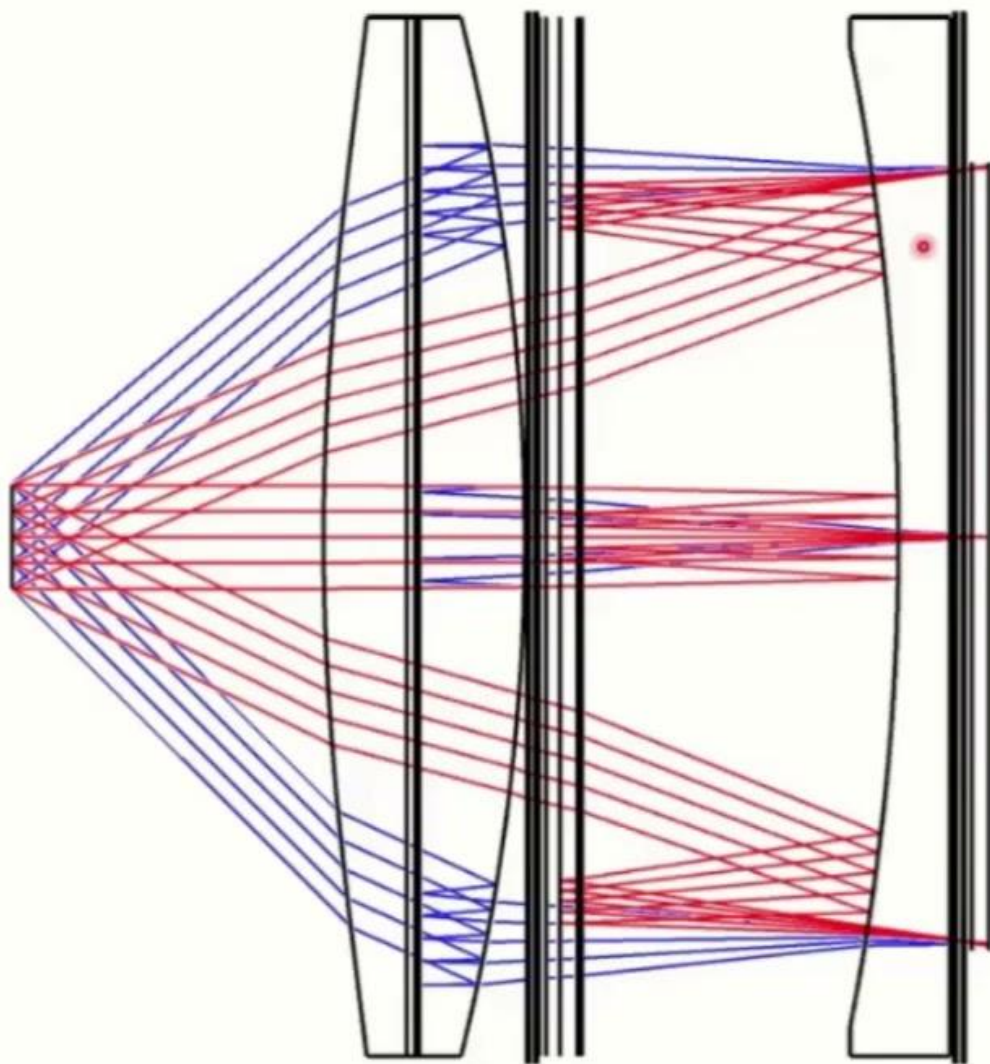


FRESNELS



PANCAKE LENSES (POLARIZATION-BASED)





What the eye sees



High Resolution in Central 50°

Further Reading

- W. J. Smith. Modern Optical Engineering, 4th Ed. SPIE Press, Bellingham, WA, 2008.
- J. E. Greivenkamp. Field Guide to Geometrical Optics. SPIE Press, Bellingham, WA, 2004.
- B. C. Kress and P. Meyrueis. Applied Digital Optics: From Micro-optics to Nanophotonics. Wiley, Hoboken, NJ, 2009.
- G. Smith and D. A. Atchison. The Eye and Visual Optical Instruments. Cambridge University Press, Cambridge, U.K., 1997.
- H. H. Barrett and K. J. Myers. Foundations of Image Science. Wiley, Hoboken, NJ, 2004.