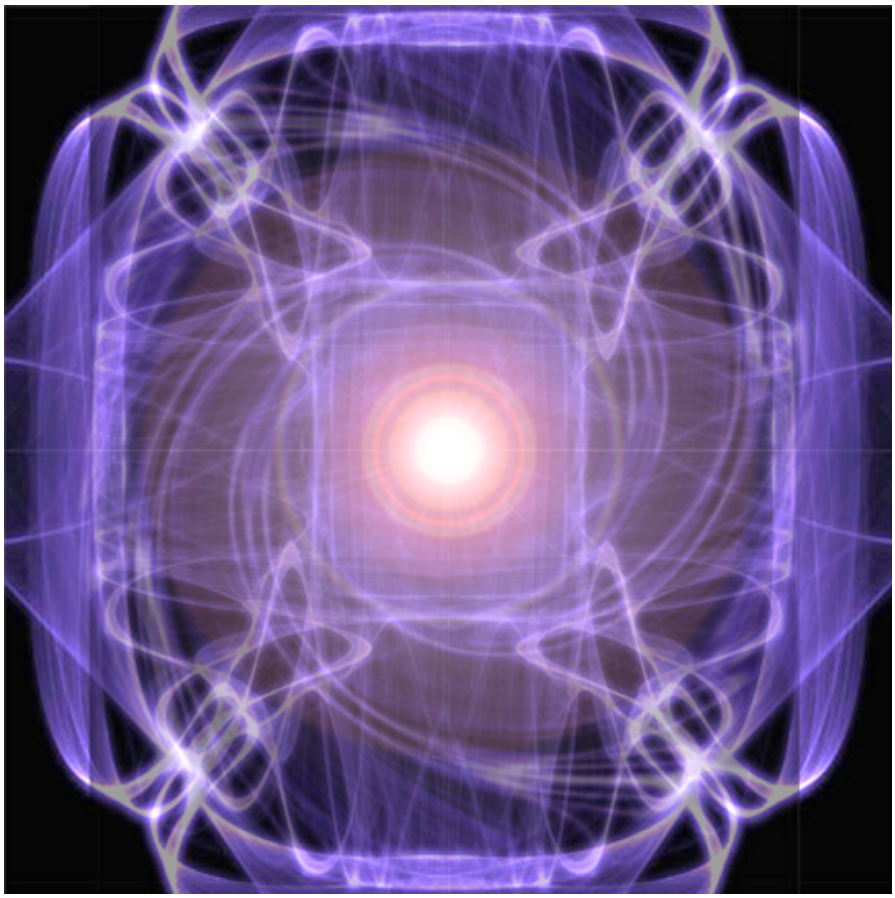
UCA Department of Physics and Astronomy

PHYS 3345: OPTICS



I thought this might be something cool, but it ended up being a random image on a really scary website full of really bad pseudo-physics.

Quiz 02: Chapter 02 **Spring 2008**

1. (5 points) A harmonic disturbance has an amplitude of **10m**, and can be described by a wave function ψ(x, t) such that ψ(0,0) = 0. If the wave has an **angular frequency of π/2** and moves with a speed of **10m/s**, write the wave function ψ(x, t). Then determine its magnitude at **t = 3s** at a point **x = 20m** from the origin.

$$A = 10\text{m}$$

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

$$v = 10\,\frac{\text{m}}{\text{s}}$$

$$k = \frac{2\pi}{\lambda} = \frac{2\pi}{v\tau} = \frac{\omega}{v}$$

$$\psi(x,t) = A\sin(kx - \omega t)$$

$$\psi(x,t) = A\sin\left(\frac{\omega}{v}x - \omega t\right) = A\sin\left[\omega\left(\frac{x}{v} - t\right)\right]$$

$$\psi(x,t) = (10\text{m})\sin\left[\frac{\pi}{2}\left(\frac{x}{10} - t\right)\right]$$

$$\psi(20,3) = (10\text{m})\sin\left[\frac{\pi}{2}\left(\frac{20}{10} - 3\right)\right] = (10\text{m})\sin\left(-\frac{\pi}{2}\right)$$

$$\psi(20,3) = -10\text{m}$$

2. (5 points) Imagine that you have a photograph of a wave at t = 0, which shows its shape to be mathematically described by:

$$\psi(x,0) = 3\sin\left(\frac{\pi x}{25}\right)$$

The wave is moving in the **–x direction** at a rate of **2m/s**. Write the wave function ψ(x, t), then write the expression for the disturbance at t = 4s: ψ(x, 4).

$$v = -2\,\frac{\text{m}}{\text{s}}$$

$$k = \frac{\pi}{25}$$

$$\psi(x,t) = A\sin k(x + vt)$$

$$\psi(x,t) = A\sin\frac{\pi}{25}(x + 2t)$$

$$\psi(x,4) = A\sin\frac{\pi}{25}(x + 8)$$