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## **Vibrometer Enclosure**

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**Mechanical Engineering Department**

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Projects Agency (DARPA)**

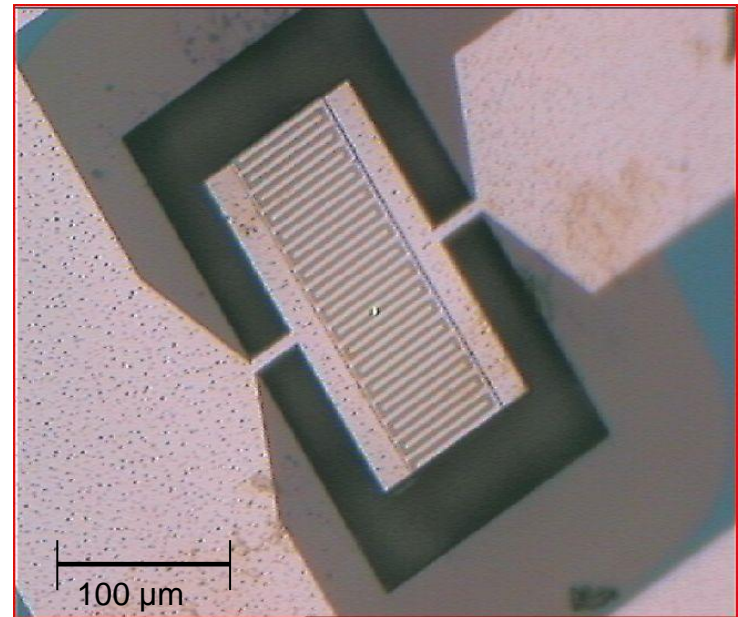


# Micro-Electro-Mechanical Systems (MEMS) resonators

**A resonator is a device that oscillates at a single frequency.**

**Resonators are used in wireless devices.**

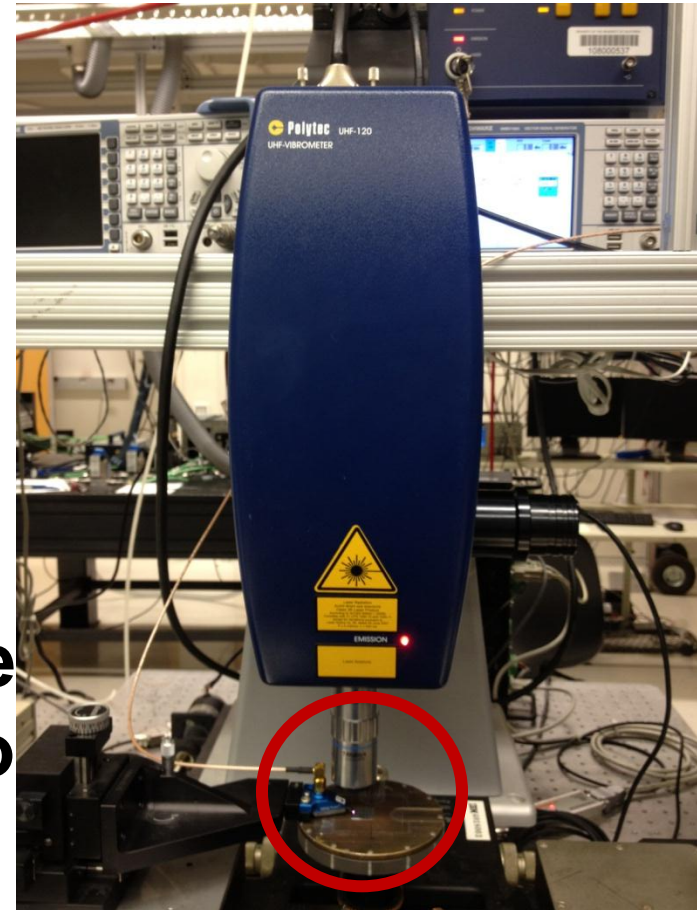
**MEMS resonators have frequencies in the giga-hertz.**



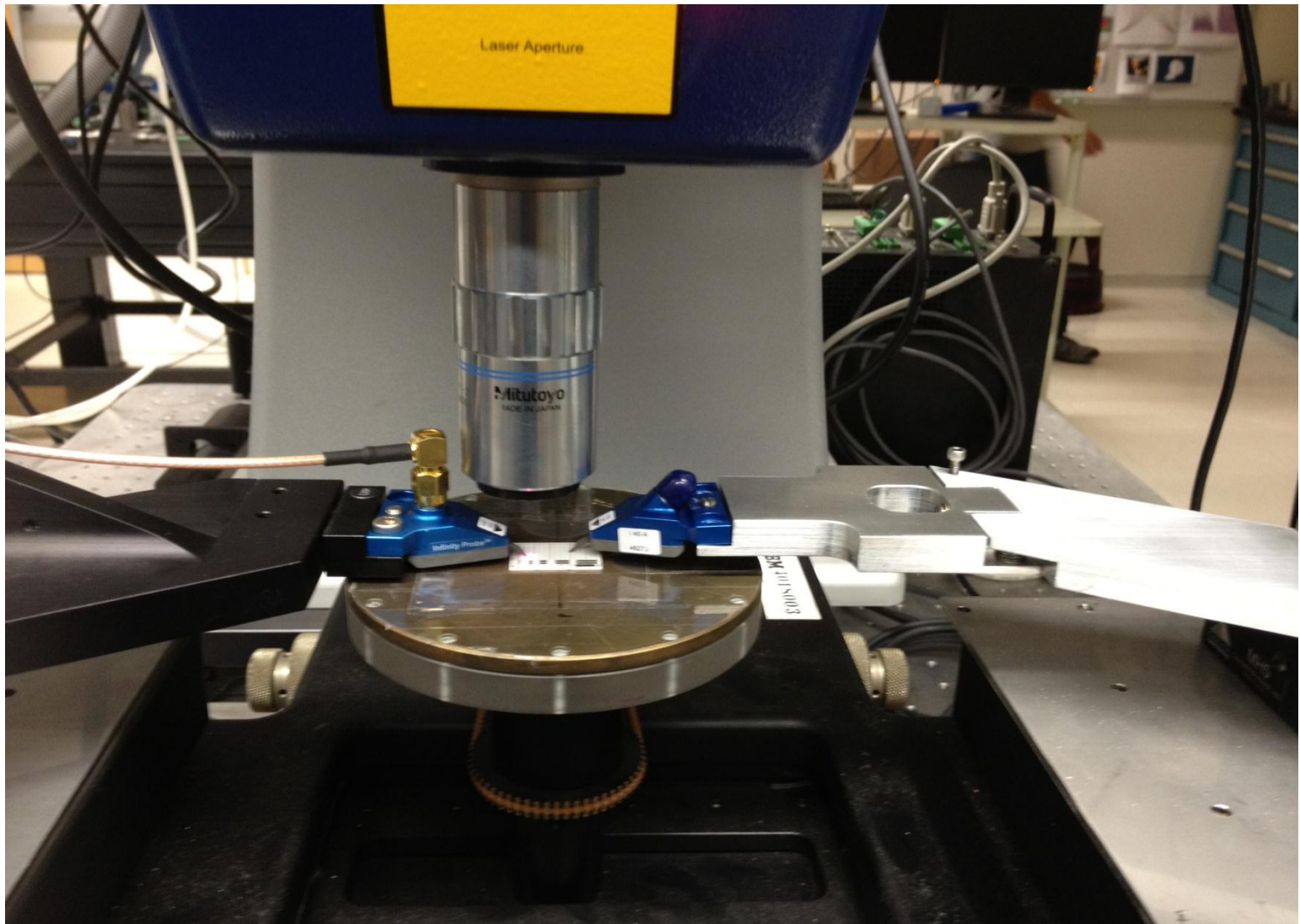
A 1 GHz Piezo-Electric Resonator.

## How are MEMS's measured?

- A vibrometer uses the Doppler effect to measure velocity.
- With velocity displacement is found.
- MEMS resonators have displacements down to the picometer.



Polytec UHF-120 Vibrometer with electrical probe station.



Complete vibrometer setup.

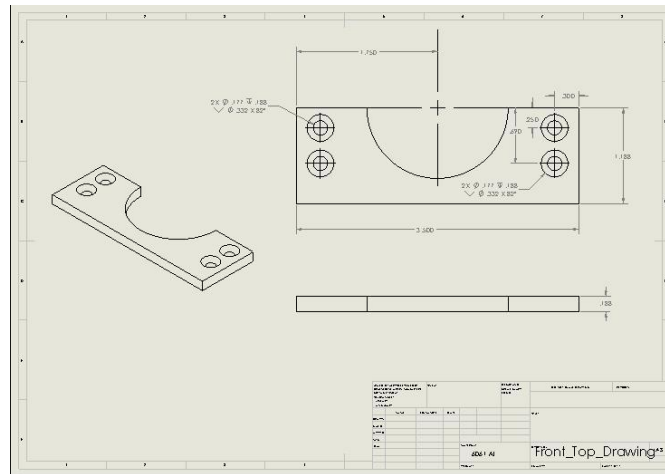
## Summer Research Project

**Design and build an enclosure that allows ease of measurement of the MEMS resonators, and lowers the dust particles around the MEMS device.**

- **Design**
- **Build**
- **Test**

# Design

- **Learn SolidWorks**
  - **Make 3D drawings**
  - **Make drawing (blueprint)**

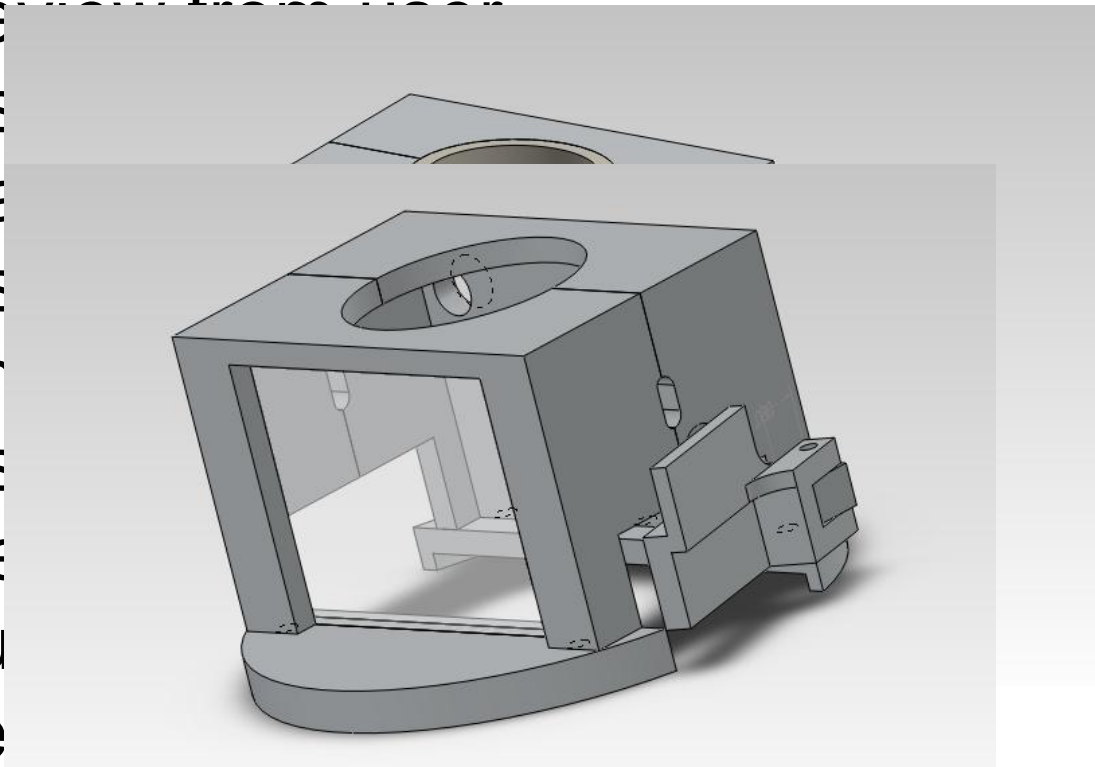


Drawing of top portion of the container made in SolidWorks.

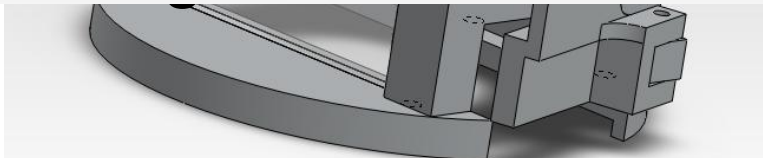
- **Learn the design process**

# Design Process

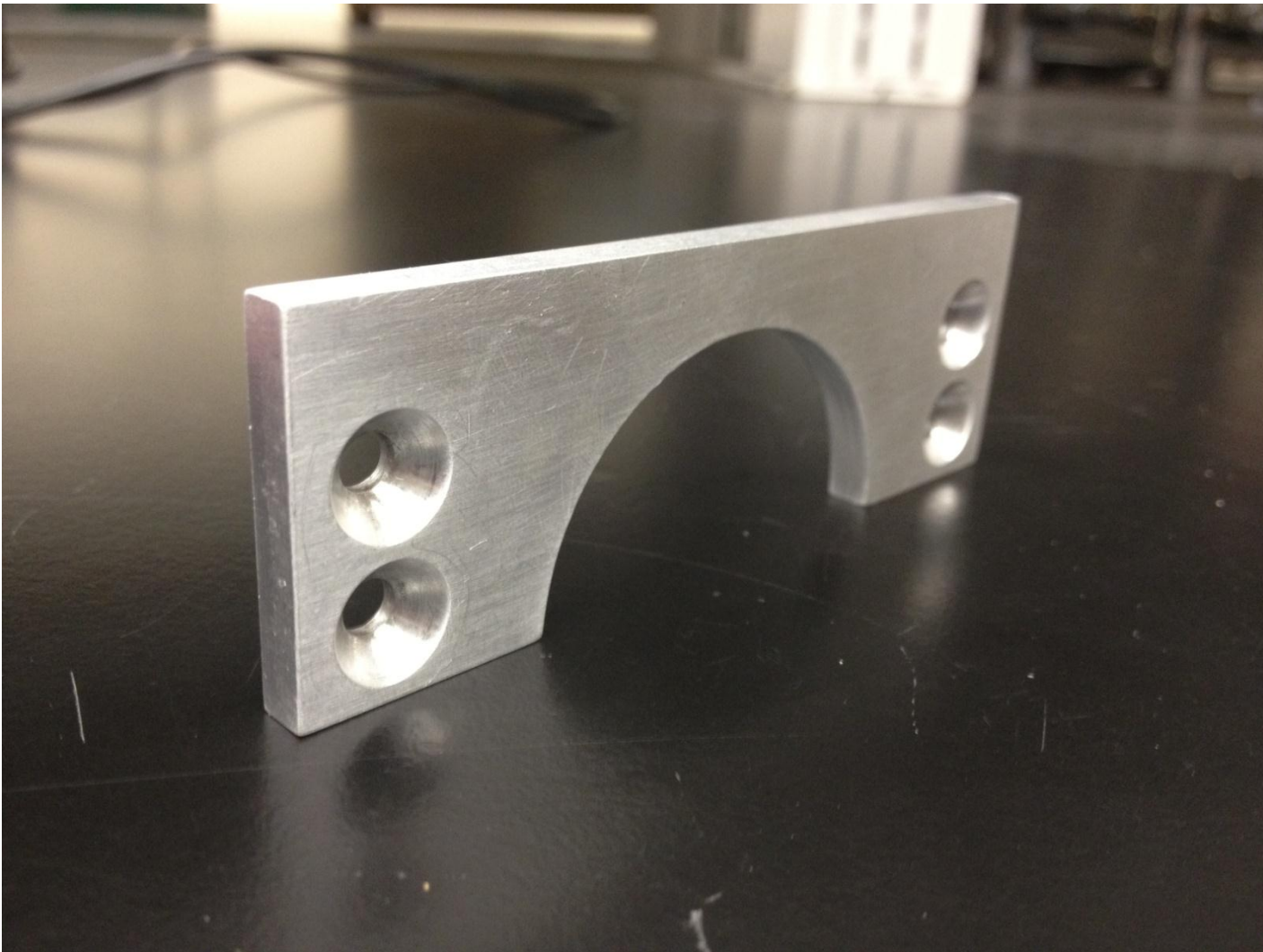
1. Have an idea.
2. Use requirements to shape your idea
3. Review from users
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# Design Process





## Building Enclosure

**Used band saw to roughly cut pieces to size.**



**Milling machine was use to shape the pieces to my drawings.**

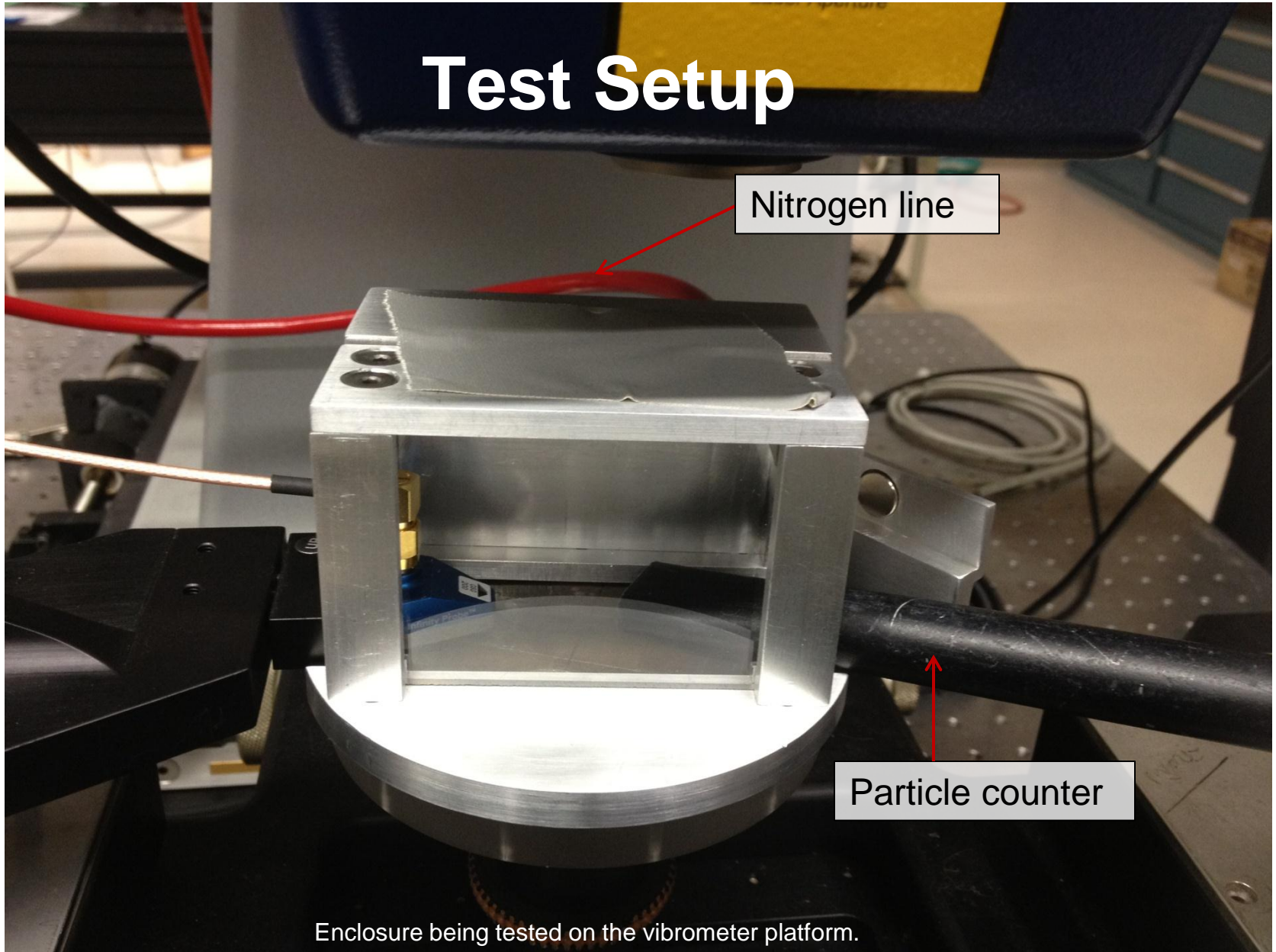


# Test Setup

Nitrogen line

Particle counter

Enclosure being tested on the vibrometer platform.



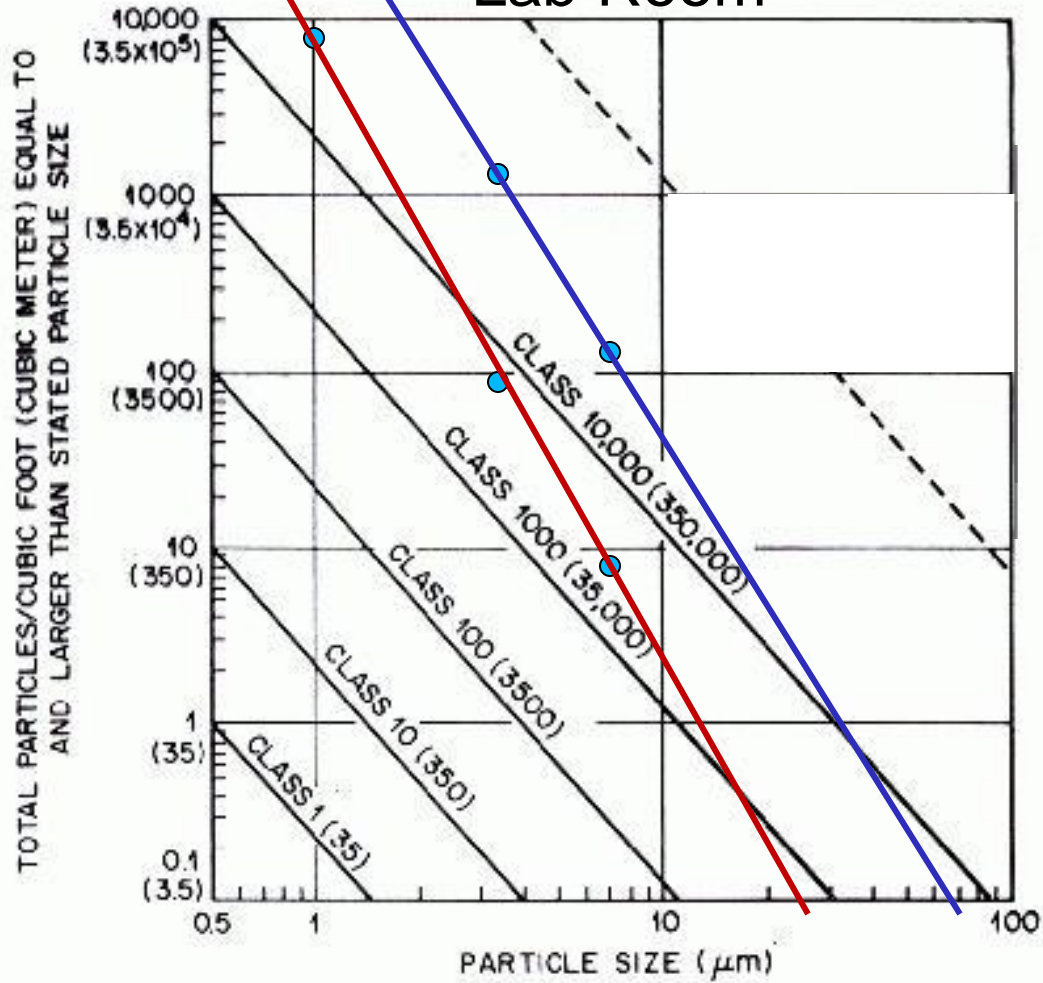
# Particle Count Results

Average number of particles in lab and enclosure.

Size ( $\mu\text{m}$ )	Lab Room particle/ $\text{m}^3$	Enclosure particle/ $\text{m}^3$	Reduction Factor
0.5	2,248,591	780,419	$\sim 3$
0.7	718,088	205,390	$\sim 3$
1	412,193	106,368	$\sim 4$
3	10,842	1,130	$\sim 10$
5	4,803	177	$\sim 20$

Enclosure

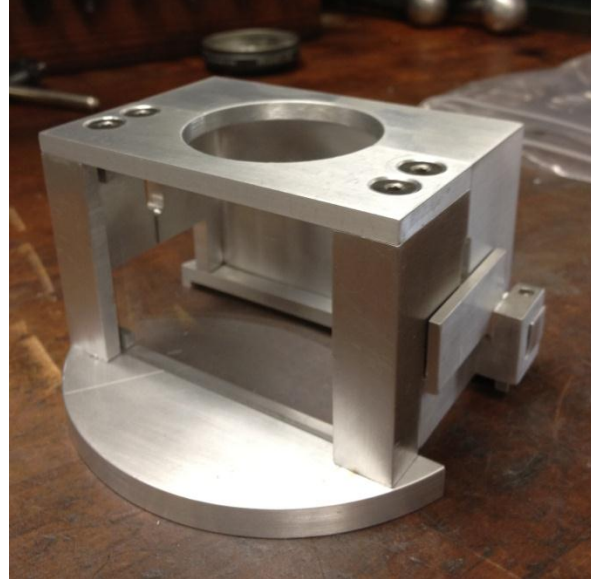
Lab Room



Graph of number of particles vs. particle size. Lab room and enclosure are roughly graphed.

## INSET

- **Project**
  - **Designed**
  - **Built**
  - **Tested**



Final product.

- **SolidWorks**
- **Machine Shop experience**

# Acknowledgement

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**Mentor: Brian Gibson**

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**UCSB Engineering Machine Shop**

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**INSET staff**

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