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## Experimental challenge\*: The strange beat

Simple waves

Deadline: 7/March/2018

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### Experimental part

You have to generate simultaneously two “pure tones” (say sine waves) in the audible range having very close frequencies but not exactly equal (Can you guess how their interference sounds before doing the experiment?). Try different frequencies and spacing and observe the effect on the result.

Now some practical help. You need a pure tone generator that allows to adjust the frequency. How to get it? Several possibilities that you can explore (and I did not check) in case you want to be creative are: learn how to use the commands for audio generation of `octave` or `matlab`; download an app for your cell phone for simple tone generation; look for online applets on the internet... If you prefer to observe the phenomenon with no machine assistance (this is probably advanced), use two identical tuning forks and modify the frequency of one of them putting small impurities like duct tape or modeling clay.

In case you prefer step-by-step instructions, here it is a checked possibility: install `audacity` in your computer (it is very light, easy to install and multi-platform). Run it and close the pop-up help window. In the menu `Generate>Tone` choose `sine`, some audible frequency, amplitude 1, whatever duration you like and press OK. Now add a new track with `Tracks>Add_new>audio_track` (or `mono_track`). Repeat again `Generate>Tone` but this time with a close frequency. If you want to save the result in an audio file, use `File>Export_audio` and choose your favorite format.

### Mathematical part

Get a formula expressing the interference of the waves in a way that explains the result of the experiment. From this formula, predict the time lapse in seconds between two consecutive pulses (beats) when the frequencies are in hertz.

The file `interference.mp3` in the web page of the course corresponds to waves of frequencies  $700\text{ Hz}$  and  $703\text{ Hz}$ . Do you think this is coherent with your last formula?

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\*Some experiments are classical, some are my idea and others come from specific sources. In the latter case I have omitted the reference here on purpose to force the students to work on their own. If you are the author, please do not get angry. I intend to incorporate the references to the final version of the notes.