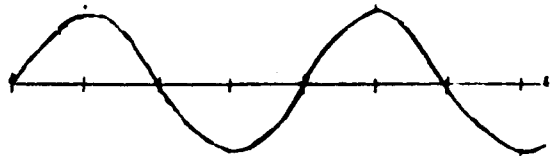
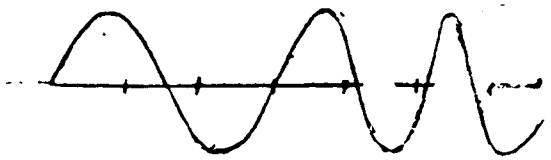
COHERENCE

Light coming out of a laser is both spatially and temporally coherent. Temporal coherence means that all the waves coming out of the laser have the same wavelength-the spacing between crests does not change with time.

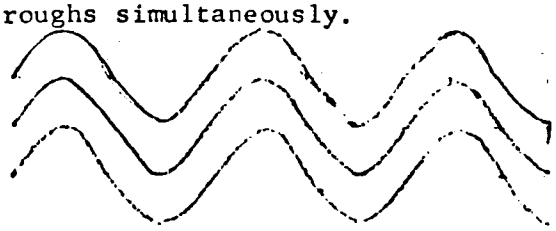


TEMPORALLY COHERENT WAVE

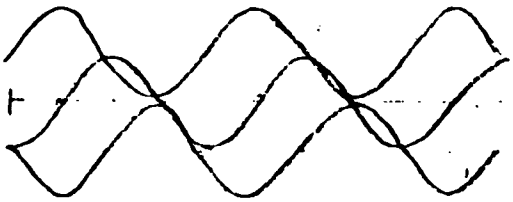


NOT A TEMPORALLY COHERENT WAVE

There is more than one wave of light coming out of the laser and these waves are all in step as they exit the port. They can be thought of as originating at the totally reflective mirror opposite the exit mirror, even though they make many round trips between the mirrors in the resonating cavity before leaving it. This is spatial coherence; all the waves make their crests and troughs simultaneously.

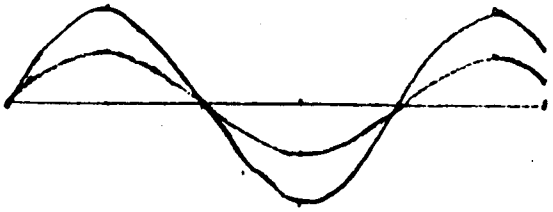


TEMPORALLY AND SPATIALLY COHERENT

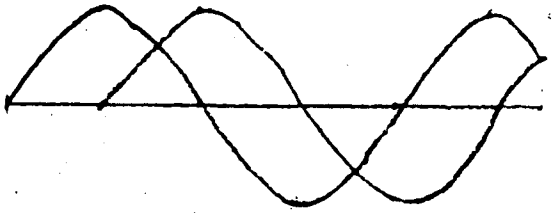


TEMPORALLY BUT NOT SPATIALLY COHERENT

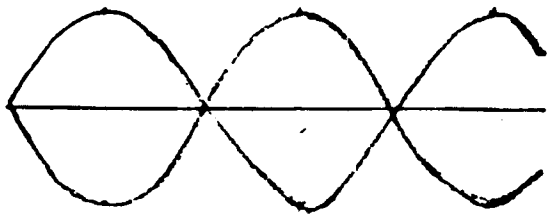
When temporally coherent waves are not spatially coherent, they are "out of phase" with each other. Crests do not match up, troughs don't match up, and neither do points in between. One way to indicate the amount that two waves are out of phase with each other would be to use fractions of a wavelength. Since these wave forms are based on the trigonometric sine curve we can also use degree measure or radian measure, assuming that every wavelength is equivalent to a 360 degree period or a 2π period.



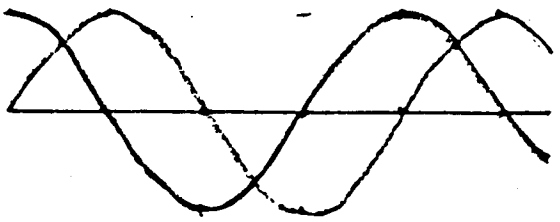
WAVES ARE IN PHASE



WAVES ARE { 1/4 WAVELENGTH / 90 DEGREES / $\pi/2$ RADIANS } OUT OF PHASE



WAVES ARE { 1/2 WAVELENGTH / 180 DEGREES / π RADIANS } OUT OF PHASE



WAVES ARE { 3/4 WAVELENGTH / 270 DEGREES / $3\pi/2$ RADIANS } OUT OF PHASE