The Phase Problem

livecyte®

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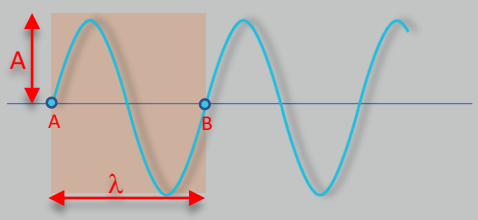
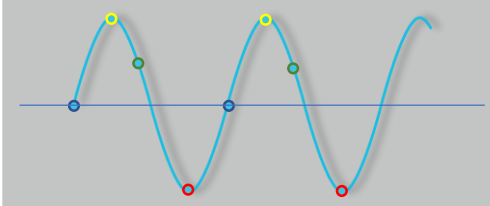
Light wave

A light wave has **Amplitude** (A)



The **wavelength** (λ) represents **1 cycle** of the wave

A light wave also has **phase**

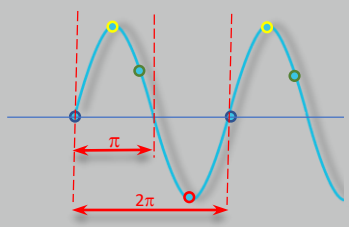


Points of **equal phase** are colour coded above

A wavelength is the distance between 2 points of equal phase

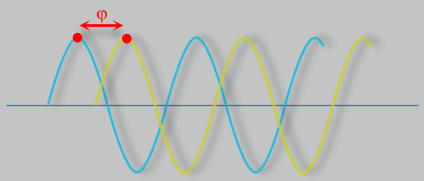
Phase difference

The distance between 2 points on a wave is stated as a value between **0 and 2π** (known as radians).



Distance between points of equal phase=1 wavelength= 2π

One wave can be ***phase shifted*** relative to another wave

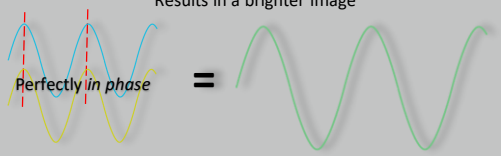


Here wave 2 is shifted by φ relative to wave 1

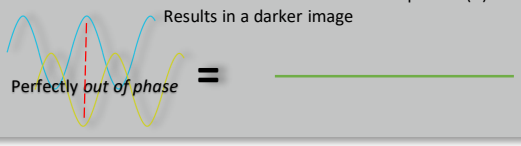
This situation can lead to waves **interfering**

Interference

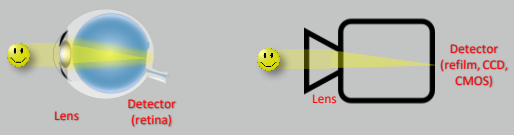
Constructive interference =overall increase in amplitude (A)
Results in a brighter image



Destructive interference = Overall decrease in amplitude (A)
Results in a darker image



Traditional imaging uses **interference** of light to **form images**



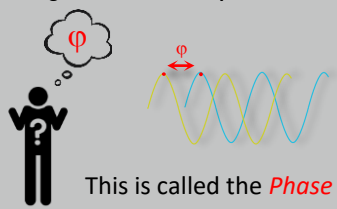
The image is an **intensity pattern** formed by the **constructive** and **destructive** interference of the **light waves**

The intensity (I) is related to the wave amplitude (A) by
$I \propto A^2$

Phase problem

Detectors are only sensitive to **intensity**

When light is interfered **all phase information is lost**



This is called the *Phase problem*

A number of techniques exist which can recover the Phase information

Within the field of cell biology we can group these techniques under the umbrella term :

Quantitative Phase Imaging (QPI)

This allows us to obtain high contrast information rich Images of living cells

phasefocus