Physics

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Spee

d of Sound in Gase

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Abstract

We review the results of our experiment to find out how t
in various gases and how mass and the structure of the g
in the phenomenon. It is predicted that both the mo
degrees of freedom in motion affect the speed at which
we used a function generator and an oscilloscope to exp
speed of sound in a tube filled with gas and fitted with s
The speed of sound was found to be proportionate to
best fit on a graph that plotted the number of antinodes
(measured by the oscilloscope) against the source frequ
generator). Our results showed that the speed of sound
gas with greater molecular mass–as well as in gases with
structure. This conclusion is in agreement with the theo

he speed of sound differs
as molecules plays a role
lar mass and molecules'
sound propagates. First,
perimentally measure the
speaker and microphone.
the slope of the line of
for a resonant frequency
ency (from the function
is slower in denser gas–
more complex molecular
retical predictions.

The

Speed of waves is affected by the densit

Velocity of Sound Wave ⟶

Sound waves are produced adiabatically a

$$v_{sound} =$$

Where γ is the ratio of specific heats o
temperature in Kelvin, and M is molar m
that the gas involved behaves like an ide
gas molecules occupy near zero volume
each other at low density and at high te

eory

y and stiffness of the medium.

$$\cdot\ v = \sqrt{\frac{\text{bulk modulus}}{\text{density}}} = \sqrt{\frac{k}{\rho}}$$

and their speed in an ideal gas is given by:

$$: \sqrt{\frac{\gamma RT}{M}}$$

f gas, R is the molar gas constant, T is
ass of gas. The above equation assumes
al gas and the process is adiabatic. Ideal
and do not interact electrostatically with
mperatures.

S

I

(Where f is frequency,
# of half-wave lengths)

Combining the above eq

∴ Velocity of sound in ga
of resonant frequency wi
and multiplying it with tv

Experiment

ꞌpeed of wave is given by: $v = f\lambda$

Resonance occurs when: $L = n\frac{\lambda}{2}$

λ is the wavelength, L is length of the system, and n is

.

ɪuations..

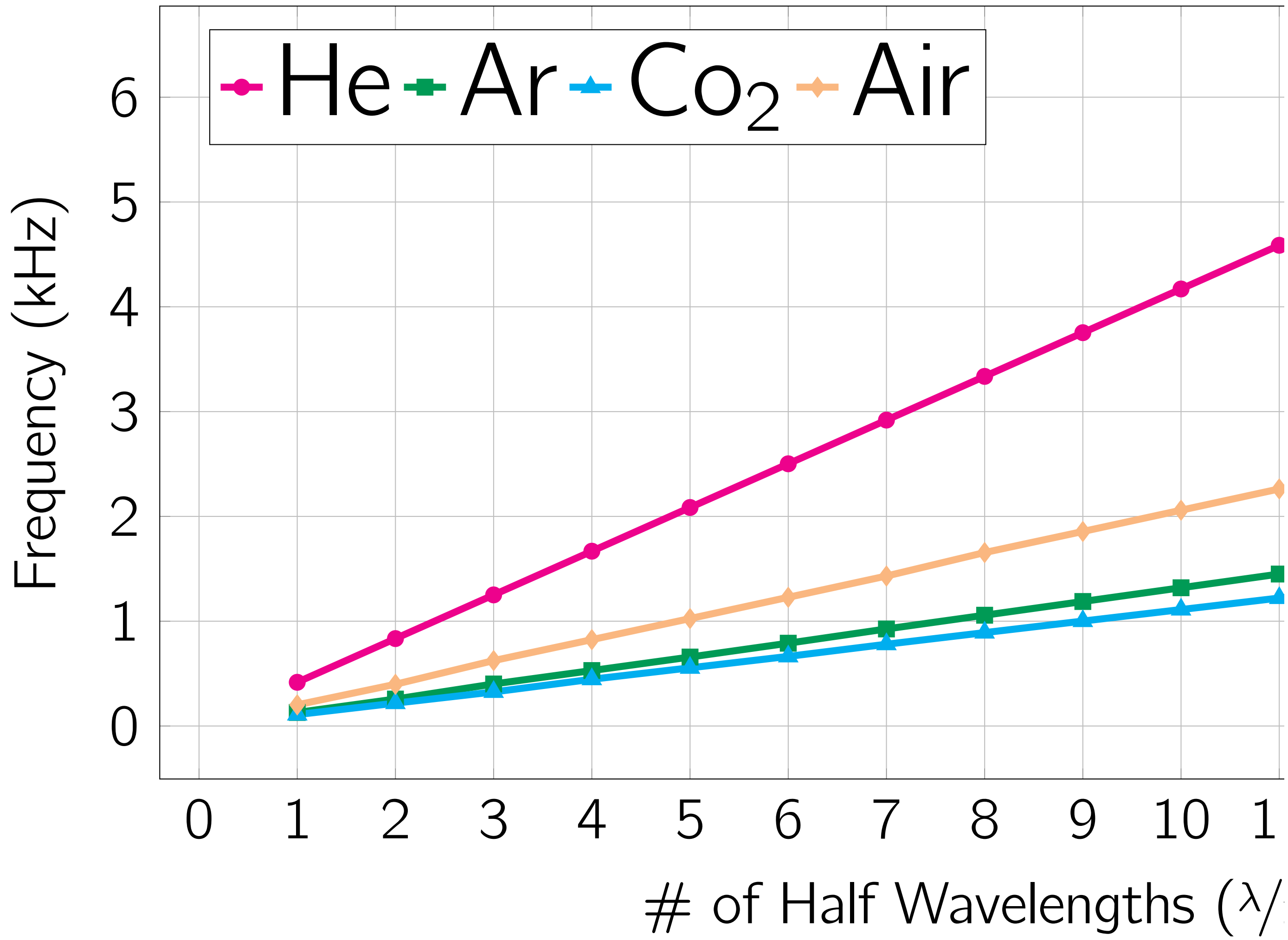
$$f = \frac{v}{2L} \times n \implies \boldsymbol{v = \frac{f}{n} \times 2L}$$

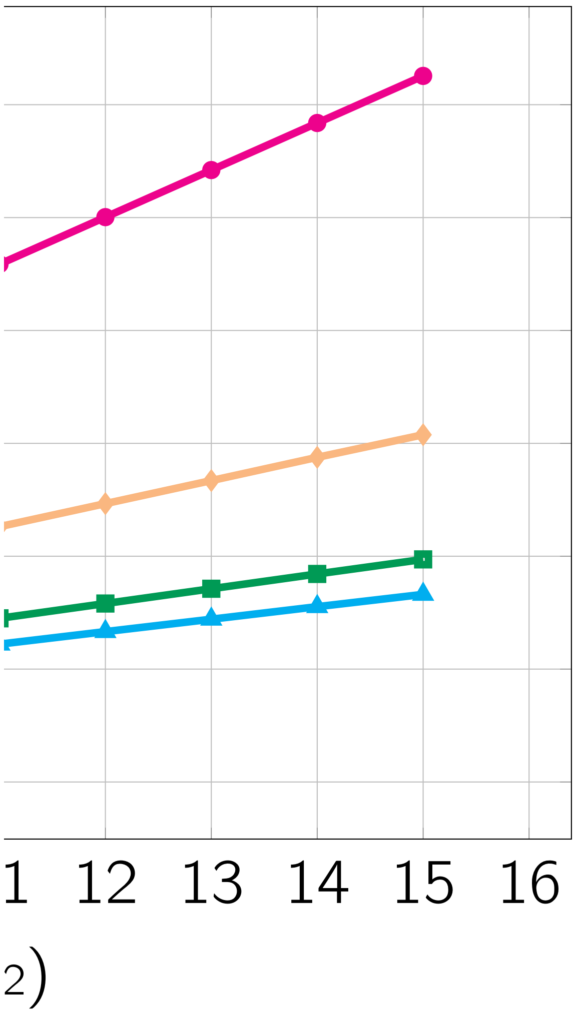
ɪs mediums can be found by measuring the rate of change

ith respect to change in number of half wavelengths $\Delta f / \Delta n$

wice the length of the pathway $(2L)$

Data


He
Ar
Co2
Air
Frequency (kHz)
0
1
2
3
4
5
6
0
1
2
3
4
5
6
7
8
9
10
# of Half Wavelengths



Final F

Here are the final results showing experi
theoretical predictions of h
in four different gas mediu

	Experimental Veloci
Gas	$v_{ex} \pm \sigma_{ex}$
Helium	1013.8 ± 4.2
Argon	320.0 ± 1.3
Carbon Dioxide	270.1 ± 1.1
Air	346.2 ± 2.1

Results

mental measurements in agreement with
now fast sound propogates
ms during our experiments

ty m/s	Theoretical Velocity m/s $v_{th} \pm \sigma_{th}$	Δ/σ
	1012.75 ± 0.86	0.245
	320.66 ± 0.27	0.497
	269.55 ± 0.23	0.489
	346.72 ± 0.29	0.245

1. Sound travels slowest monoatomic gases.

2. Molecular mass of the in the gas.

Conclusion

in linear triatomic gases in comparison with diatomic or

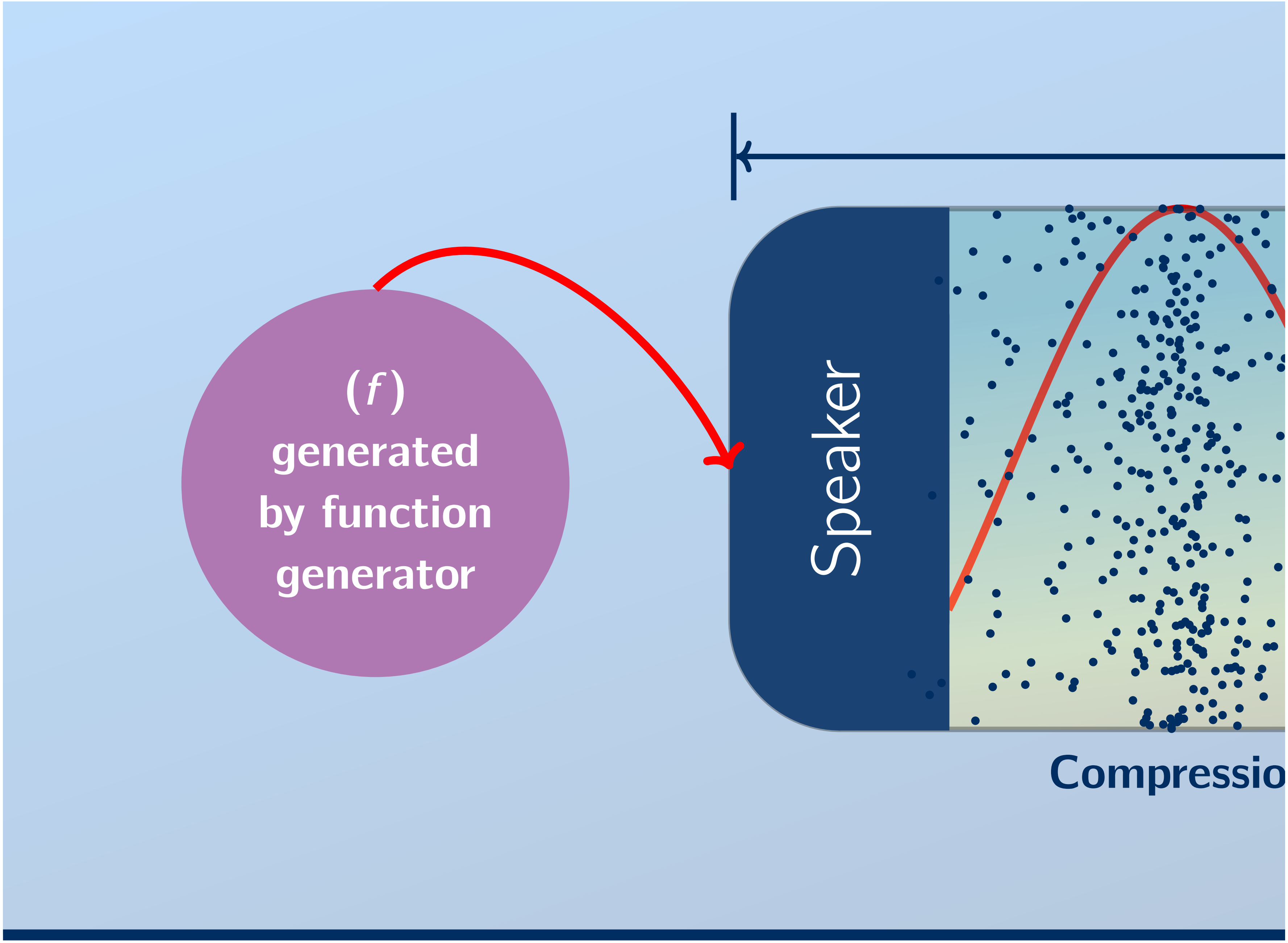
- Monoatomic: He, Ar
- Diatomic: Air

} *Faster*

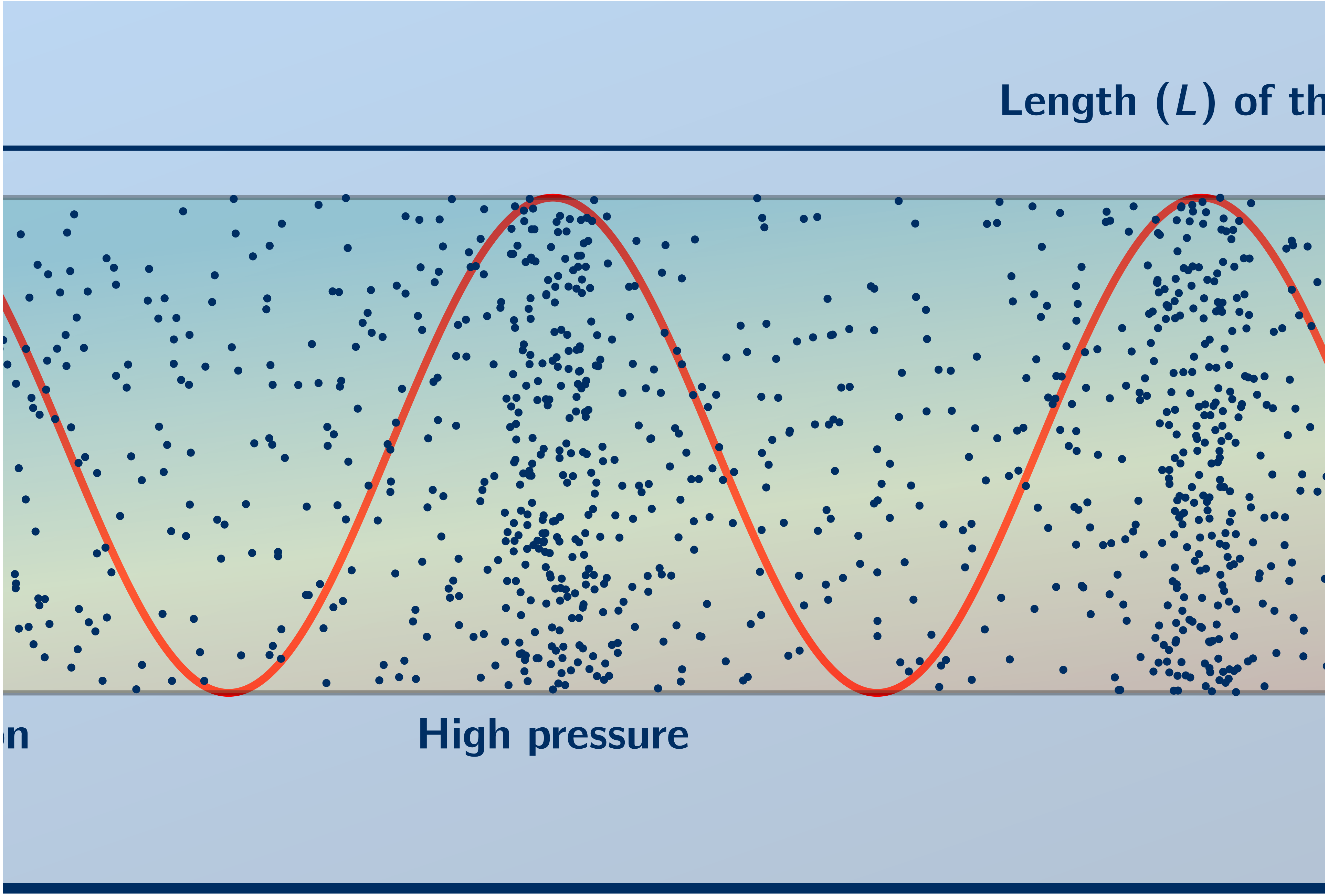
- Linear Triatomic: Co_2 } *Slower*

gas molecules is inversely related to the speed of sound

- Lighter: He, } *Faster*
- Heavier: Air, Ar, Co_2 } *Slower*

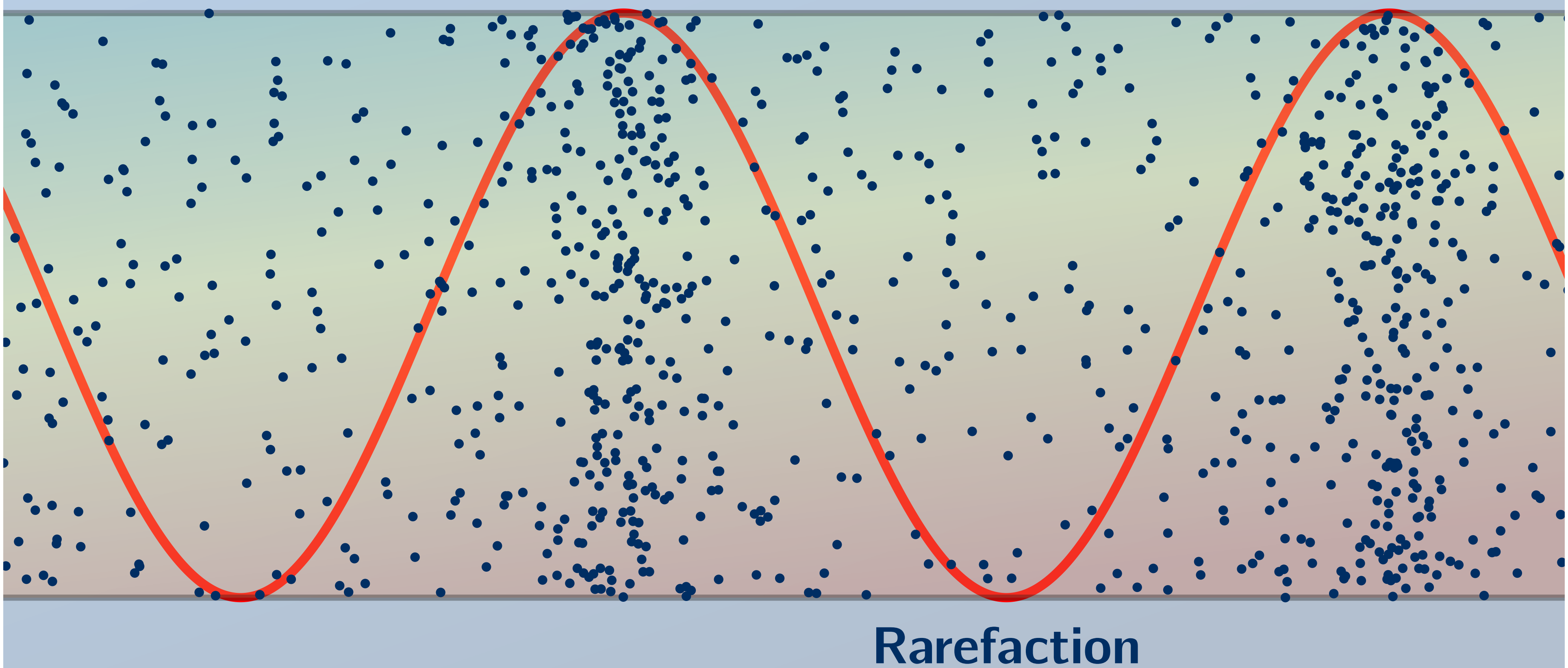


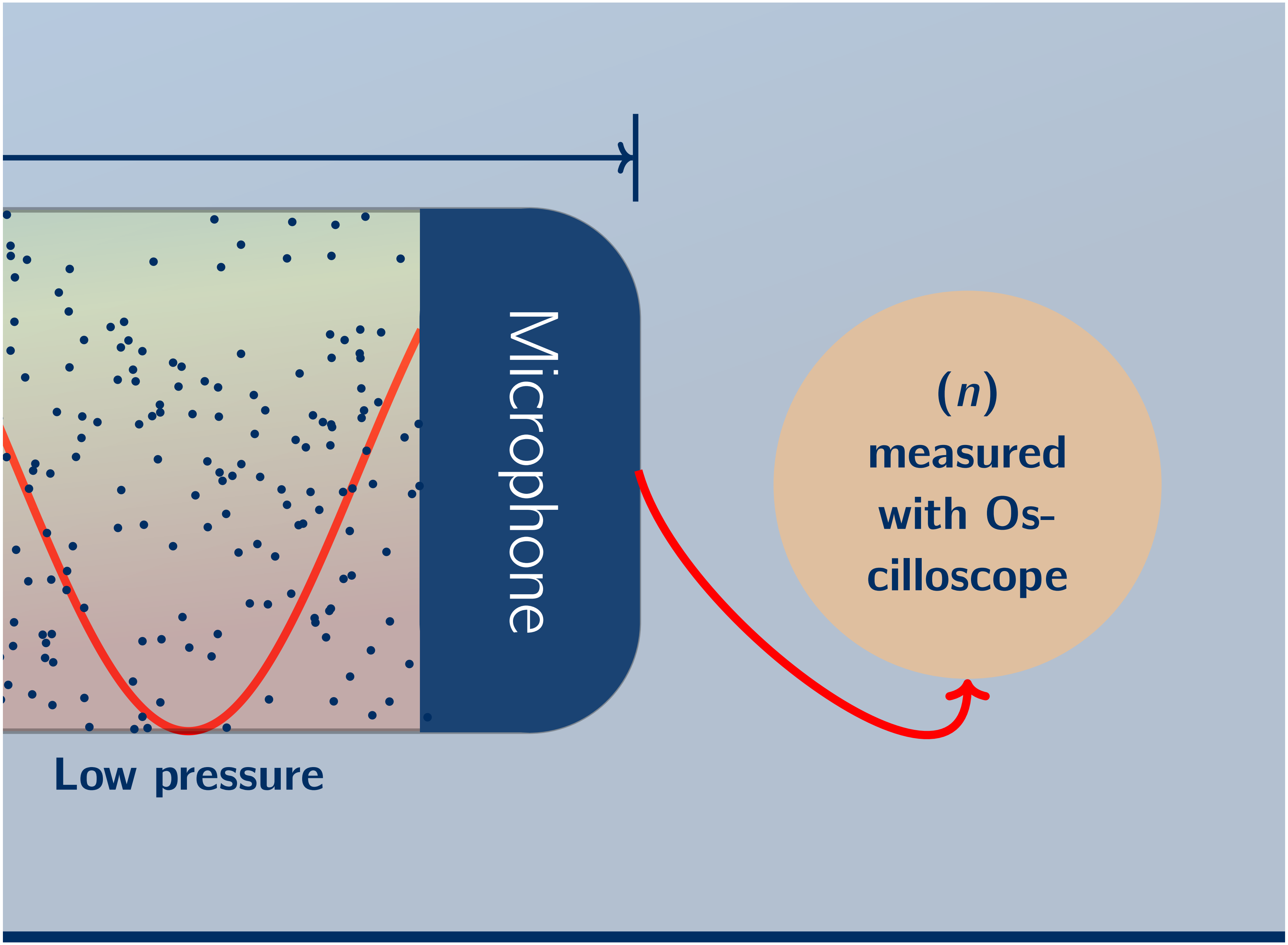
(f)
generated
by function
generator
Speaker
Compressio



Length (L) of th
on
High pressure

ıe system = 1.215 m




Microphone
(n) measured with Oscilloscope
Low pressure