qbio
quantitative biology

Imaging Biological Systems

Practicals : Optics basics

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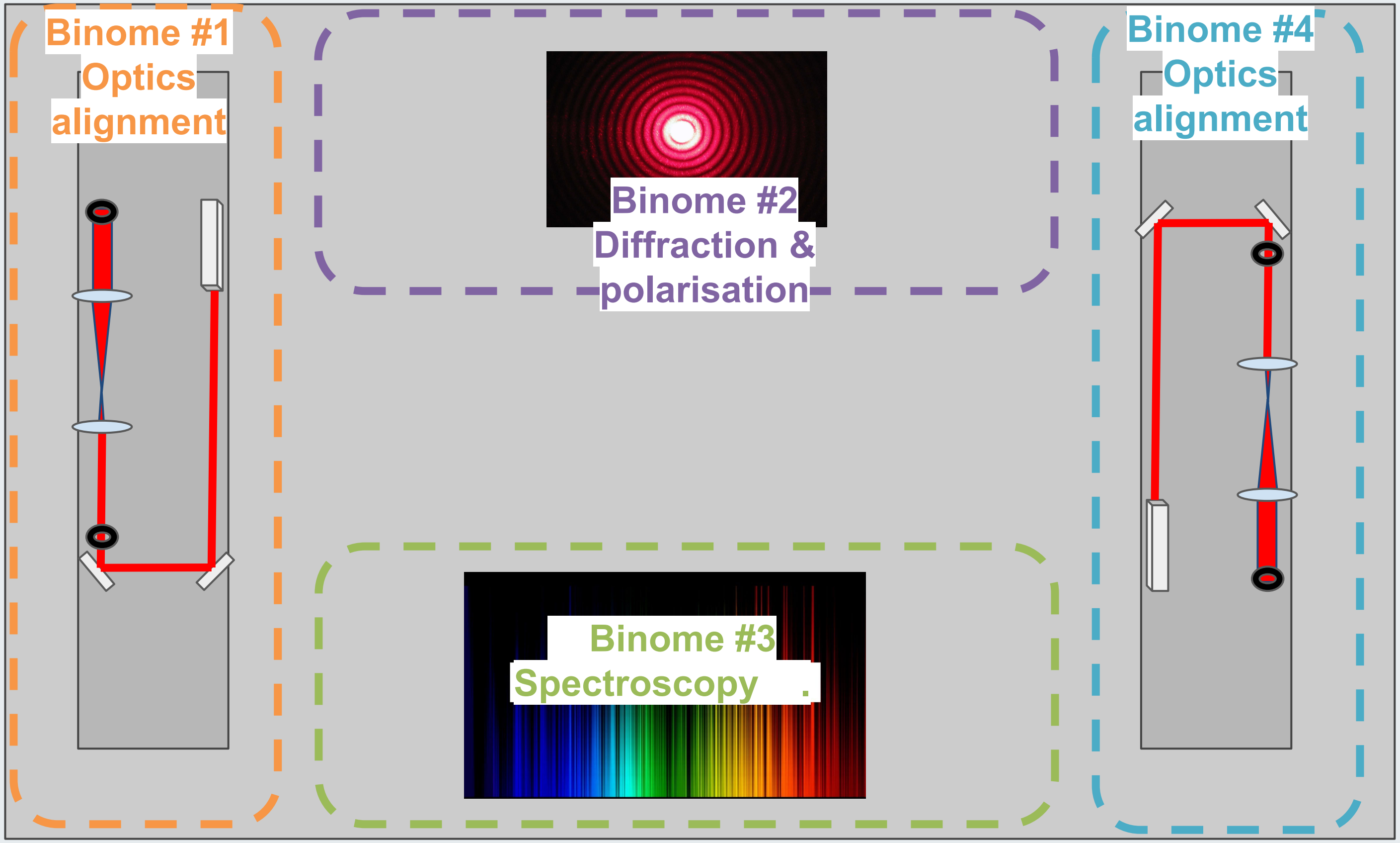
ORGANISATION

3 independent parts
4 binomes

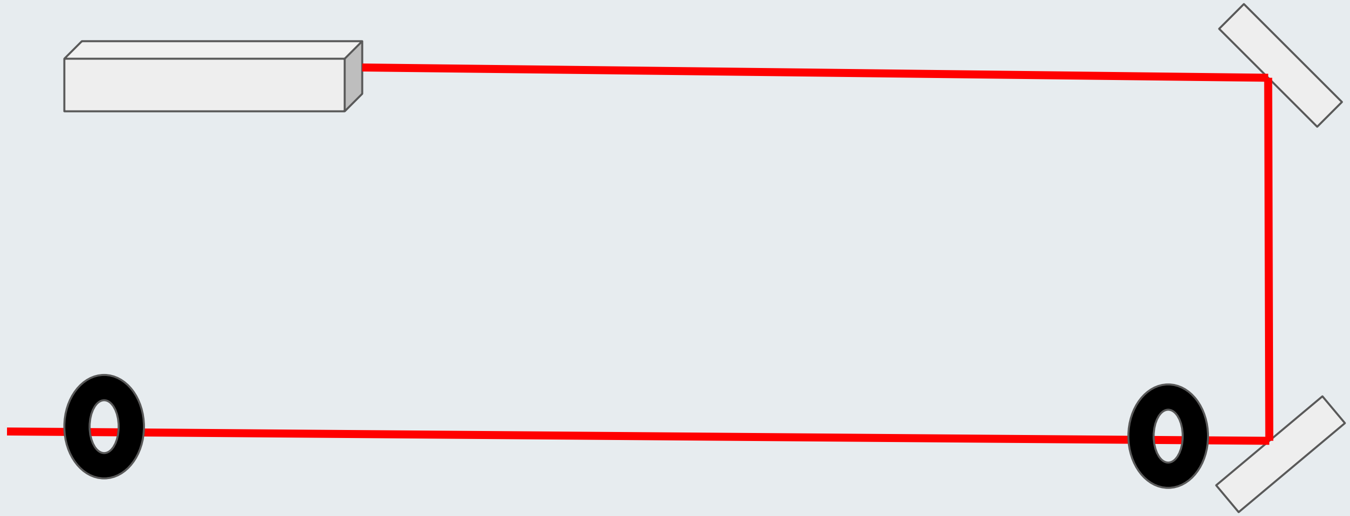


PART 1

Optics alignment

Objective : define a perfectly horizontal optical axis using 2 mirrors

1. Set the 2 irises to the same height to define a reference optical axis
2. Use the two mirrors to bring the laser beam along the optical axis

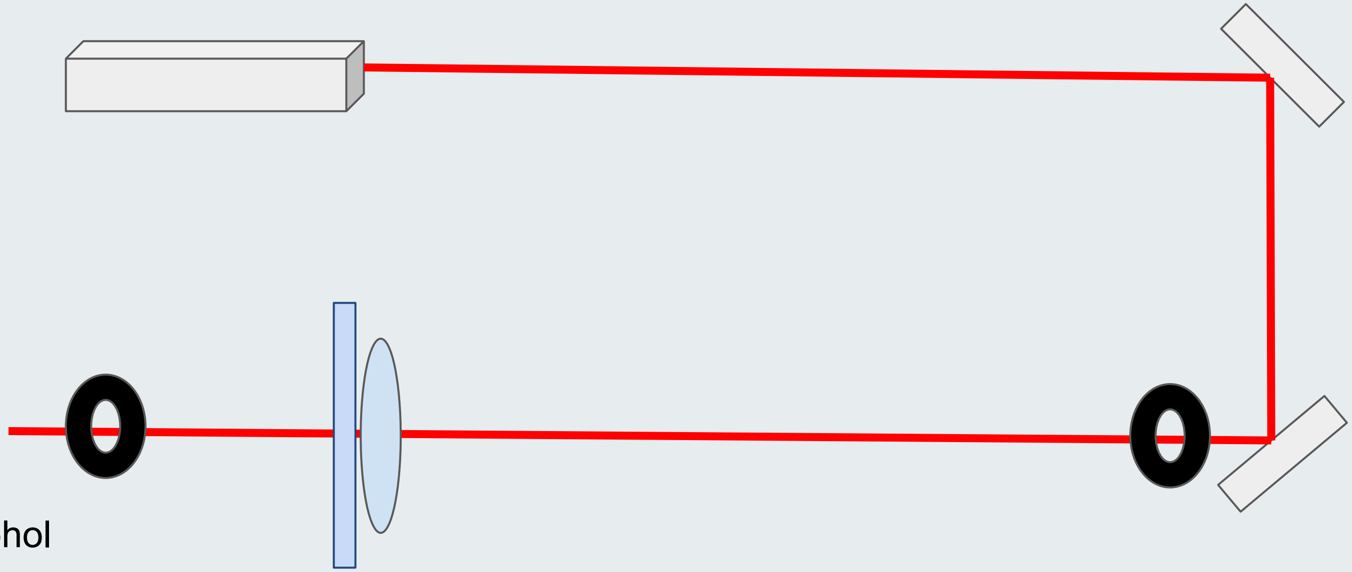


Posts,
Tightening rings
Iris
Mirrors

PART 1 - Lens alignment

Objective : align a lens

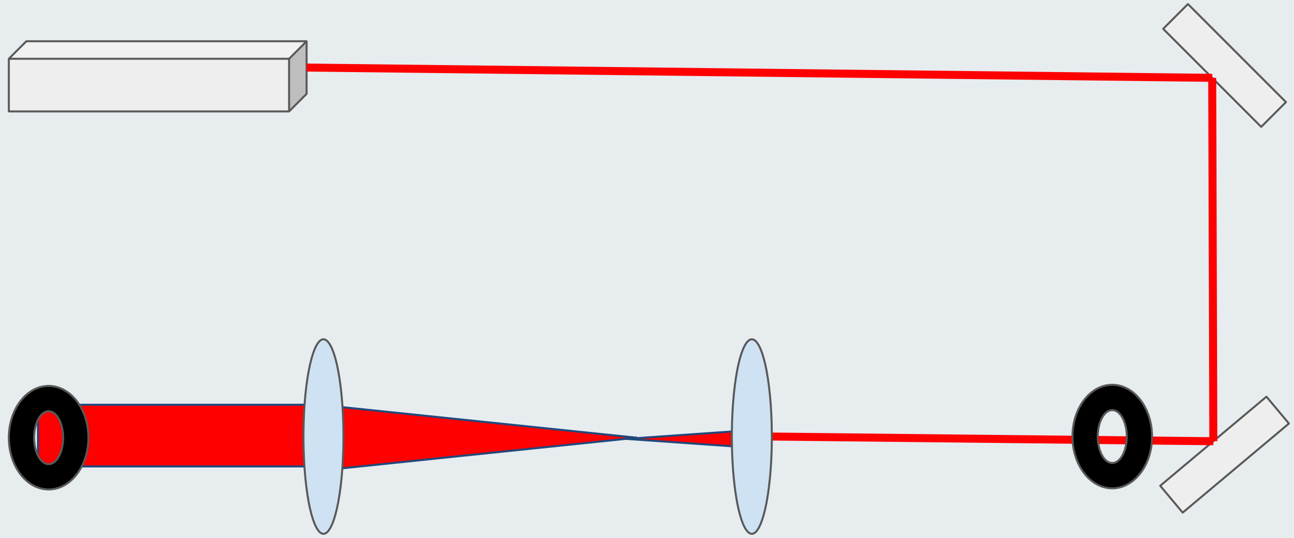
1. Insert the lens and roughly place it such that it looks perpendicular to the optical axis and that the output beam is center on the second iris
2. Insert a glass slide against the lens and look at the back reflection of the laser.
3. Use the glass slide to tilt the lens by checking the back reflection of the laser



Lens set
Glass slides
Optical paper and alcohol
White paper
Gloves

Objective : build a telescope.

1. Insert the second lens and roughly place it such that it appears perpendicular to the optical axis and such that the output beam is centered on the second iris
2. Use a glass slide to tilt the lens by checking the back reflection of the laser



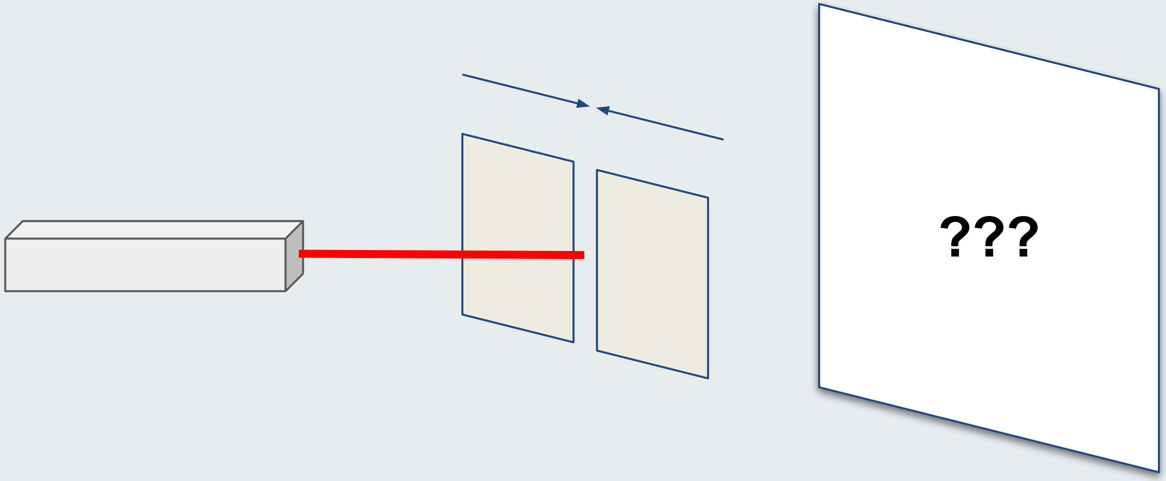
PART 2

Light polarisation and diffraction

PART 2 - Variable slit diffraction

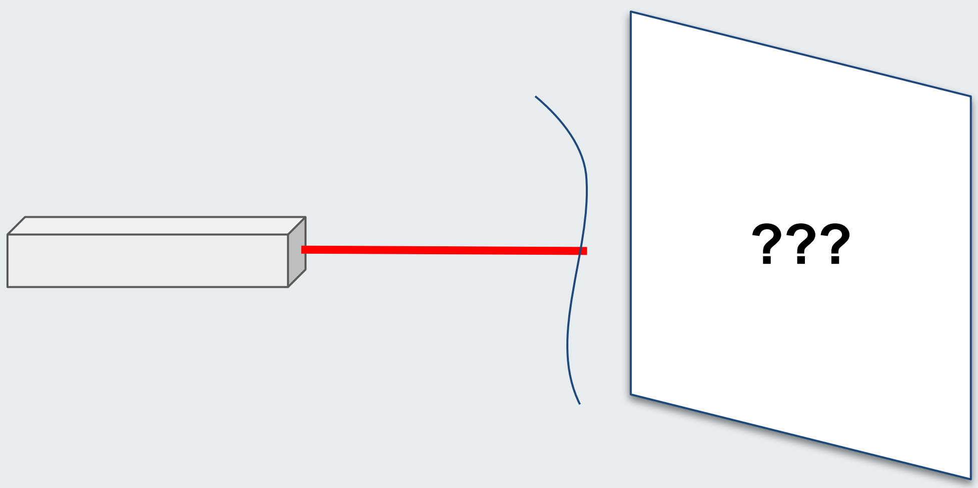
Objective : Observe the diffraction pattern of an aperture.

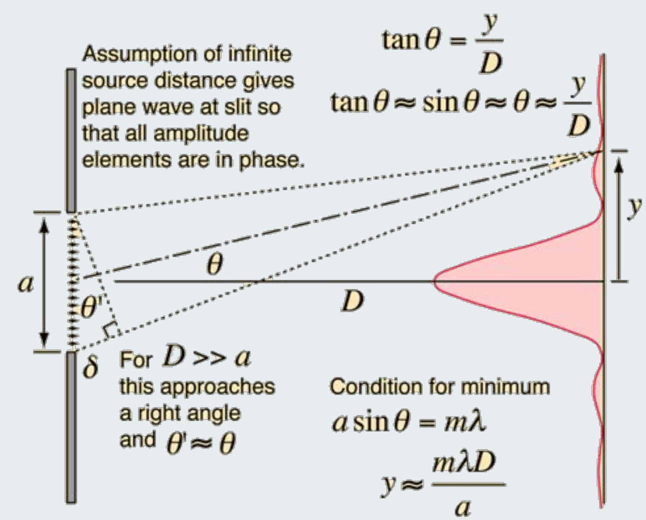
1. Insert a variable slit along the optical path of the beam
2. Change the slit width and see how it affects the diffraction pattern



Objective : Observe the diffraction pattern of the complementary of the slit (wire/hair for instance)

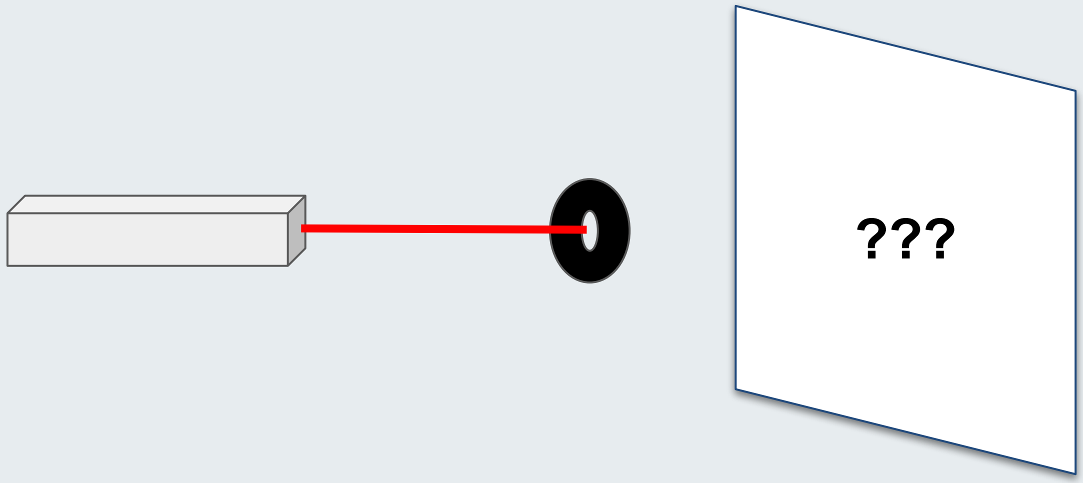
1. Insert a the wire along the optical path of the beam
2. Calculate the width of the wire based on the diffraction pattern!





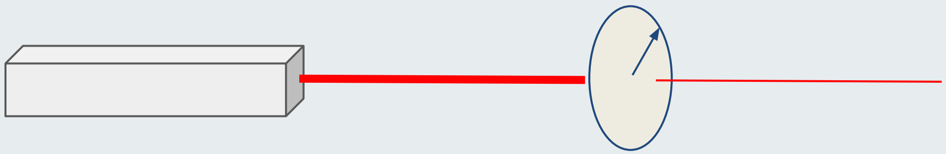
Objective : Observe the diffraction pattern of a 2D aperture

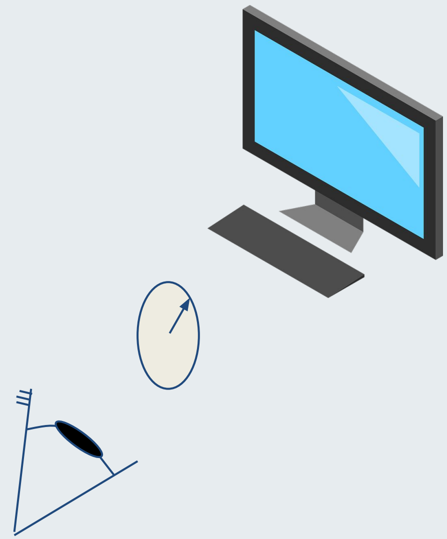
1. Insert a the pinhole along the optical path of the beam
2. See the diffraction pattern and how it changes as you close the iris



Objective : Understand light polarisation

1. Insert a polarised optical element along the laser beam path and see how the transmitted light varies with the optics orientation angle.
2. Use the same polarised optical element to look at the white computer screen. What do you see?





Polarized computer screen
Polarizers
Polarized sunglasses

PART 3

Light sources and optics spectra

PART 3 - Light sources spectra

Objective : know the difference between distinct light sources in terms of wavelength.

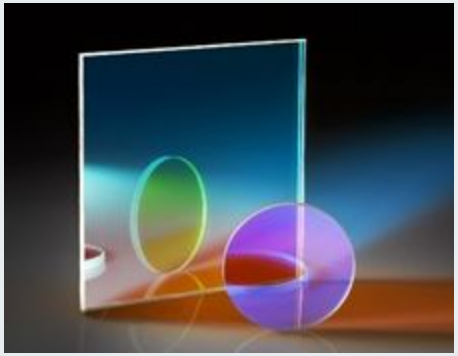
1. Point at a white light source with the spectrophotometer
2. What wavelength range do you see?
3. Point the optical fiber at different light sources (Laser diode, LED, phone torch). Which ones are the narrowest? the brightest?

White light source
Laser
LED
Phone torch
UV torch

PART 3 - Optics transmission spectra

Objective : know what an emission filter / excitation filter / dichroic filter does

1. Point at a white light source with the spectrophotometer
2. Insert and emission filter / excitation filter / dichroic filter
3. What wavelength range do you see?



PART 3 - Quinine fluorescence

Objective : understand fluorescence and how optics may be used in a microscope

1. Point separately at the schweppes bottle and at the UV LED with the spectrophotometer. Which wavelength do you see?
2. Now shine the UV LED through the bottle. What do you see?
3. What wavelength do you measure if you position the spectrophotometer optical fiber along vs perpendicular to the UV excitation path?
4. Position the spectrophotometer optical fiber along the UV excitation path and add a 405/488nm excitation/emission filter. What wavelengths do you measure?
5. Where in a microscope would you insert an excitation filter / emission filter?

https://www.thoughtco.com/what-glows-under-a-black-light-607615