Physics

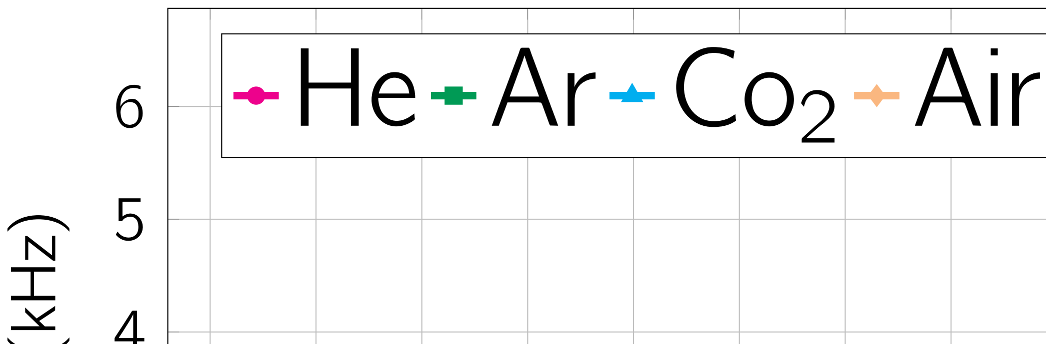
Carnegie Mellon University

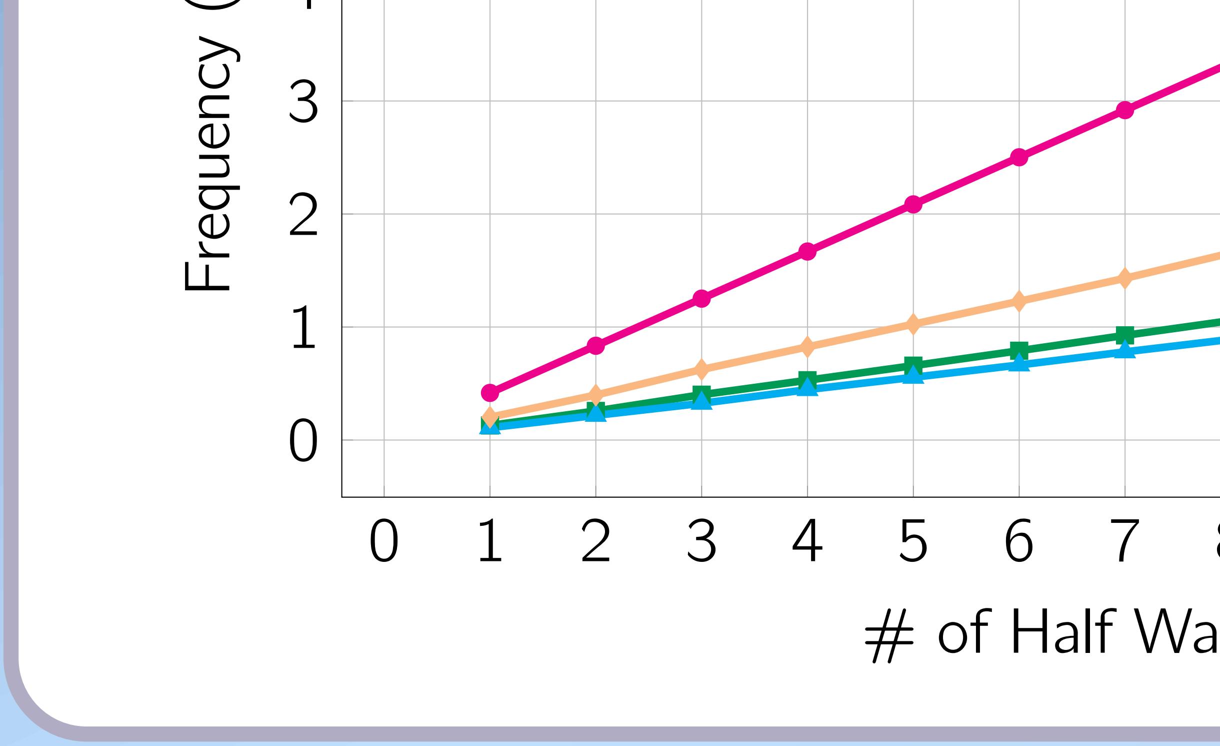
Sp

Abstra

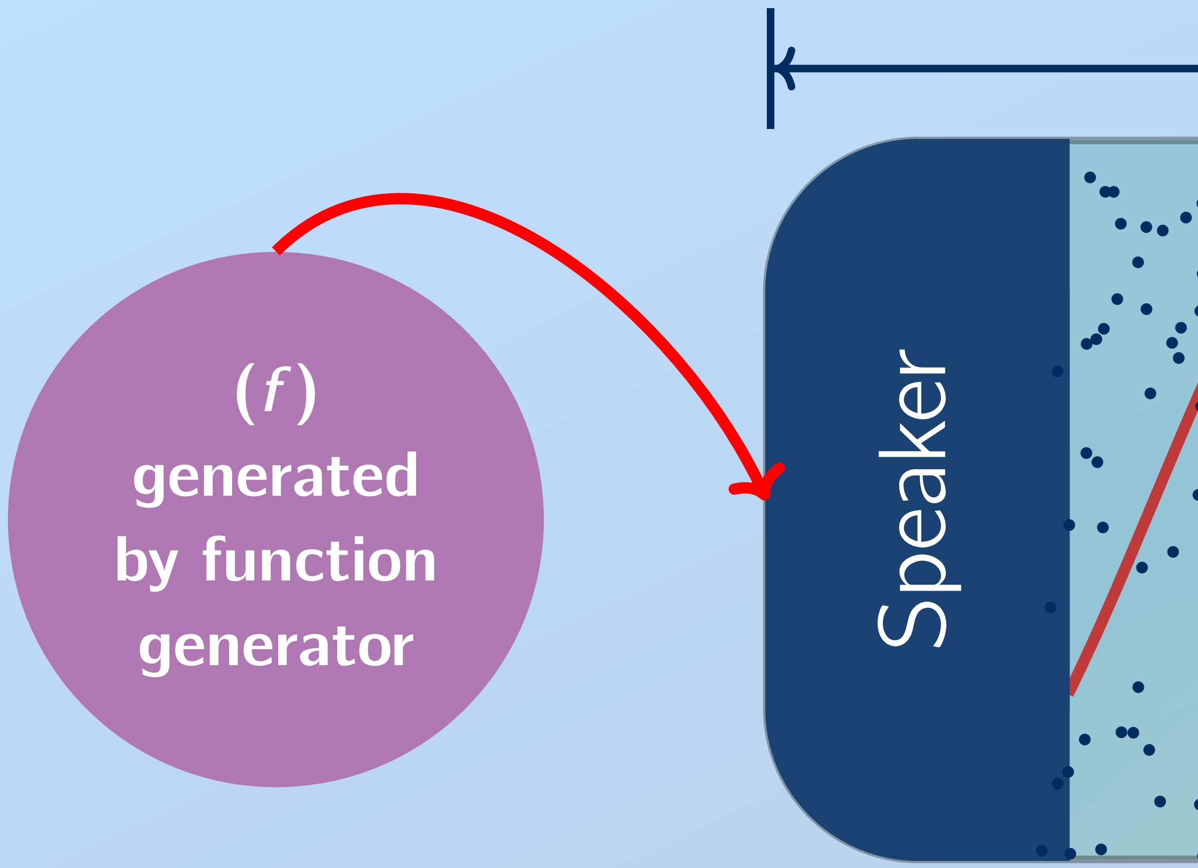
We review the results of our experiment to f
in various gasses and how mass and the st
role in the phenomenon. It is predicted that
degrees of freedom in motion affects the spe
the gas. First, we used a function generator
measure the speed of sound in a tube filled
microphone. The speed of sound was foun
the line of best fit on a graph that plotted th
frequency (measured by the oscilloscope) ag
function generator). Our results showed t
denser gas–gas with greater molecular ma
with the theoretical predictions.

Data





Frequency (
3
2
1
0
0
1
2
3
4
5
6
7
# of Half Wa



(f)
generated
by function
generator
Speaker

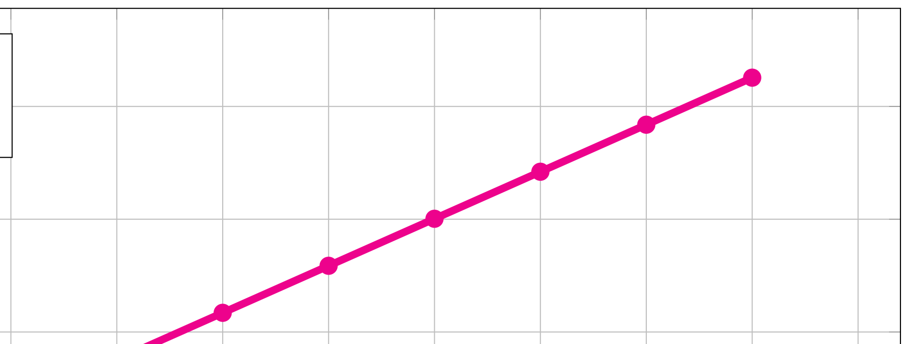
eed of Sound in

Department of

act

find out how the speed of sound differs
tructure of the gas molecules plays a
t both the molar mass and molecules'
eed at which sound propagates through
r and an oscilloscope to experimentally
with gas and fitted with speaker and
d to be proportionate to the slope of
he number of antinodes for a resonant
gainst the source frequency (from the
that the speed of sound is slower in
ss. This conclusion is in agreement

a



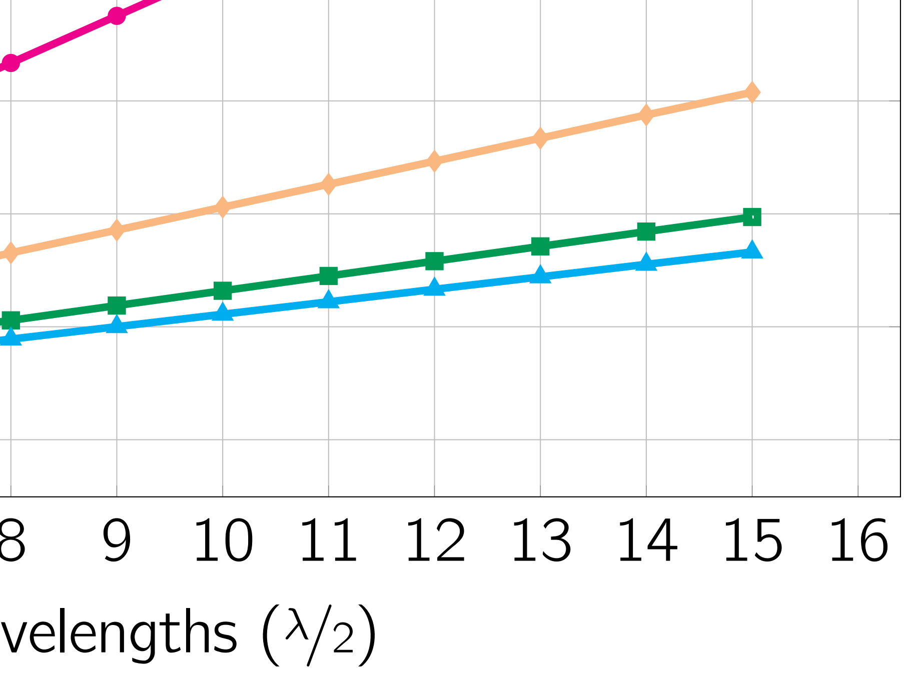
Speed of Wav

Ve

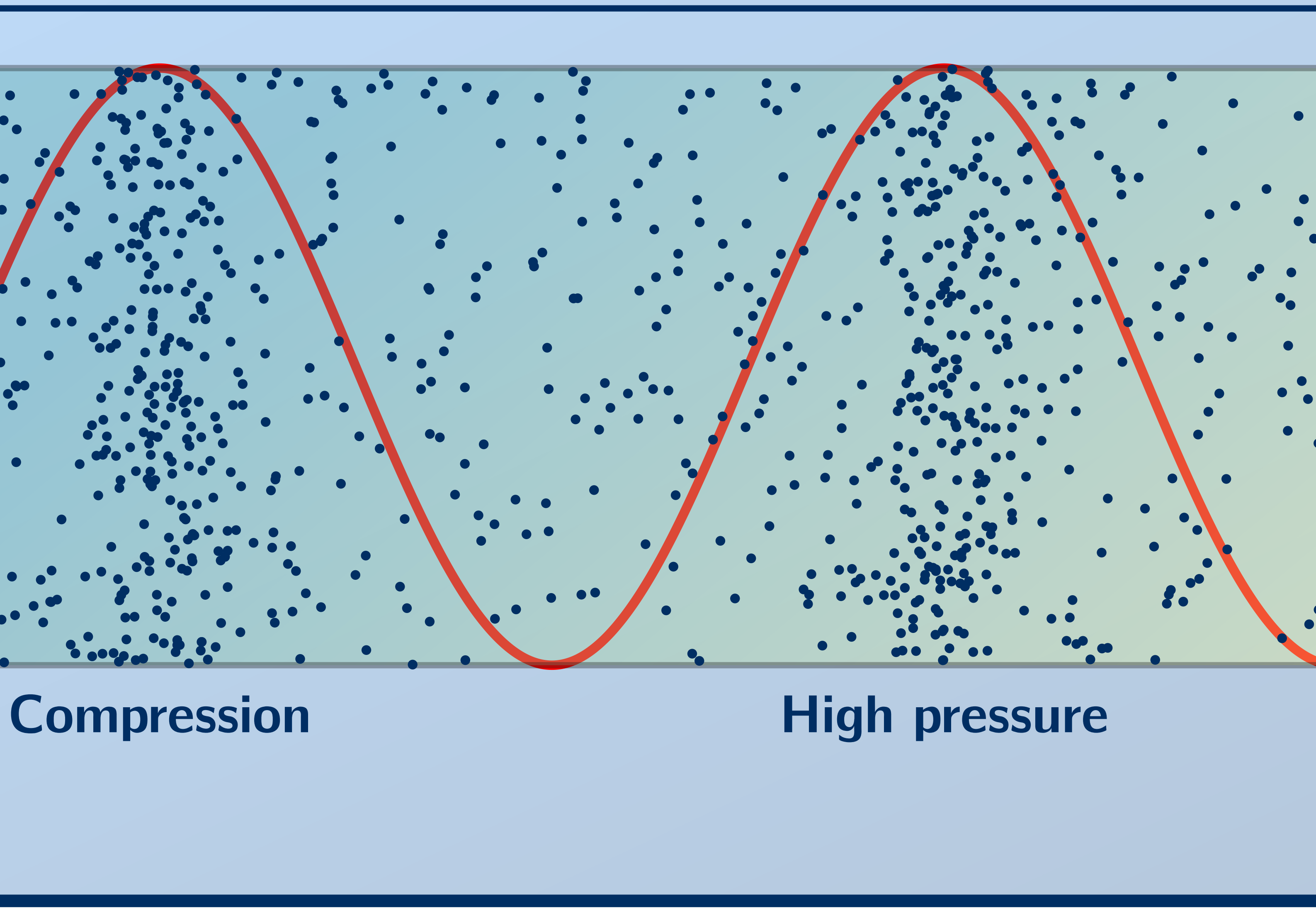
Sound waves a

Where γ is th
temperature in
that the gas in
zero volume a
and at high te

Results sho



Gas
Helium
Argon
Carbon Dioxi
Air



n Gasses at Roo

Tanvi Jakkampudi

f Physics, Carnegie Mellon

Theory

es is affected by the density and stiffness of the medium.

$$\text{elocity of Sound Wave} \longrightarrow v = \sqrt{\frac{\text{bulk modulus}}{\text{density}}} = \sqrt{\frac{k}{\rho}}$$

are produced adiabatically and their speed in an ideal gas is give

$$v_{sound} = \sqrt{\frac{\gamma RT}{M}}$$

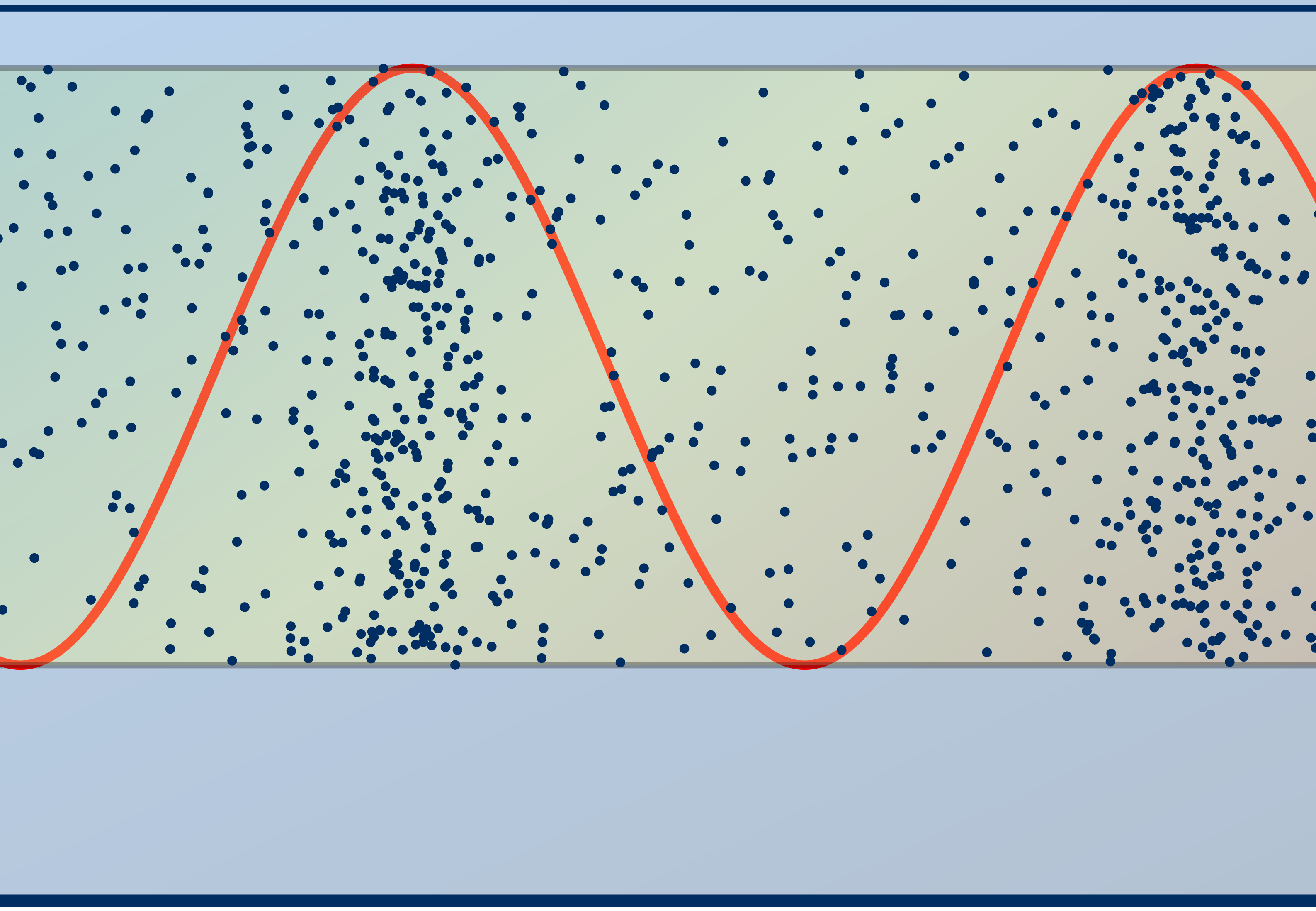
e ratio of specific heats of gas, R is the molar gas constant, n Kelvin, and M is molar mass of gas. The above equation assu nvolved behaves like an ideal gas. Ideal gas molecules occupy nd do not interact electrostatically with each other at low de mperatures.

Final Results

wing Experimental measurements in agreement with Theoretic
predictions of the velocities of sound
in three different gas mediums

	Experimental Velocity m/s	Theoretical Velocity m/s	
	$v_{ex} \pm \sigma_{ex}$	$v_{th} \pm \sigma_{th}$	
	1013.8 ± 4.2	1012.75 ± 0.86	0
	320.0 ± 1.3	320.66 ± 0.27	0
de	270.1 ± 1.1	269.55 ± 0.23	0
	337.7 ± 2.1	346.72 ± 0.29	4

Length (L) of the system = 1.215 m



m Temperature

University

Experimen

Speed of wave is given by: v =

Resonance occurs when: L =

(Where f is frequency, and λ is the wave lengt
is # of half-wave lengths).

n by:

T is
umes
near
nsity

Combining Equations (1) and (2)..

$$f = \frac{v}{2L} \times n$$

$\therefore$ Velocity of sound in gas mediums can be foun
of resonant frequency with respect to change in
and multiplying it with the twice the length of t

Conclusio

cal

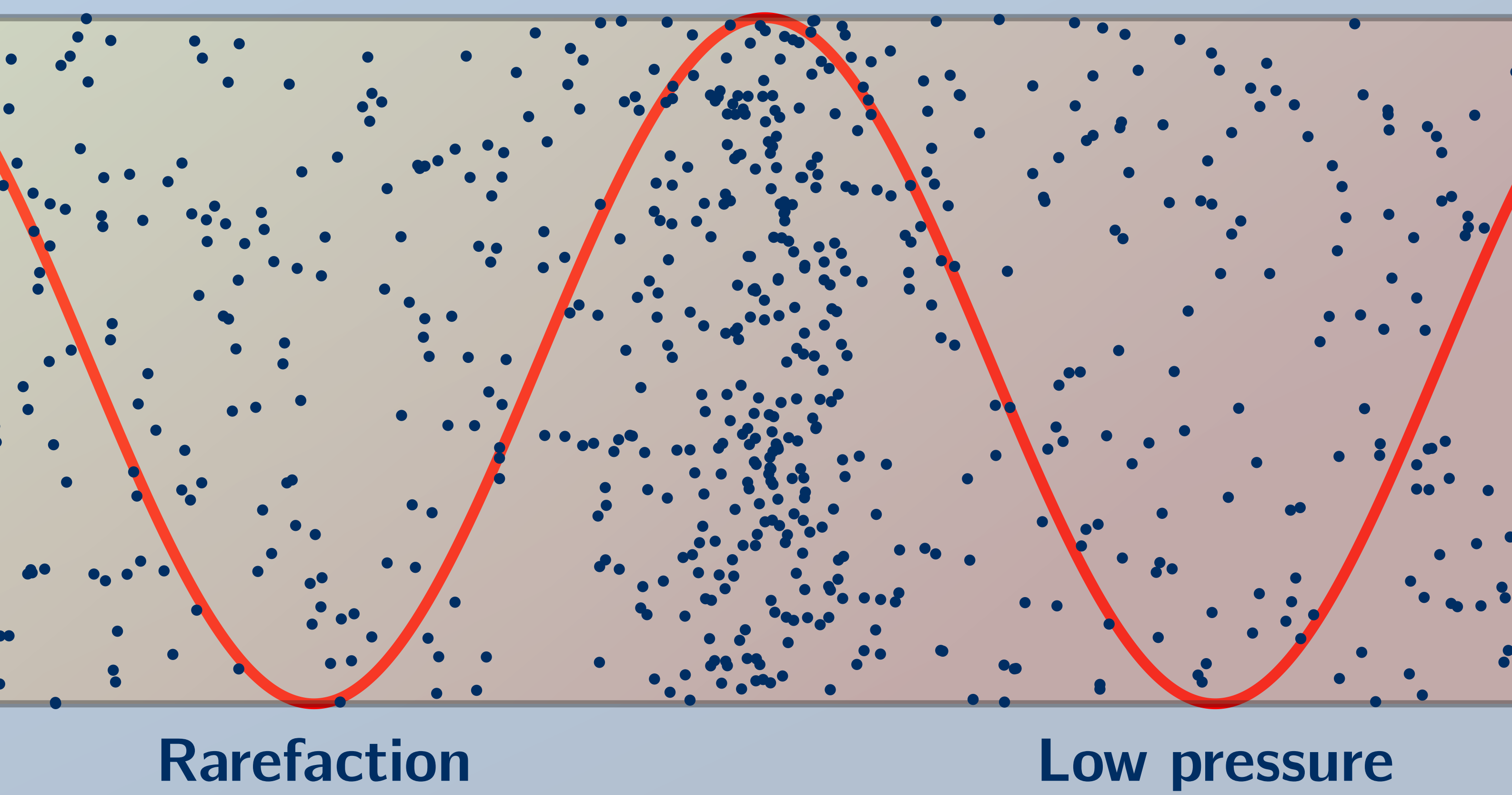
1. Sound travels slowest in linear triatomic gas
   monoatomic gases.

- Monoatomic: He, Ar
- Diatomic: Air

Δ/σ
.245
.497
.489
.254

- Linear Triatomic: Co

2. Molecular mass of the gas molecules is inver
in the gas.
    - Lighter: He,
    - Heavier: Air, Ar, Co_2



Physics

Carnegie Mellon University

nt

$= f\lambda$

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

h L is length of the system, and n

$\implies \boldsymbol{v = \frac{f}{n} \times 2L}$

d by measuring the rate of change
number of half wavelengths $^{\Delta f}/_{\Delta n}$
the pathway $(2L)$

on

es in comparison with diatomic or

$\Big\}$ *Faster*

$_2$ } *Slower*

sely related to the speed of sound

} *Faster*

$_2$ } *Slower*