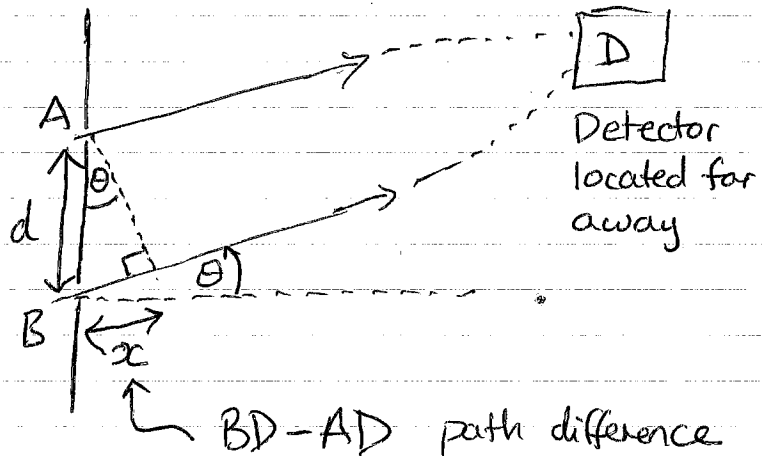
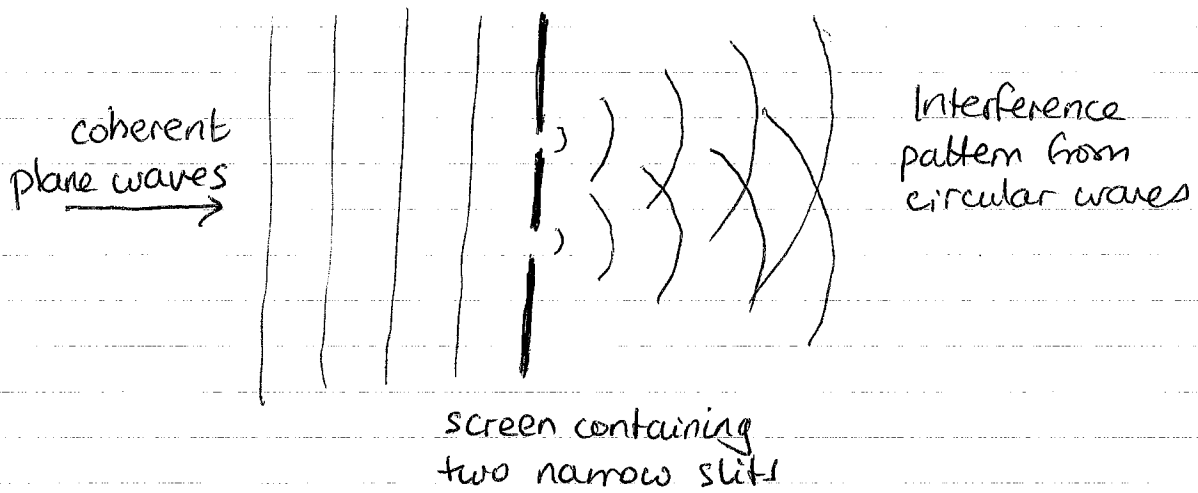


# Young's slits experiment

Illustrates phase shifts and interference of coherent waves due to varying path lengths



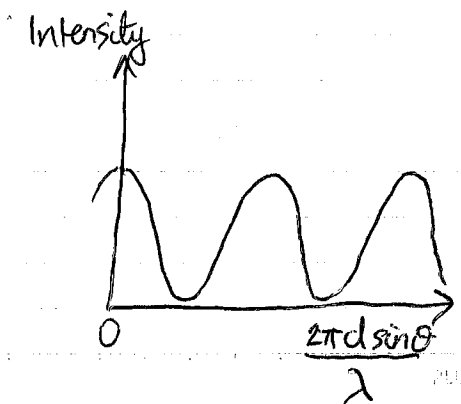
$$x = d \sin \theta$$

Phase difference  $\phi = \frac{2\pi x}{\lambda}$  (radians)

$$= \frac{2\pi d \sin \theta}{\lambda}$$

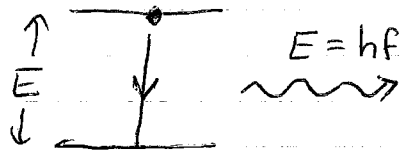
If  $\phi = 2\pi n$  — constructive interference

$= 2\pi (n + \frac{1}{2})$  — destructive interference



## Laser: example of coherent light

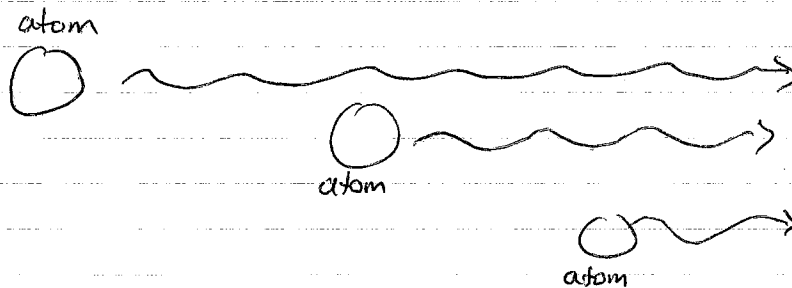
Atoms have well defined 'quantised' energy levels:



Excited atoms can emit light packets (photons) which have frequency given by the ~~E=hf~~ Einstein relation

$$E = hf$$

Emitted photon of freq.  $f$  can stimulate another excited atom to radiate a photon



### Stimulated emission

Photons are emitted in phase with stimulating photon, and of same frequency, i.e. they are coherent

### Magnetic flux quantum

$$\Phi_0 = \frac{h}{2e} = 2.07 \times 10^{-15} \text{ Wb.}$$

e.g. 1 flux quantum in area of  $1 \text{ mm}^2$

$$\rightarrow B \approx 2 \times 10^{-9} \text{ Tesla}$$

c.f. Earth's magnetic field  $5 \times 10^{-5} \text{ Tesla}$