

LABORATORY EXPERIENCE ON THE **BEAT PHENOMENON**  
WITH THE USE OF THE GRAPHIC CALCULATOR AND THE SOUND SENSOR

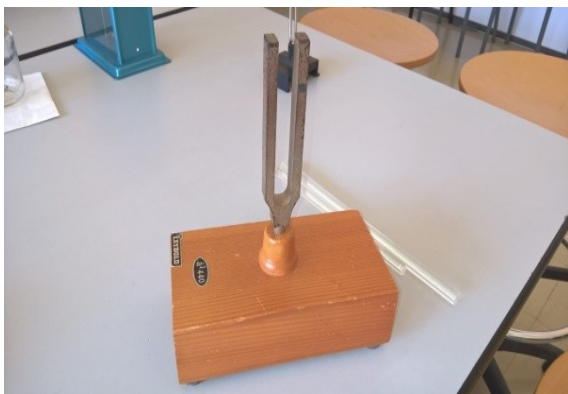
**INTRODUCTION**

The phenomenon called **beats** occurs when two waves of the same nature but with a slightly different frequency propagate within the same medium, in the same direction, interfere with each other and overlap. The idea is to reproduce the phenomenon in the laboratory. To do this we will use a graphing calculator connected to a control unit and a sound sensor.

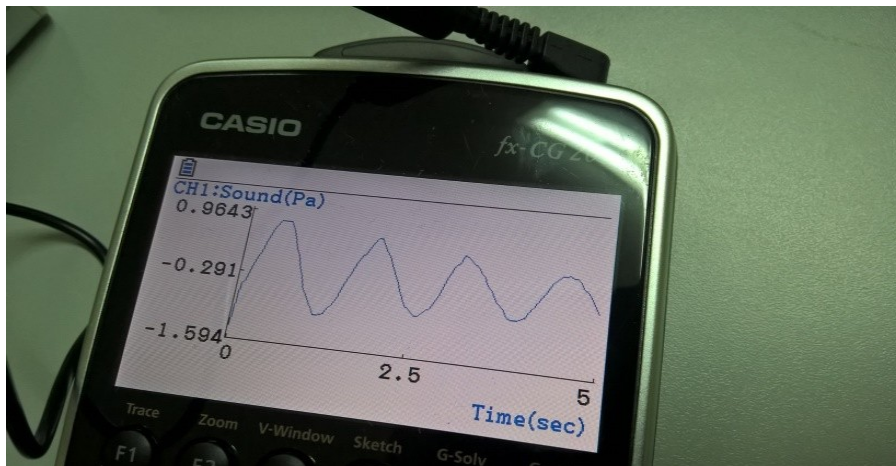


**DESCRIPTION OF EXPERIENCE**

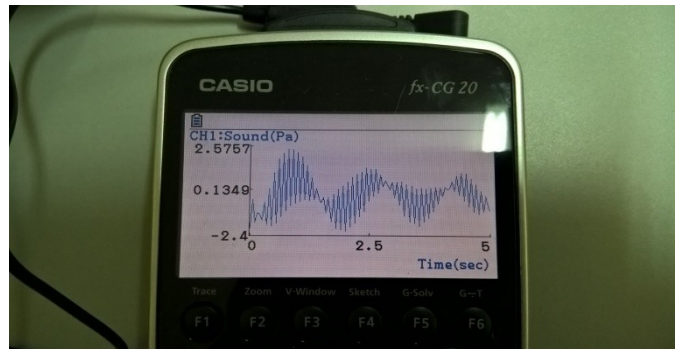
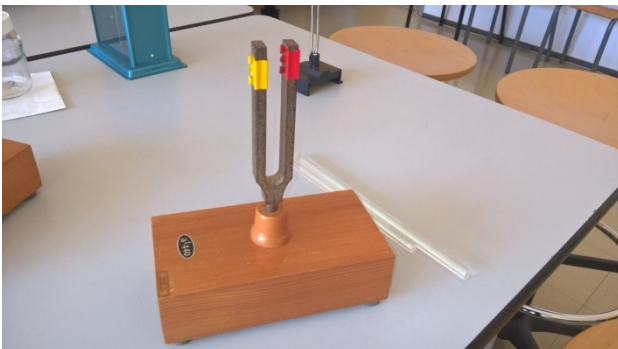
To reproduce the phenomenon, we will use a tuning fork equipped with an underlying sound box whose aims are to amplify the sound. As is known to musicians and music lovers, the most common is the tuning fork in La, which oscillates at a frequency of 440 Hertz, corresponding to the A note (LA) of the fourth octave of the piano, and is used to tune the instruments. When the tuning fork is struck with a rod, it begins to vibrate producing a **pure sound**.



A **pure sound** can be represented, with a good approximation, by a **sinusoidal function**. We connect the graphing calculator to the control unit and to the sound sensor. The latter detects the sound produced by the tuning fork and the calculator processes the graph shown in the figure: We note that the sinusoidal graph is not completely regular.



This is due to the fact that during the measurement the inevitable background noise interferes with the sound produced, slightly modifying the obtained graph. At this point we want to reproduce the phenomenon of beats. To do this we will use the same tuning fork appropriately modified. Exactly, we will apply to each of the tines of the tool some terminals/clamps, at slightly different heights. Once hit with the wand, the two prongs start to vibrate with slightly different frequencies, giving rise to the well-known beating phenomenon. It will be possible to recognize the phenomenon both acoustically, as a sort of "pulsation" of the produced sound and graphically, by observing the characteristic "**candy**" graphic, typical of the phenomenon.



Also in this case the graph obtained is slightly different from the ideal one that we can see on all the textbooks describing the phenomenon because of the background disturbances that inevitably accompany the experience

### **PHENOMENON OF BEATS IN MUSIC**

Often the beats are specially used to achieve special effects; in the case of the organ, the register of the human voice is made up from two not perfectly tuned tubes, in order to obtain a kind of flicker that imitates the voice of the singers.