$\hat{n} = n + ik$

$r = \frac{1-\hat{n}}{1+\hat{n}}$ can get phase shift from relative values of...

for glass, the critical angle is 43°, at 45° get total internal reflection

$$\alpha = \frac{2\pi}{\lambda}\sqrt{\frac{\sin^2\theta}{n^2} - 1} = \frac{2\pi}{\lambda}\sqrt{\frac{1}{2}(1.5)^2 - 1} = \frac{2\pi}{\lambda}\sqrt{1.125-1} = \frac{2\pi}{500}(0.35) = \frac{2.2}{500nm}$$

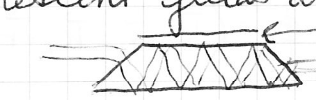
$k'' \rightarrow \frac{2\pi}{\lambda}\cdot$ n_{air} for $k'' \approx 1$ $\alpha = \frac{2.2}{500nm} = 0.0044\,nm^{-1}$

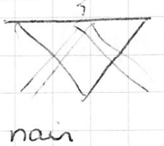
at a steeper angle $\alpha\uparrow \Rightarrow 1/\alpha \downarrow$ smaller

maximum effect

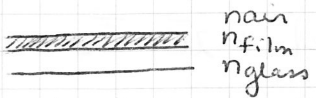
evanescent fields are used to sample materials monolayer of material

IRspectroscopy





interference layers

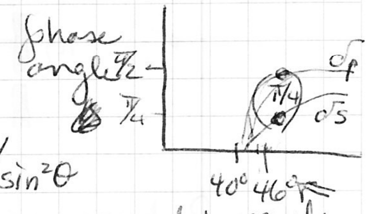


$n_{film} \sim \sqrt{n_{glass}}$ $d \sim \frac{\lambda}{4}$

apply same Boundary Conditions $\Rightarrow$ 4% reflection → 99% transmission
w/o film

multilayered films for low reflectors or high reflectors high + low n
coatings

$$r_s = \frac{\cos\theta - i\sqrt{\sin^2\theta - n^2}}{\cos\theta + i\sqrt{\sin^2\theta - n^2}}$$



for glass take $n = \frac{1}{1.5}$ in $\tan(\Delta/2) = \cos\theta\sqrt{\sin^2\theta - n^2}/\sin^2\theta$

fresnel rhomb

gives you a phase shift of ~~45~~ π/4 (45°) when cut ~46°
because of the relative phase shift $500

used to make circular polarized light fresnel Rhomb

11:15

Reflection or Transmission Matrix
$$\begin{bmatrix} A' \\ B' \end{bmatrix} = \begin{bmatrix} -\left(\frac{1-n}{1+n}\right) & \\ & \left(\frac{1-n}{1+n}\right) \end{bmatrix}\begin{bmatrix} 1 \\ -i \end{bmatrix} = \left(\frac{n-1}{n+1}\right)\begin{bmatrix} 1 \\ i \end{bmatrix}$$

right circ polarized

left circ polarized light

both s,p suffer a phase shift ~~on~~ of 180° upon reflection

fresnel relations plots in book – once past Brewster angle the phase relation changes.

grazing incidence (instead of normal incidence) then Right circ doesn't get converted to left circularly polarized light

$$\begin{bmatrix} A' \\ B' \end{bmatrix} = \begin{bmatrix} e^{-i\delta_p} & \\ & e^{-i\delta_s} \end{bmatrix}\begin{bmatrix} A \\ B \end{bmatrix} = \left[Ae^{-i\delta_p} + Be^{-i\delta_s}\right] = \cancel{A}\, e^{-i\delta_p}\begin{bmatrix} A \\ Be^{-\cancel{i}\Delta} \end{bmatrix}$$

arbitrary polarization

simple to understand Jones Matrix

after 2 bounces $\Delta = \pi/2$ in the fresnel rhomb

interference = diffraction = manifestations of wave nature of light.

* fresnel coef at normal $r = \underline{1-n} \rightarrow \underline{1-\hat{n}}$ complex

Interference

March 26

If you superpose 2 or more waves from a source get intensity square of amplitude

add amplitudes $\vec{E} = (\vec{E}_1 + \vec{E}_2 + \vec{E}_3 + \dots)$ $I \propto (E)^2$

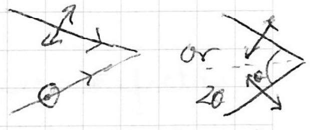
cross-terms give you the interference phenomenon

2-plane harmonic linearly polarized wave.

$$\vec{E}_{(1)} = \vec{E}_1 \exp i(\vec{k}_1 \cdot \vec{r} - \omega t + \phi_1)$$

$$\vec{E}_{2(2)} = \vec{E}_2 \exp i(\vec{k}_2 \cdot \vec{r} - \omega t + \phi_2)$$

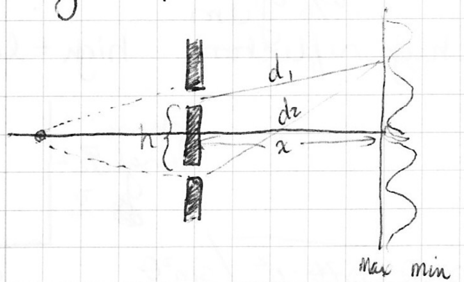
$$\phi = (\vec{k}_1 \cdot \vec{r} - \vec{k}_2 \cdot \vec{r} + [\phi_1 - \phi_2])$$



(IDK) (5 done)

$$I \propto |E|^2 = \vec{E} \cdot \vec{E}^* = |E_1|^2 + |E_2|^2 + 2\vec{E}_1 \cdot \vec{E}_2 \cos\phi$$

Young's Experiment



max

$$k(d_2 - d_1) = \pm 2n\pi \Rightarrow |d_2 - d_1| = n\lambda$$

min

$$\frac{2\pi}{\lambda}|d_2 - d_1| = \pm(n + 1/2)2\pi \qquad |d_2 - d_1| = (n + 1/2)\lambda$$

use Pythogoreans Theorem: $d_\pm = \sqrt{x^2 + (y \pm h/2)^2}$ $\Delta d = \sqrt{x^2 + (y + h/2)^2} - \sqrt{x^2 + (y - h/2)^2}$

expand by binomial theorem

$$\Delta d = (x^2 + y^2 + yh + h^2/4)^{1/2} - (x^2 + y^2 \mp yh + h^2/4)^{1/2}$$

$$= \frac{1}{x}\left[(1 + (y/x)^2 + (yh/x^2) + (h^2/4x^2))^{1/2} - (1 + (y/x)^2 - \frac{yh}{x^2} + h^2/4x^2)^{1/2}\right] = \frac{hy}{x} \Longleftrightarrow n\lambda$$

$$y = 0, \pm n\frac{\lambda x}{h}$$

Can you to calculate the wavelength of light.

$I = I_1 + I_2 + 2E_1E_2\cos\phi$ if the whole pattern moves rapidly up + down eye averages

$\Delta\phi$ has to have a fixed of value or vary so slowly it drifts very slowly.

$$I = c\langle E \cdot E^* \rangle = c\langle |E_1|^2 + |E_2|^2 + 2\mathrm{Re}(\vec{E}_1 \cdot \vec{E}_2^*)\rangle = I_1 + I_2 + 2\,\mathrm{Re}\langle \vec{E}_1 \cdot \vec{E}_2^* \rangle$$

$$= I_1 + I_2 + 2\sqrt{I_1}\sqrt{I_2}\,\mathrm{Re}\,\gamma_{12}$$

$$f = \frac{\int_0^T f(t)\,dt}{T}$$

$\Gamma_{12}(\tau)$ = time average of the field $= \langle E_1(t)\,E_2(t+\tau)\rangle$

$$\underbrace{\gamma_{12}(\tau) = \frac{\Gamma_{12}(t)}{\sqrt{I_1}\sqrt{I_2}}}_{=0 \text{ or } 1}$$

$$I_{max} = I_1 + I_2 + 2\sqrt{I_1}\sqrt{I_2}\,\mathrm{Re}\,\gamma_{12}$$

$$I_{min} = I_2 + I_1 - 2\sqrt{I_1}\sqrt{I_2}\,\mathrm{Re}\,\gamma_{12}$$

$m = \frac{2\sqrt{I_1 I_2}}{(I_1+I_2)}$ = modulation of interference pattern $I_1 = I_2$ ∴ $m = 1$

$I_1 >> I_2$ ∴

if $I_1 = I_2$ complete cancelation $m=1$

if $I_1 \neq I_2$ $m<1$ max + min such that the minimums don't go to zero

$$I = (I_1 + I_2)\left(1 - \frac{2\sqrt{I_1 I_2}}{I_1 + I_2}\right)$$

coherence
modulation

$\left.\begin{matrix}\cos\phi = +1 \\ -1\end{matrix}\right\}$ difference $\frac{4\sqrt{I_1 I_2}}{(I_1 + I_2)} = 2m$

11:15

use a beam splitter

$\Delta\vec{k} = \vec{k}_2 - \vec{k}_1$

$\frac{\Delta\vec{k}/2}{|\vec{k}|} = \sin\theta$ gives spatial period

$\Lambda = \frac{\lambda}{2\sin\theta}$ interference of 2 lasers then combine at ∠θ

$\Delta k = (k\sin\theta)2 = \frac{2\pi}{\lambda}\sin\theta = \frac{2\pi}{\Lambda}$

↑ crossing angle

interference Λ period

spatial period

distance over which they repeat

$\phi = (k_2 - k_1)r + \Delta\phi$ gives spatial period of interference pattern

31 March 2009

3.1 3.2 3.6 3.8 3.9 3.12 Optics Hmwk Due Next Thursday.

2ND Midterm Middle of April 7th

Read Handout
Ch. 7 of Hetch

Periodic function → ~~ape~~ aperiodic function – fft

$I_1 = I_0 = I_2$ $m = 1 = \frac{2\sqrt{I_1 I_2}}{I_1 + I_2}$ $\boxed{I = I_T\left[1 + \mathrm{Re}|\gamma_{12}|\cos\left(\frac{kyh}{x}\right)\right]}$ very simple form

$\mathrm{Re}|\gamma_{12}|$ Normalized coherence function = 1 for complete coherence close for lasers

$\langle E_1(t)E_2(t+\tau)\rangle$ $I_T = 2I_0$ $0 \le \gamma_{12}$ ~~≤~~ 1 ⇒ partial coherence

$$I = 2I_0\left[1 + \mathrm{Re}|\gamma_{12}|\cos\left(\frac{kyh}{x}\right)\right]$$

Shifts in phase in gas tube due to lifetime of excited states, line broadening interference at screen – time difference of arrival at screen interference is washed out because the wavetrain length ≤ path length difference (no contrast)

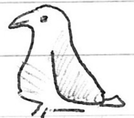
τ = time of wavetrain to exist
Coherence time $l_\tau = c\tau$ = temporal coherence length or longitudinal coherence length

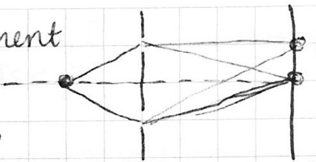
$\Delta E\Delta\tau \approx \hbar$ $E = \hbar\Delta\omega$ $\Delta\omega \propto \frac{1}{\tau}$ $\tau = \frac{1}{\Delta\omega}$

$l_\tau = c\tau = \frac{c}{\Delta\omega} = \frac{\lambda^2}{2\pi\Delta\lambda}$ $\Delta\nu = \frac{c}{\lambda^2}\Delta\lambda$ l_c = coherence length = max ~~Δ~~ can be to maintain

example = ~~500~~ $\frac{|5\cdot10^{-5}|^2}{10^{-8}} \sim \frac{25\cdot10^{-10}}{10^{-8}}$ m $\sim .25$cm

↑ line width in

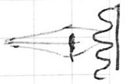


Youngs Experiment  longitudinal coherence length $\sim \frac{|\lambda|^2}{\Delta\lambda}$ ← central λ
← width of light arises because of finite duration of wavetrain

(cm)

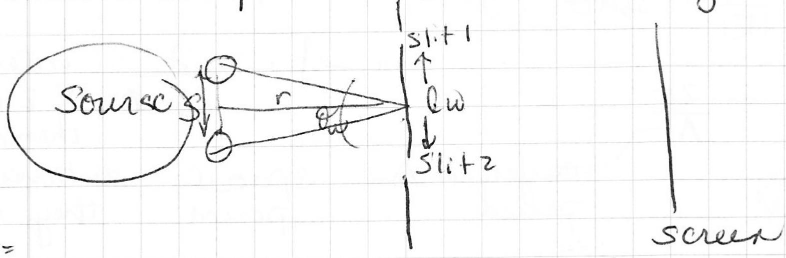
$\frac{(5.\cancel{5}\cdot 10^{-5})^2}{\cancel{3000}\ 3\cdot 10^{-5}}$ $\frac{25\cdot 10^{-10}}{3\cdot 10^{-5}}$ ~8000A coherence length is very short
Small path length difference – soon into regime of no interference

monochromatic light $\Delta\lambda \to 0$ $\Delta\omega \to 0 \Rightarrow$ nice, complete interference + modulation/contrast



Now consider a broader source pinhole $r \to \infty$
the interference pattern starts losing contrast

lw = maximum separation between emitting sources.



$l\omega \propto \frac{1}{\theta_\omega} = \frac{\lambda_{light}}{\theta_\omega}$

r=
$\theta = \frac{s}{r}$ r = distance source to slits θ = width of source

pinhole θ = 0 and $\Delta\lambda \to 0$ infinite coherence length

Van Cittert Zerniche Theorem = in Born + Wolf $= \frac{1.22\lambda_{light}}{\theta\omega} = l\omega$

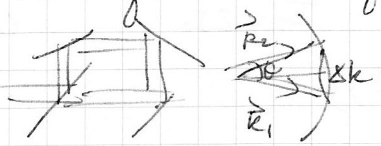
if the width is large longitudinal coherence length is small

thermal sources – narrow wavelength light λ = .01Å

pinhole ~ .5 mm ⇒ puts limitations on what can be the separation of the slits

holographic gratings – arise from interference Boy! Sheesh!

$\Lambda = \cancel{\frac{\lambda}{2\sin\theta}}\ \frac{\lambda}{2\sin\theta}$



$E_1 \propto e^{i\vec{k}_1\cdot\vec{r}}$ $E_2 \propto e^{i\vec{k}_2\cdot\vec{r}}$
interference
$(\vec{k}_1 - \vec{k}_2)\cdot\vec{r}$
$e^{\underbrace{i(\vec{k}_1-\vec{k}_2)\cdot\vec{r}}_{\text{spatial frequency}}}$

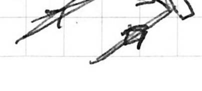
to make a grating interferen on a photoresist
ex. violet/blue light
488nm Argon laser
can make a grating
$\frac{488}{2(\sin 30)}$ = period of grating

$\frac{\Delta k}{2} = k_1 \sin\theta$

$\frac{2\pi}{\Lambda} = \Delta k = 2k_1\sin\theta = \underbrace{\frac{4\pi}{\lambda}\sin\theta}_{?}$

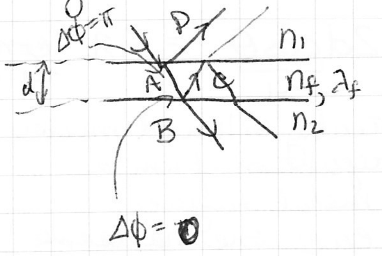
$\Lambda = \frac{\lambda}{2\sin\theta}$

p 401 handout
9.33

p. 62 in book interfence pattern 

Tuesday April 7. 2009
Interference
2 glass slides - thin film of air (pile of plates)

light source



$AB = BC = d/\cos\theta_t$ $\lambda_f = \lambda_0/n_f$

$\Lambda = n_f[\overline{AB} + \overline{BC}] - n_1 AD$

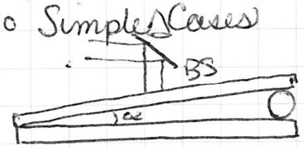
$\Lambda = 2n_f d\cos\theta_t$ path length difference

$d\cos\theta_t = (2m+1)\lambda_f/4 \Rightarrow 2d\cos\theta_t = (m+\frac{1}{2})\lambda_f$ bright
$2d\cos\theta_t = m\lambda$ dark

$2m\pi = \delta = \frac{2\pi}{\lambda_0}(2n_f d\cos\theta_t) \pm \pi$
↖ depends on relative refractive indices

Two Simple Cases

①



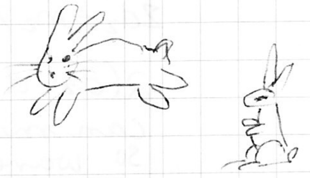
Fizou's fringes

$d = x\alpha$ α in radians

condition for Bragg fringes $(m+\frac{1}{2})\lambda_0 = 2n_f d$ $\cos\theta_t \to 1$

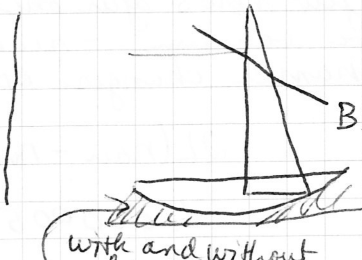
$x_m = \frac{(m+\frac{1}{2})\lambda_f}{2\alpha}$ condition for the mth bright fringe's position

$x_m \quad \frac{m\lambda_f}{2\alpha}$ condition position for dark fringe

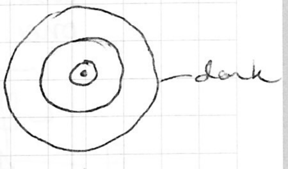


$\Delta x = \frac{\lambda_f}{2\alpha}$ can tell if surfaces aren't flat

② Newton's Rings



with and without liquid like water



if you know λ_f
diameter of rings
can measure either
bright or dark rings

$x^2 = R^2 - (R-d)^2$

$x^2 \sim 2Rd$

$2n_f d_m = (m+\frac{1}{2})\lambda_0$

$x_m = \sqrt{(m+\frac{1}{2})\lambda_f R}$ bright fringes $= \sqrt{\frac{3}{2}\lambda_f R}$, etc.

$2n_f d = m\lambda$ central fring is dark $\Rightarrow x^2 = \frac{m\lambda R\lambda}{n_f} = m\lambda_f R$

$x = \sqrt{m\lambda_f R}$

$\lambda_f = \frac{\lambda_0}{n_f}$ results can be used for understanding Michaelson. Interferometer.

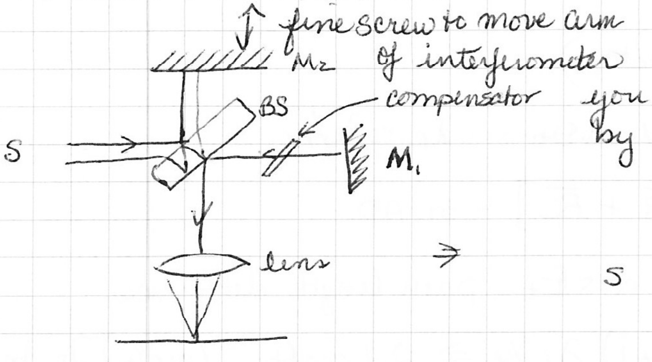
example

cm cm

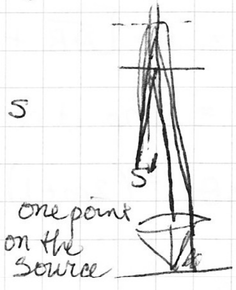
$\sqrt{\frac{3}{2}(5\cdot 10^{-5})10^{2}} = \sqrt{7.5\cdot 10^{-3}}$ cm
$\approx 8.6\cdot 10^{-2}$ cm
↖ guestimate

$x_1 = 860 \mu m$
bright fringe

Michaelson Interferometer



you can adjust difference in path by tilting compensator



$2d\underbrace{\cos\theta}_{\sim 1} = m\lambda$ condition for maxima

partially silvered mirror
reflection from a metal surface
each one has same relative phase Shift

order of central fringe

d = path lenth difference

$m = 4\cdot 10^3 = \frac{2d}{\lambda} = \frac{2\cdot 10^4}{5}$

Applications

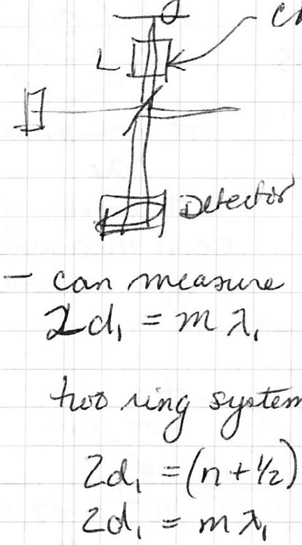
- can measure λ accurately
  don't look at entire pattern - just look at central fringe w/PMT, CCD
  move the arm accurately - count the number of fringes which passed.

$2d_1 = m_1\lambda$
$2d_2 = m_2\lambda$ } moving arm

$2(d_2 - d_1) = (m_2 - m_1)\lambda$ number of fringes that go by

can measure $(d_2 - d_1)$ to accuracy of less than micron
So wavelength accuracy is very accurate

- air - quite a few zero's after one
  once you have vacuum - reads max or min



Chamber changes optical path length

$2L(n_{air} - n_{vac})$ just use relationship

1,000005 ← can get n. of gas. air

- can measure wavelength differences very accurately

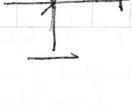
$2d_1 = m\lambda_1$

max of one falls on min of the other.

two ring systems

$2d_1 = (n + 1/2)\lambda_2$
$2d_1 = m\lambda_1$

$2d_2 = (m + \Delta n \pm 1/2)\lambda_1$ dark
$2d_2 = (n + \Delta n)\lambda_2$ } 4eq's



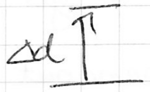
max of one is min of the other. contrast changes

$\frac{2(d_2-d_1)}{\lambda_1} = \Delta n + 1/2$ $\qquad$ $\frac{2(d_2-d_1)}{\lambda_2} = \Delta n - 1/2$

~~$2d_2 = d$~~ Δd = position between two consecutive loss of contrast conditions

bright goes to dark and dark goes to bright

$2\Delta d(1/\lambda_1 - 1/\lambda_2) = 1$



$2\Delta d \left(\frac{\Delta\lambda}{\lambda^2}\right) = 1$

$\Delta\lambda = \frac{\lambda_{av}^2}{2\Delta d}$ move mirror to where you lose contrast $= d_1$

move to next position " " $= d_2$

λ_{av} = average value of the wavelength

Closer $\Delta\lambda$ bigger distance you have to move

example

$\Delta\lambda \sim .1$ Å $\quad \lambda^2 =$ ~~25×10^{-10} cm^2~~

mirror placement

$\Delta d \rightarrow 1.25$ cm

between Separation btwn closely Spaced lines

spin - orbit splitting of lines

Thursday

- Coherence Length w/ Michaelson Interferometer

- Wedge-Shaped path length dif - straight line fringes

Mirrors not parallel

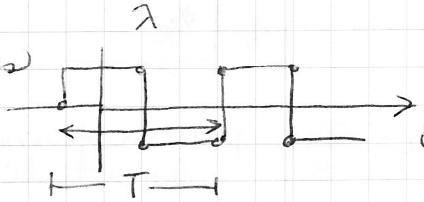
Anharmonic Waves Periodic Waves Fourier Transforms

and case where T (period) → ∞ get a pulse - represent as continuous spectrum of frequency components.

Square, Triangular Waves not pure sines or cosines

If you have a periodic function

$f(x) = \frac{A_0}{2} + \sum_{m=1}^{\infty}[A_m \cos(kxm) + B_m \sin(mkx)]$



Spatial - λ - wavelength

temporal - T - period

Calculating the coef A_m, B_m

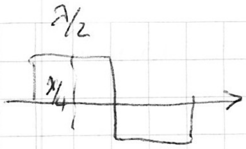
Integrate over a complete period

$$\int_0^{\lambda} f(x)dx = \frac{A_0}{2}\int_0^{\lambda} dx + \sum_{m=1}^{\infty}\int_0^{\lambda} \overset{0}{\cancel{(A_m \cos kxm + B_m \sin mkx)dx}}$$

$$= \frac{A_0\lambda}{2}$$

$$0 = \int_0^{\lambda} f(x)\cos(mkx)dx = \frac{A_0}{2}\int \overset{0}{\cancel{\cos mkx dx}} + \sum_{m=1}^{\infty}\int^{\lambda} A_m \cos kmx \overset{\cos}{~~\sin mkx~~} + \cancel{B_m \sin mkx \cos mkx dx}$$

$$= \sum_{m=1}^{\infty} A_m \int_0 \cos^2 \overset{1/2}{\cancel{mkx}} dx = A_m \int_0^{\lambda} 1/2(1+\cos 2mkx)dx = \frac{A_m\lambda}{2}$$



$-\frac{\lambda}{4} > x \geq \lambda/4$

integrate to get the coefficents

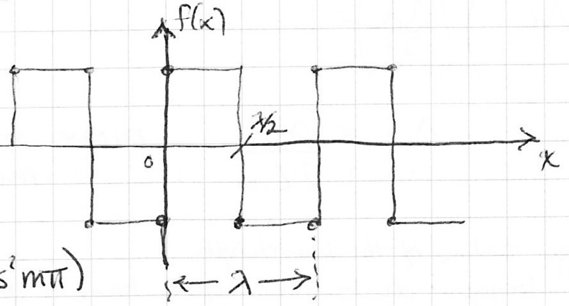
multiply by sin(mkx) to get the B_m

<u>Simple Example from handout</u>

$$A_0 = \frac{2}{\lambda}\int_0^{\lambda} f(x)dx = 0$$

$$A_m = \frac{2}{\lambda}\int_0^{\lambda} f(x)\cos mkx\, dx = 0$$

$$B_m = \frac{2}{\lambda}\int_0^{\lambda} f(x)\sin mkx\, dx = \frac{2}{m\pi}(1-\cos^2 m\pi)$$



$f(x) = +1 \quad 0<x<\lambda/2$
$f(x) = -1 \quad \lambda/2<x<\lambda$

~~att~~ · symmetry about x axis – no A_0

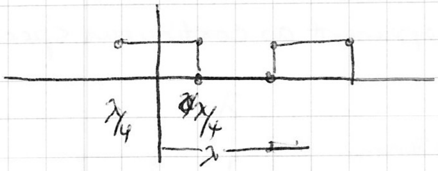
$$f(x) = -f(x)$$

$\int_0^{\lambda} f(x)dx = 0$ one period

Calculate both sin and cos terms

$$f(x) = \frac{4}{\pi}\left(\sin kx + \tfrac{1}{3}\sin 3kx + \tfrac{1}{5}\sin 5kx + \cdots\right)$$

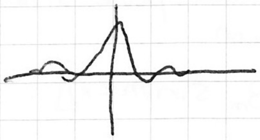
Starts to approximate the square waveform.



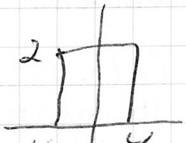
$$f(x) = 2/a + \sum_{m=1}^{\infty} \frac{4}{a}\operatorname{sinc}\left(\frac{2\pi m}{a}\right)\cos(mkx)$$

~~Cos~~

$\operatorname{sinc} u = \frac{\sin u}{u}$ pattern of single slit amplitude



$\frac{2\pi}{\lambda} = k \qquad \lambda = \frac{1}{k}$ spatial frequency



$\lambda \to \infty$

$$= \frac{1}{\pi}\left[\int_0^{\infty} A(k)\cos kx\, dk + \int_0^{\infty} B(k)\sin kx\, dk\right]$$

pulse is even just use cos kx

$k_p = \frac{2\pi}{\lambda_p}$

Euler's Equations

$$e^{i\theta} = \cos\theta + i\sin\theta$$

$$f(x) = \frac{1}{\pi}\int_{-\infty}^{+\infty} \cos kx\left[\int_{-\infty}^{+\infty} \cancel{A} f(x')\cos kx'\,dx'\right]dk$$

$$+ \frac{1}{\pi}\int_{-\infty}^{+\infty} \sin kx\left[\int_{-\infty}^{+\infty} f(x')\sin kx'\,dx'\right]dk$$

ft.

Algebraic relations $e^{i\theta} = \cos\theta + i\sin\theta$ can go from cos to sin

$$f(x) - \frac{1}{2\pi}\int_{-\infty}^{+\infty}\left[f(x')e^{ikx'}dx'\right]e^{-ikx}\,dk$$

called fourier transform pairs

$$f(x) = \frac{1}{2\pi}\left[\int_{-\infty}^{+\infty} F(\cancel{k})e^{-ikx}dk\right.$$

$F(k)$ has both amplitude + phase $F(k) - F(\lambda)e^{i\phi(k)}$

The narrower the pulse - the more frequency components you need.

A_q = 99% of amplitude ... etc. depends on pulse width

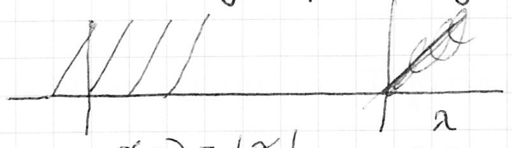
Tuesday April 14, 2009

Fourier Series + Fourier Transforms, Relevance in Theory of Optics

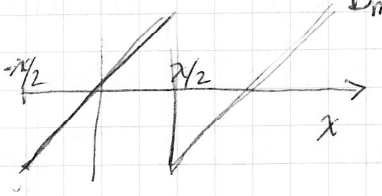
$$f(x) = \frac{A_0}{2} + \sum_m\left[A_m\cos(mkx) + B_m\sin(mkx)\right]$$

essentially, by the way the function is defined $A_m = \int_{-\lambda/2}^{+\lambda/2} f(x)\cos(mkx)\,dx$

$$B_m = \int_{-\lambda/2}^{+\lambda/2} f(x)\sin(mkx)\,dx$$



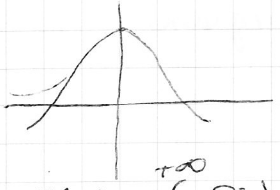
$f(x) = |x|$ $0 > \lambda > \lambda$



$f(x) = x$ $-\lambda/2 < x < \lambda/2$

add function $A_m = 0$

$$f(x) = \frac{1}{2\pi}\int_{-\infty}^{+\infty}\underbrace{\left[\int_{-\infty}^{+\infty} f(x)' e^{ikx'}dx'\right]}_{F(k)} e^{-ikx}\,dk = \frac{1}{2\pi}\int_{-\infty}^{+\infty} F(k)e^{-ikx}dk$$

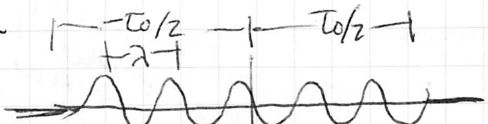


$$f(t) = \frac{1}{2\pi}\int_{-\infty}^{+\infty} F(\omega)\, e^{-i\omega t}\, d\omega$$

Sym: both have $\frac{1}{\sqrt{2\pi}}$ vs 1 has $1/2\pi$

$$F(k) = \int_{-\infty}^{+\infty} f(x)e^{ikx}dx$$

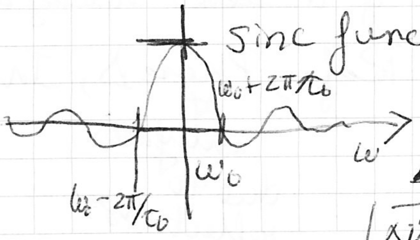
Fowles wavetrain



$k = \frac{2\pi}{\lambda}$ $k_p = \frac{2\pi}{L}$

$f(t) = e^{i\omega_0 t}$

$$g(\omega) = \sqrt{\frac{2}{\pi}}\,\frac{\sin(\omega-\omega_0)\tau_0/2}{(\omega-\omega_0)}$$



$\Delta\nu\tau_0 \sim \frac{1}{\Delta\nu}$

$\boxed{\Delta\nu\tau_0 = 1}$

Coherence time

$\sigma_x\sigma_k \sim 1$

$\Delta\omega = \frac{2\pi}{\tau}$

if you want to create a pulse $\Delta\tau = \left(\frac{1}{\Delta\nu}\right)$

100 fsec pulse $= \left(\frac{1}{\Delta\nu}\right)$ $\Delta\nu = \frac{1}{10^{-13}} \sim 10^{13}$ Hz with a factor of 1.5 - 2

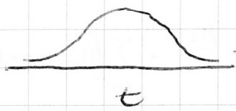
$\lambda = 800$ nm $\Delta\lambda \sim 30$ nm need to make the short pulse

if you want a short pulse - need a big bandwidth

$l_c = c\tau_0$

for good temporal coherence, need line width.
narrow wavelengths... on order of a few megahertz for $l_c \sim$ km

one good use of fourier tranforms is Spectroscopy
michaelson interferomete,
two arms - one moves broadband IR
in time domain FT → frequency domain.
find frequency components



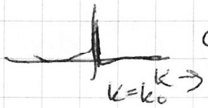
→ ω components

intensity of M.I pattern in book

$I(x) = I_0(1 + \cos kx)$ modulation of I as mirror moves

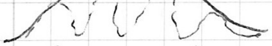
measures - $(I(x) - I_0) = I_0\cos(kx)$

p.81 $$\int (I(x) - I_0)\, e^{-ikx}\, dx = I_0 \int (e^{ikx} - e^{-ikx})\, dx$$



$$\delta(k-k_0) = \int_{-\infty}^{+\infty} e^{i(k_0-k)x}\, dx$$

Sample absorbs

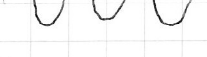


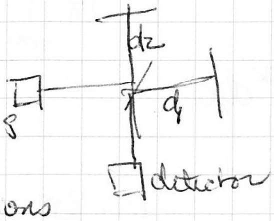
to get absorption

record interferogram
differnet get

Fourier transform spectroscopy

$2d = m\lambda$
$2|d_2 - d_1| = m\lambda$
small modulation





exam - use the materials - ask questions
if it seems heavy detai

Refl, Refr, Phase Δ, Interference of Two Beams
at interfaces
due to reflections
Spatial Period
Beam Splitter at diff angles
here Interference patterns

Thermal Sources depends on geometry - pinhole has perfect coherence extended Source
Concept of
Temporal
Spatial
Coherence