

Model: 2-D Superposition of Waves**Act 8.3.3 Two Sources and More: FNTs from DLM 05 (~30 min)****Learning Goals:**

- Recognize that radio waves are a type of harmonic waves, so are thus subject to interference phenomena
- Reinforce the idea that when two waves of the same frequency and fixed phase constant are superposed, the interference at a particular point depends only on the difference between their path lengths from the source to the point.
- Recognize that multiple sources that are equally spaced can ALL interfere together to produce strong interference maxima at certain angles and that this angle is the same angle at which two-slits spaced by the same difference produces constructive interference

Act 8.3.4 Multiple Sources and Diffraction (~25 min)**Learning Goals:**

- Understand where the diffraction formula $n\lambda = d\sin\theta$ comes from
- Understand the geometry of the location of “bright spots” in a diffraction set-up.

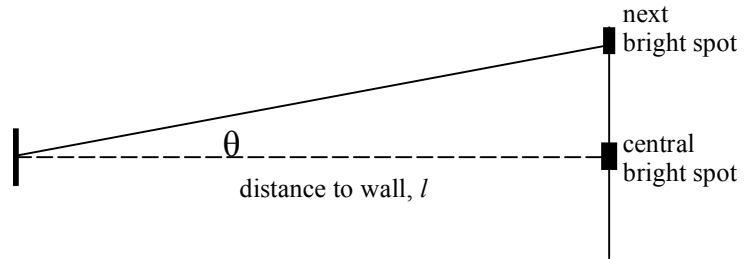
Act 8.3.5 Light and Diffraction—Lasers and White Light (~80 min)**Learning Goals:**

- To understand that the diffraction formula $n\lambda = d\sin\theta$ applies to interference from both two-sources (two slits) as well as to multiple sources (slits) that are all equally spaced.
- To understand that all the slits act as sources of separate waves with the same frequency and phase of the wave impinging on the slits.
- To understand that ridges or other factors that cause different amounts of wave energy to be reflected from a surface can cause the reflected wave to show diffraction patterns similar to those from slits or diffraction gratings that let the light pass through
- To understand how to apply the diffraction formula $n\lambda = d\sin\theta$ to various geometries and to make sense of the patterns seen by both transmission and reflection diffraction gratings.
- To understand that white light is a combination of a multiple wavelengths in the range from 400 to 700 nm, with red being at the longer end and violet at the shorter end of the continuous spectrum

8.3-1 (Reflect) Look back over the three DL Activities, 8.3.3, 8.3.4, and 8.3.5, and make sure you understand everything. Write down anything you are unsure about so it can be cleared up at the beginning of DLM 07.

8.3-2 **Spacing of spots on the wall.**

(Solidification) Suppose you found the spacing between the central bright spot and the next spot above it to be a distance s , as measured along the wall. Express the angle θ at which this constructive interference occurs in terms of a trig function and the distances l and s .

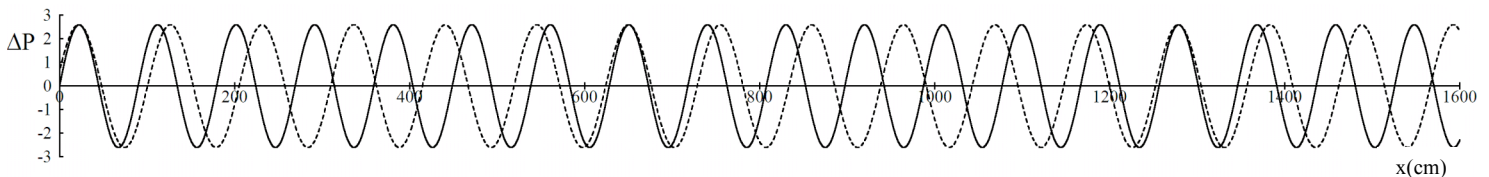


In Activity 8.3.2 you developed an expression for the angle θ at locations of constructive interference, which you used extensively in 8.3.3, 8.3.4, and 8.3.5. List the two relationships that you now have that involve the angle θ for this condition of *constructive interference*, one pertaining to the diffraction grating the other to what you see on a wall.

Review: what does $d \sin\theta$ approximate?

8.4-1 **Superposition of two waves that differ slightly from each other**

(Introduction) The graph below shows a snapshot in time (call this time $t = 0$) of the pressure difference as a function of position for two sound waves traveling through the **same medium** at the same time. Analyze these two waves (and, eventually, the total wave) by answering the questions below.



- 1) Of the various parameters (A , T , λ , ϕ , and v) that are used to describe the space and time dependences of these two waves, which are different and which are the same? Explain. Find values for the parameters A , T , λ , and v , assuming the sounds are traveling through the air in the DL room, for each wave. (Hint: two numerical values are 90 and 105...in what units? For what quantity?)
- 2) Identify locations in space (values of x) where the interference is constructive and locations where it is destructive.
- 3) Suppose the sound waves are both traveling to the right. As time goes on, what happens (in general, not specifically) to the locations of the constructive and destructive interference?
- 4) Now suppose you are standing at $x = 1600$ m listening to these waves. What will you hear (i.e. how is the constructive and destructive interference manifested)?