

# The effect of mouth shape on tone selection

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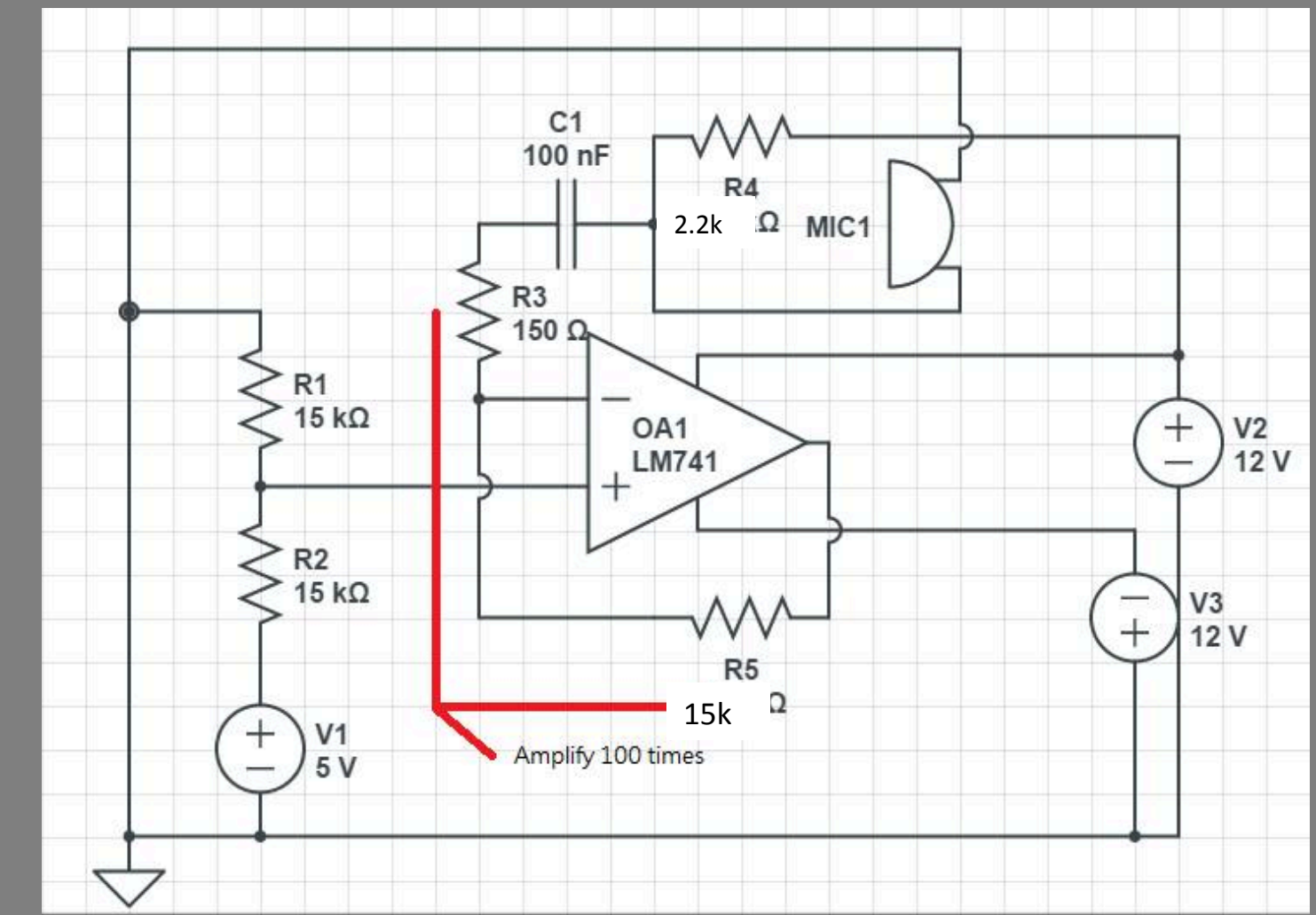
Experimental Physics I, Department of Physics, National Central University

## Introduction

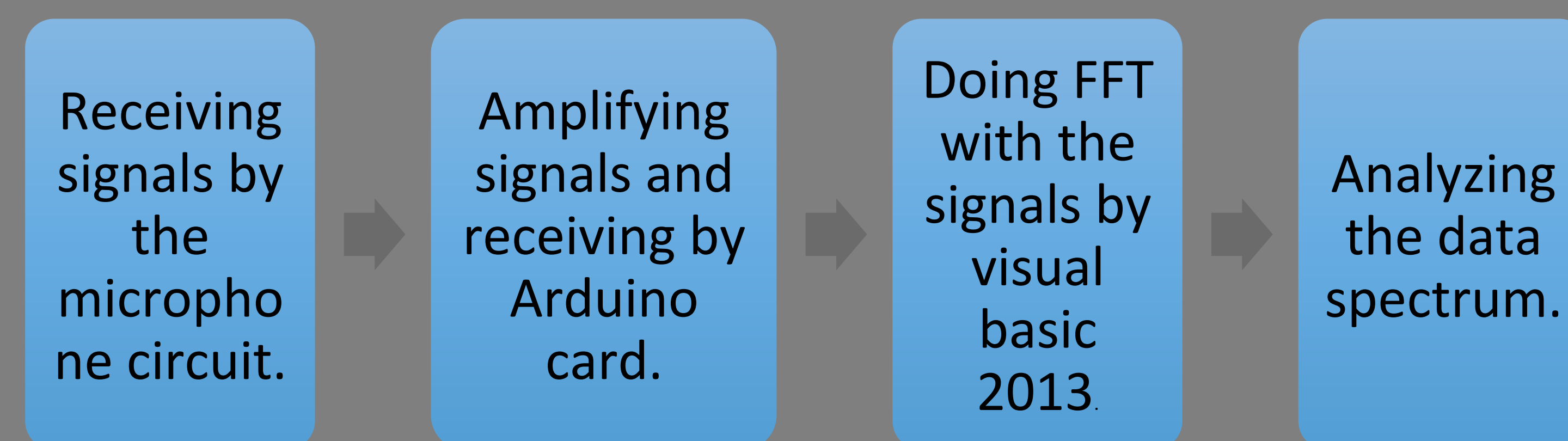
We connect Arduino card, the VB program and the analog circuit that we have learned in the experiment to explore the voice. We used to think of how different tune will affect the spectrum and the outcome will be the shift of base frequency. Meanwhile, what if we pronounce the same words in the same tune but different embouchure? In this project, we are going to find out the relationship between the spectrum and the embouchure.

## The Microphone Circuit

In this circuit, we choose the Operational Amplifier-UA741 to amplify our signal. The R3 and R5 is used to control the magnification, and we choose 100 as our rate. Then, in order to let the voice become positive, we add the DC voltage. With the feedback of the output signal and the signal of microphone, we get the inverting input. The inverting input is used to control the output signal to be between 0 and 5 V.



## How to work

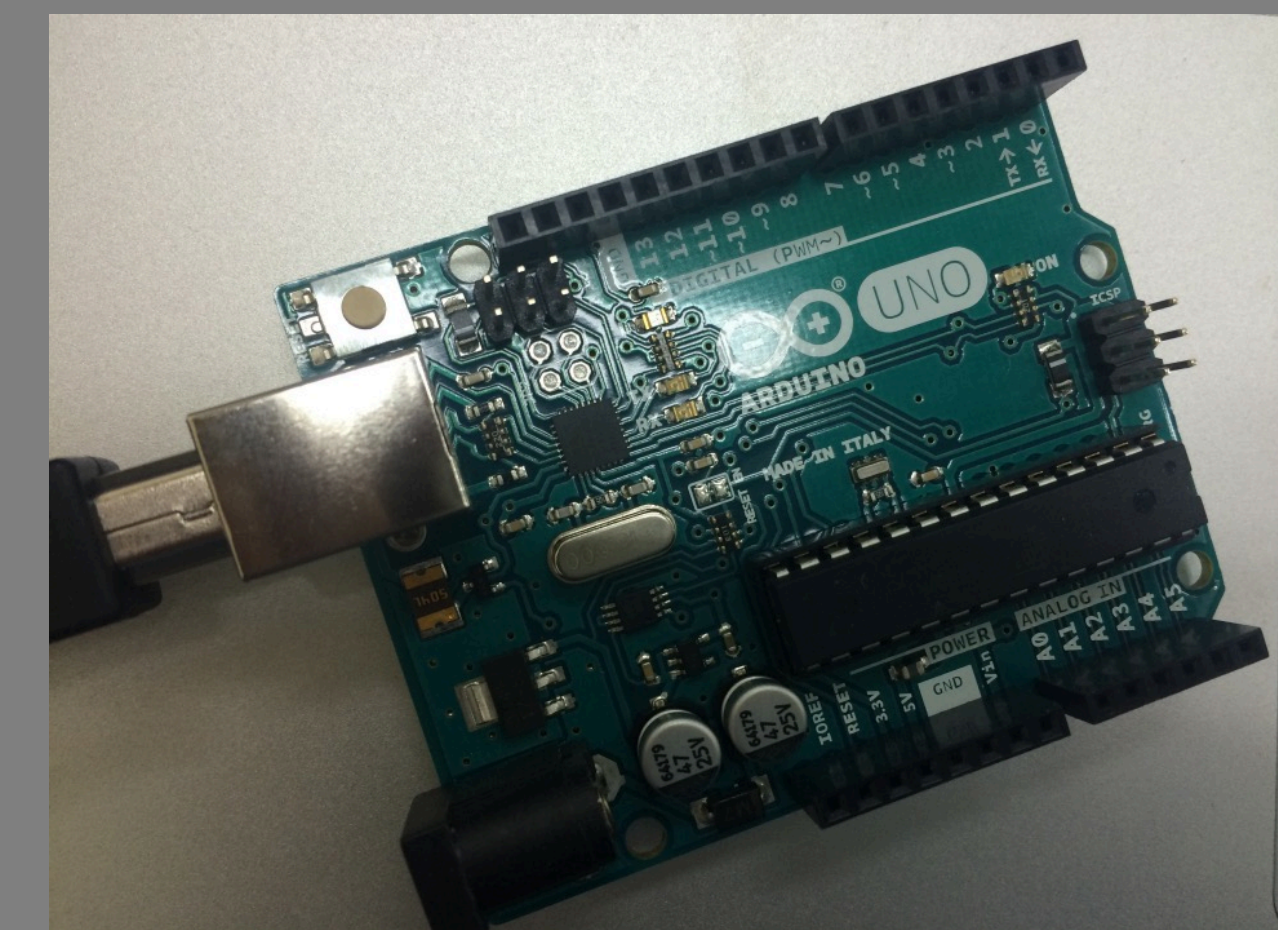


## Method of analysis Fast Fourier Transform

Fourier transformation, in generally speaking, is used to transform the signal from real time to the frequency. This transformation will transform the periodic signal to the peak on the spectrum. And we know that all kinds of wave are composed by the sine wave and cosine wave, and we can get spectrum of those wave.

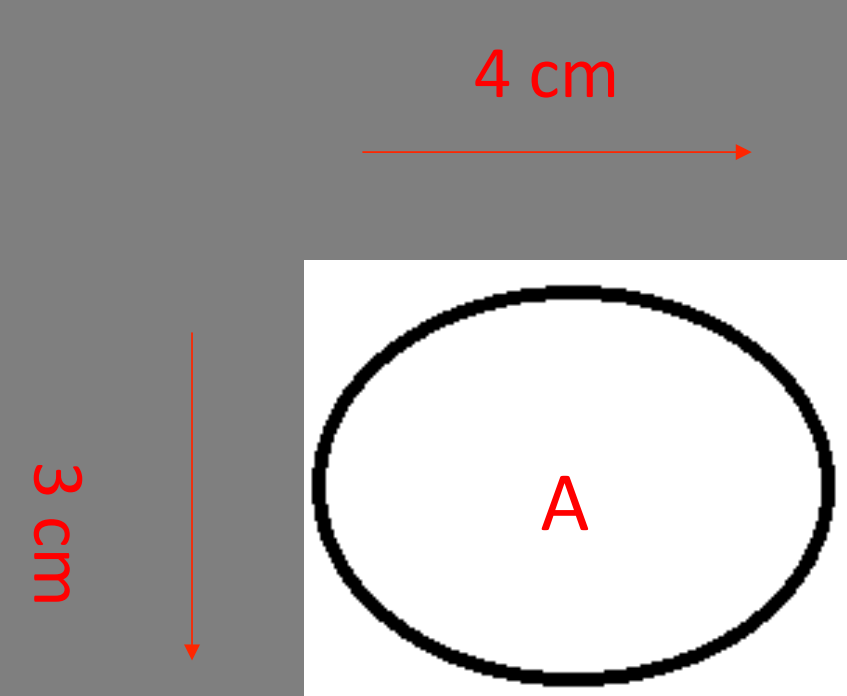
## Arduino Uno Card

Arduino Uno card is a device that can transform analog signal to digital signal or digital signal to analog signal by voltage reading and writing. It can also control by the program. It can only read the positive voltage and it can give the maxima voltage of 5V. We use it to make an oscilloscope on the computer



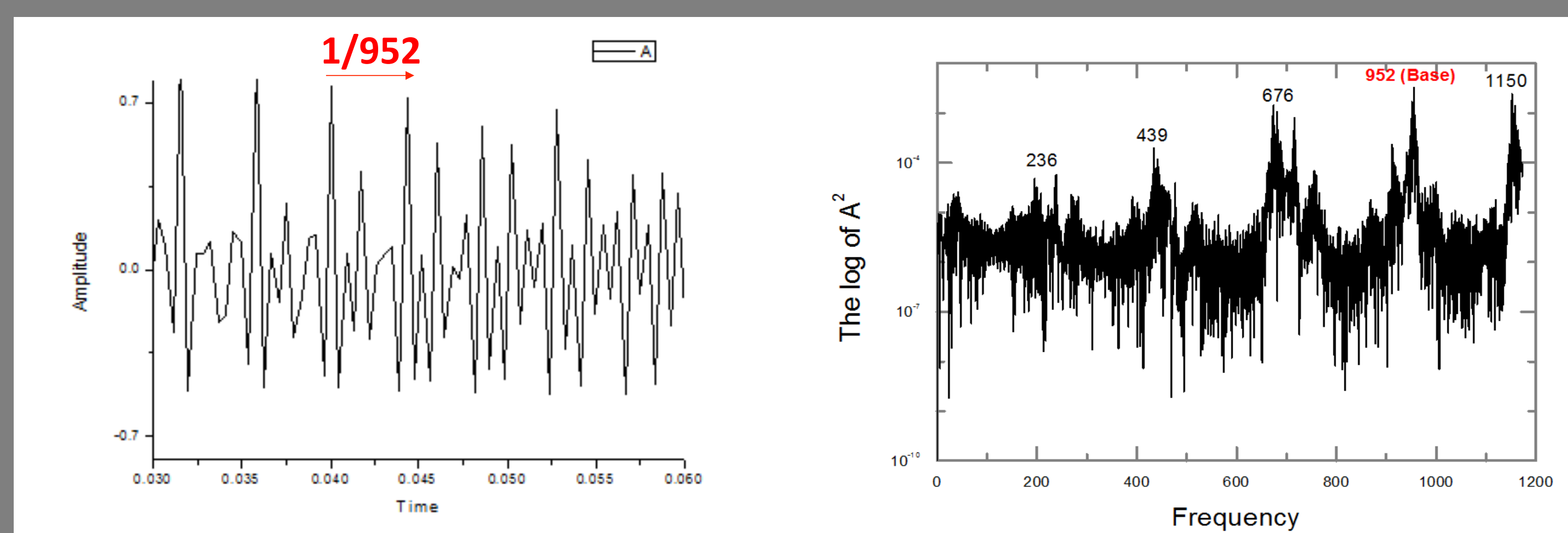
## Experimental Outcome

### Mouth Shape



### Real wave

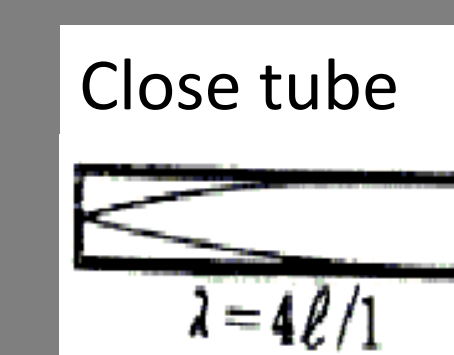
Pronounce A with the embouchure of A



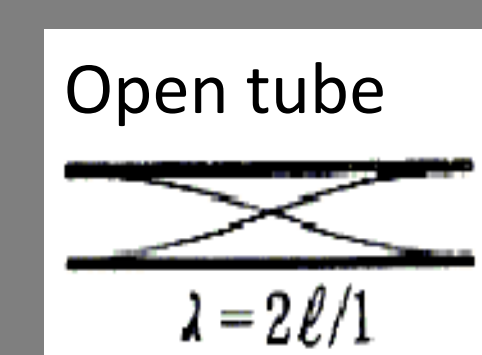
### Spectrum

## Standing Wave

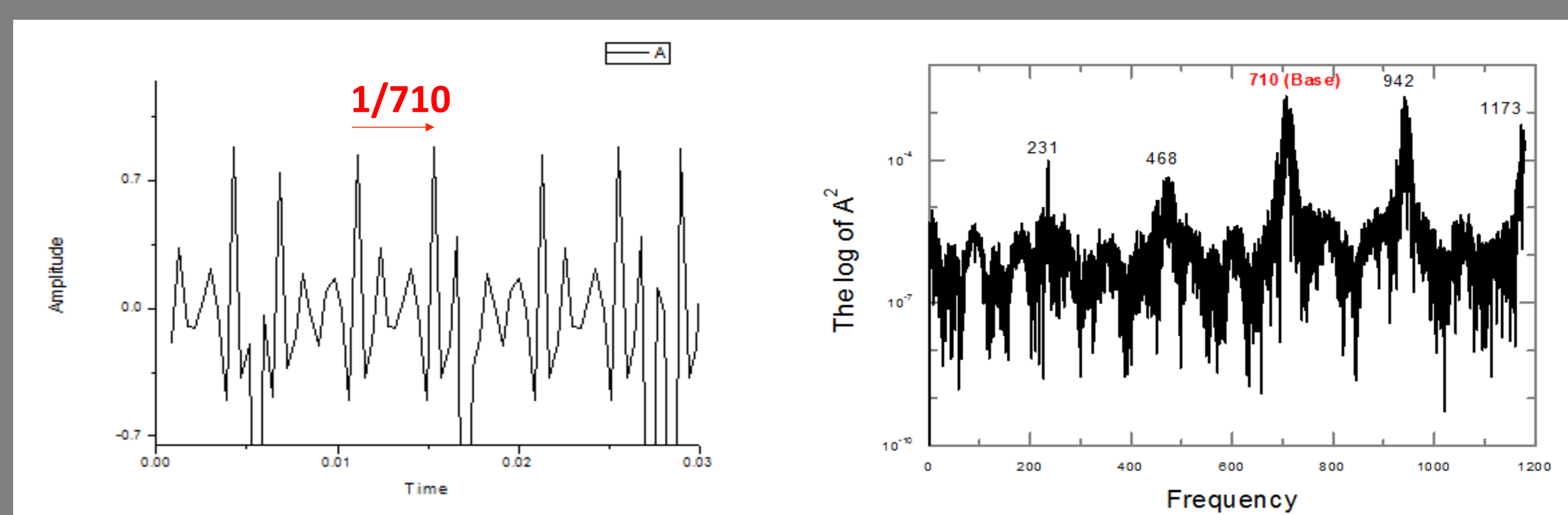
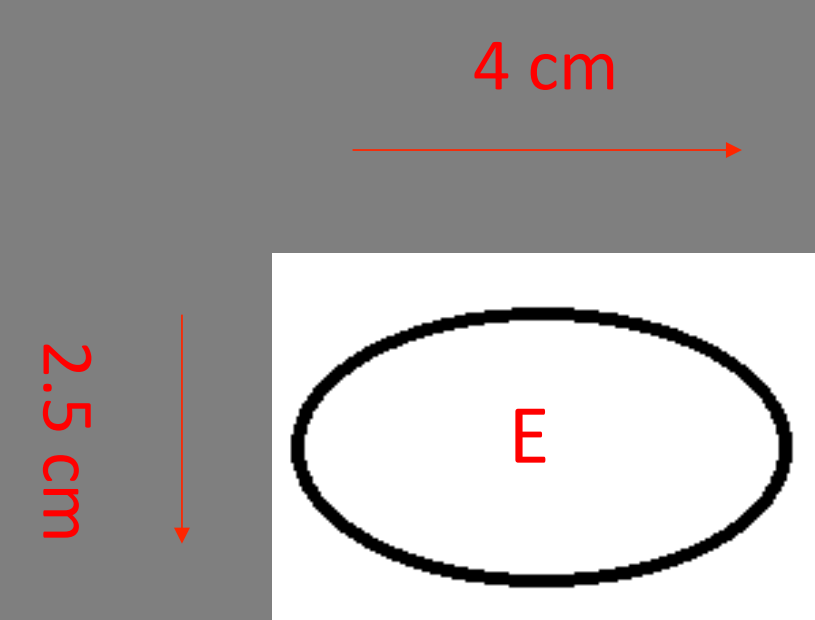
Close tube:  
bigger wave length and  
lower frequency.



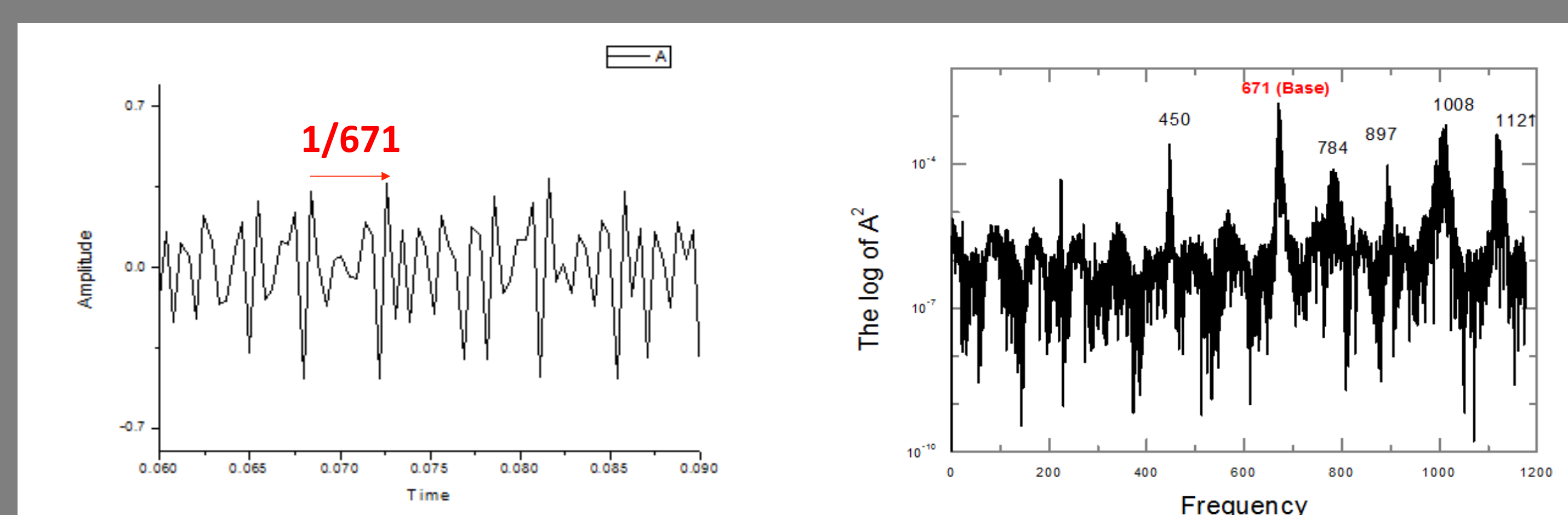
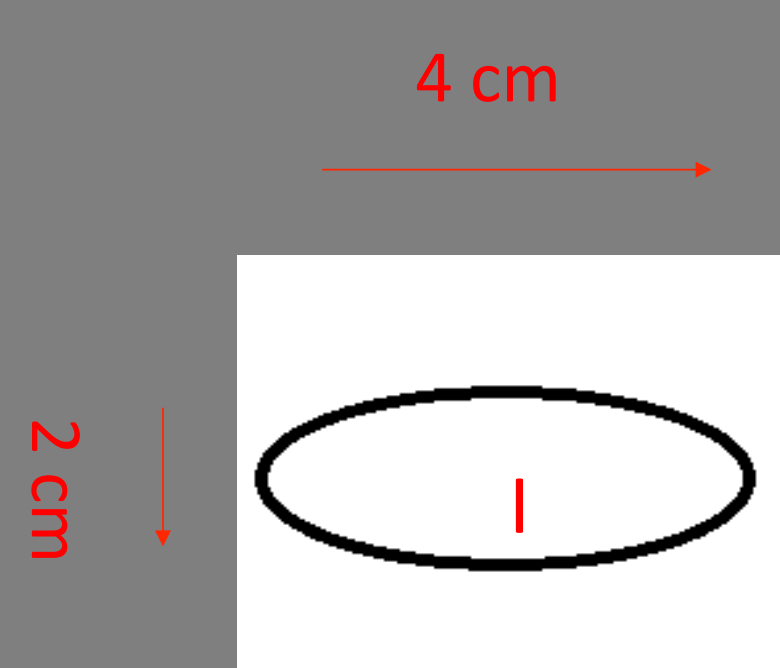
Open tube:  
Smaller wave length and  
higher frequency



Pronounce A with the embouchure of E



Pronounce A with the embouchure of I



## Conclusion

1. As for the mouth shape, A has the biggest bore and the highest frequency. I has the smallest bore and the lowest frequency.
2. We can compare the mouth shape with the tube and they will have the same properties.

With the same tone, we change the embouchure and used the spectrum to analyze it. We can assume the oral cavity as tube opened in both side. With the mouth becoming smaller, the one side will like closed, which can be explained by the standing wave.