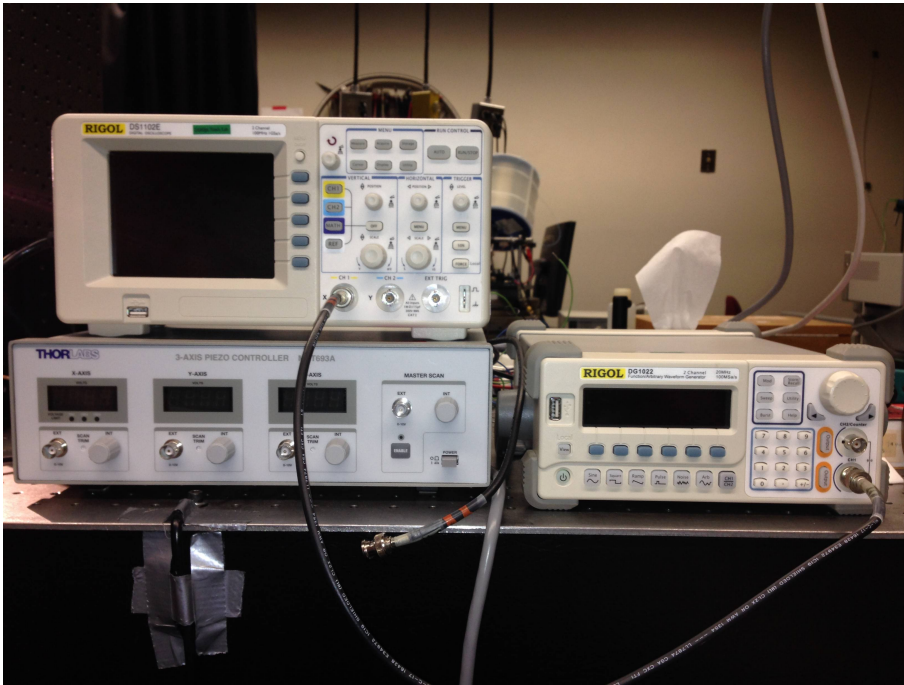# Setup for Computing Trap Force Using Stokes' Drag Force

You will need these 3 devices along with the wires which connect them.

- – Piezo Controller
- – Oscilloscope
- – Function Generator

In the end, you will connections will be as follows...
Function Generator > Piezo controller > Translation Stage
-You may notice that the oscilloscope is not included in the scheme. The oscilloscope is there purely to view what kind of wave you have. Once you know what wave it is that you are making, it is no longer necessary.

Step 1: Connect Wave Function Generator to Oscilloscope.
-Turn the oscilloscope and Function Generator on.
-On the Function Generator, select Arb (Arbitrary).
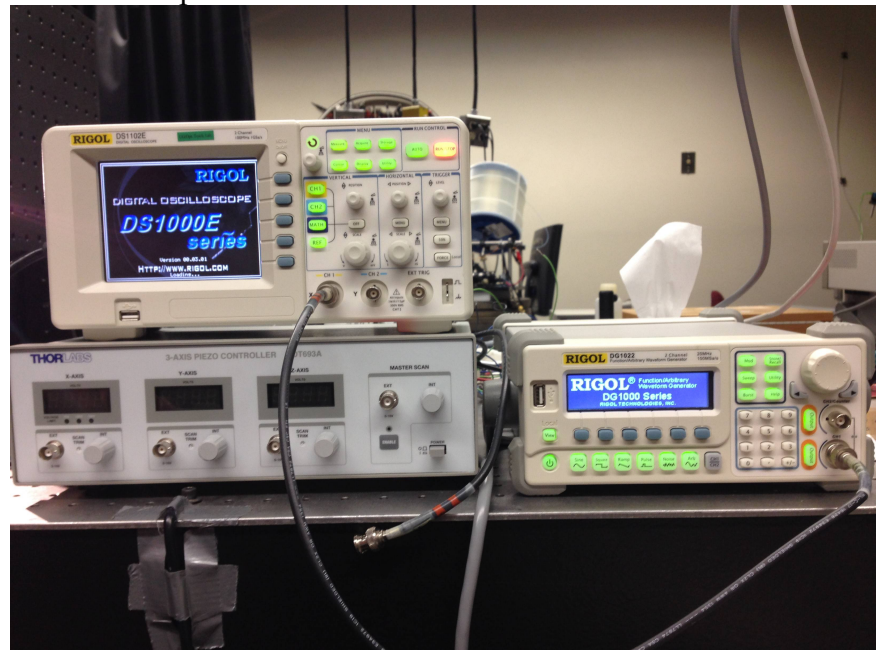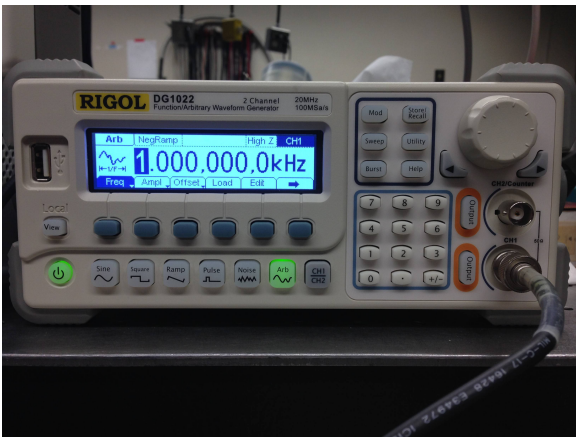
-Now choose Load > Built-in > Neg-Ramp
-Choose a more acceptable frequency. 1KHz is much too high. You will be moving the microspheres 15-20 microns in whatever time you choose. Make the period some time between 0-1 second(s).

Step 2 – Change the amplitude:
-First Change the Vpp (peak to peak) to 4.4 Volts.
-Change the offset to 2.2 Volts. (We want to make sure the voltage does not go below 0, because the Piezo Controller only accepts positive voltages)
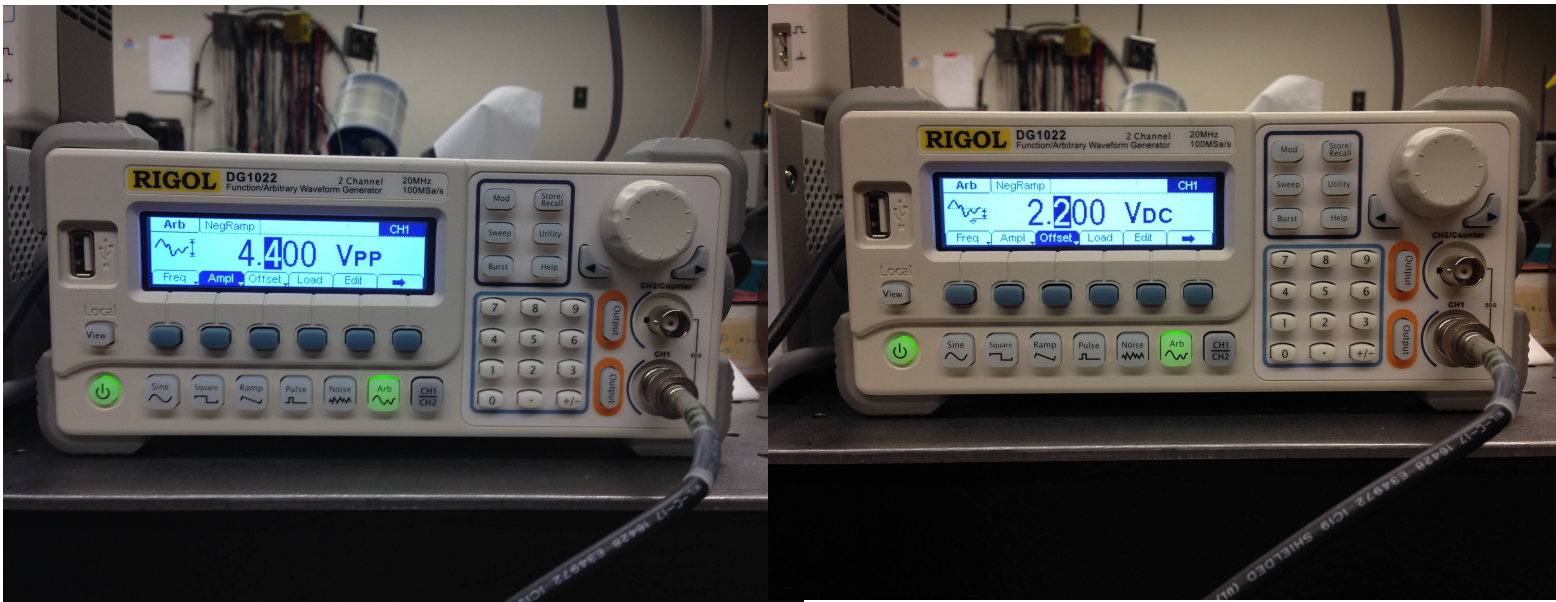
-Hit "output" on CH1 on the Function Generator. You should start to see something on the oscilloscope.

-Press "Auto" on the oscilloscope, and the oscilloscope will try give you a better window for viewing your wave. You may have to do some manual adjustments.

-Be sure to note the peak to peak voltage. When we run our current through the piezo controller, it will multiply the voltage by 7.5 times. You want to be sure that Vmax does not exceed 75 volts.
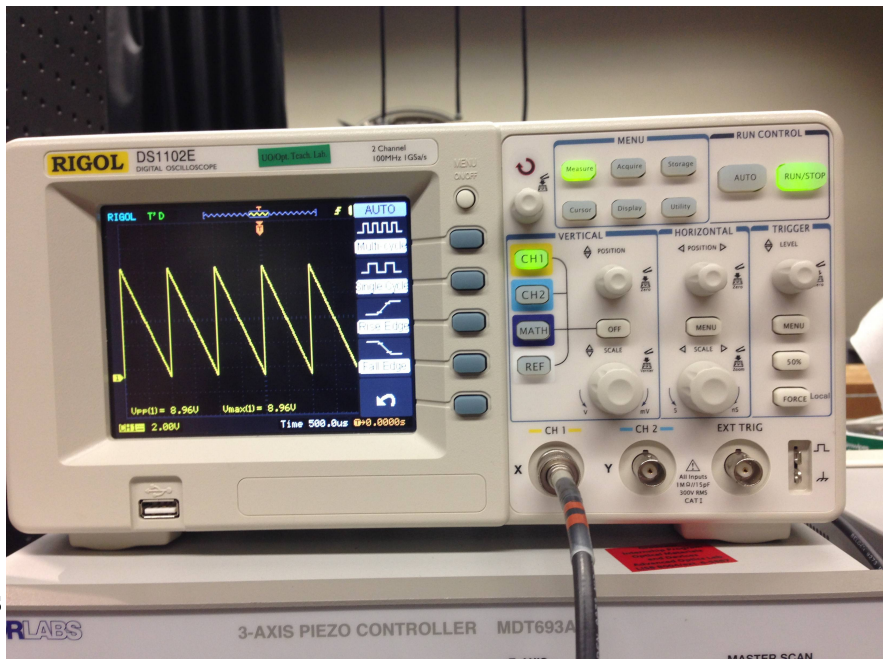
Step 3 – Burst Mode:

-Taking measurements will be quite difficult if the translation stage is constantly moving. To make this easier, we can turn on "Burst" to make it so the voltage ramp only happens once in a while.

-Hit "burst" on the Function Generator.

-Change the period to something like 10 seconds. Now the ramp will only occur every 10 seconds.
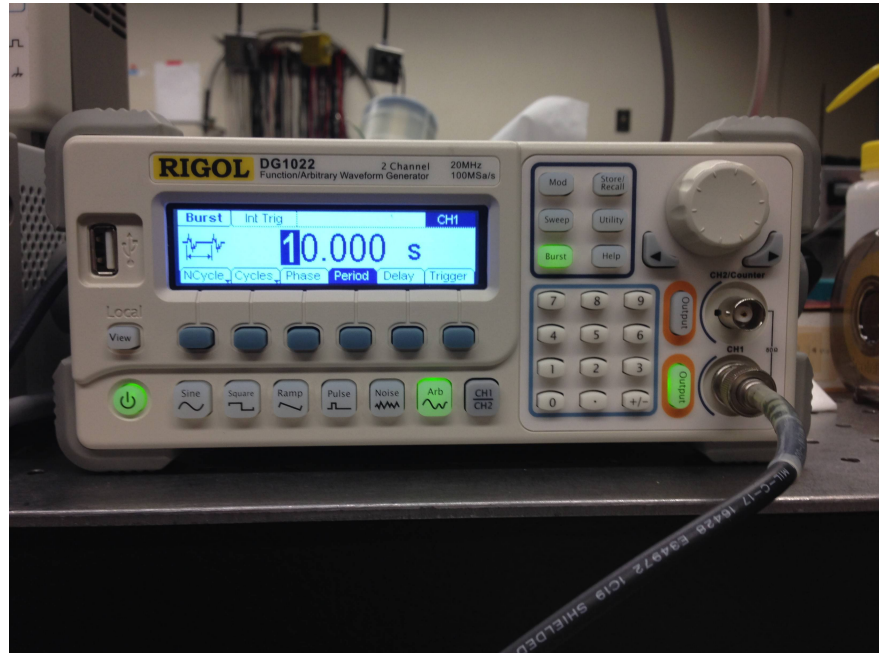
-The Oscilloscope should now look more like this. The ramp should only happen once, with a large delay in between.
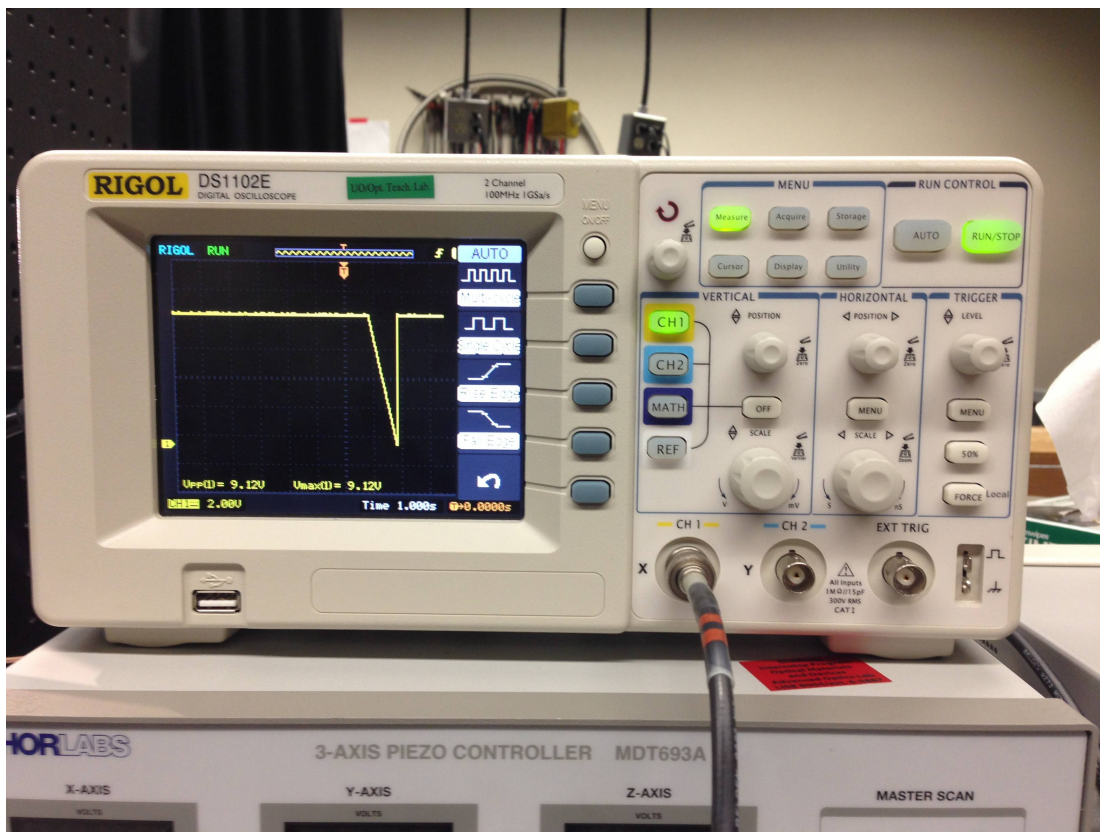
Step 4 – Attach Piezo Controller:
-You will first want to make sure that the Piezo Controller is set to the lowest setting (75V) in the back.
Notice the yellow switch set to 75V.

-Now connect the output of the Function Generator to the input of the Piezo Controller, and the output of the Piezo Controller to the input of the Oscilloscope, so it is like so...

Function Generator > Piezo Controller > Oscilloscope

-Now we can see that the voltage has been multiplied 7.5 times on the Oscilloscope, which is what we want. Take note of the Vpp and the period of the wave. This is what will define the velocity of the microsphere. If Vpp = 75V for example, the translation stage will move 20 microns over the period of the wave.
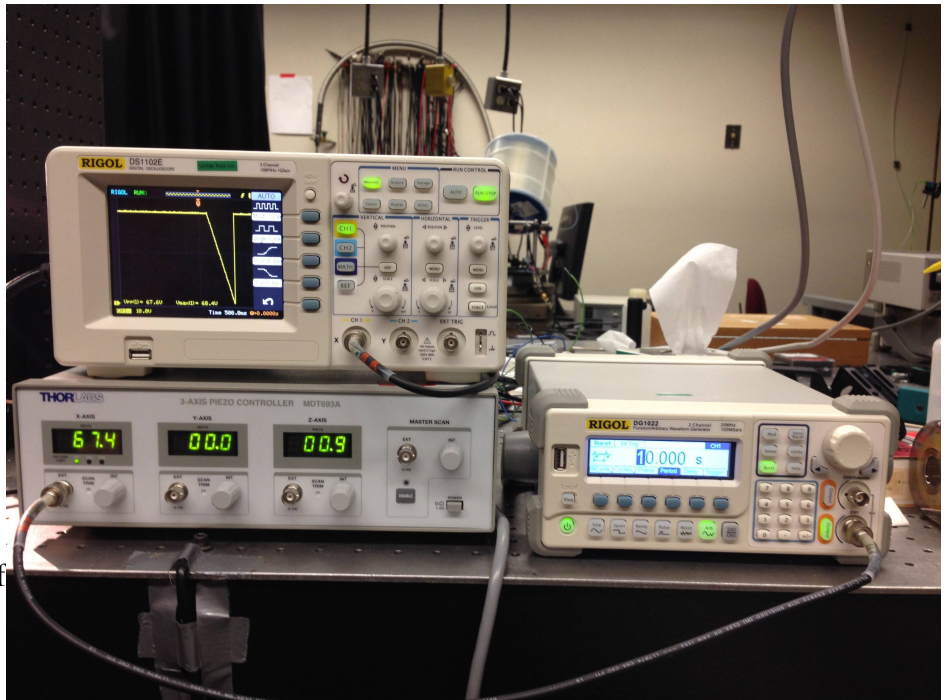
-Now that you know what the wave looks like, you can disconnect the oscilloscope and connect the piezo controller directly to the translation stage. Function Generator > Piezo controller > Translation Stage.
-You can now vary the period of the wave to get different velocities and find when the microspheres break from the trap.

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