南京邮电大学
Nanjing University of Post & Telecom

物理实验教学中心

Physics Expeiment Center

SOUND VELOCITY MEASUREMENT

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NJUPT

Purposes:

1. Learn two methods for measuring the velocity of sound in the air: the resonance interference method and the phase comparison method;
2. Understanding of the theory of wave and vibration synthesis;
3. Learn the application of oscilloscope.

Principles:

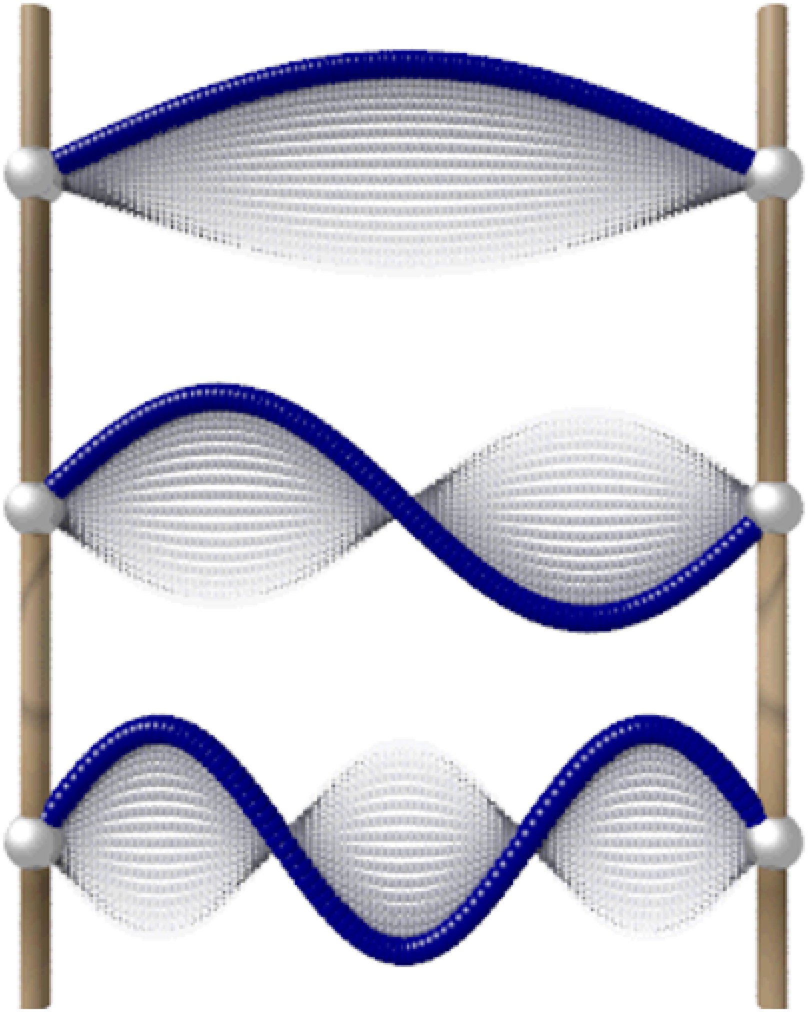
The most familiar acoustic phenomenon is that associated with of sound. For the average young person, a vibrational disturbance is interpreted as sound if its frequency lies in the range of about 20 to 20000Hz. However in a broader sense acoustic also includes the ultrasonic frequencies above 20000Hz and the infrasonic frequencies below 20Hz.

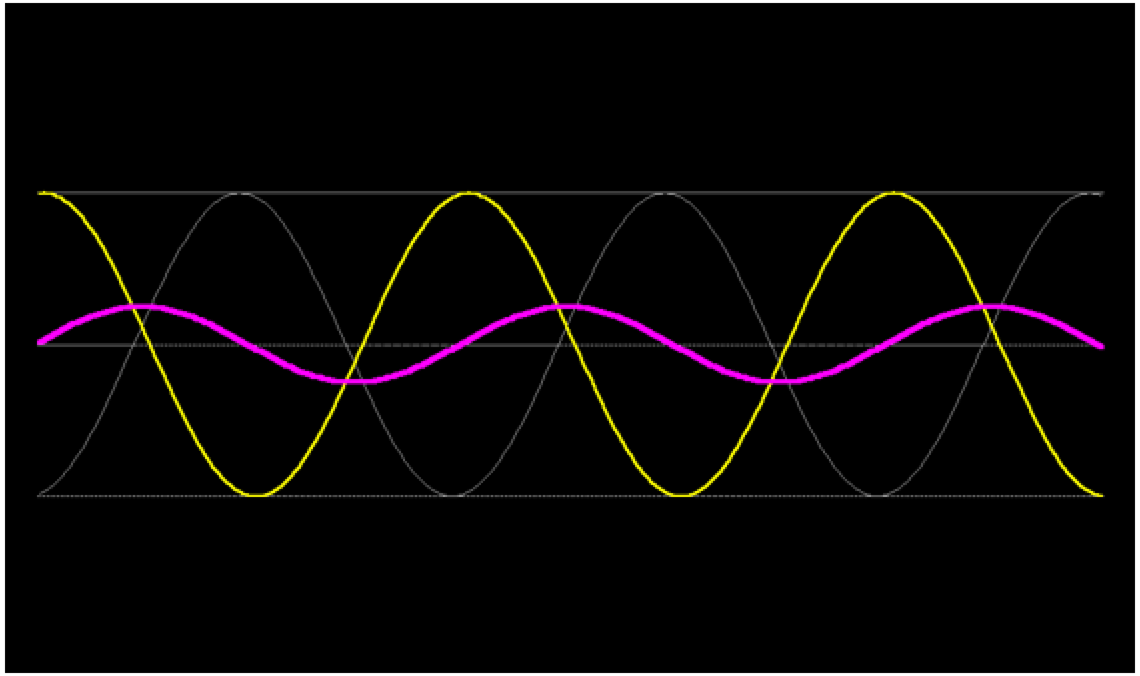
The measurement of speed of sound is of interesting for understanding the main property of sound. One can easily obtain the velocity of sound through the following expression:

$$\boxed{V = F \times \lambda}$$

F is frequency, λ is wavelength.

STANDING WAVE



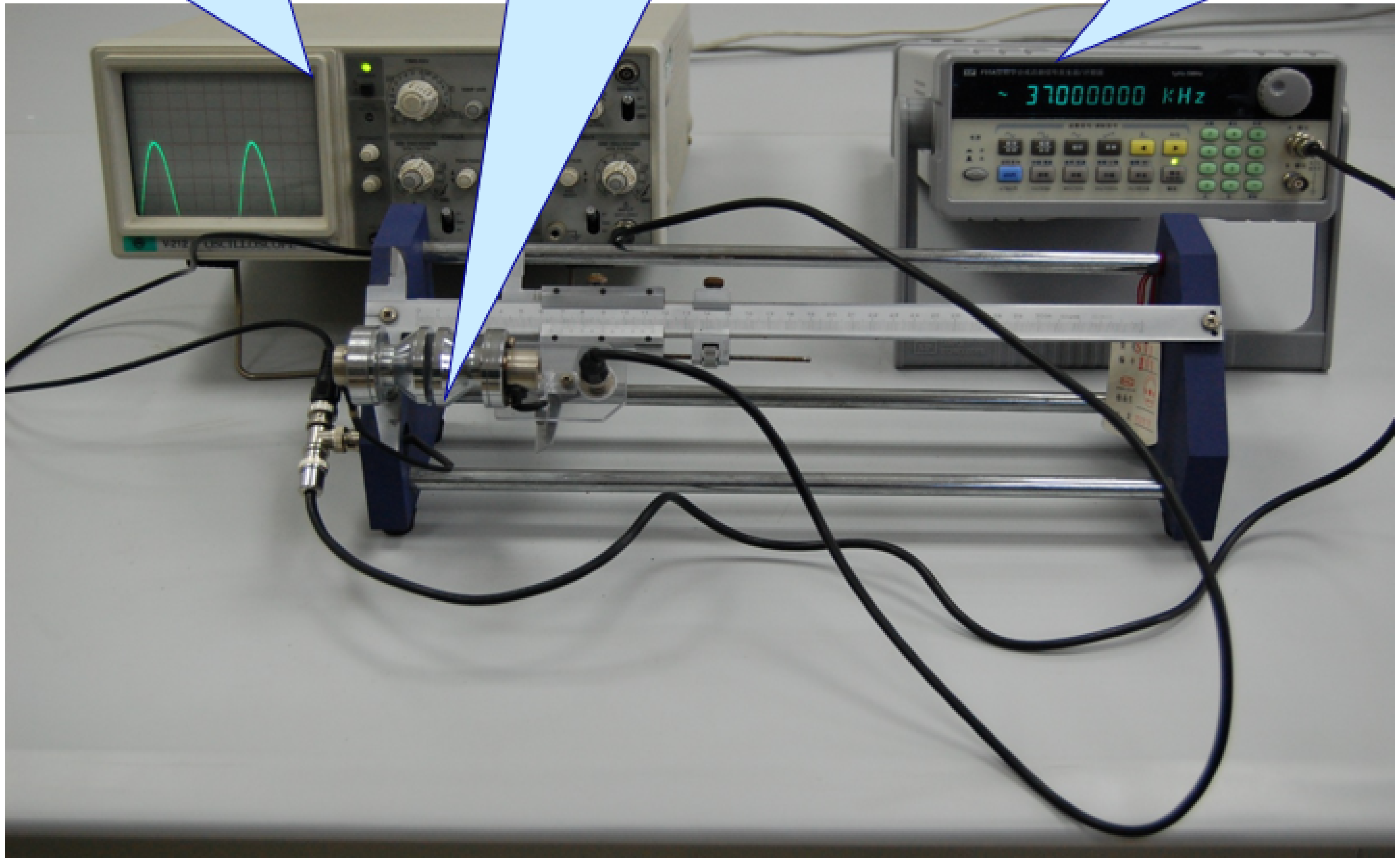


Instruments

Oscilloscope

Sound velocity meter

Signal generator



Contents:

1. Resonance interference method

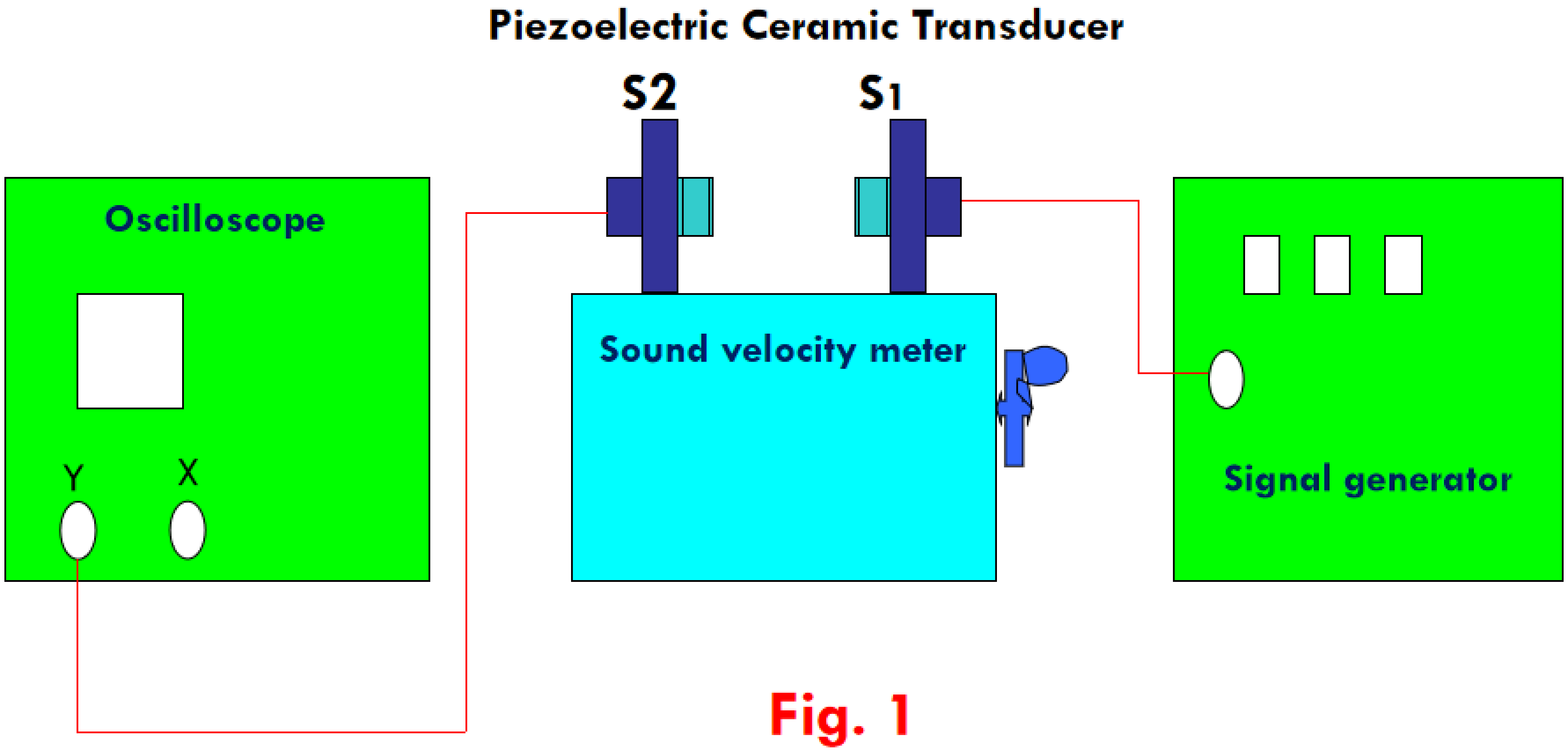


Fig. 1

Determine the optimal resonance frequency F

The optimal resonance frequency is around 37 KHz, adjust it carefully and see the amplitude of the wave in oscilloscope. When it reaches maximum, stop and record the freq.

Standing wave

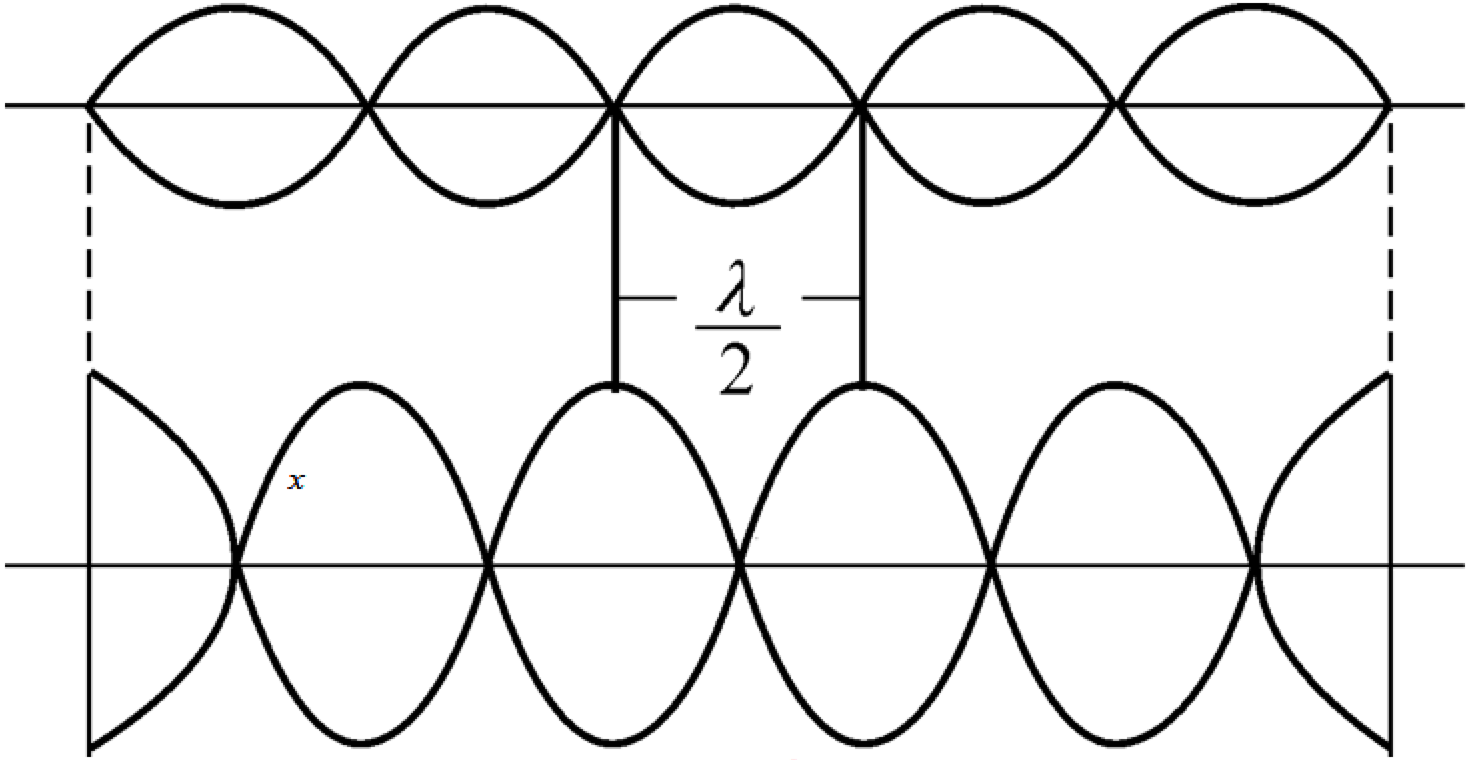


Fig. 2

When the distance between the two transducers is an integer multiple of the half wavelength, the resonance occurs. Amplitude reached maximum, we record the position of S2.

Table I Resonance interference method

Position of S2	0	1	2	3	4
L_k (cm)					
L_{k+5} (cm)					
$\Delta L = L_{k+5} - L_k$ (cm)					
Average ΔL (cm)					

$$V1 = \frac{2}{5} F \cdot \Delta L$$

F = ______ KHz

2. Phase comparison method

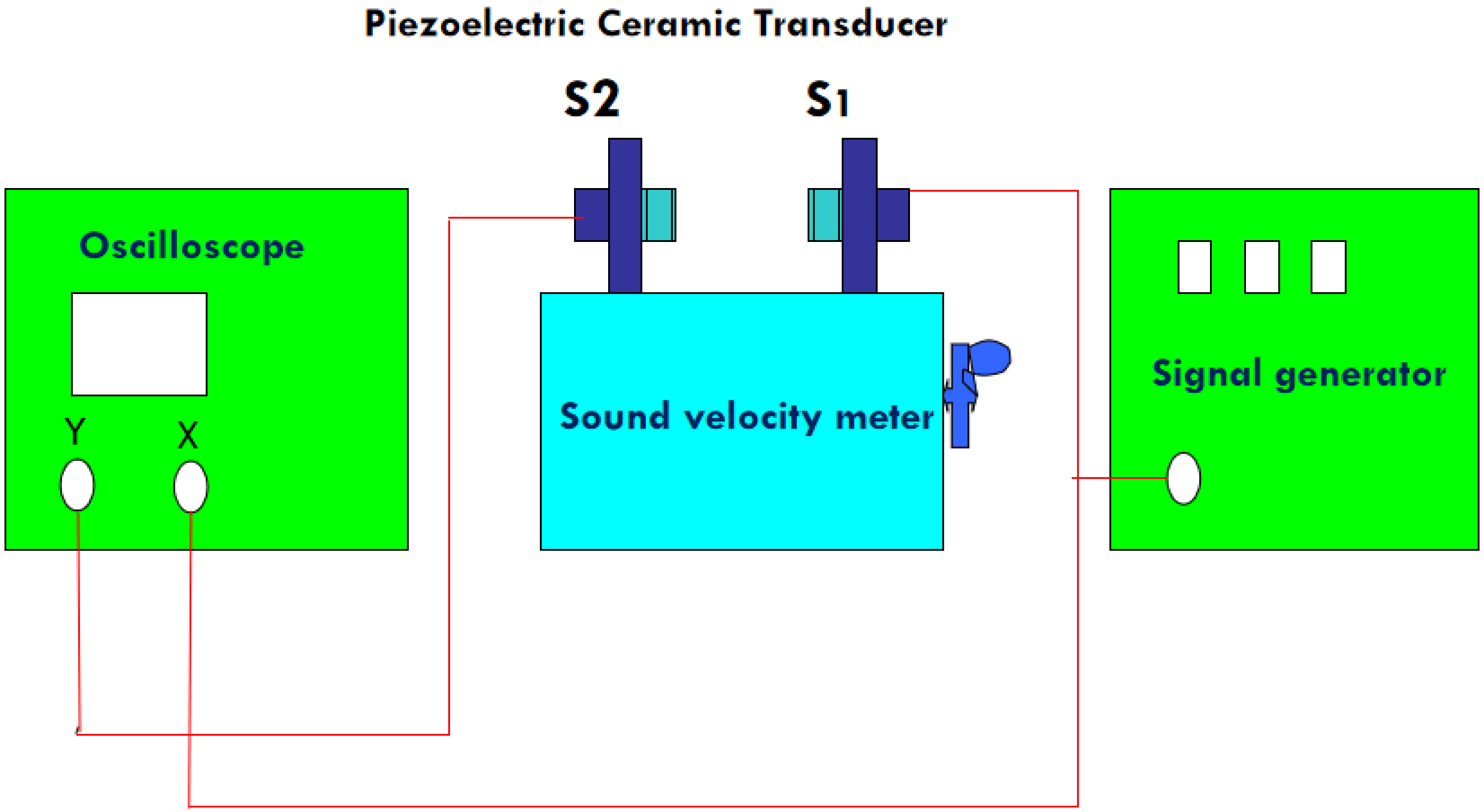


Fig. 3

Lissajous figures

Read the position of S2

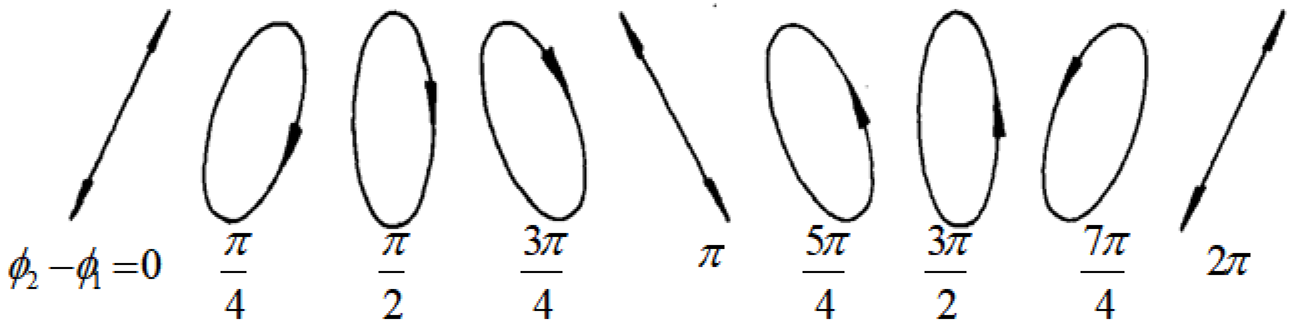


Table II Phase comparison method

Position of S2	0	1	2	3	4
L_k (cm)					
L_{k+5} (cm)					
$\Delta L=L_{k+5}-L_k$ (cm)					
Average ΔL (cm)					

$$V2 = \frac{2}{5} F \cdot \Delta L$$

F = ______ KHz

Theoretical value of sound speed:

$$v_0 = 331.45 \times \sqrt{1 + \frac{t}{273.15}}$$

Room temperature： t =   ℃

HOMEWORK

Please complete the report to describe this experiment, fullfill two tables and calculate sound speeds from the tables: V_1, and V_2, and compare with the theoretical value V_0.

DL: October 26, 2023

Useful link(s):

1. https://github.com/bliseu/phylab

END