Optics

Yichao Yu

Journal Club

Oct. 18, 2022

Geometrical optics

Useful for $> 90\%$ of calculation.

Geometrical optics

Useful for $> 90\%$ of calculation.

Exceptions

- Focus
- Long propagation
- Diffraction optical elements
  e.g. gratings.

Geometrical optics

Useful for $> 90\%$ of calculation.

Exceptions

- Focus
- Long propagation
- Diffraction optical elements
  e.g. gratings.

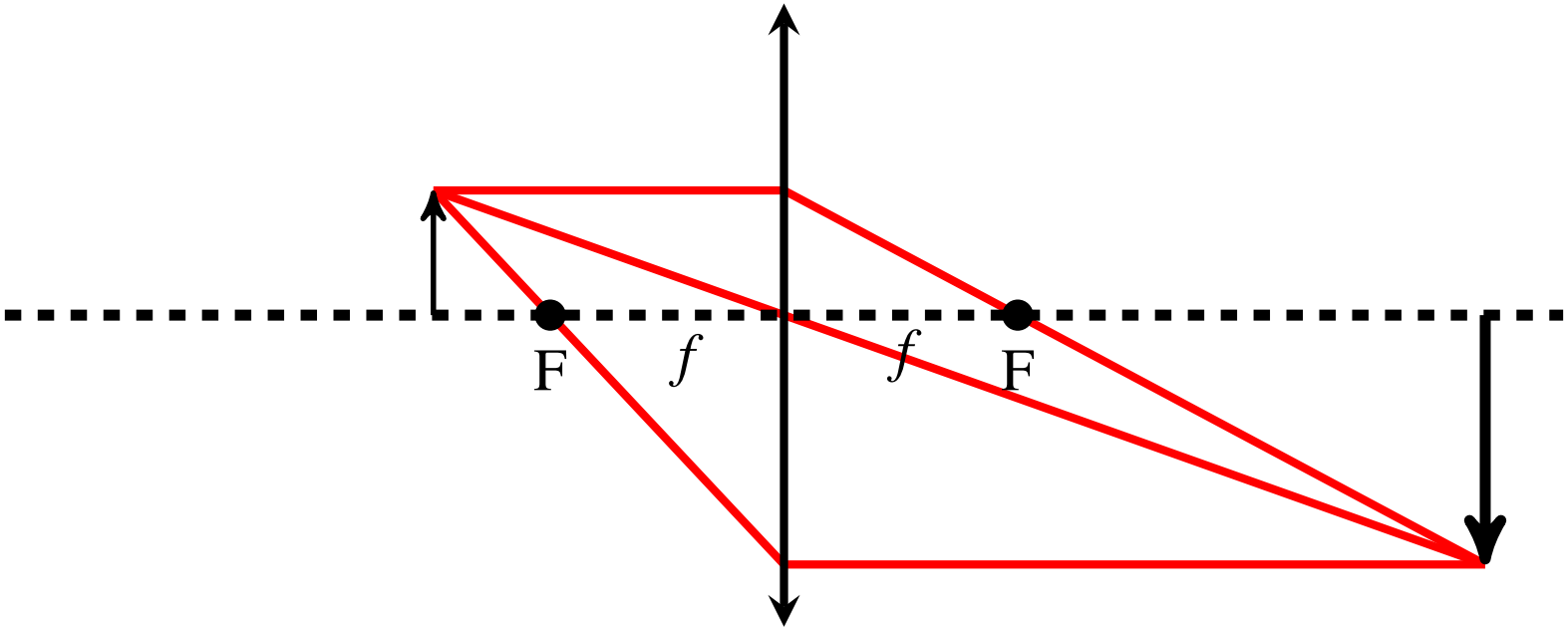
Geometrical optics

Useful for $> 90\%$ of calculation.

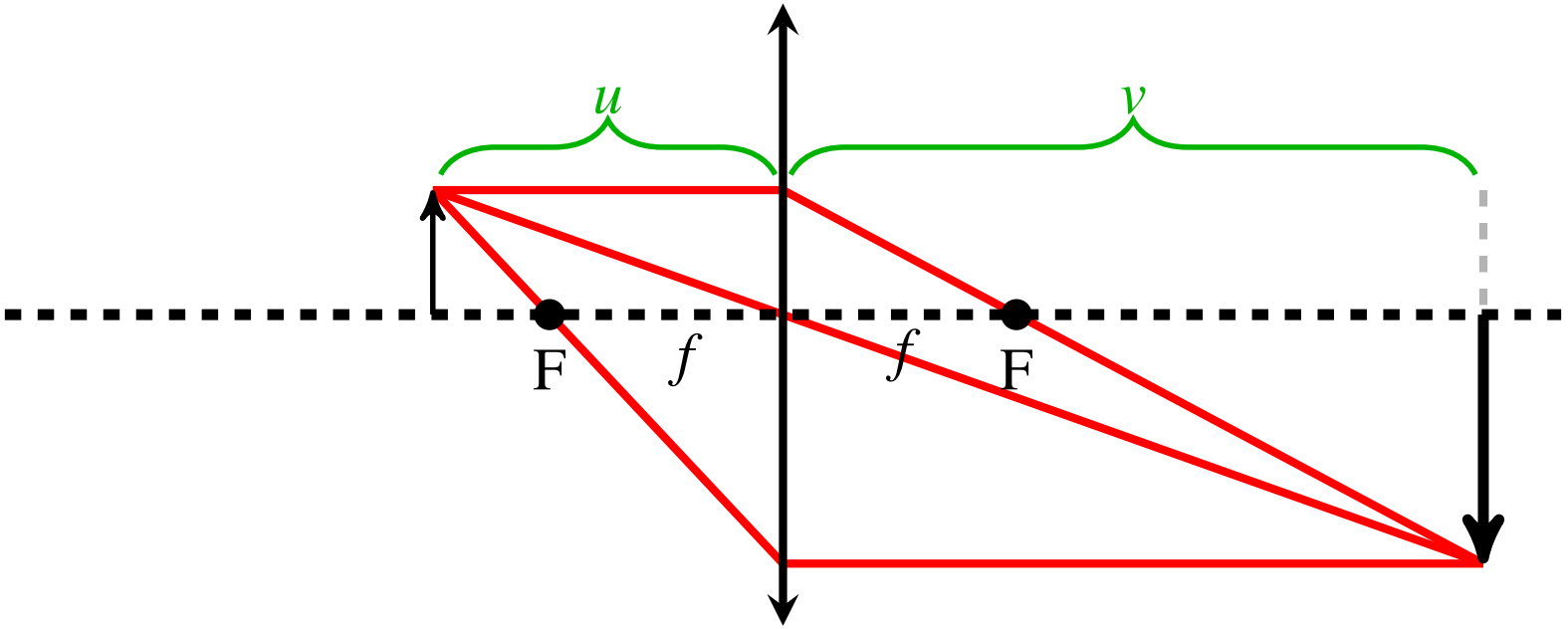
Exceptions

- Focus
- Long propagation
- Diffraction optical elements
  e.g. gratings.

Ideal Lens

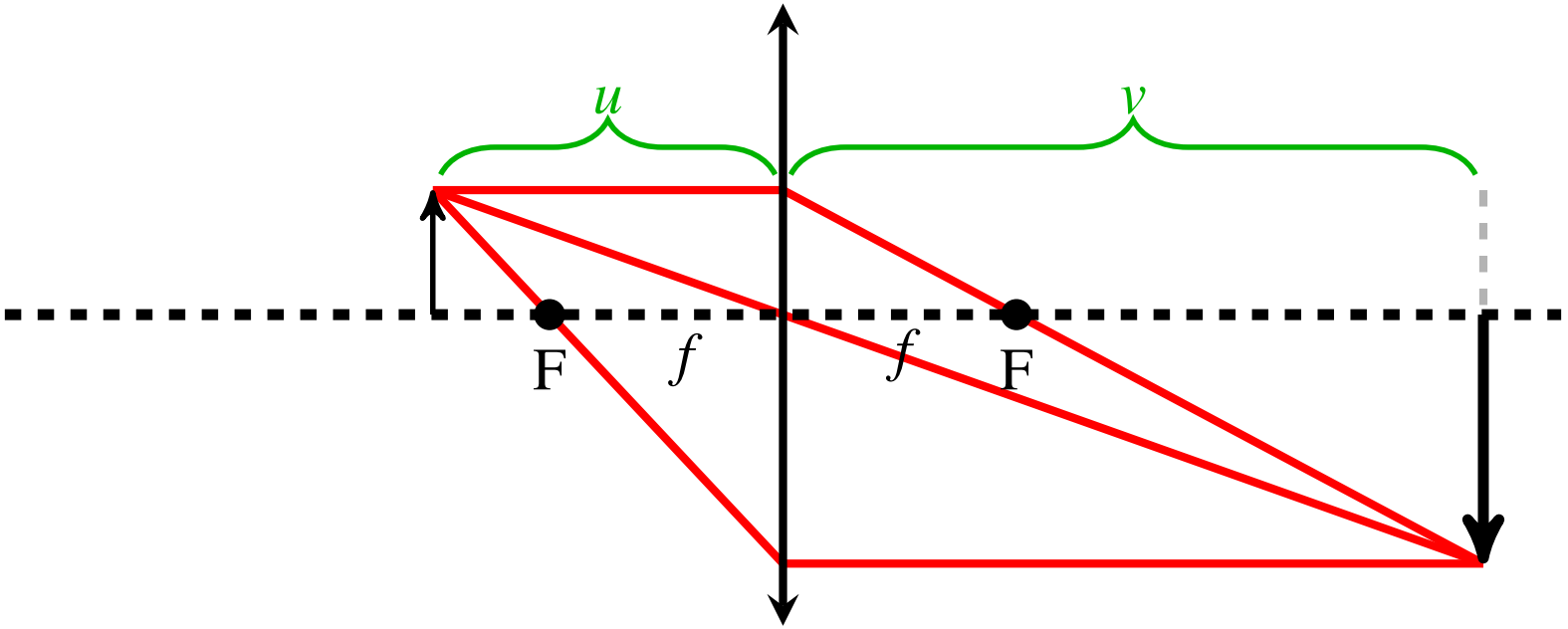


Ideal Lens



$$\frac{1}{u}+\frac{1}{v}=\frac{1}{f}$$

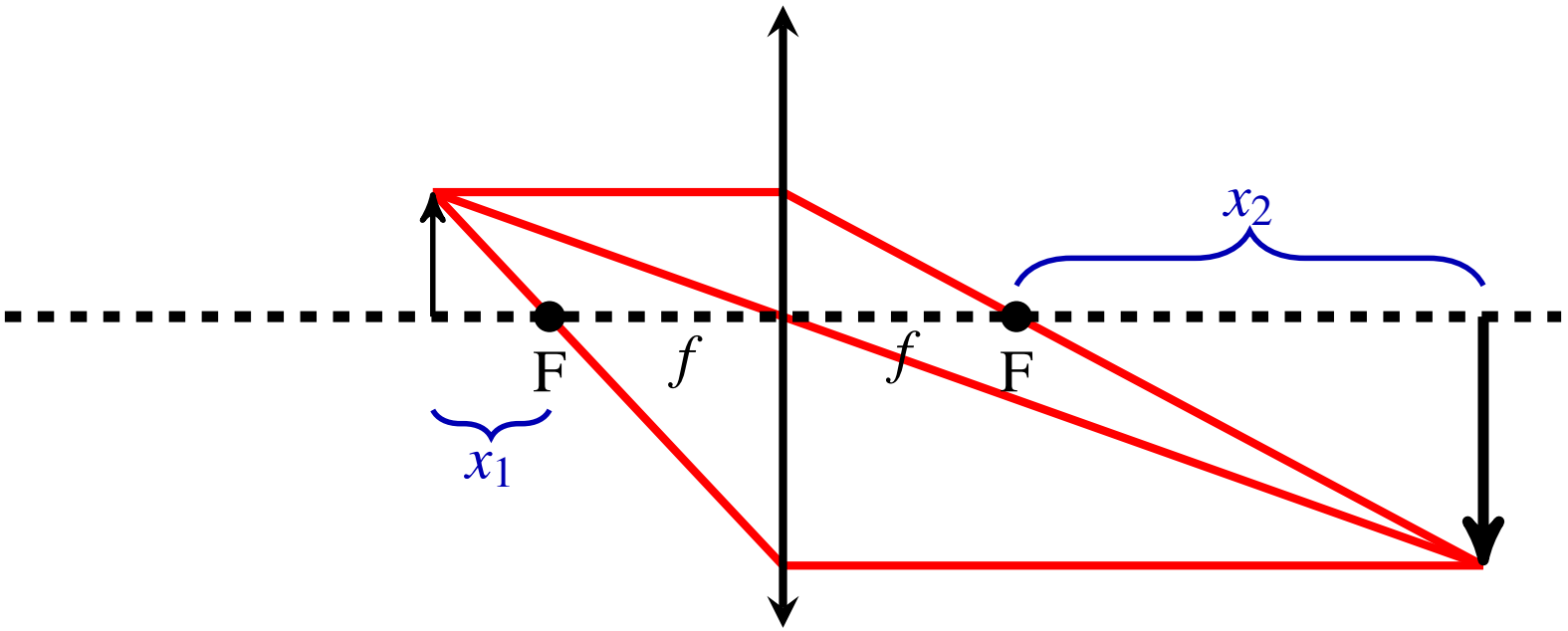
Ideal Lens



$$\frac{1}{u}+\frac{1}{v}=\frac{1}{f}$$

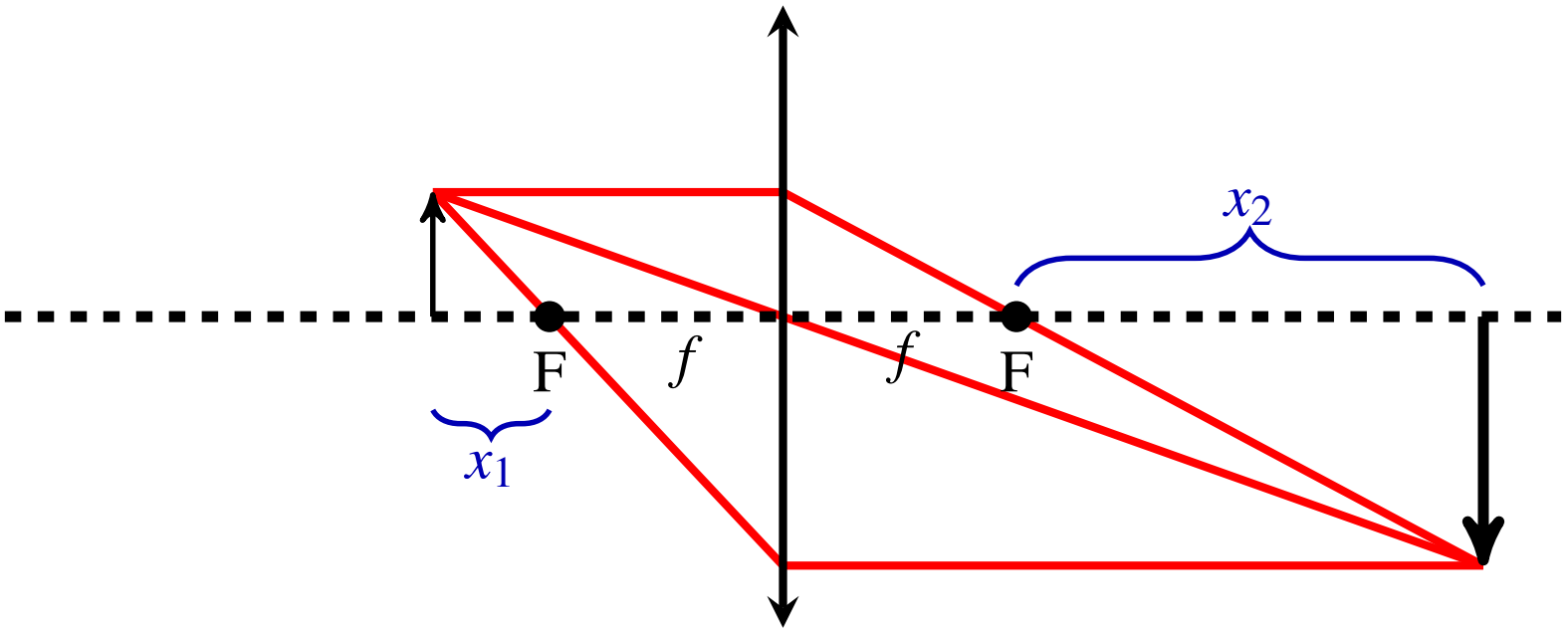
$$M=\frac{v}{u}$$

Ideal Lens



$$x_1 x_2 = f^2$$

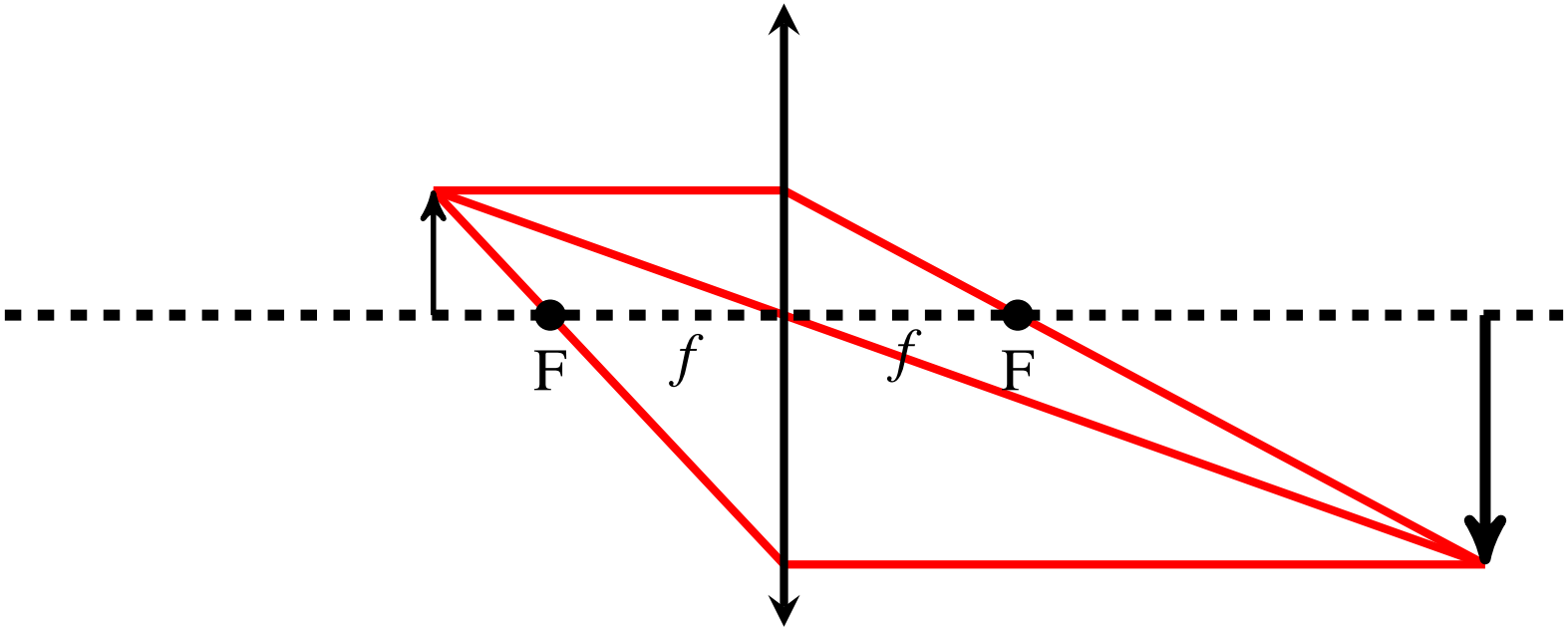
Ideal Lens



$$x_1 x_2 = f^2$$

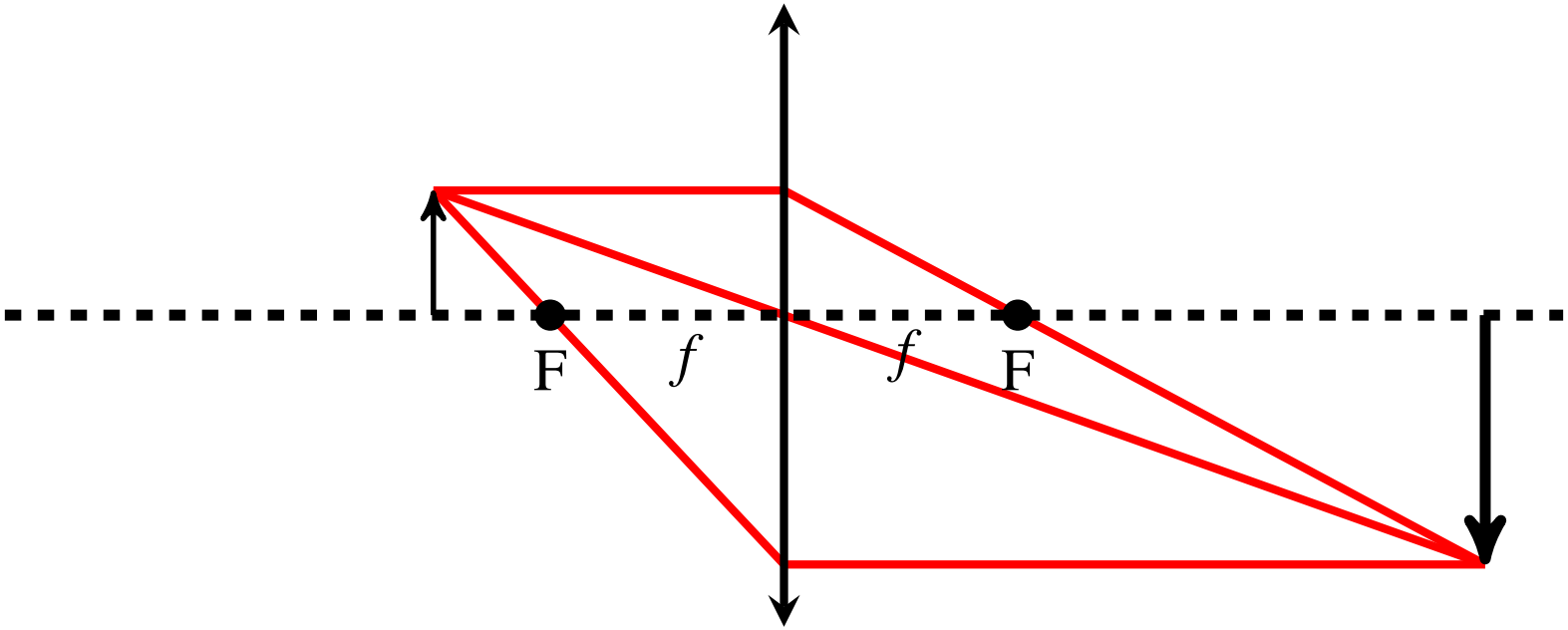
$$M = \frac{f}{x_1} = \frac{x_2}{f} = \sqrt{\frac{x_2}{x_1}}$$

Ideal Lens



Conjugate plane: Perfect image under ray optics

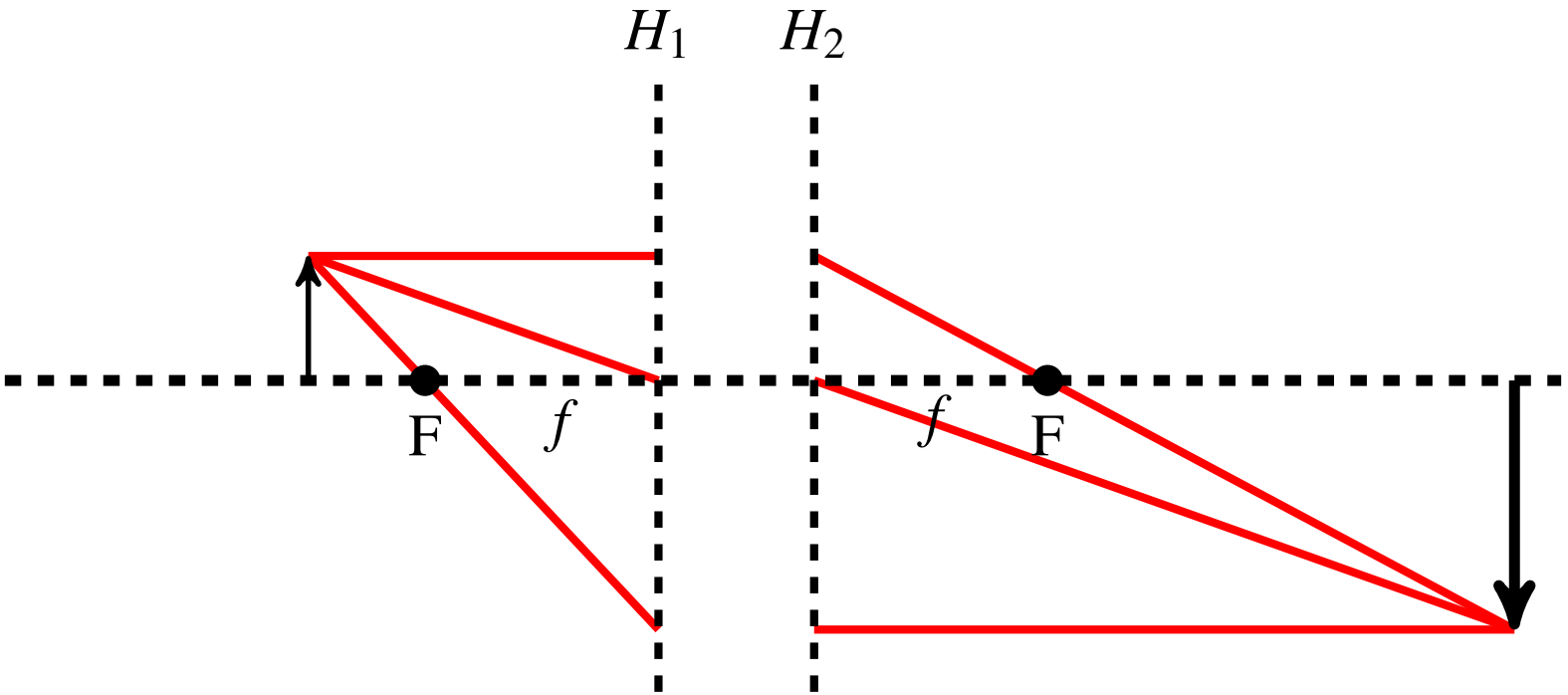
Ideal Lens



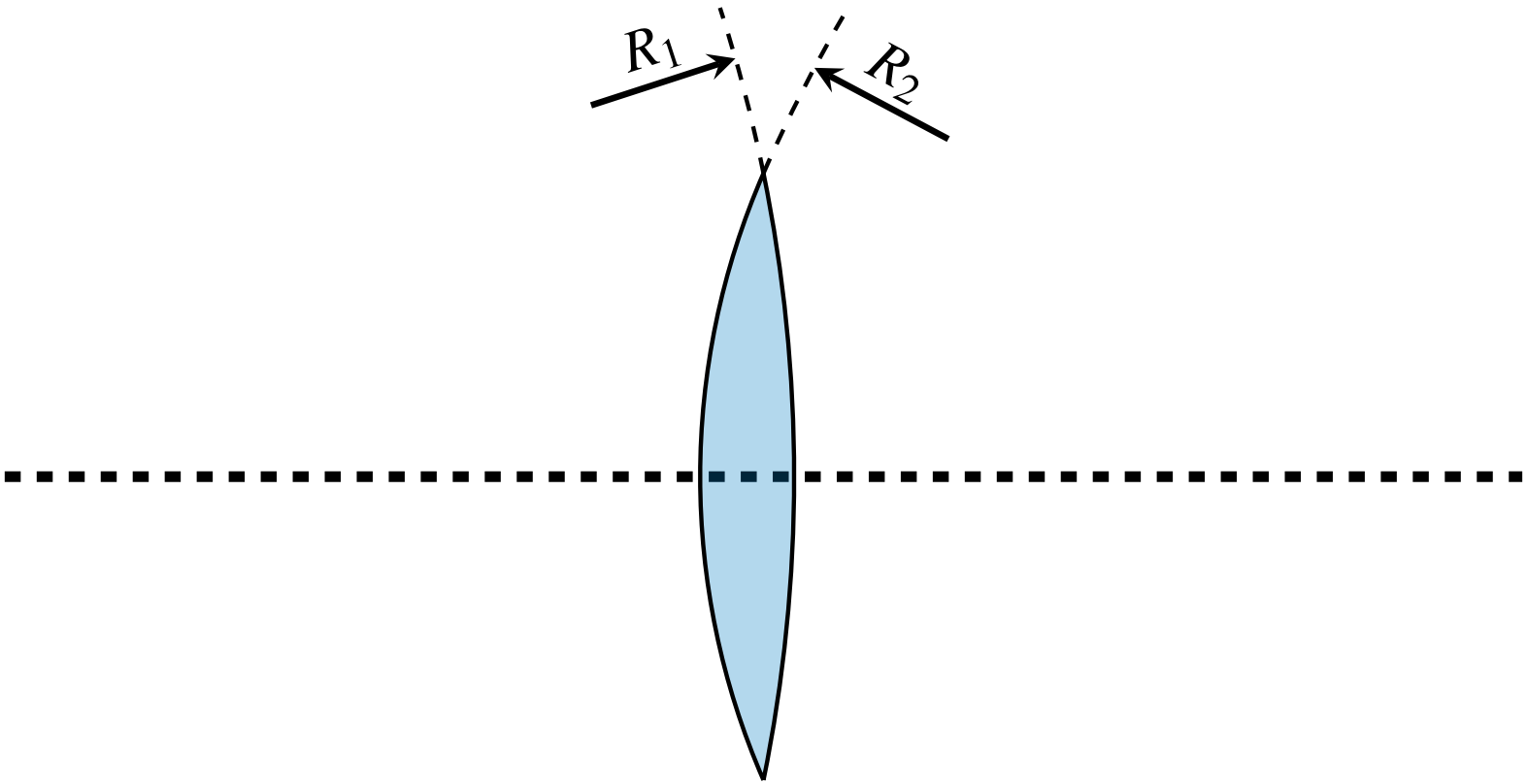
Conjugate plane: Perfect image under ray optics

Principal planes: Conjugate plane where $M = 1$

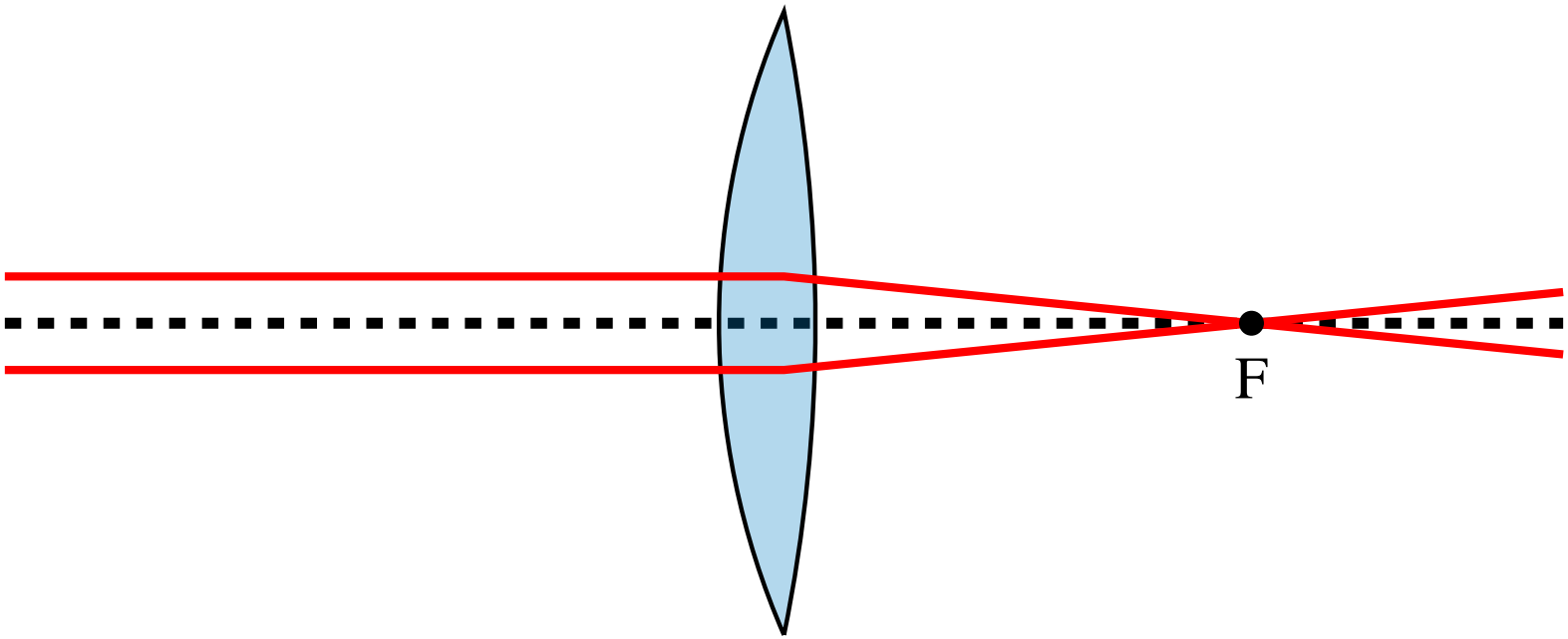
Ideal Lens



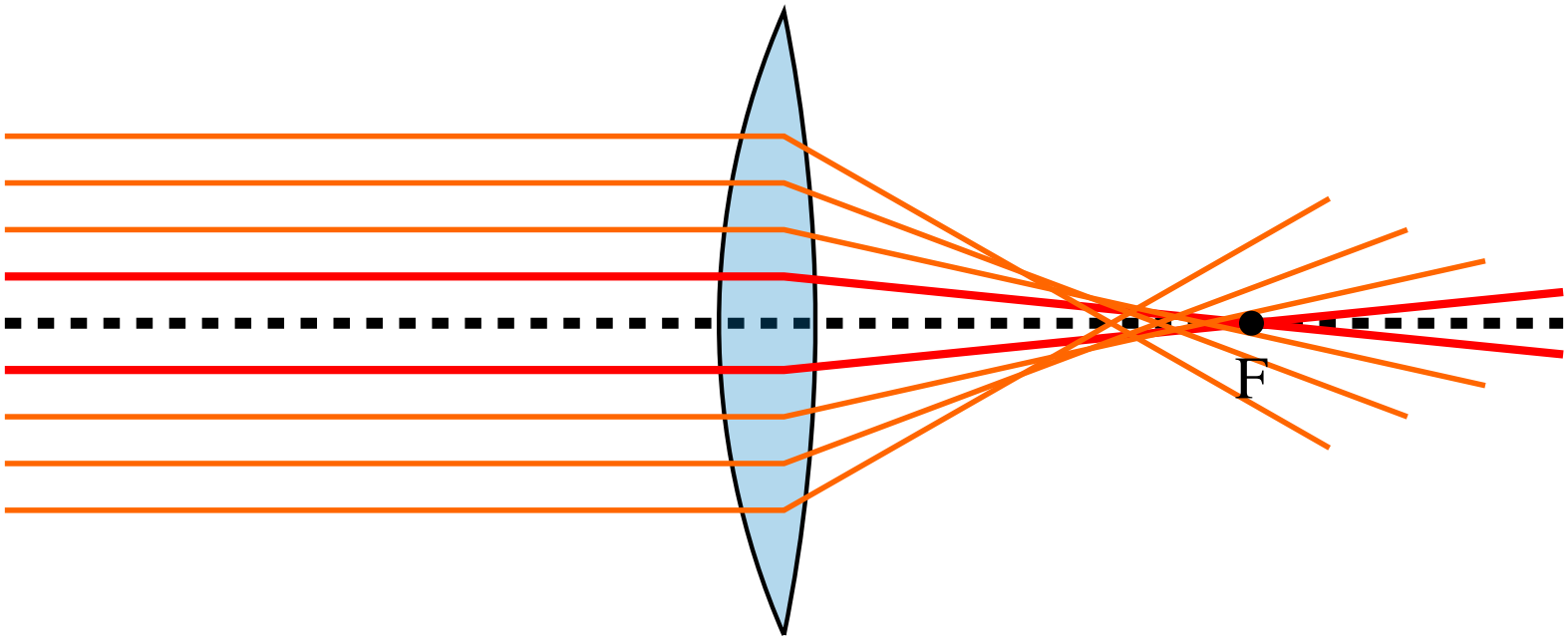
Spherical lens



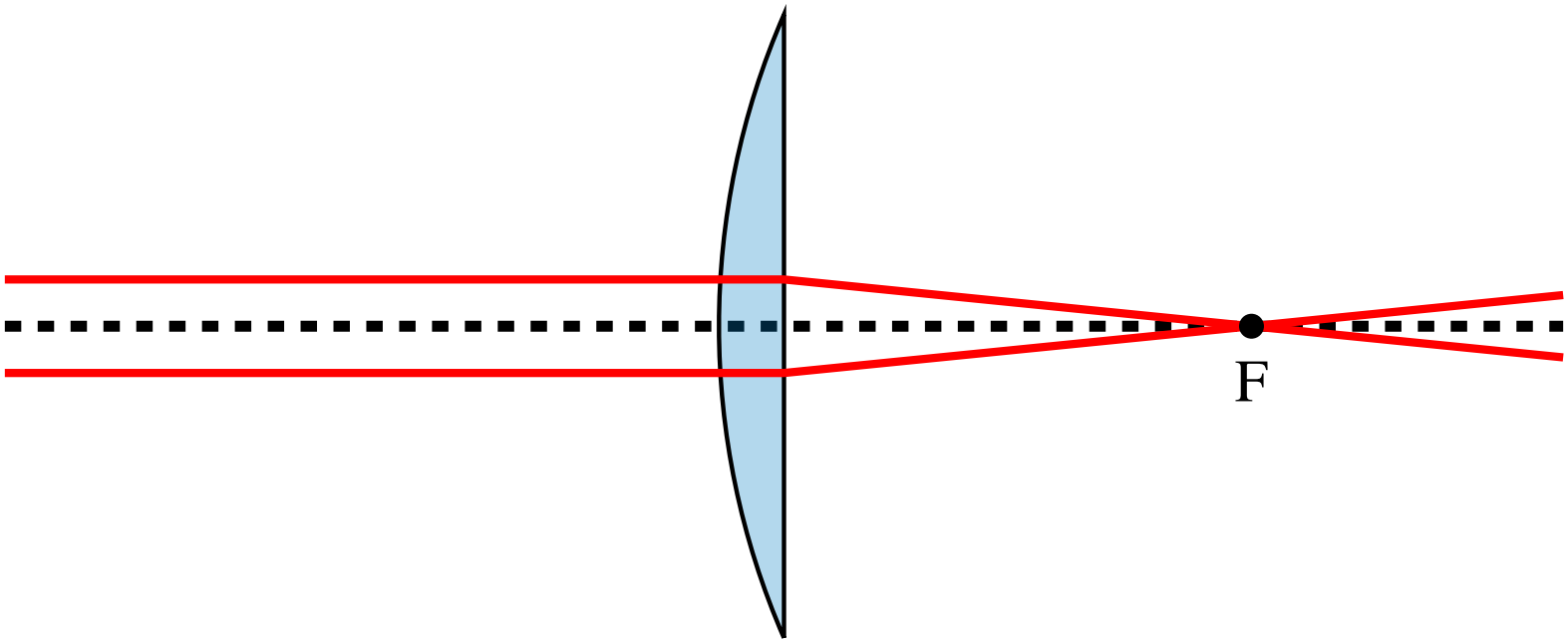
Spherical lens



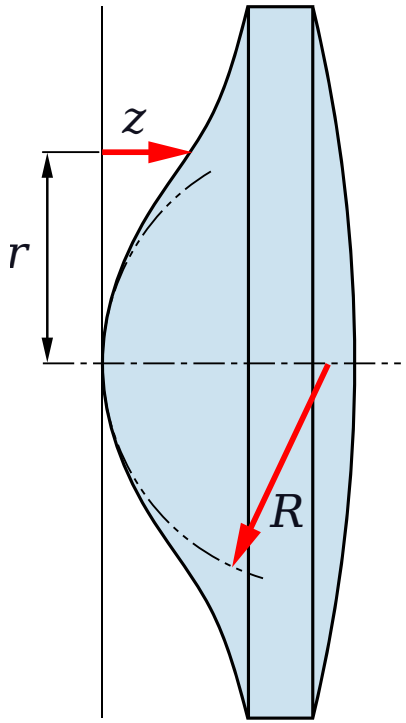
Spherical lens



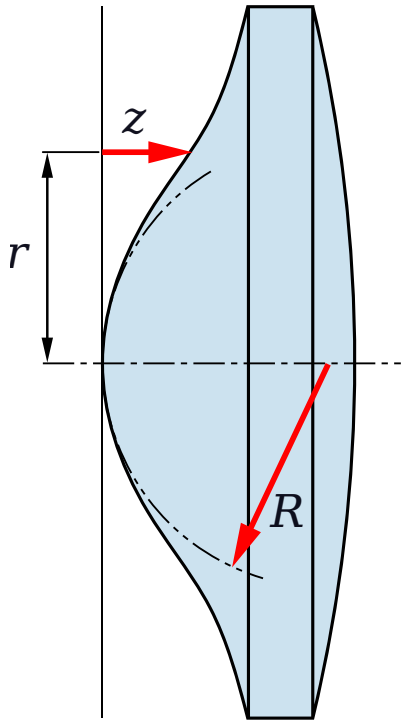
Spherical lens



Aspherical lens



Aspherical lens



Use cases

- Collimation
- Fiber coupling

Other lens types

Reflective

- No chromatic shift
- Can be aspherical
- More difficult beam path layout

Other lens types

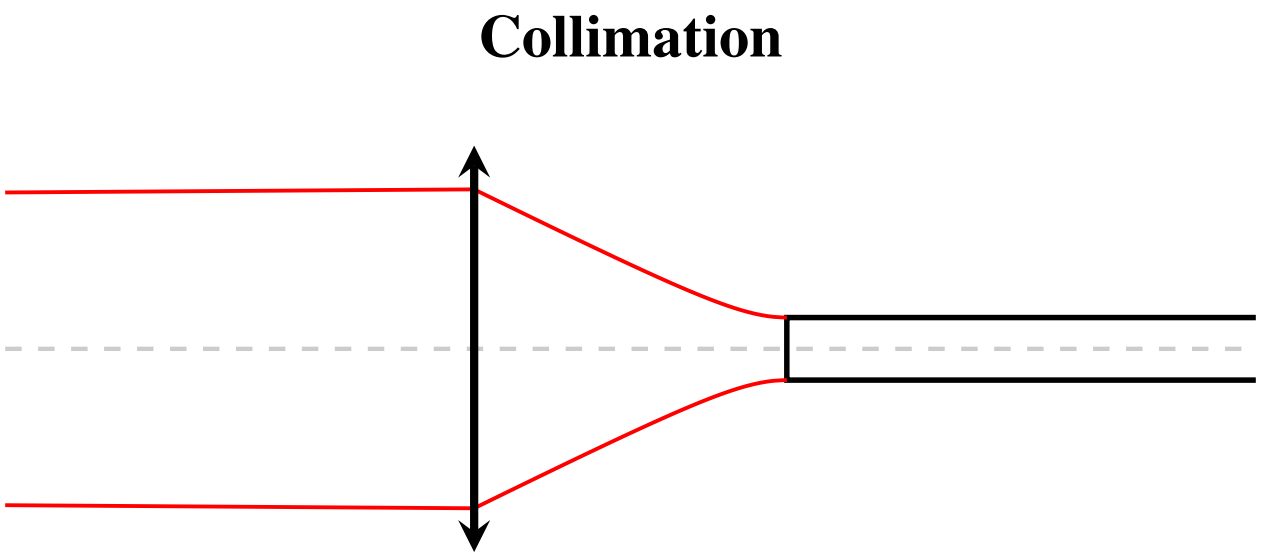
Reflective

- No chromatic shift
- Can be aspherical
- More difficult beam path layout

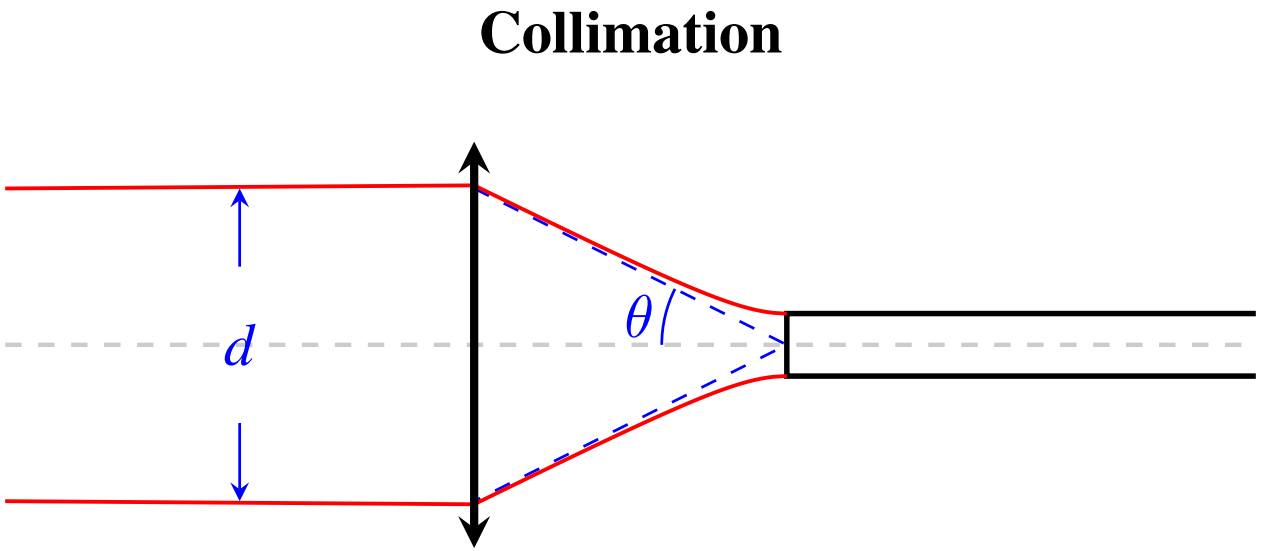
Lens set

- Could fix chromatic shift
- Could fix monochromatic aberration
- Better surface quality
- May not be UV compatible

Fiber coupling

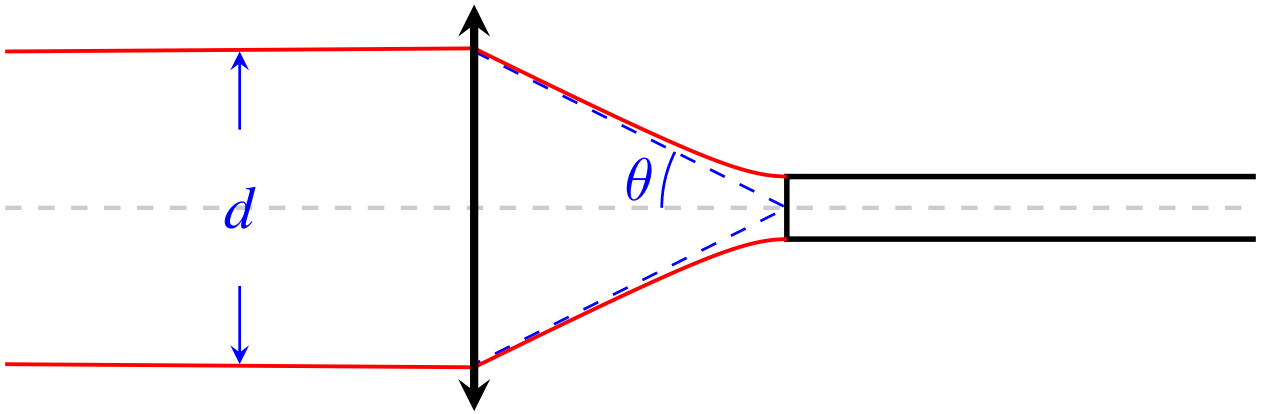


Fiber coupling



Fiber coupling

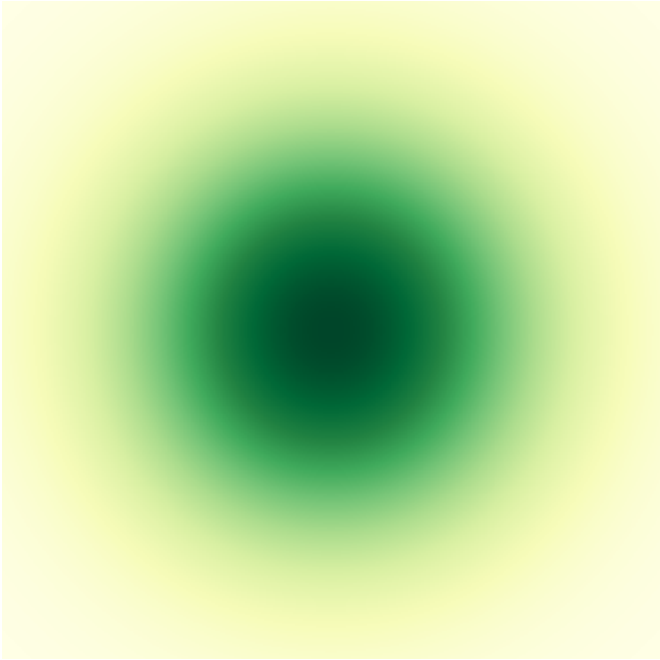
Collimation



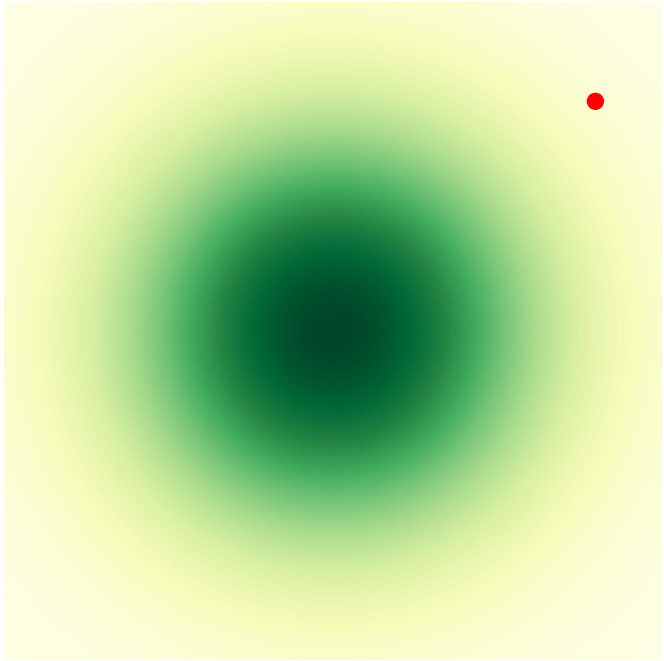
$$d \approx 2f \tan\theta$$

Alignment

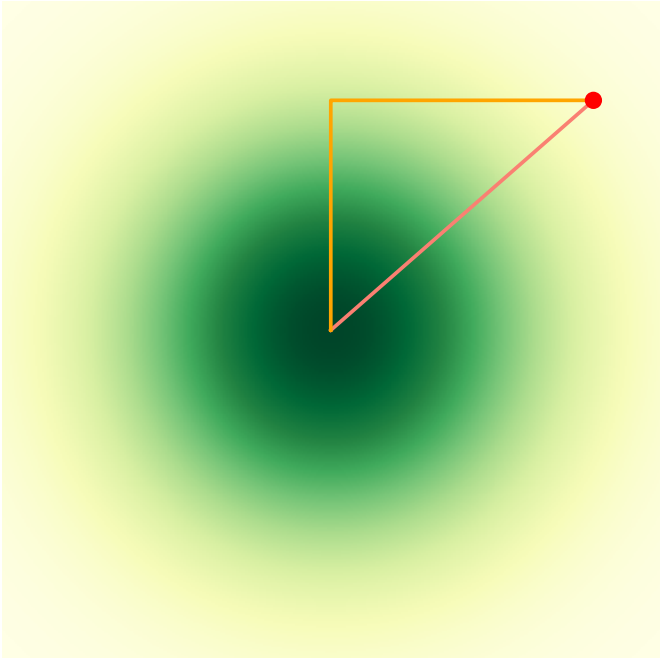
Alignment



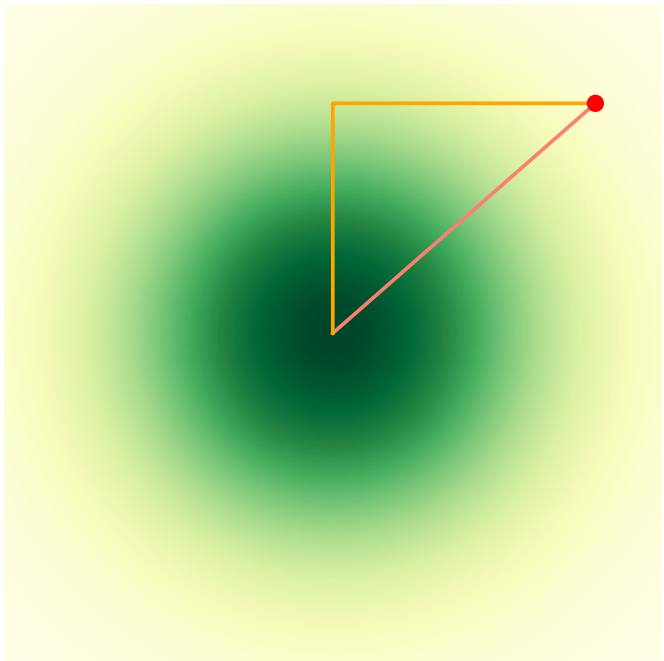
Alignment



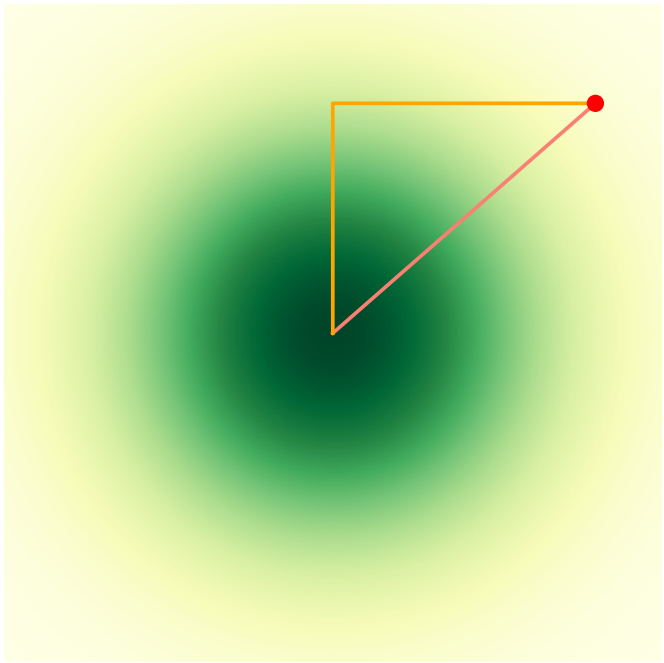
Alignment

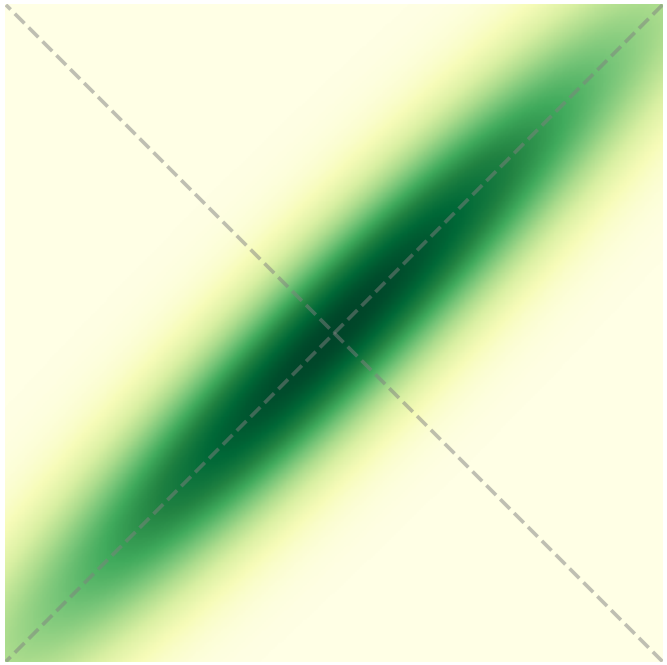


Alignment

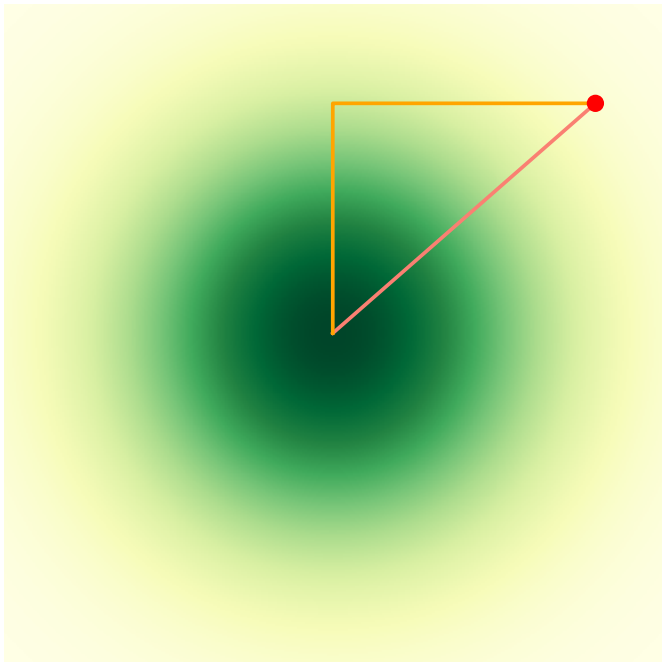


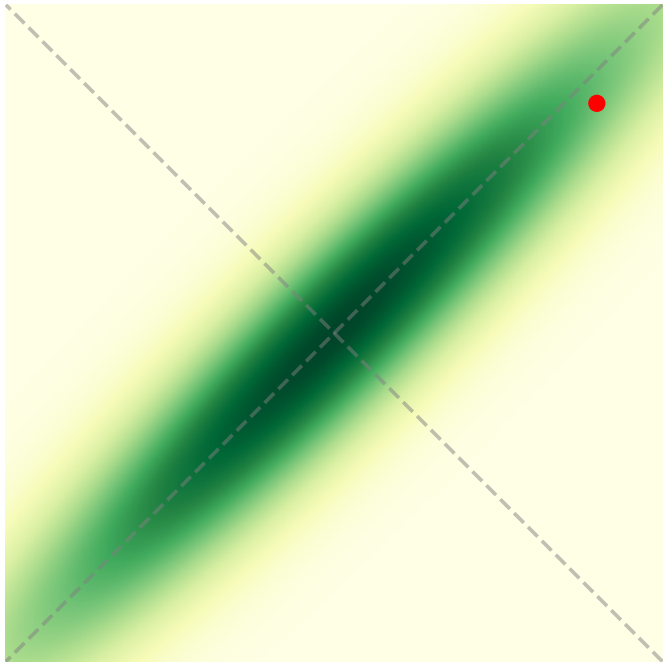
Alignment



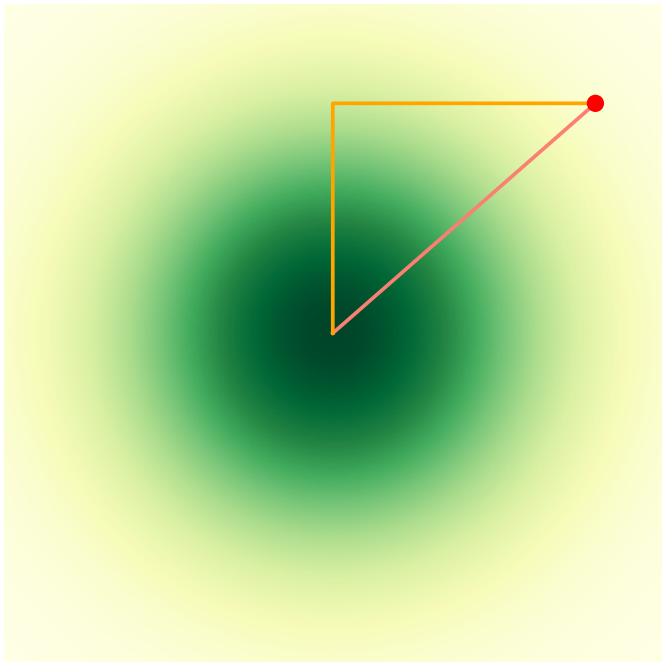


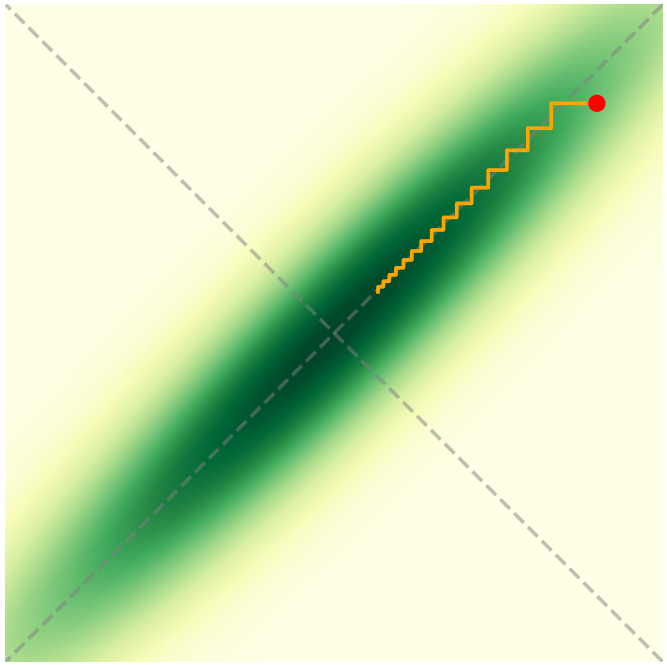
Alignment





Alignment





Alignment