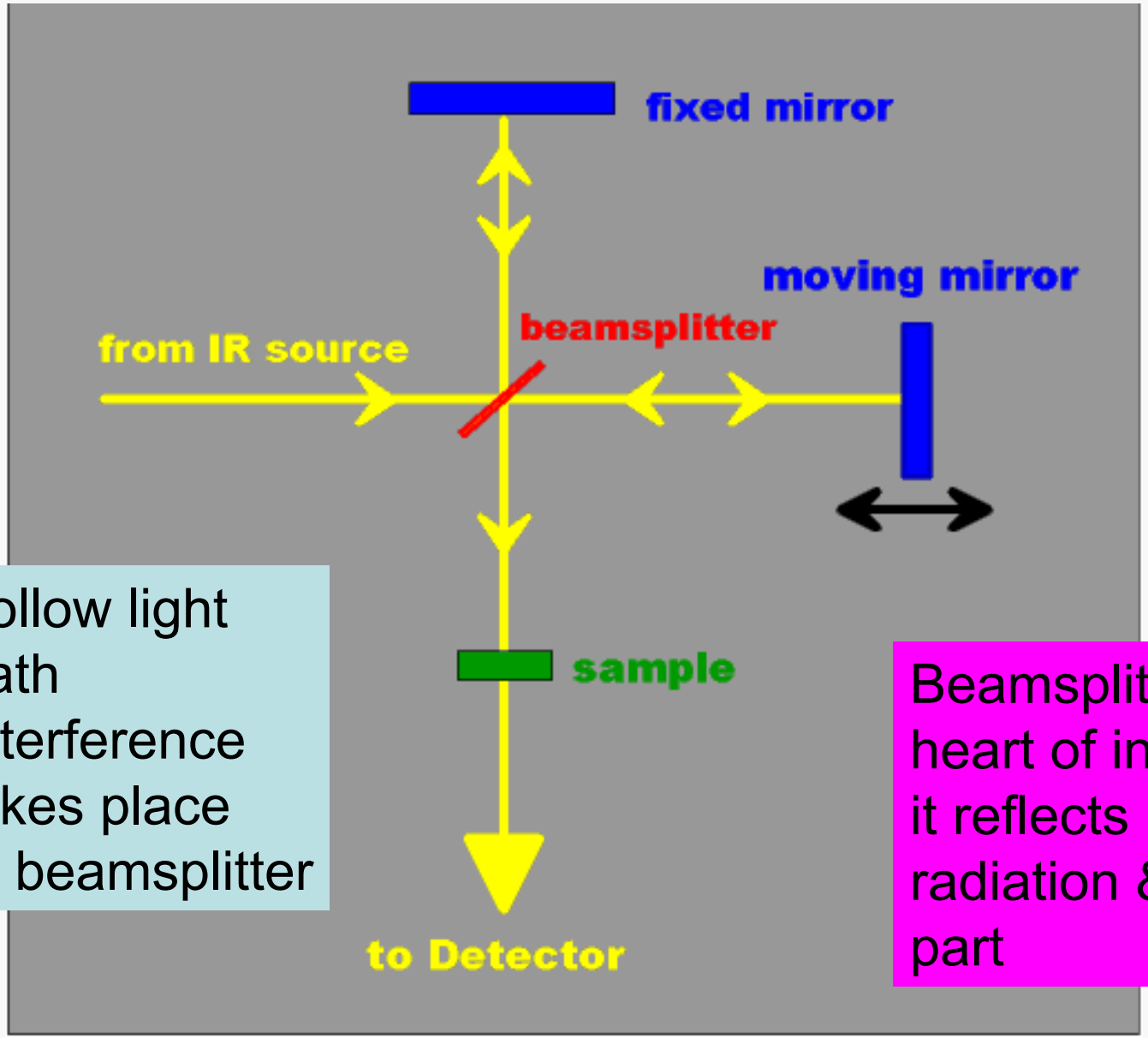
Basic diagram of a Michaelson Interferometer



Follow light path
Interference takes place at beamsplitter

Beamsplitter is at the heart of interferometer, it reflects part of the radiation & transmits part

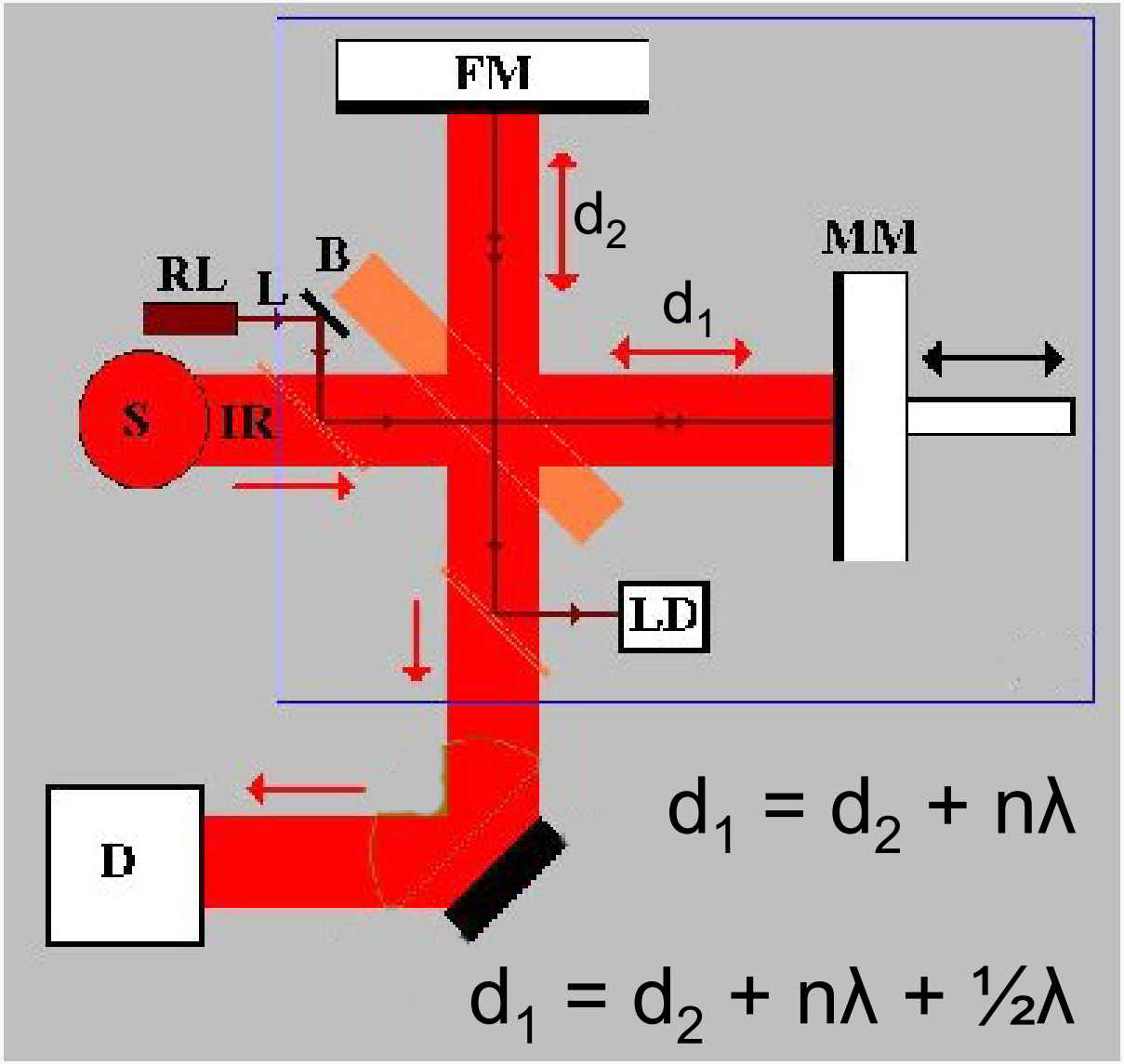
Interferometers have no slits so a wide beam of radiation can be used

Assuming monochromatic radiation

$d_1 = d_2 + n\lambda$ → for maximum constructive interference

$d_1 = d_2 + n\lambda + \frac{1}{2}\lambda$ → for maximum destructive interference

Michaelson Interferometer as commonly used in an FTIR



Where:

S = IR source

IR = infrared beam

D = detector

B = beamsplitter

FM = fixed mirror

MM = moving mirror

RL = reference laser

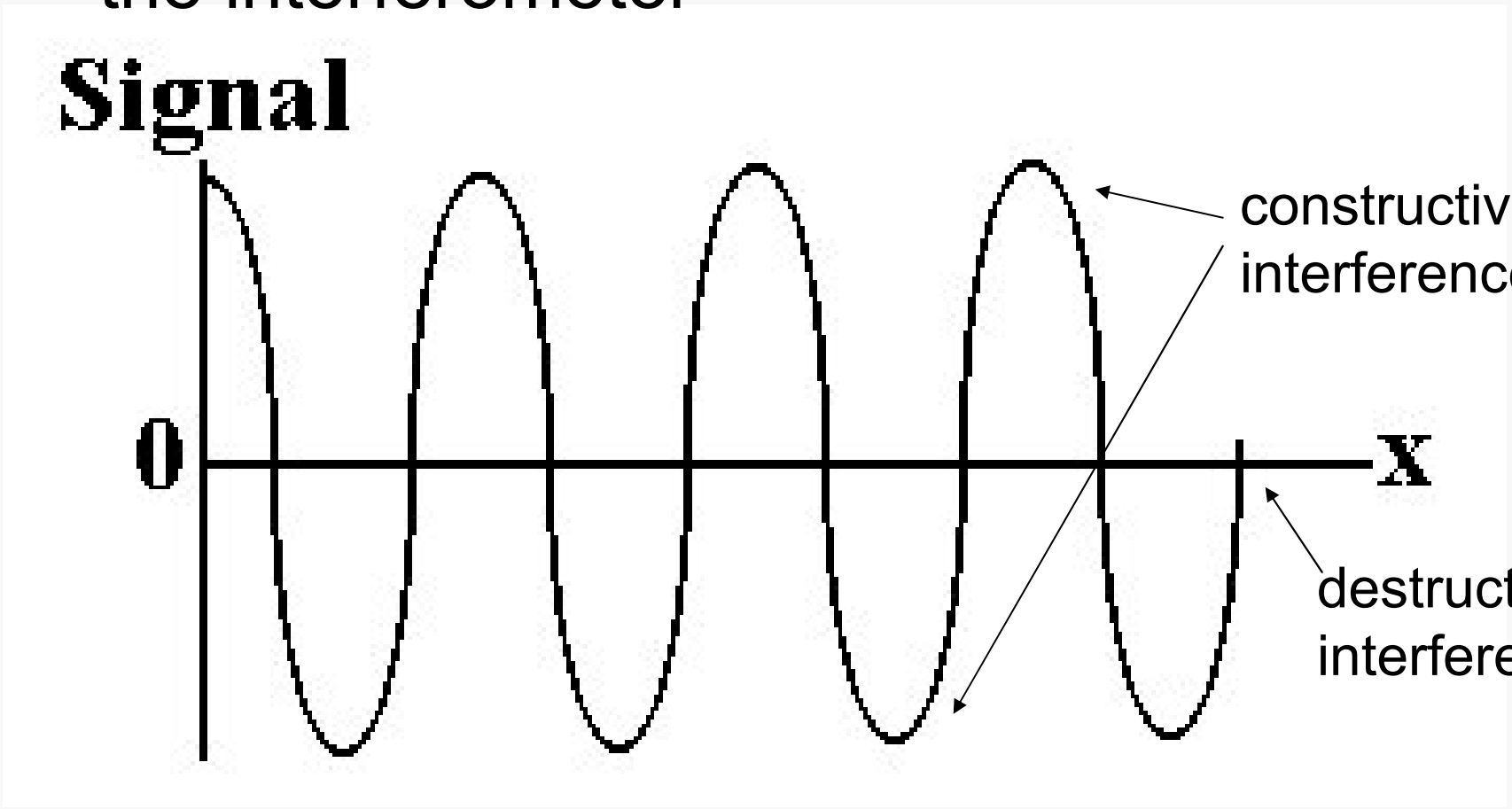
L = laser beam

LD = laser detector

d_1 = distance to moving mirror

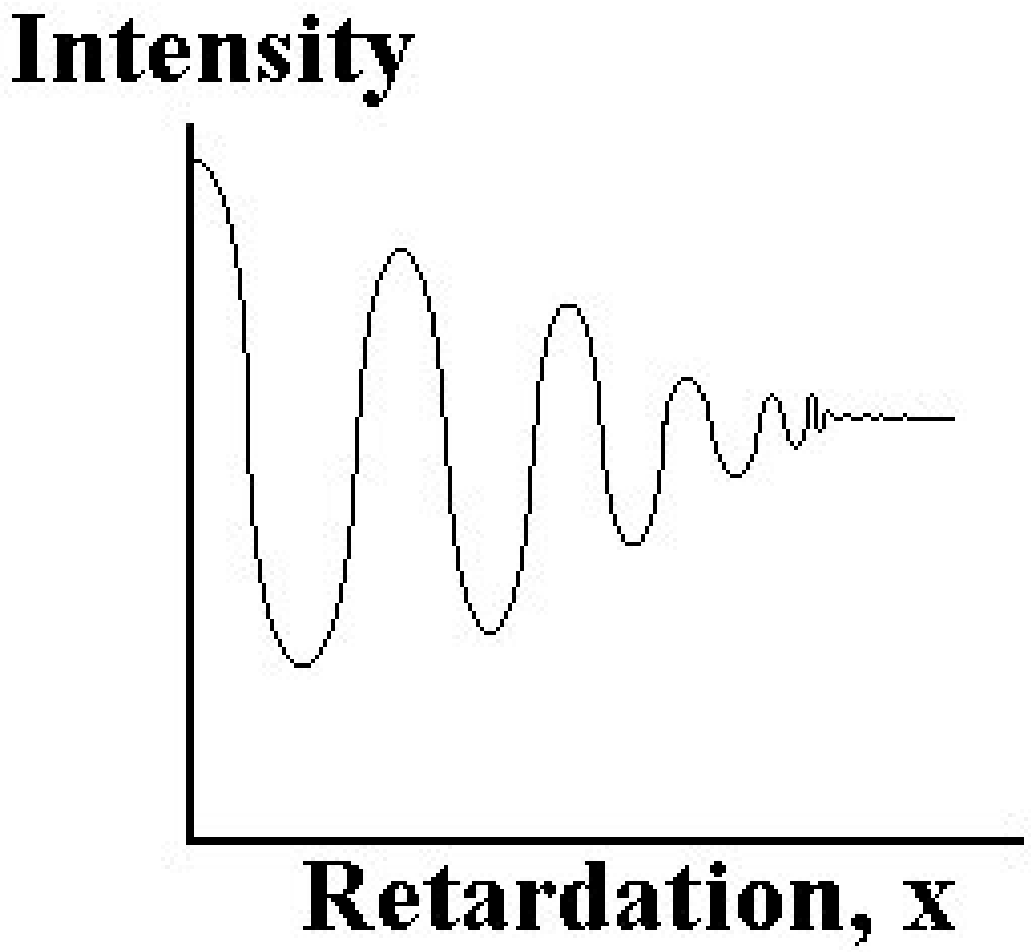
d_2 = distance to fixed mirror

Reference laser signal as it passes through the interferometer



This allows the position of the moving mirror to be determined accurately

Interferogram is a plot of energy vs mirror displacement from zero (i.e. $d_1 = d_2$)



This is for polychromatic radiation

Mechanical specifications for mirror movement are very exacting → gets worse as λ gets shorter, therefore interferometers are used in the IR region but are not very feasible in the visible and UV regions

Extracting a conventional spectrum (i.e. I vs λ) from interferogram involves the complex mathematics of the Fourier integral also known as Fourier Transform → need computer to do calculations

Advantages of Interferometers:

1) Energy throughput is much grater than for monochromators → better signal to noise ratio because there are no slits – this is particularly important in IR where the sources are relatively weak
2) Multiplex Advantage – all signals are viewed simultaneously

Disadvantage: Mechanical tolerance for mirror movement is severe – can't do interferometry in the UV-vis region, λ too short