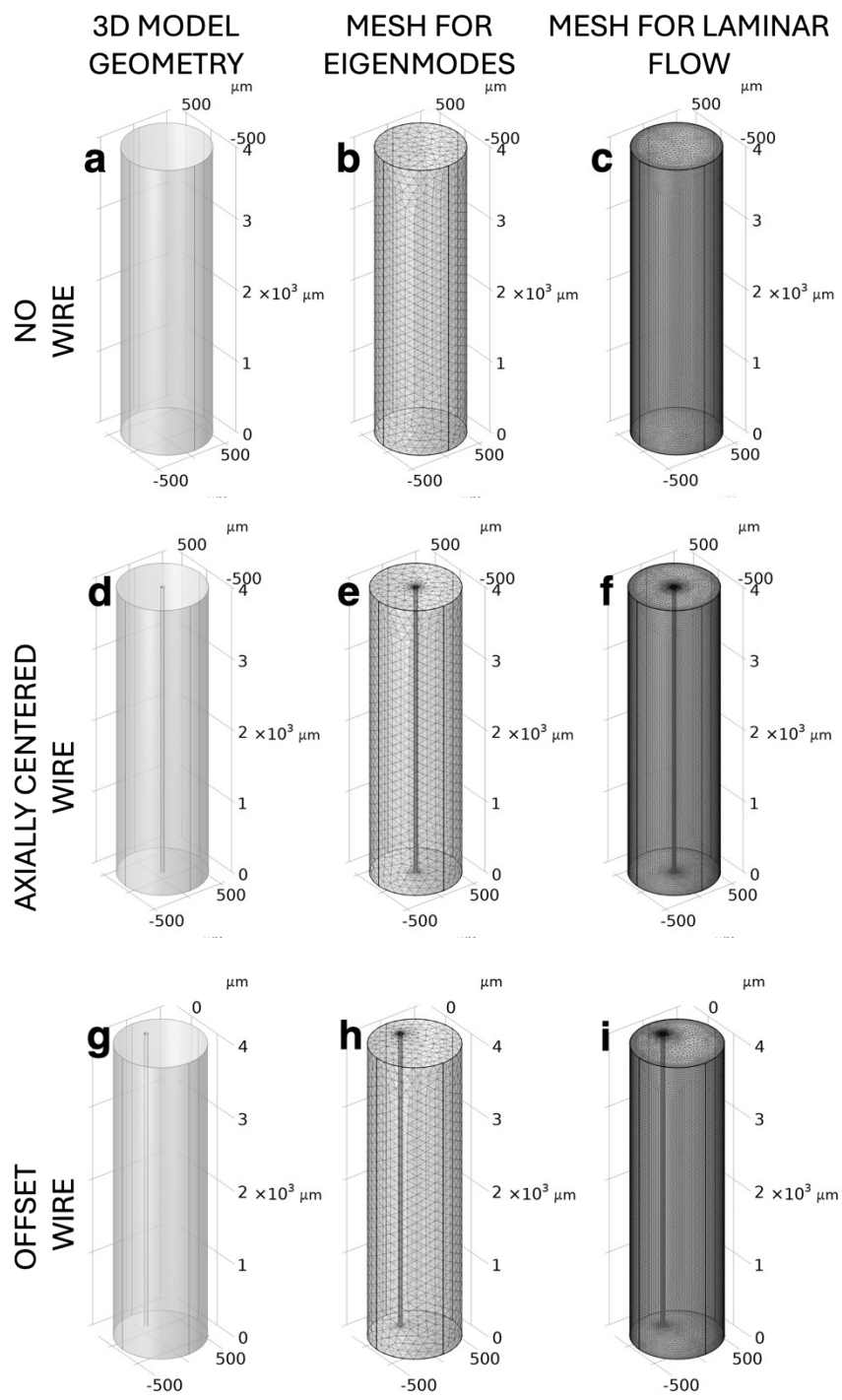


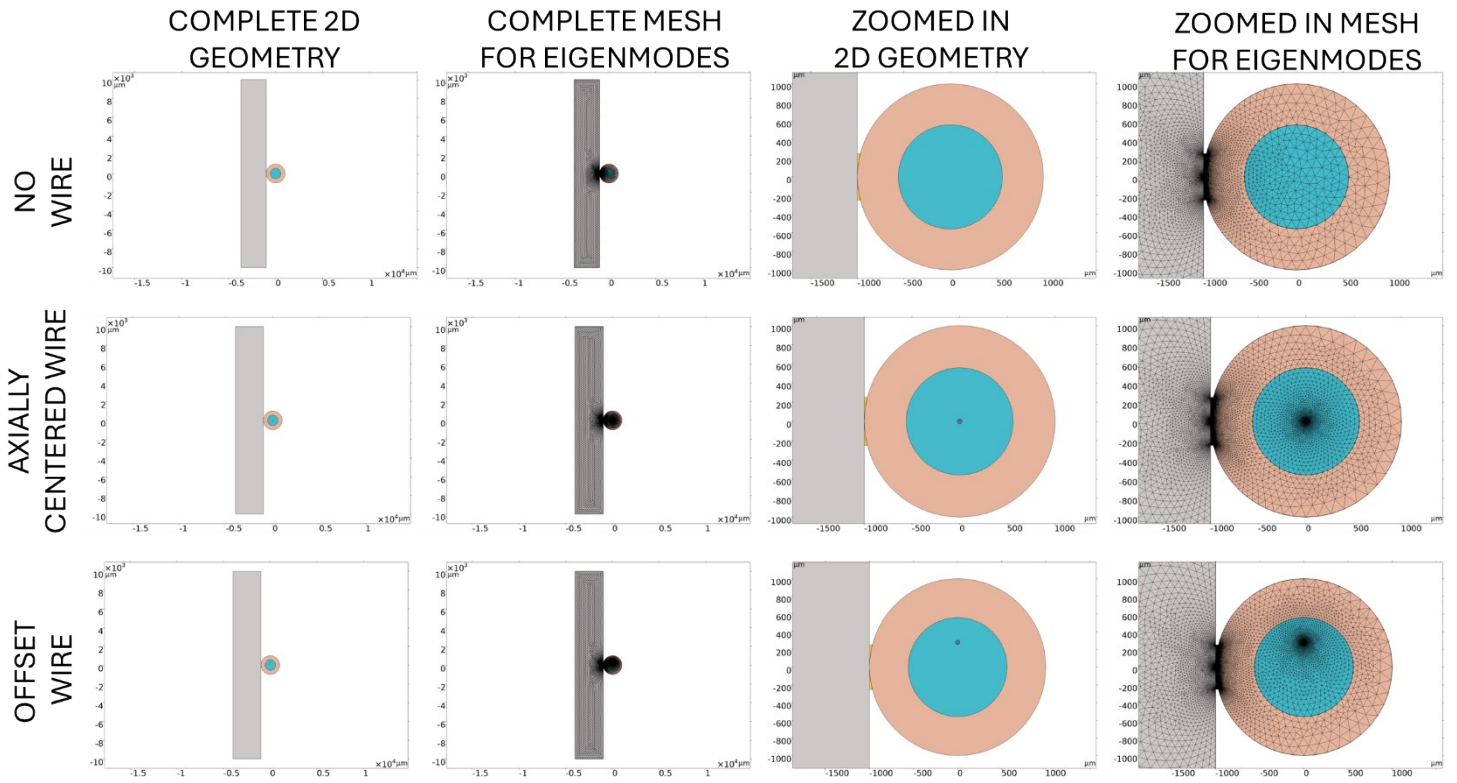
## Supplementary Information for

# Acoustofluidic Trapping of Microparticles to Axially Centered Wires in Cylindrical Microcapillaries

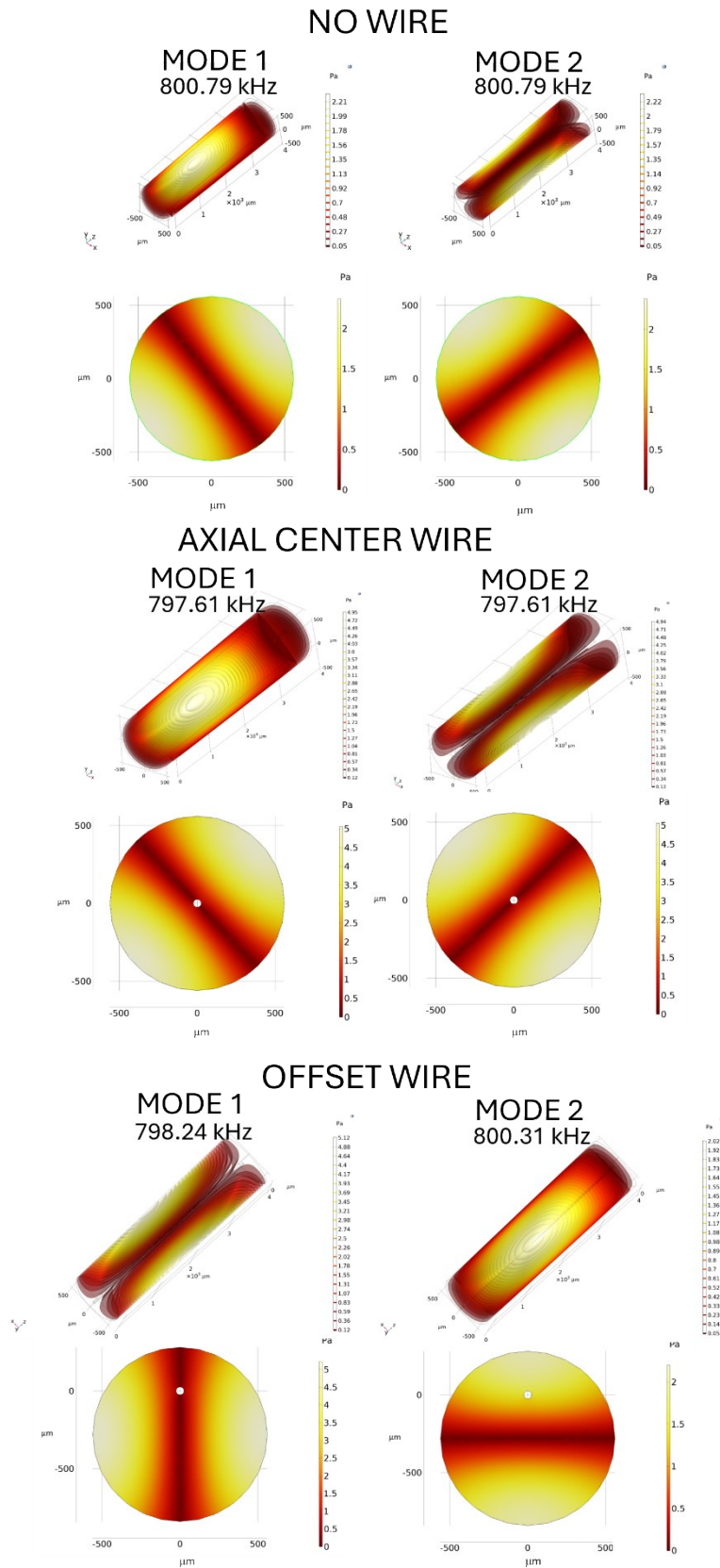
Ruben J. Trujillo,<sup>a</sup> Phung H. Bui,<sup>a</sup> Andrew P. Shreve,<sup>a</sup> Matthew J. Campen,<sup>†b</sup> Menake E. Piyasena<sup>†c</sup> and Steven W. Graves<sup>\*a</sup>



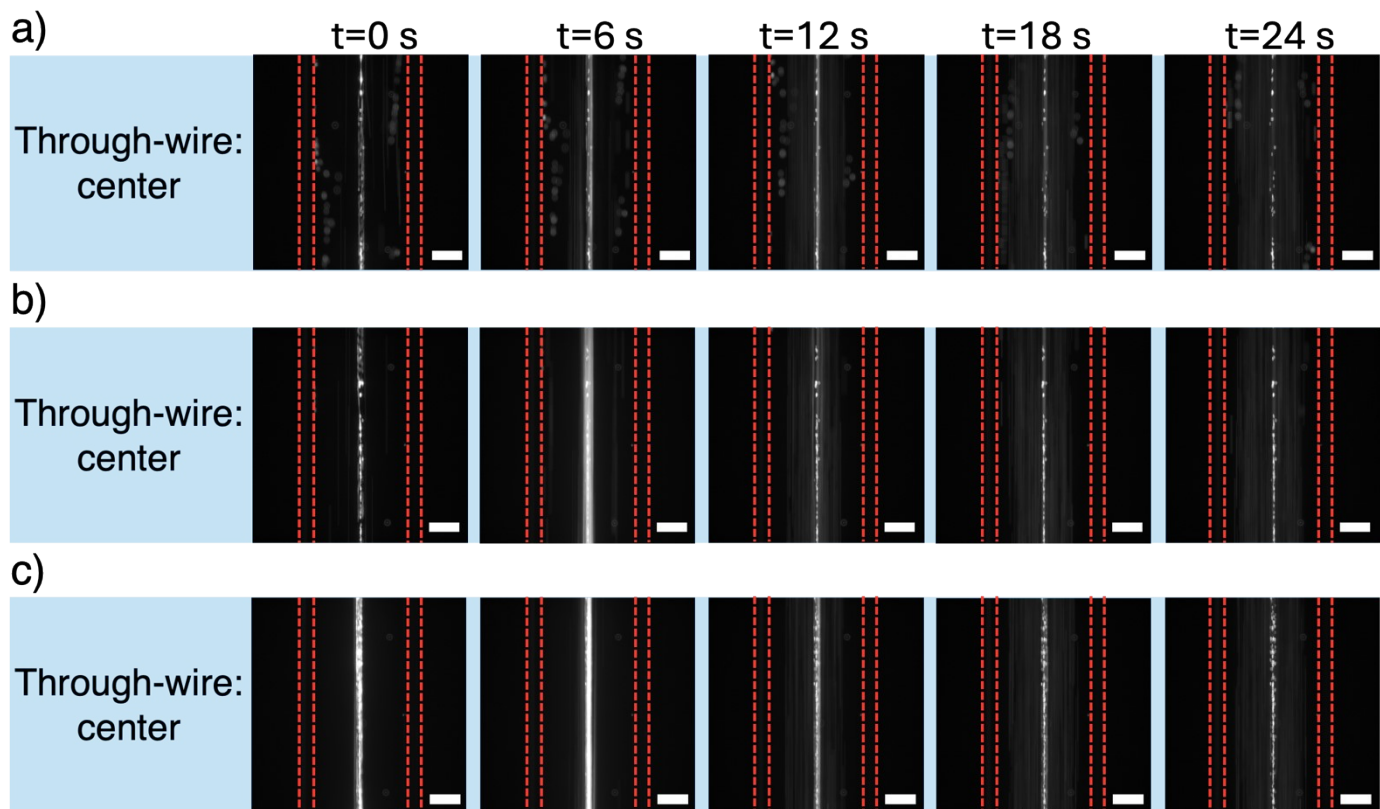
**Figure S1:** 3-dimensional COMSOL Multiphysics model geometry, mesh structure used for pressure eigenmodes, and mesh structure used for laminar flow for devices with no through wire (a, b, c), with an axially centered through wire (d, e, f), and an offset through wire (g, h, i).



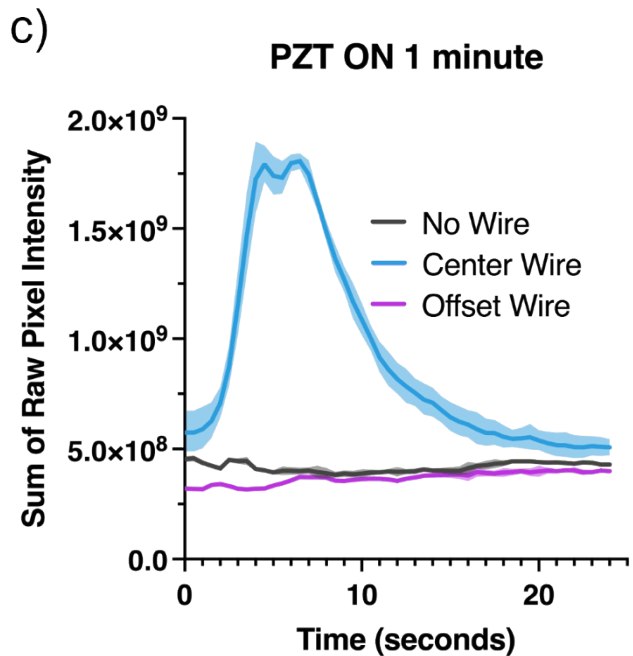
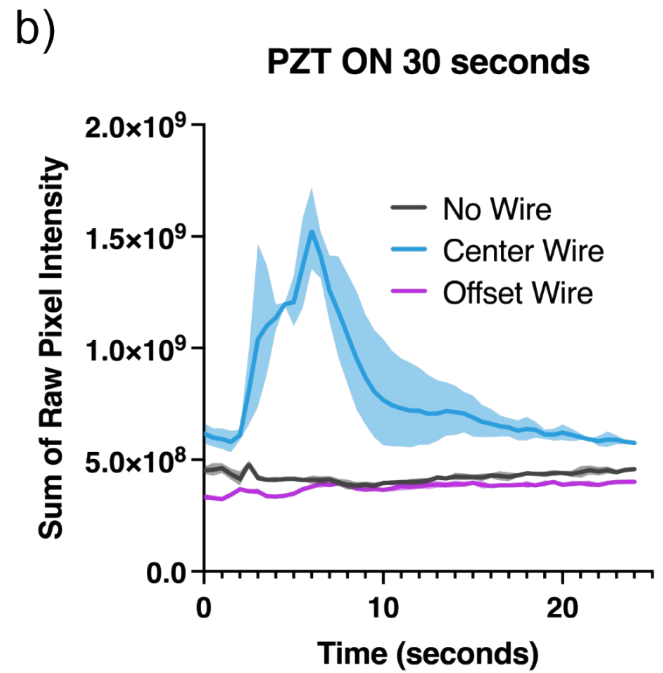
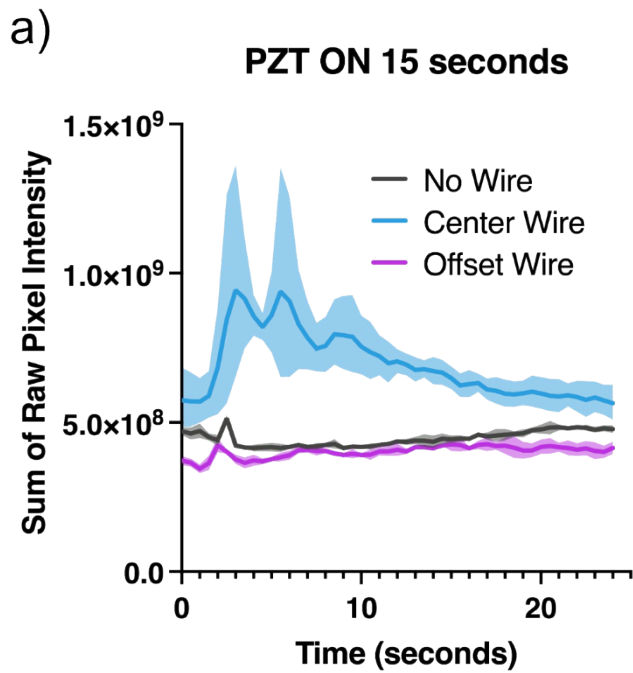
**Figure S2:** 2-dimensional COMSOL Multiphysics model geometry and mesh structures used for pressure eigenmodes for devices with no through (top row), with an axially centered through wire (middle row), and an offset through wire (bottom row).



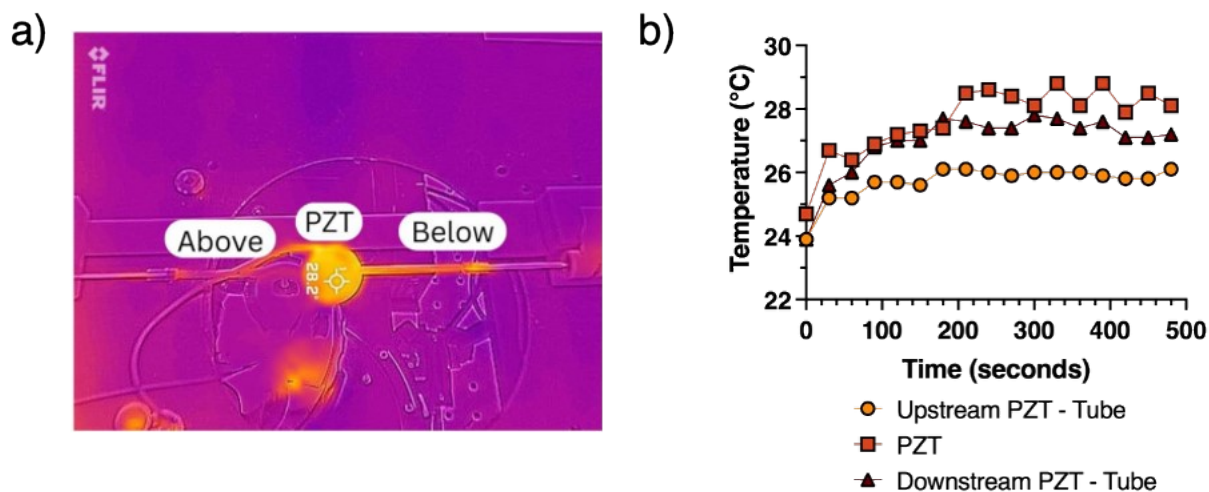
**Figure S3:** 3-dimensional COMSOL Multiphysics model predicted acoustic pressure profiles for devices with no through wire, with an axially centered through wire, and an offset through wire.



**Figure S4:** Representative panel images over time immediately after the PZT is turned off with a centered through-wire. The PZT was on for a duration of a) 15 seconds, b) 30 seconds, and c) 2 minutes prior to turning off. The tube walls are represented by dashed red lines. All scale bars = 500  $\mu\text{m}$ .



**Figure S5:** Sum of the raw pixel intensity of the video frames immediately after the PZT was turned off after the PZT was on for a) 15 seconds, b) 30 seconds, and c) 1 minute. All graphs display the mean sum of the pixel intensity with standard deviation ( $n=3$ ).



**Figure S6:** a) Thermal infrared image of the glass capillary system while the acoustic field is on ( $V_{pp} = 30$  V,  $200 \mu\text{L}/\text{min}$ ). ‘Above’ represents the portion of the capillary upstream from the PZT, while ‘Below’ represents the portion of the capillary downstream from the PZT. b) Temperature ( $^{\circ}\text{C}$ ) of the acoustofluidic system as a function of time (s) that the acoustic field is turned on. The temperature was measured for the tube upstream from the PZT, the tube downstream from the PZT, and the PZT itself. All three locations plateau in temperature by 210 seconds. Data was collected using images from an infrared camera at 30 second intervals ( $V_{pp} = 30$  V,  $200 \mu\text{L}/\text{min}$ ).

### Calculation of Number of Trapped Particles

Total captured particles were estimated from all of the videos captured after the PZT was turned on for either 15 seconds, 30 seconds, 1 minute, or 2 minutes. Using the device without a through-wire as the baseline case, we

Center Wire		
<b>Total # of particles that appeared in FOV in 24 seconds</b>		
<b>PZT ON Time (seconds)</b>	<b># of particles</b>	<b>STDEV</b>

know that the concentration of particles at any given time in the field of view (FOV) is 150,000 particles/mL, assuming the polystyrene microspheres do not adhere to the tube wall surface in the presence of the acoustic field. Because the particles have a positive acoustic contrast factor, and our experimental results demonstrate the particles move to the pressure node, the

assumption that particles do not adhere to the tube wall is justified. Videos taken after the PZT was turned off were captured for a total of 24 seconds, and using the concentration of particles, the total time of flow that was videoed, and the volumetric flow rate (0.2 mL/min), we can calculate that approximately 12,000 particles should enter the FOV during each experimental condition (15 seconds, 30 seconds, 1 min, or 2 min) (Table S1). Using

**Table S1:** Total number of particles calculations for the device without the through-wire. the average area under the curve (AUC) for the device without the

through wire, we can estimate how much area one given particle represents by the AUC. This can be done by dividing the 12,000 particles we expect to see in the FOV by the respective AUC for each experimental condition (15 seconds, 30 seconds, 1 minute, and 2 minutes) (Table S1).

No Wire				
<b>time (s)</b>	24			
<b># particles in 24 seconds</b>	12000			
<b>PZT ON Time (seconds)</b>	<b>Average AUC for No Wire</b>	<b>STDEV</b>	<b># of particles / AUC</b>	<b>STDEV</b>
15	1.07E+10	8.3E+06	1.12E-06	8.7E-10
30	1.02E+10	2.1E+08	1.18E-06	2.5E-08
60	1.00E+10	2.0E+08	1.20E-06	2.4E-08
120	9.11E+09	1.4E+08	1.32E-06	2.0E-08
<b>Total Time for Particles to Enter FOV (s)</b>	<b>Total # of particles during time (particles)</b>	<b>Total # of particles that could be trapped (particles)</b>		
39	19500	7500		
54	27000	15000		
84	42000	30000		
144	72000	60000		

Additionally, as the PZT is on for a variable amount of time, the total possible number of particles that could be captured were calculated by multiplying the volumetric flow rate, particle concentration, and duration the PZT was turned on (Table S1). Using the particle to AUC ratio for the device without the through-wire, we can then calculate the total number of particles we observed in the device with the centered through-wire by multiplying the ratio by the average AUC (Table S2). As we expected to see 12,000 particles flow through the FOV due to normal experimental conditions, the number of trapped particles was determined by subtracting the 12,000 particles from the total number of particles observed after the PZT was turned off. Finally, the percentage of trapped particles was estimated by dividing the calculated number of trapped particles by the total number of particles that could be trapped during the time the PZT was on (Table S2).

15	2882	571
30	2906	83
60	26501	1480
120	43365	3446
	<b>Total % of particles trapped</b>	<b>STDEV</b>
	91.8%	8.1%
	72.0%	5.8%
	48.3%	2.7%
	52.3%	4.2%

**Table S2:** Total number of particles observed for each experimental case with the PZT on. As we expected to see normal experimental conditions, the number of trapped particles was determined by subtracting the 12,000 particles from the total number of particles observed after the PZT was turned off.