Safety Testing Observations

Day 1.) Beams started slightly veering down to [illegible] cooling conditions, This issue was fixed. Otherwise No damage was detected

Day 2.) No change otherwise.

Day 3.) No change otherwise

Day 4.) No change otherwise

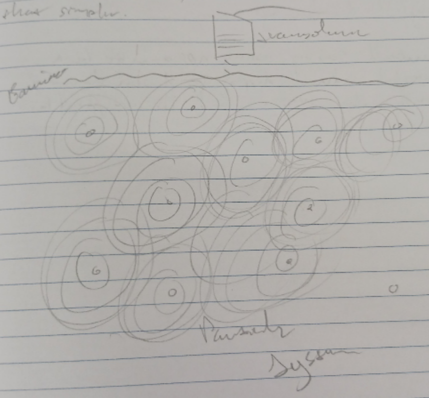
Day 5.) No change otherwise

Day 6.) No change otherwise

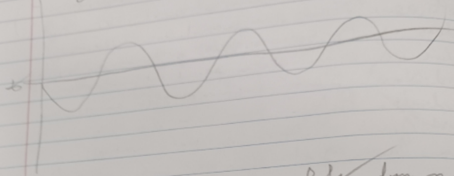
Day 7.) No change otherwise

Overall safety testing appeared to be a successful endeavor, displaying little damage within the crystals, and the artifical lasting [illegible]

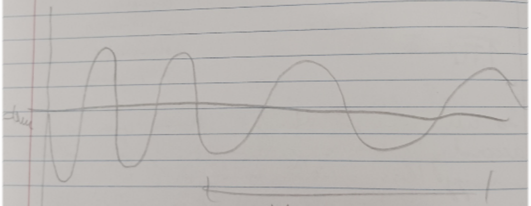
This is of course reliant on the fact that the energy loss is primarily occurring from the square inverse energy propagation law, and not due to other factors. But nonetheless, this methodology becomes wonderful when analyzing a system of particles such as the one below, where the wave mechanics need to be known, since many make that simpler.



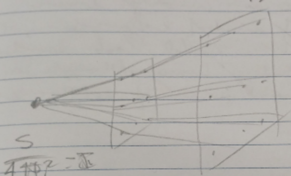
Original sine wave



If thus we are randomly drawn sine wave of assorted deformation, the sine wave shaped wave would look something like the following wave although in this case exaggerated for ease of appearance.

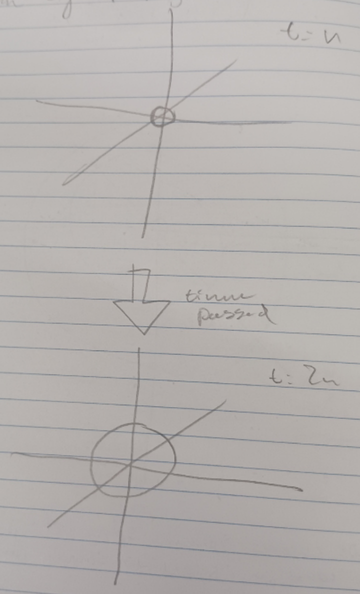


Thus from this, we have a semi appropriate description of the standing surface of the spherical propagation of the wave. From this we can use the radius of the sphere, taking some arbitrary value at some given point off of some coordinate plane, and transfer any wave accordingly. Before we can do this, we must first account for the inverse square law of the energy wavefront.

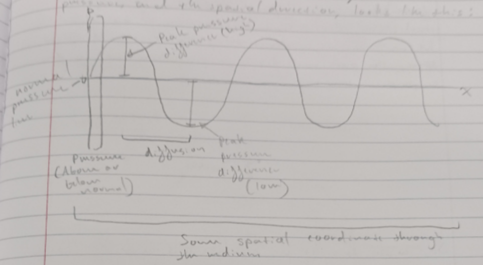


So we must shift the wave accordingly when accounting for this energy loss which can be described as the frequency loss, as well as amplitude loss.

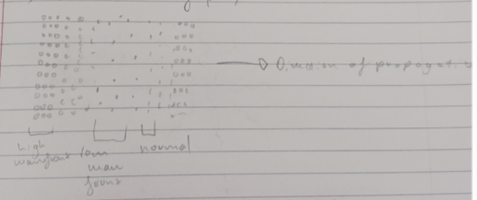
When we consider this in relation to wave propagation through time (t), we can set our previous constant of time t to equal at k. So as time changes, so does the surface of propagation.



So the wave instead, when taking into consideration pressure and the spatial direction, looks like this:



Or, more intuitively put,

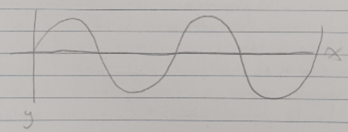


So, let's now consider a slightly more complex case.

From the previous second order PDE, of pressure with respect to time, to the equivalency of this to the summation of the second order derivatives of pressure with respect to each spatial coordinate, multiplied by the factor of the speed of the wave in the medium, we can change the equation to better account for different attenuation factors.
The standard wave equation:

$$\frac{\partial^2 p}{\partial t} = c^2 \frac{\partial^2 p}{\partial x^2}$$

Accounts not for energy loss or wave speed through the medium. Instead, let us first look at the most basic foundational idea of a wave, a sine wave.



This simple mathematical expression is a wonderful model of a wave, as y can be modeled as the pressure beyond or above the normal within a medium, and x represents some spatial dimension.

When also accounting for a wave, or when trying to predict or analyze the results we get from some experiments, there exists not only one, but 3 spatial dimensions for which we must account for. So the equation turns from:

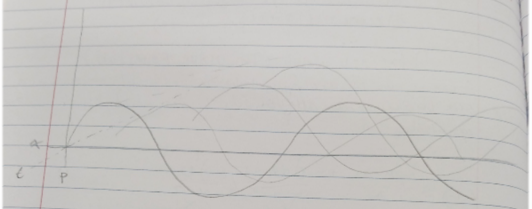
3.1) $$\frac{\partial^2 p}{\partial t^2} = c^2 \frac{\partial^2 p}{\partial x^2}$$

with $f(x,t)$ or $f(x,p)$ or $f(t,p)$ to

3.2) $$\frac{\partial^2 p}{\partial t^2} = c^2\left(\frac{\partial^2 p}{\partial x^2} + \frac{\partial^2 p}{\partial y^2} + \frac{\partial^2 p}{\partial z^2}\right)$$

with several other complications of the functions, as well as the equational function changes of each variable. So instead of a flat membrane plane of the 3rd dimension of the plane constituting time, it becomes that the wave must be modeled at different pressure fronts and energies, but in time, as well as each spatial coordinate. This becomes computationally and mathematically difficult for the determination of variables at any set value point, so a different method is needed. Further research will be done.

Which if analyzed is just a rewritten PDE accounting for p (pressure) of the acoustic medium while all other factors remain the same. In one spatial dimension x, this simple wave description can roughly be drawn out as this:



Note that this is not a mathematical description but is rather a direct description of the wave, and only becomes a true mathematical description when the second order derivative is applied to some respective value against some other respective value.

WHEN CALCULATING, IN TERMS OF PREDICTION, OR ACCOUNTANCE OF ACOUSTIC WAVE SCATTER, FIRST, EXPLAIN THE WAVE. OR:

1.) EXPLAIN WAVE
2.) ACCOUNT (TRAVEL$_{\text{INITIAL}}$)
3.) EXPLAIN SCATTER (Rayleigh, ORDINARY)
4.) ACCOUNT (TRAVEL$_{\text{BACKSCATTER}}$)

SO:

1.) EXPLAIN WAVE (THE WAVE EQUATION)

A wave, be it acoustic, light, vibrational, or even a sea wave, can all roughly be described by the wave equation.

$$\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2} \qquad (1.1)$$

The PDE responsible for the description of a wave travelling over t (time), in a spatial dimension at some disturbance or pressure u. c is the speed of travel of the wave in medium, and the [illegible] is in reference to the second order of differentia[illegible]. This is discussed later, so first, let us look at the e[illegible] specific to the acoustic wave:

$$\frac{\partial^2 p}{\partial t^2} = c^2 \frac{\partial^2 p}{\partial x^2} \qquad (1.2)$$