## Fluid Structure Interaction Validation Experiments

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## **Motivation and Goals**





• Gas damping is an important fluid-structure interaction effect which strongly influences many aspects of MEMS performance (Q-factors, impact velocities in RFMEMS, wear) •Investigate the effect of ambient pressure (Knudsen number) on gas damping of flexible microscale structural elements •Set up an experimental procedure to measure gas damping of RF MEMS switches.

# **Y2 Experiments**







Kn based on half-width of the cantilever

**Regimes loosely** defined based on Kn numbers where a specific theory starts diverging from the experiments

Horizontal bars signify the uncertainty in pressure readings

Repeatability analysis done for Cant. C with 15 readings at every pressure.



- State of the art vacuum probe station with integrated pressure control, for high fidelity measurements •Pressure control down to 75 microTorr Integration of MSA Laser Doppler Vibrometer
- Measure the effect of ambient pressure on gas damping of a doubly clamped nickel beam
- •Measure ring down and FRF at many different pressures via electrostatic excitation







 $10^{-3}$ 10<sup>-1</sup> 10<sup>1</sup> Ambient pressure [Torr]

#### **Uncertainty Quantification**

 $10^{3}$ 







 Probability Distribution functions of Q and wn at each pressure

•Zeta and wn for every pressure, with error bounds

## Conclusions

• We have an experimental setup to generate high quality validation data for structural dynamics of MEMs under different ambient conditions

• PRISM device FSI validation data complete