BRAZILIAN TEAM

17th IYPT - AUSTRALIA - Brisbane - 24th June to 1st July

11.STRING TELEPHONE

How do the intensity of sound transmitted along a string telephone, and the quality of communication between the transmitter and receiver, depend upon the distance, tension in the line and other parameters? Design na optimal system.

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Introduction

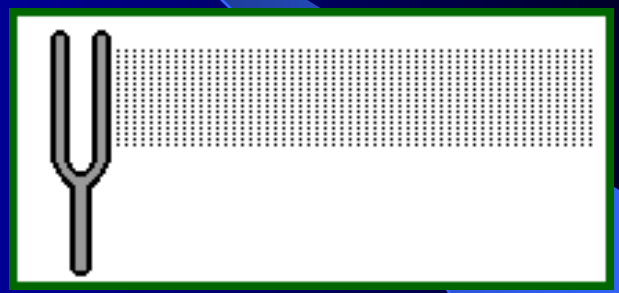
- Sound
- Characteristcs
- Experiment
- Source of errors
- Conclusion

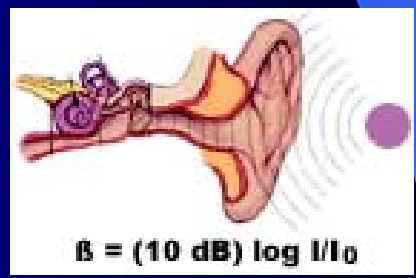
Importance

- Sound is everywhere
- It has been used for many purposes
- Evolution of technology
- Comunication between distant people is necessary

The Sound

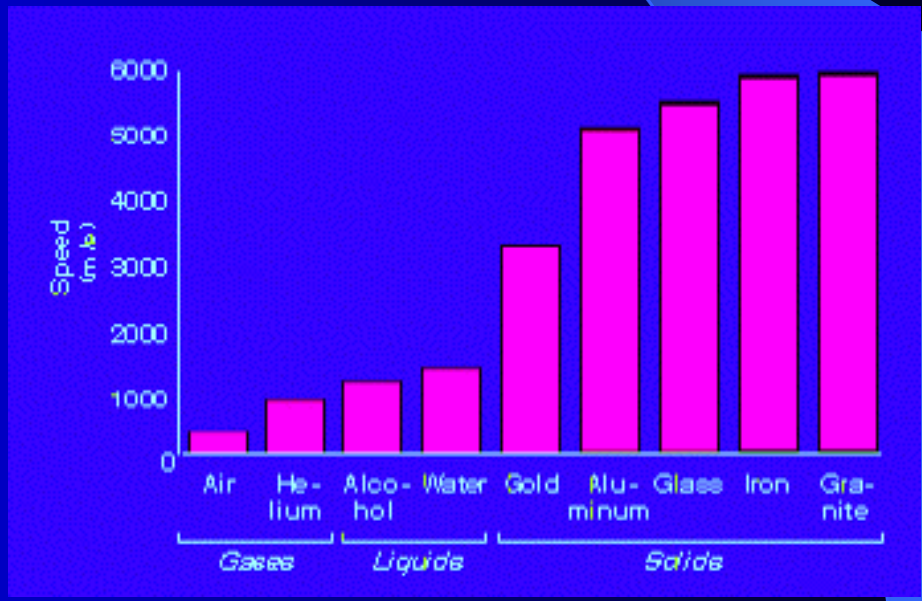
- The sound is a vibration, in wave form
- It needs a material way to propagate, once it’s a mecanical wave
- Our human body possesses an auditory system that allow us to capture the waves





The Sound

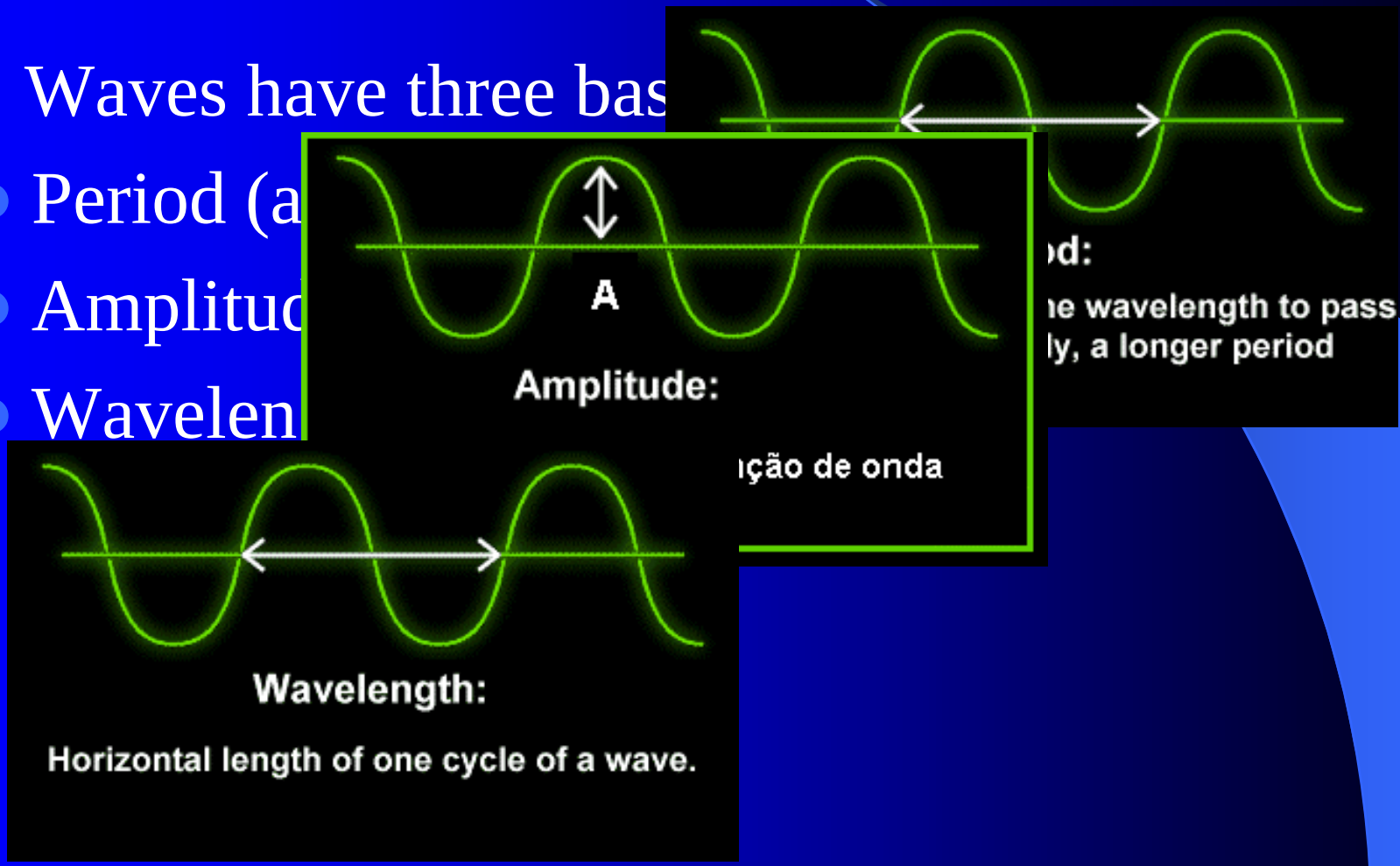
- The sound's speed depends on the way it propagates, because it depends on the aggregation of molecules
- When molecules are dispersed the speed is much lower than the one when molecules are compact



Waves

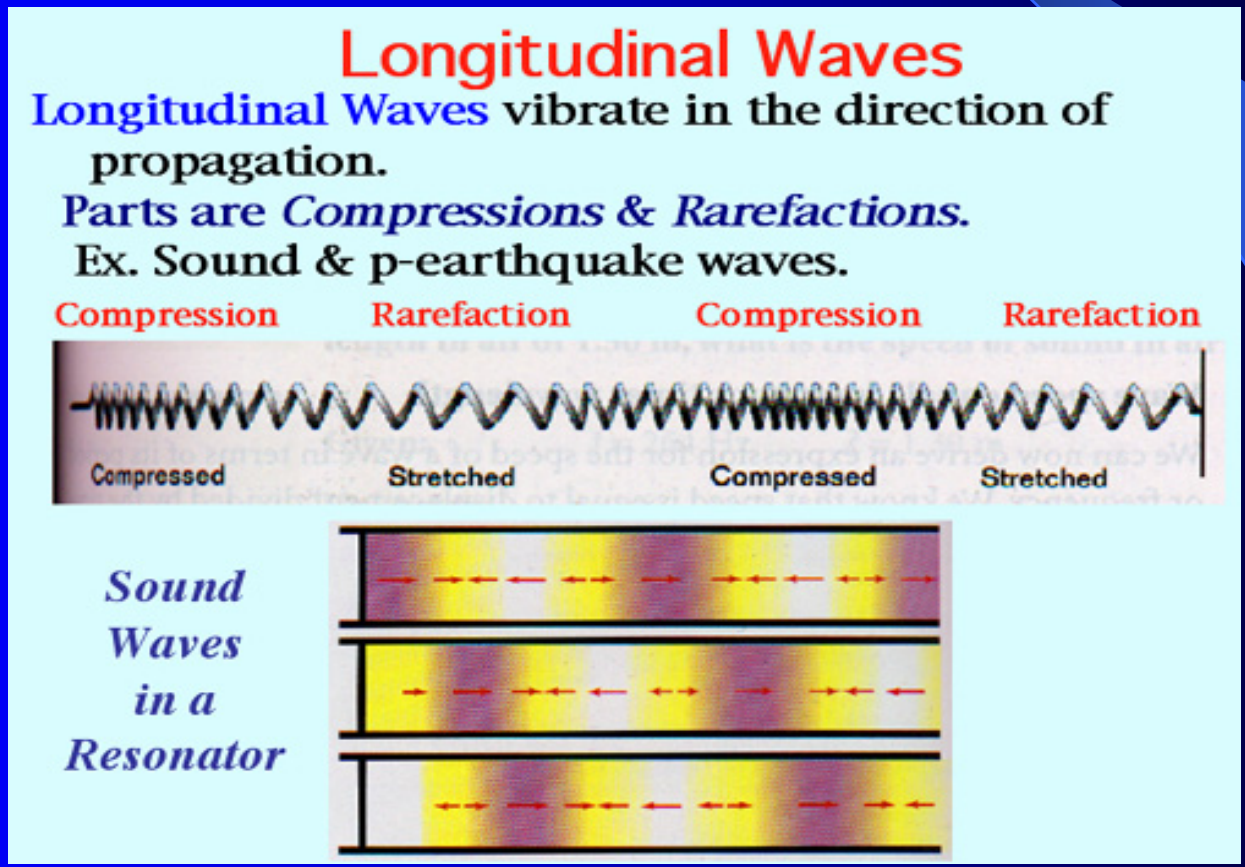
Waves have three bas

- Period (a
- Amplitud
- Wavelen



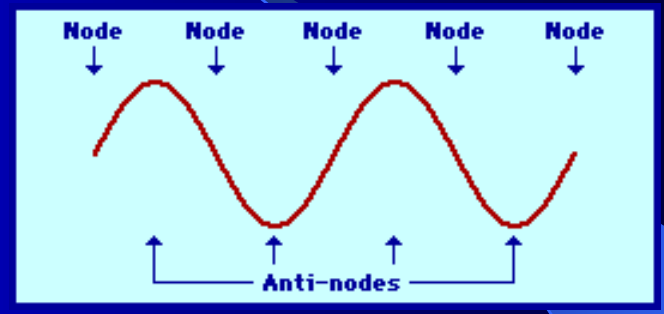
Waves

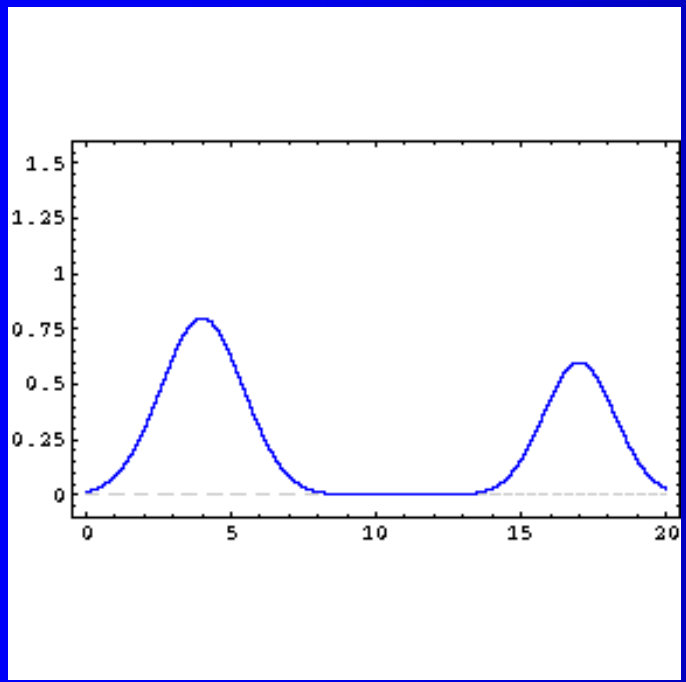
Sound is a longitudinal wave, once it's formed by a diference of pressure (compreesion and rarefaction of air)



Waves

- Node and anti-node





- Superposition

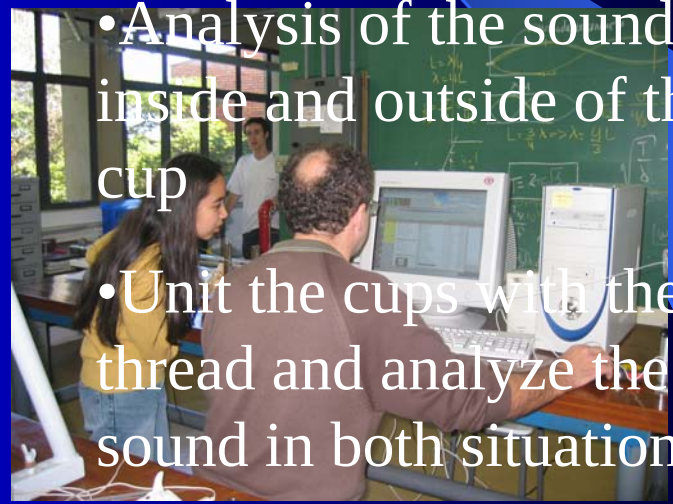
Experiment

Material:

- Metallic cups
- Threads
- Sound generator
- Computer program

Procedure:

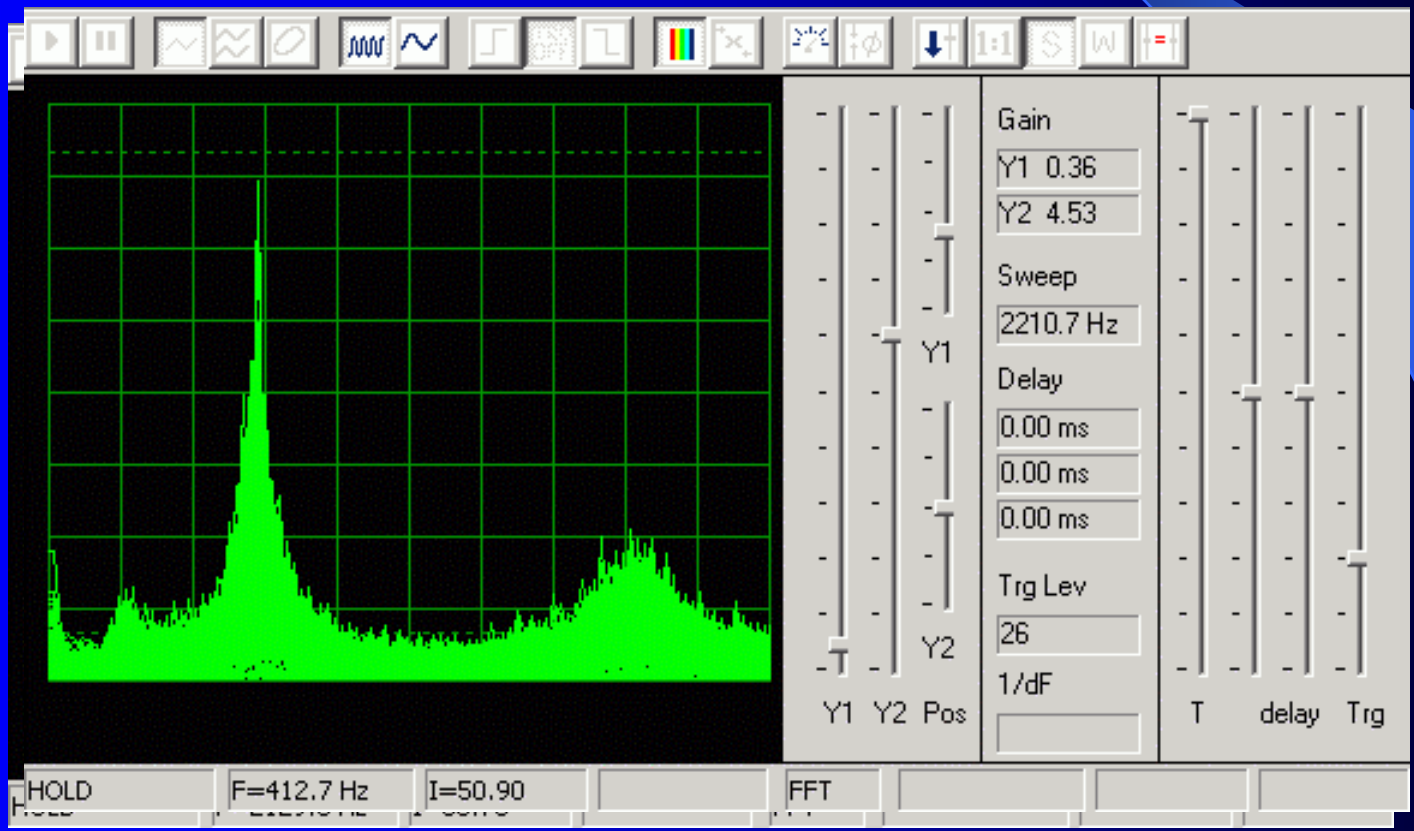
- Analysis of the sound inside and outside of the cup
- Unit the cups with the thread and analyze the sound in both situations



Experiment

Sound generator

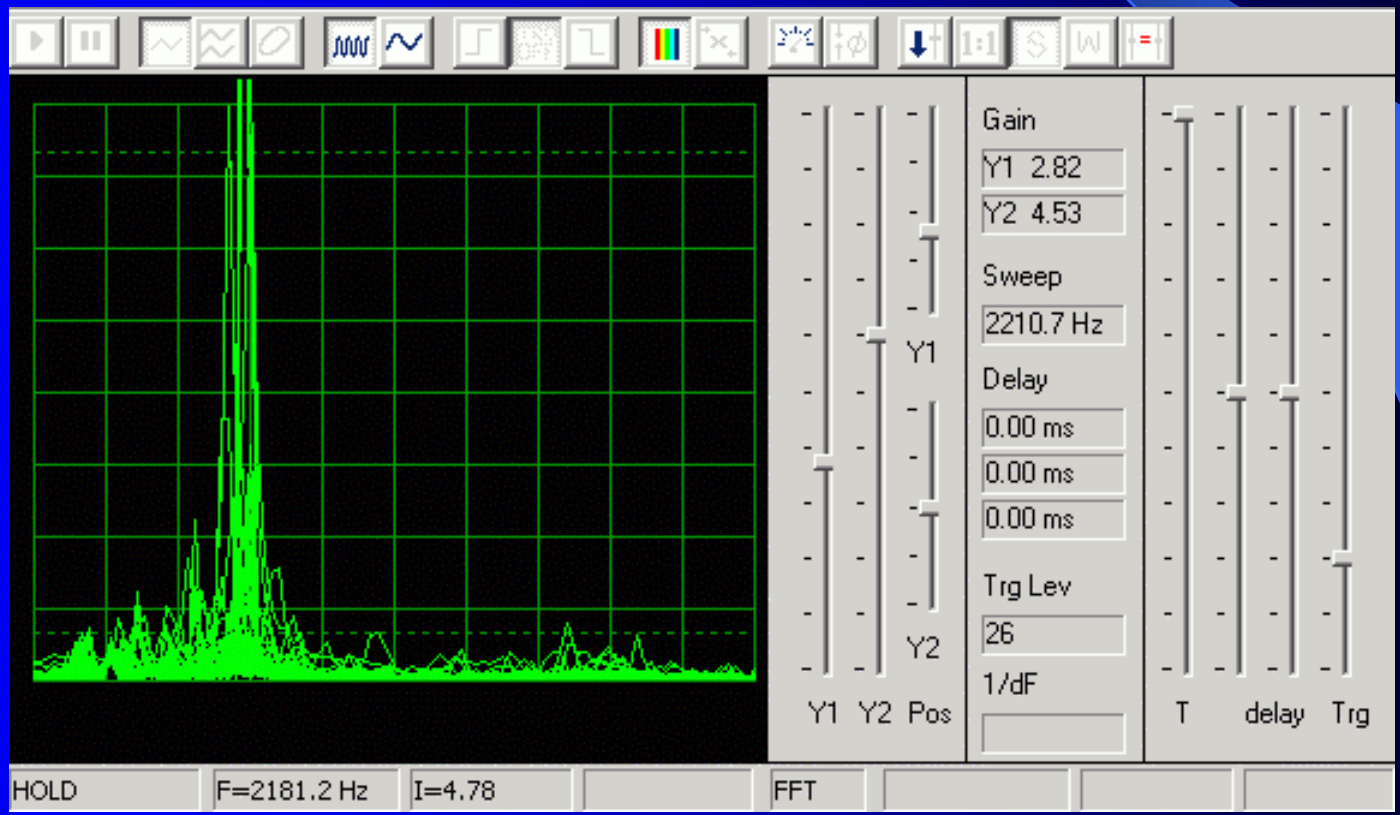
Inside the cup



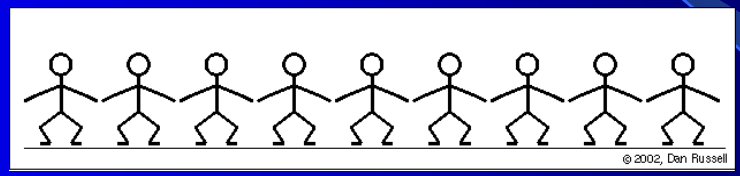
Experiment

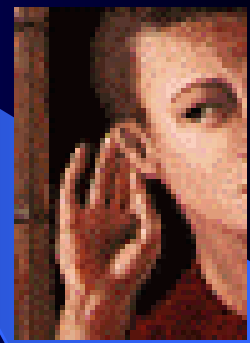
Human voice

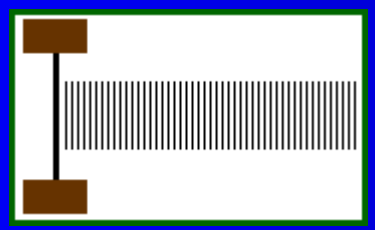
Inside the cup

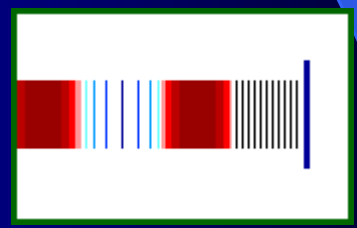


Experiment





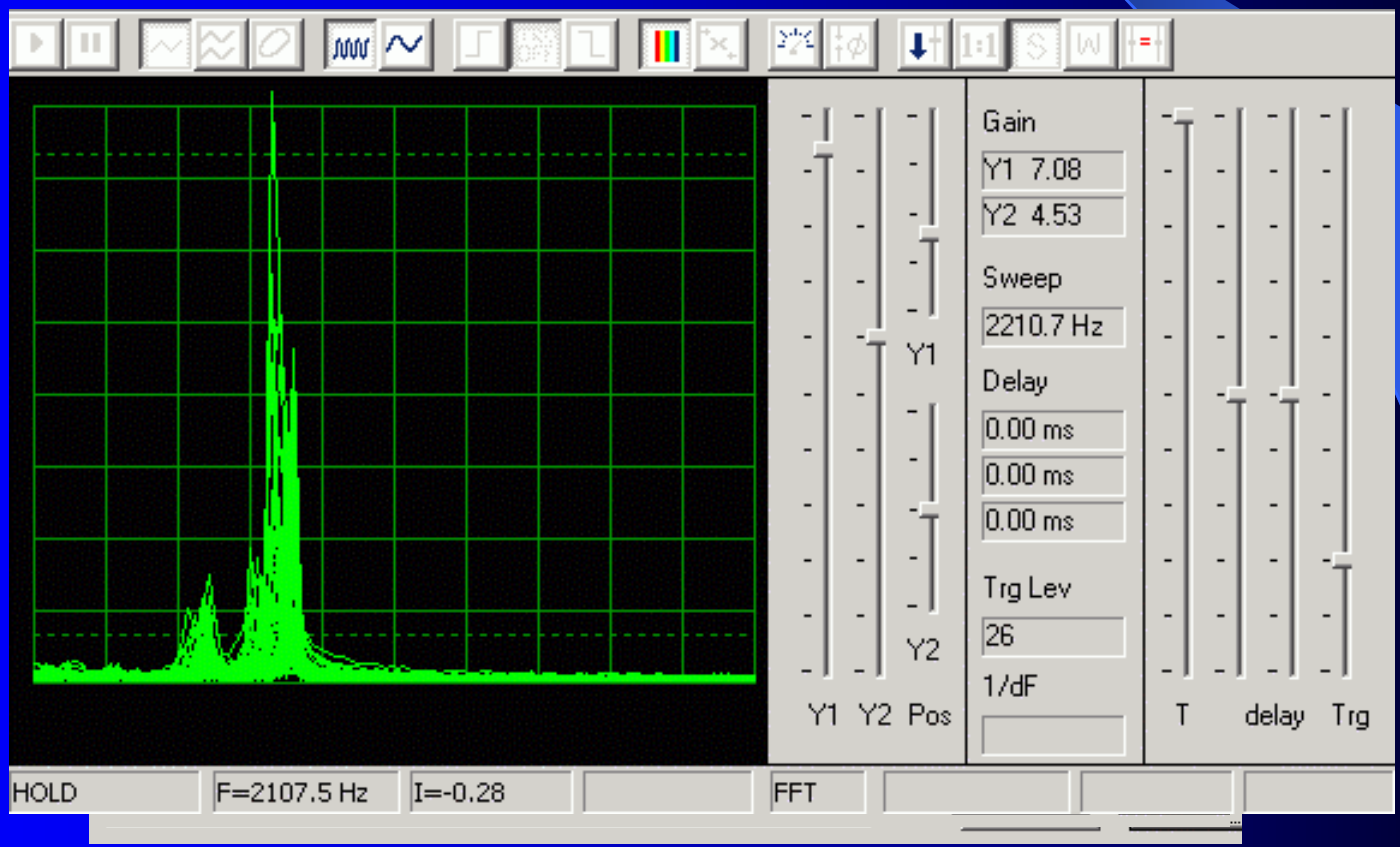




Experiment

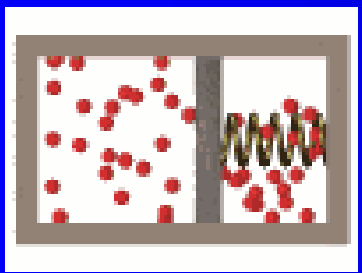
Human voice

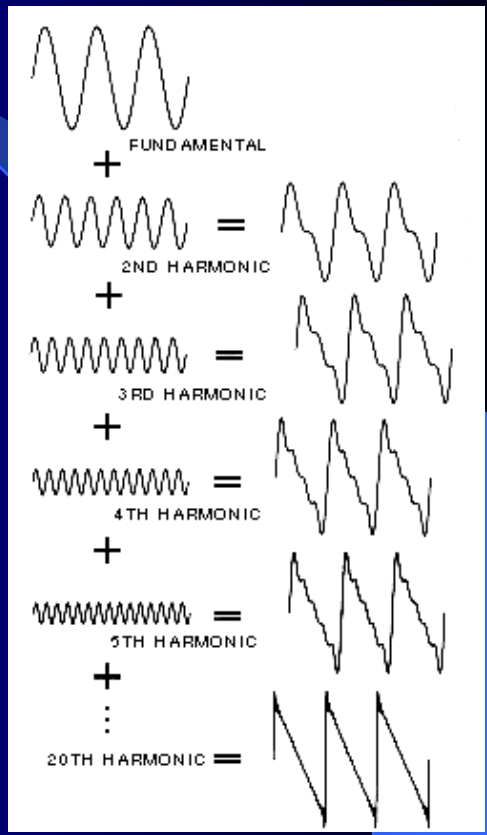
Human voice inside the telephone receiver



The Phenomenom

The cup works like a filter of frequencies and an amplifier of these frequencies.





Equations

$$v = \sqrt{\frac{T}{\mu}}$$

$$where: \mu = \frac{m}{l} (or) \mu = \rho.A$$

$$I = \frac{1}{2}.\rho.v.\omega^2.y^2$$

$$where: \omega = 2\pi.f$$

The thread must be thinner but “denser” and the sound must remain a short period in the thread.

The bottom of the cup must be “free” to oscillate (flexible and thin)

Source of Errors

- Loss of energy
- Environment's vibration
- The conection between the thread and the cup

Conclusions

In order to have an optimized system:

- The cups must be the same type, once we don’t want to have two “filtrations”, that means loss of quality
- The thread must have small linear density and suport high tensions (like guitar string)
- The distance between the transmitter and the receiver must not be excessive big
- People must touch as less as possible, because the hands’ compression prevent the cup’s oscillation