Air Tuner
201 MHz MICE Cavity

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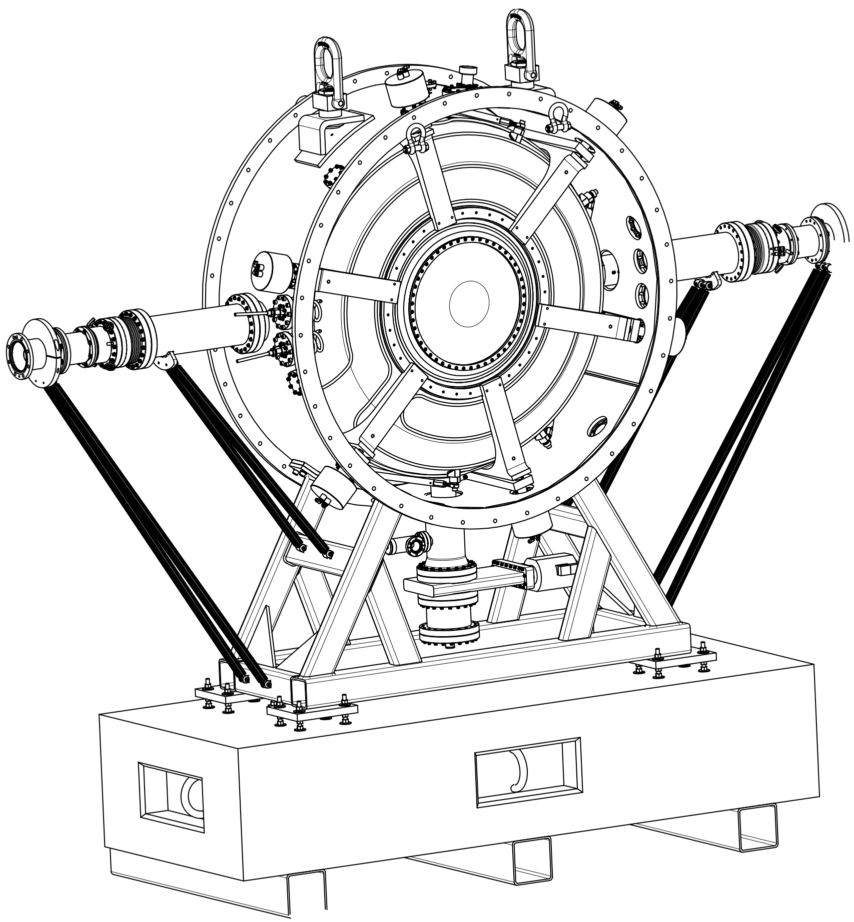
INFN - PISA

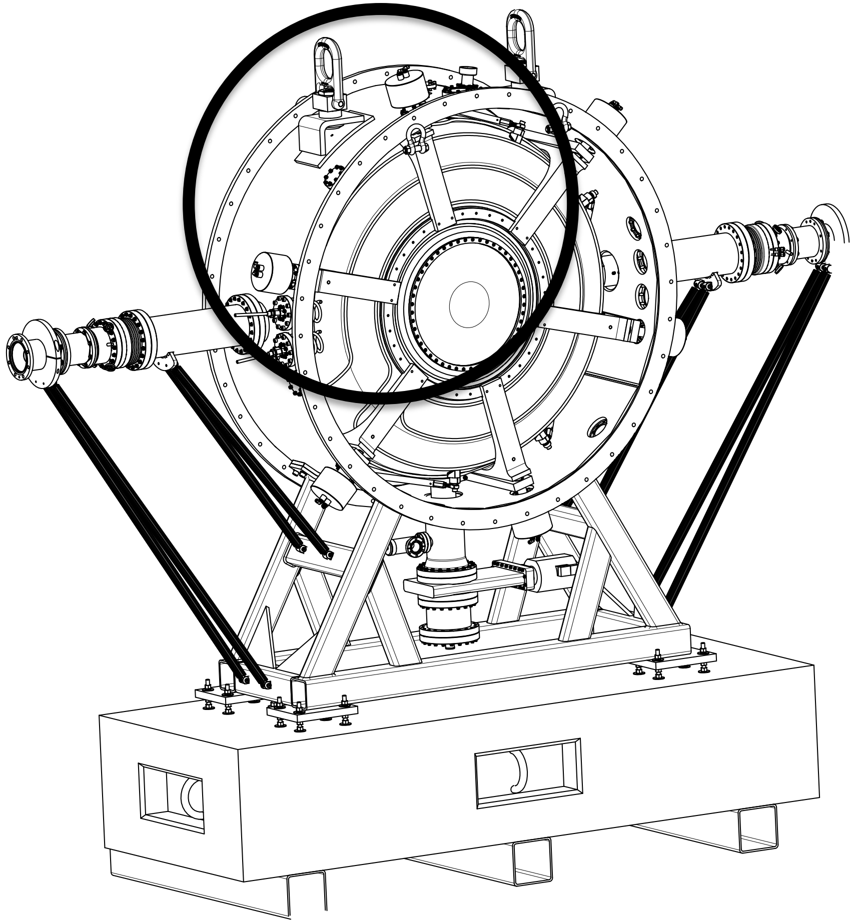
Single Cavity Module

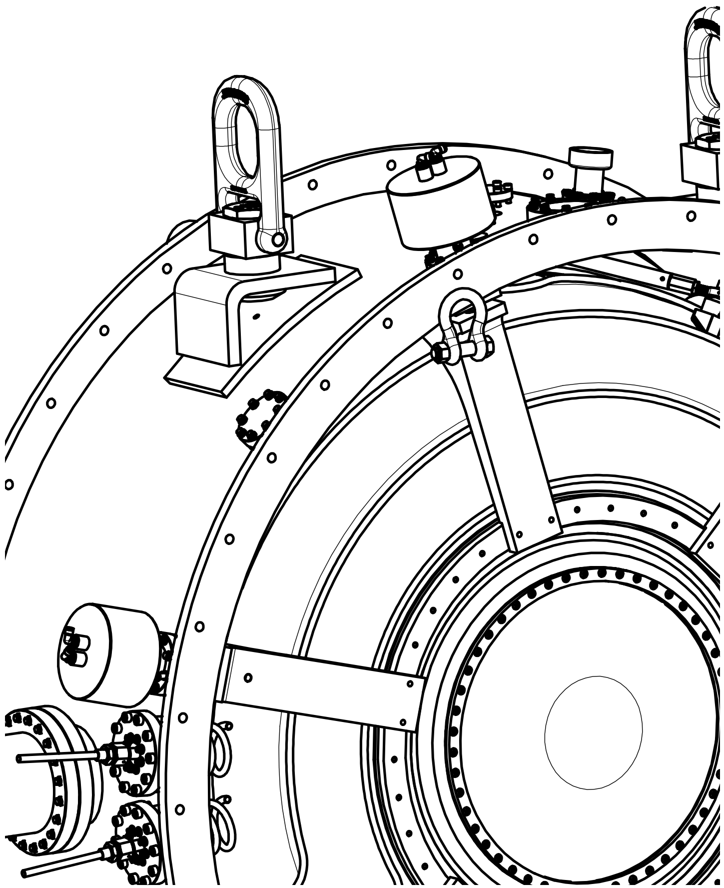


Tuning System:

- 6 Forks per cavity
- Controlled by 6 pneumatic actuators

Single Cavity Module

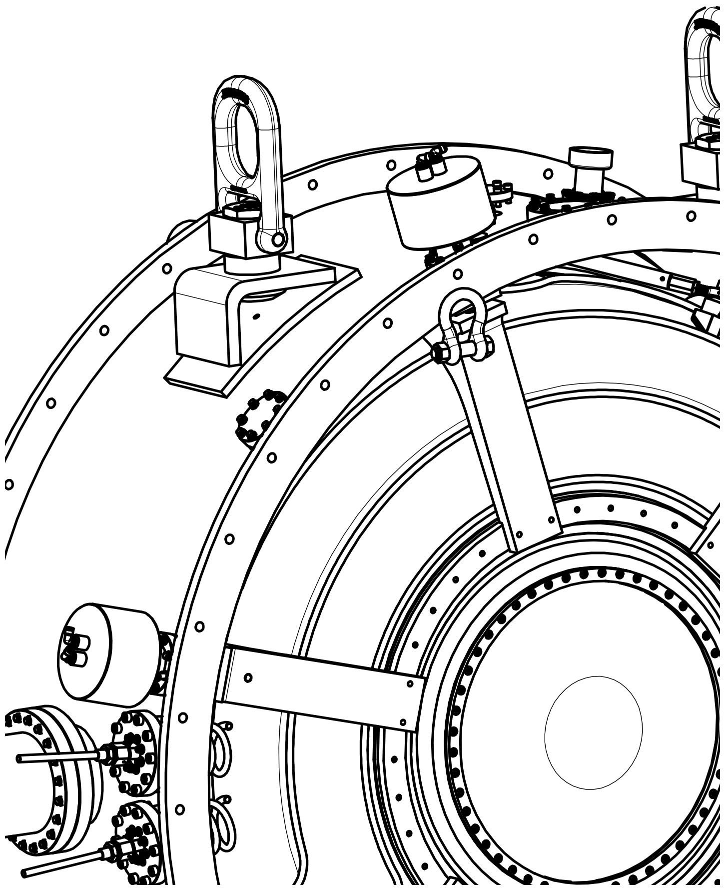




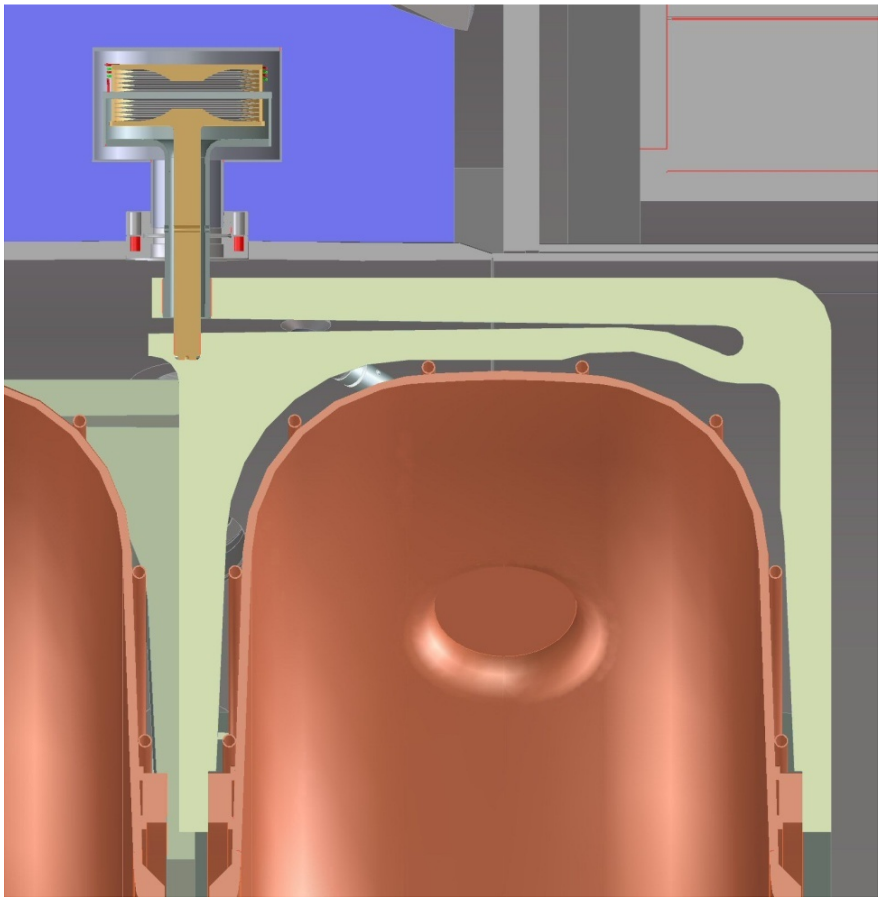
Single Cavity Module

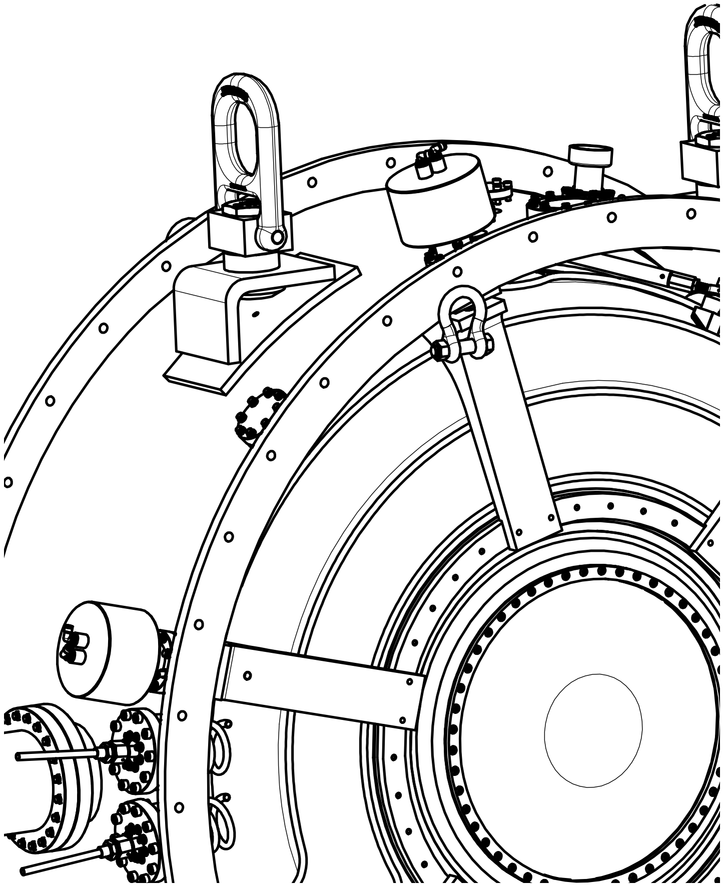
Tuning System:

- Forks will be in vacuum
- Actuators will be outside vacuum vessel

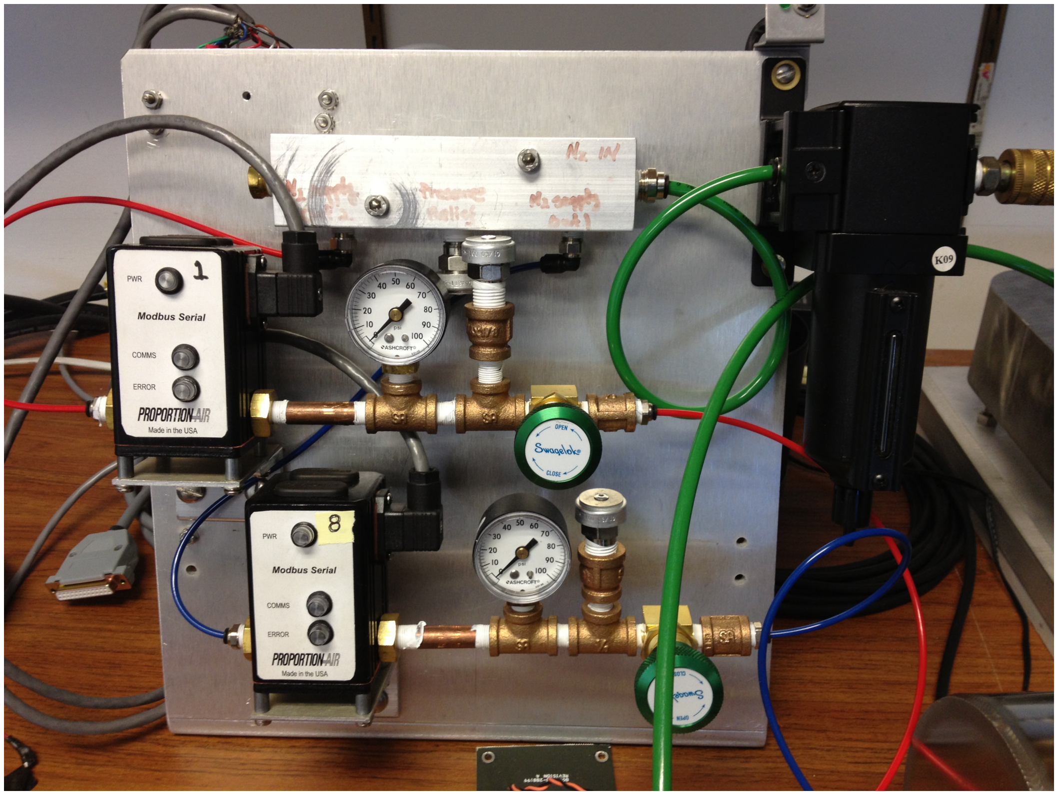


Single Cavity Module



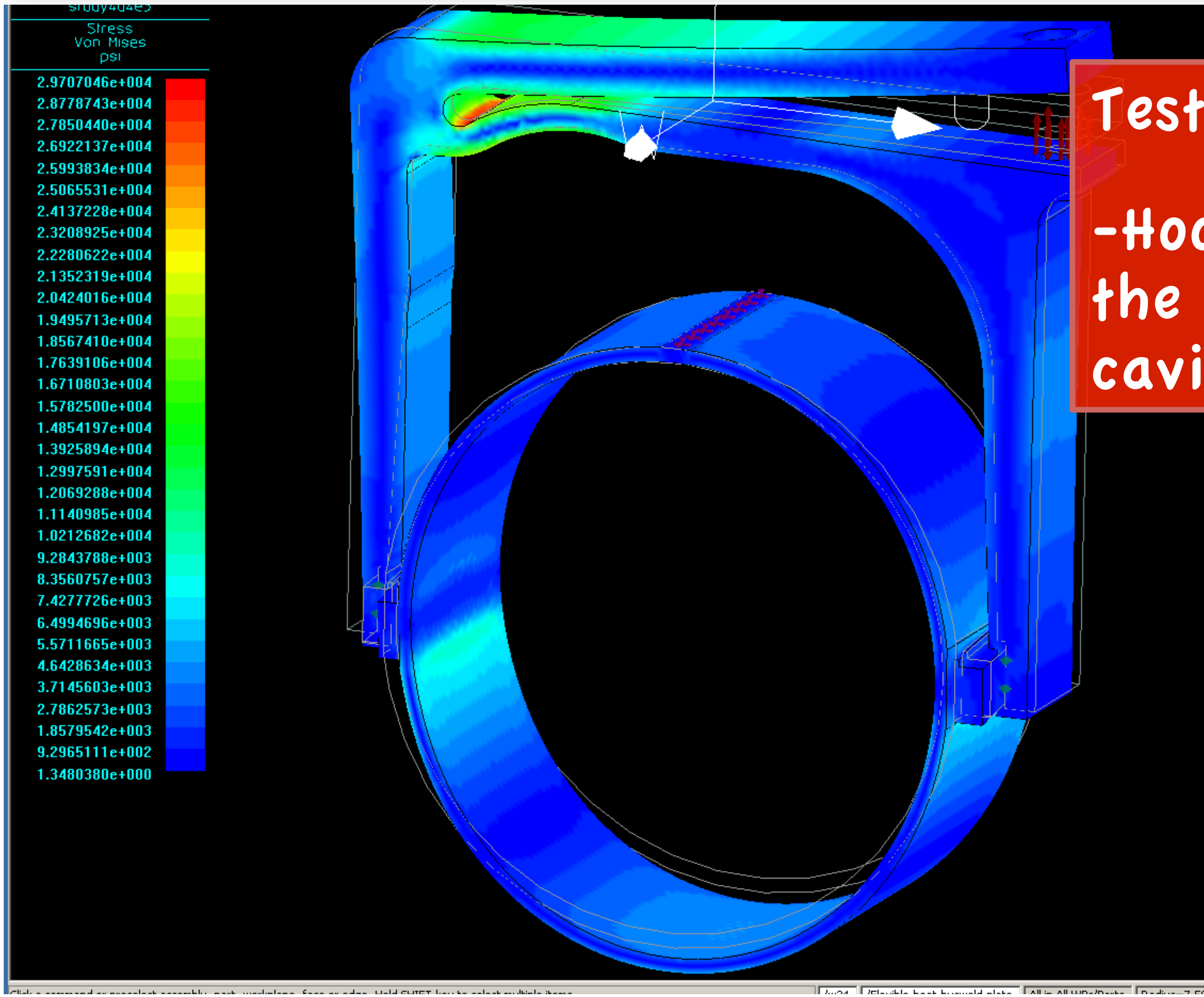


Test Stand



- Proportional Valves
- LabView ModBus controller
- One set of valves for all 6 pistons

Test Stand



Test Stand:

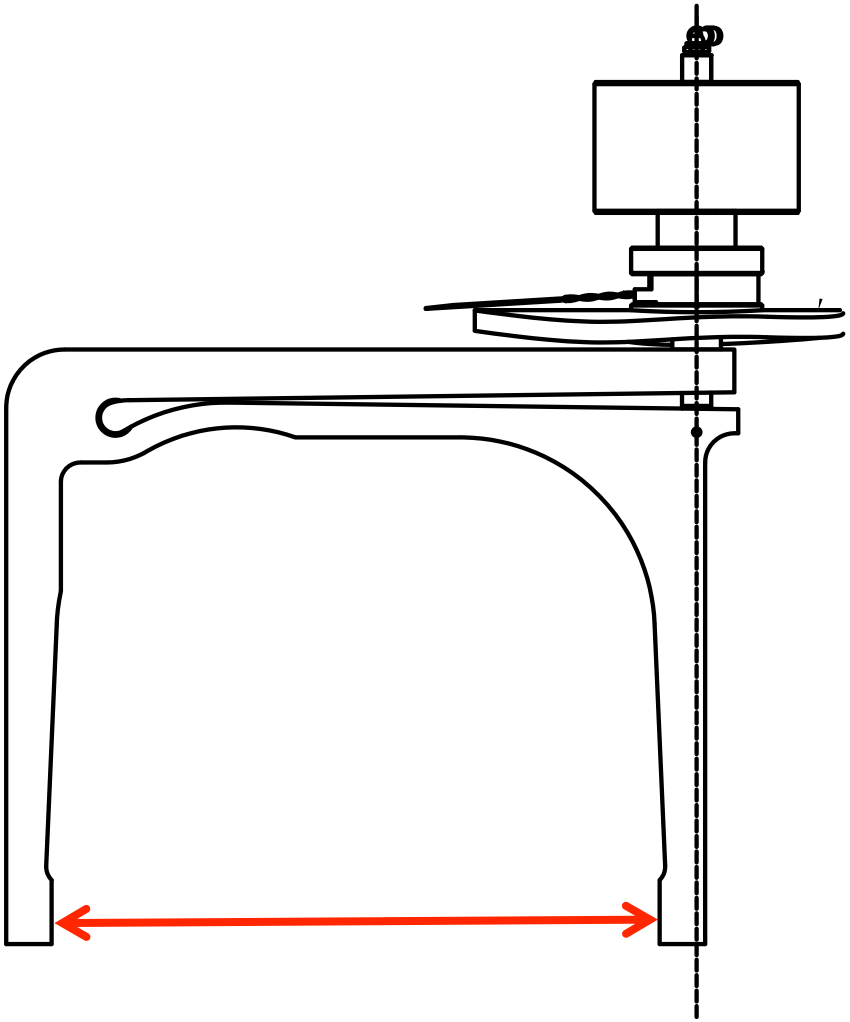
-Hoop to simulate the response of the cavity

Measurements

Goal(s) - Already Achieved:

- Write a control software (LabView)
- Check for a uniform response of all 6 actuators
- Calibrate the control system: P vs Deflection curve

Measurements

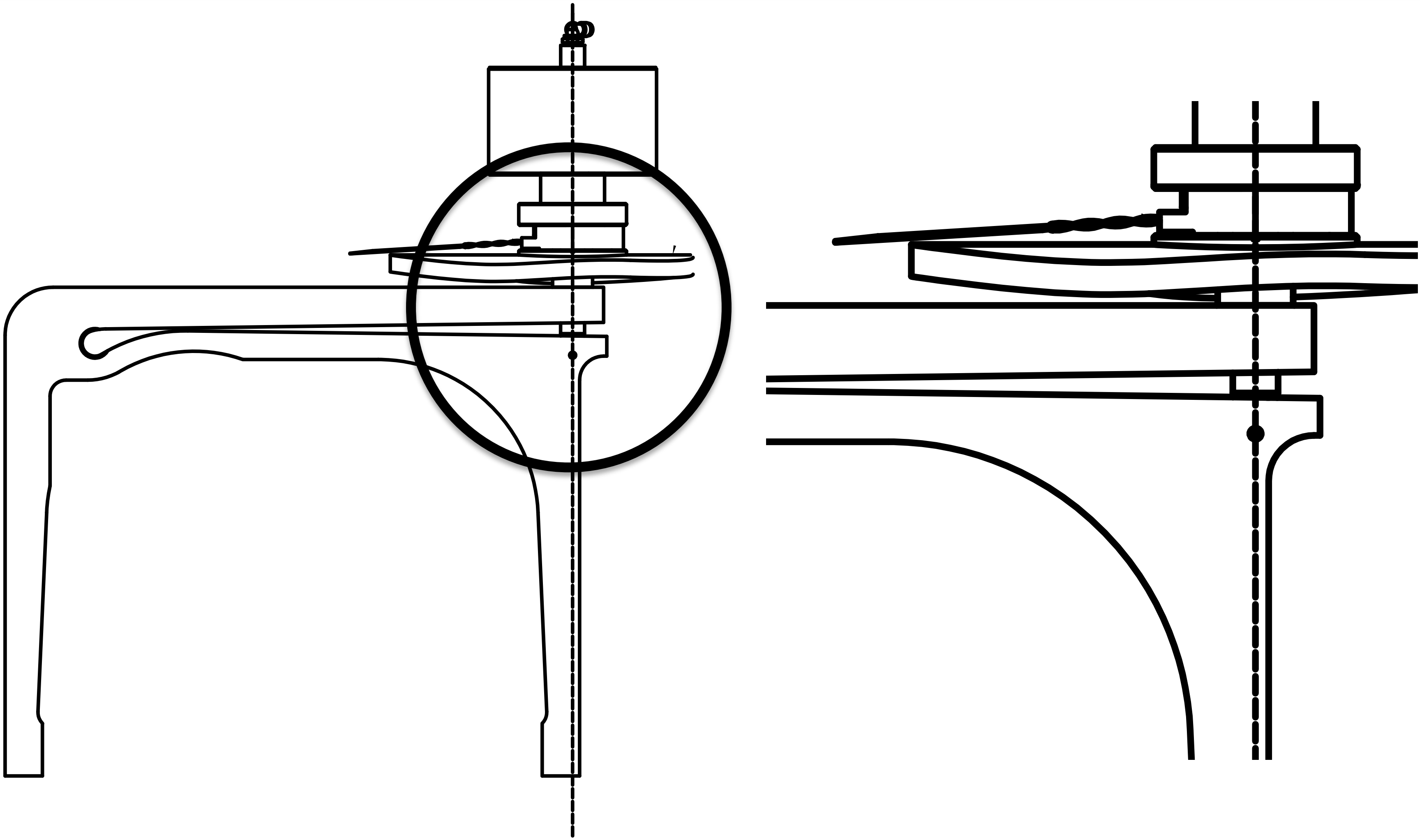


1) Deflection:

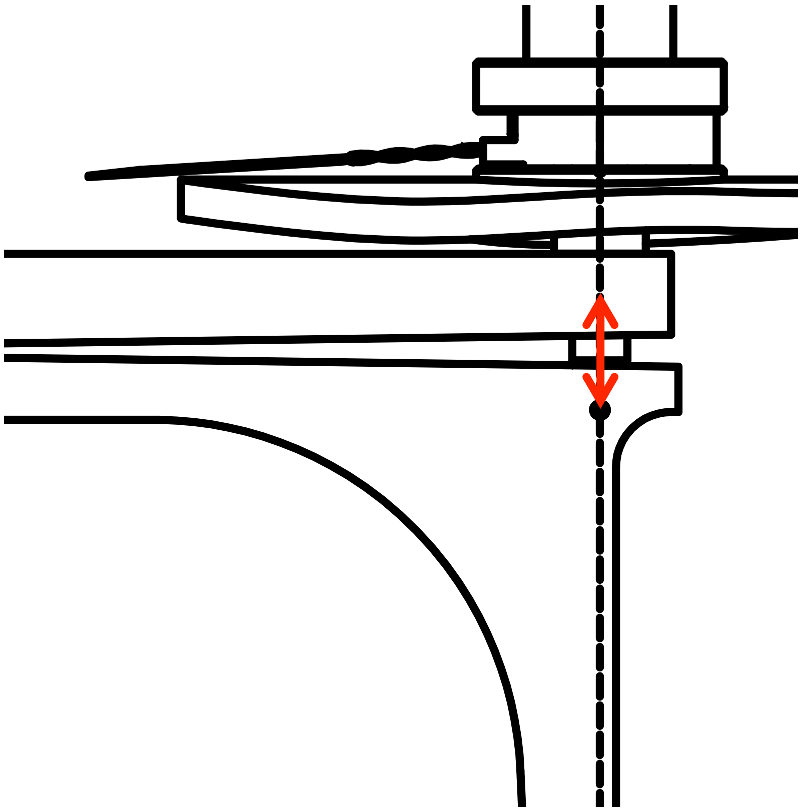
- Test hoop deflection measured with a dial gauge.


14.190" D
Starrett

Measurements



Measurements



2) Δx Gap:

- Fork gap Variation measured with a lineal potentiometer
- Readout with NI ADC and LabView
- Voltage output converted into mm.

Measurements

converted into mm.

Measurements

3) Pressure:

- Pressure measured directly from ModBus controllers read-out.

Ranges and Sensitivity

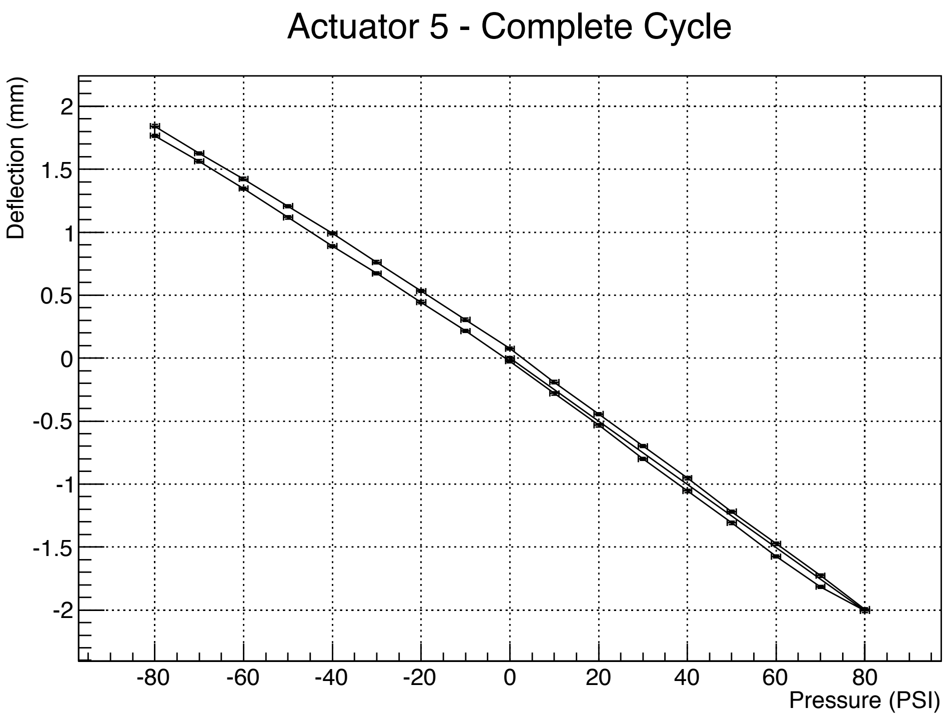
Ranges Results				
	Pressure (PSI)	***Deflection (mm)***	***Transducer (V)***	***Δ Gap (mm)***
Range	± 80	± 1.78	± 0.787	± 4.002
Mean Error	1.5	1.3E-02	4E-03	8E-03

We have a good resolution

Single Actuator Analysis

- We consider the example of one actuator
- All other actuator behave similarly

Single Actuator Analysis



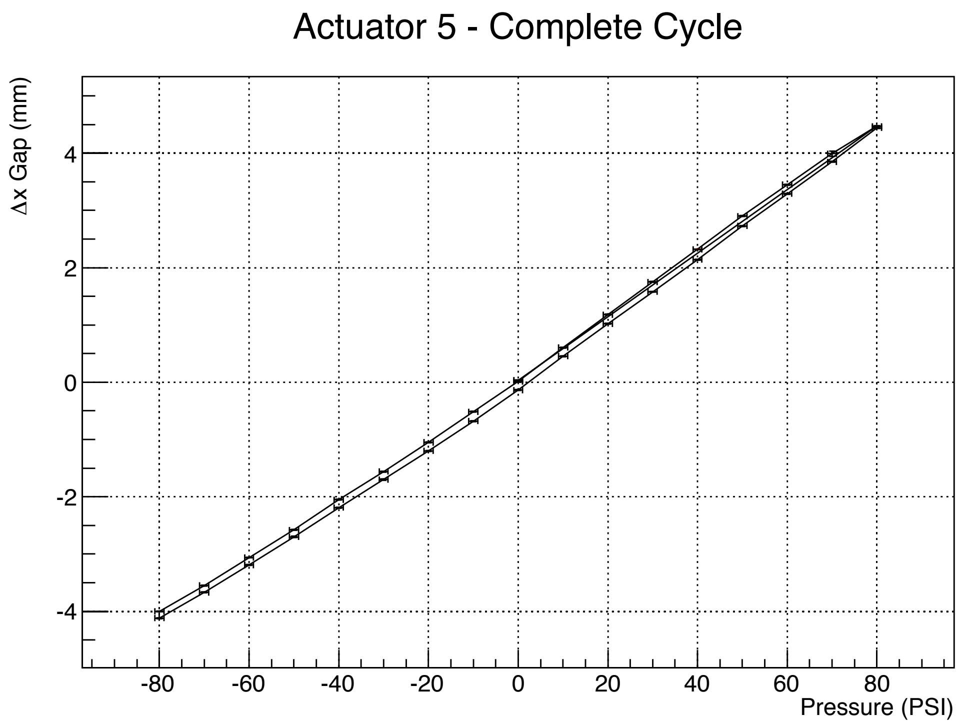
1) **Hysteresis:**

- Data show a small hysteresis (+/- 0.3 mm)
- If the cycle is repeated it overlaps the previous one

2) **Slopes:**

- Slopes obtained by pushing and pulling are different

Single Actuator Analysis



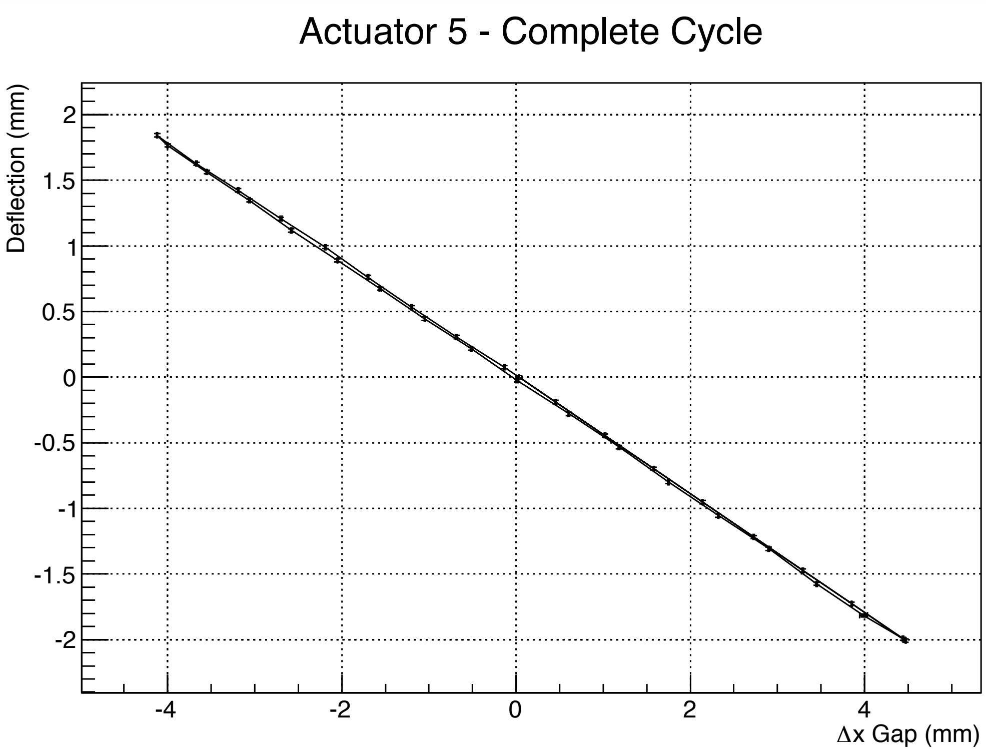
1) **Hysteresis:**

- Also this variables show a small hysteresis

2) **Slopes:**

- Slopes obtained by pushing and pulling are still different

Single Actuator Analysis



1) Hysteresis:

- The cycle area is significantly smaller

2) Slopes:

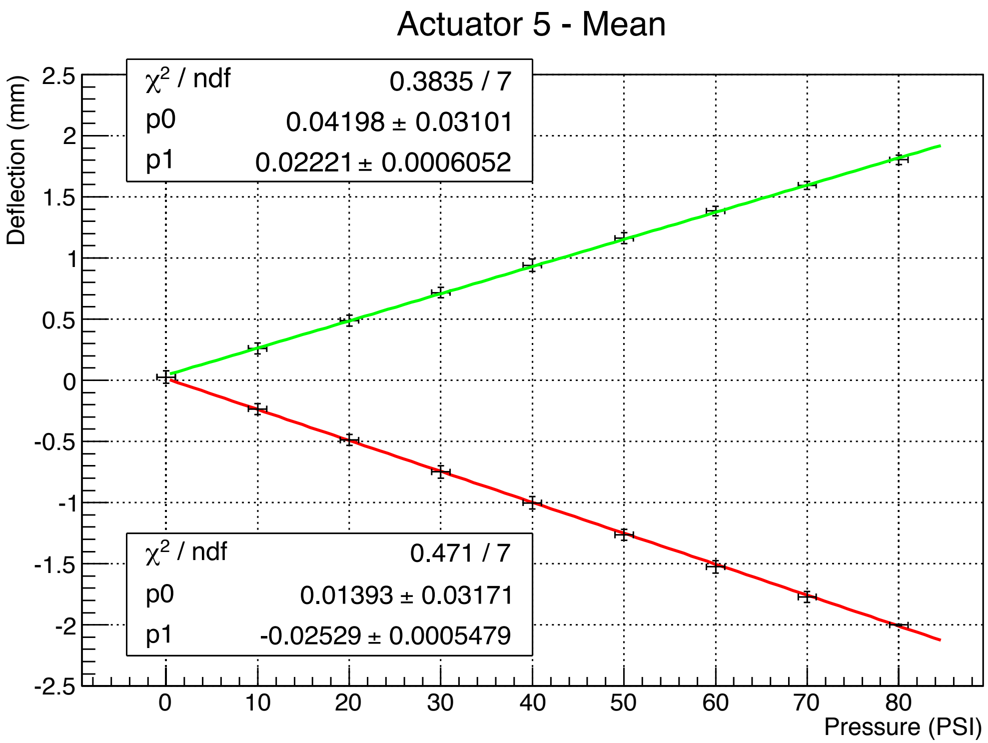
- Same slope for pushing and pulling

Hysteresis is not due to fork - hoop and and seems to depend on the actuator

Single Actuator Analysis

Let's now consider the mean value of each hysteresis cycle branch

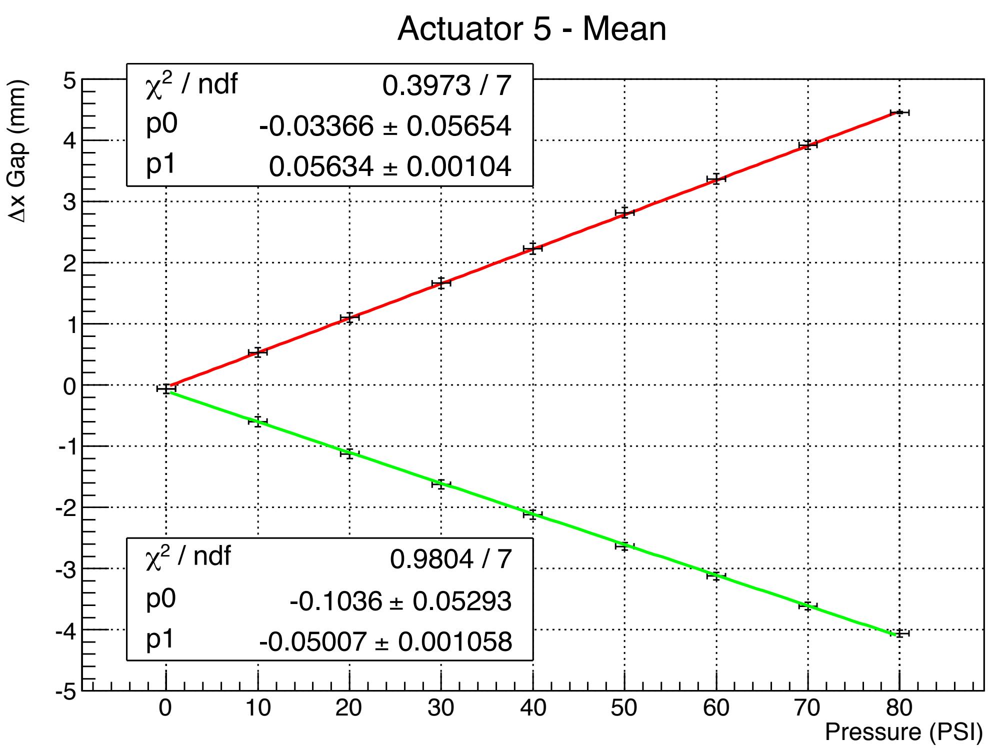
Single Actuator Analysis



Slopes:

- As expected the two slopes are slightly different
- 13% of difference

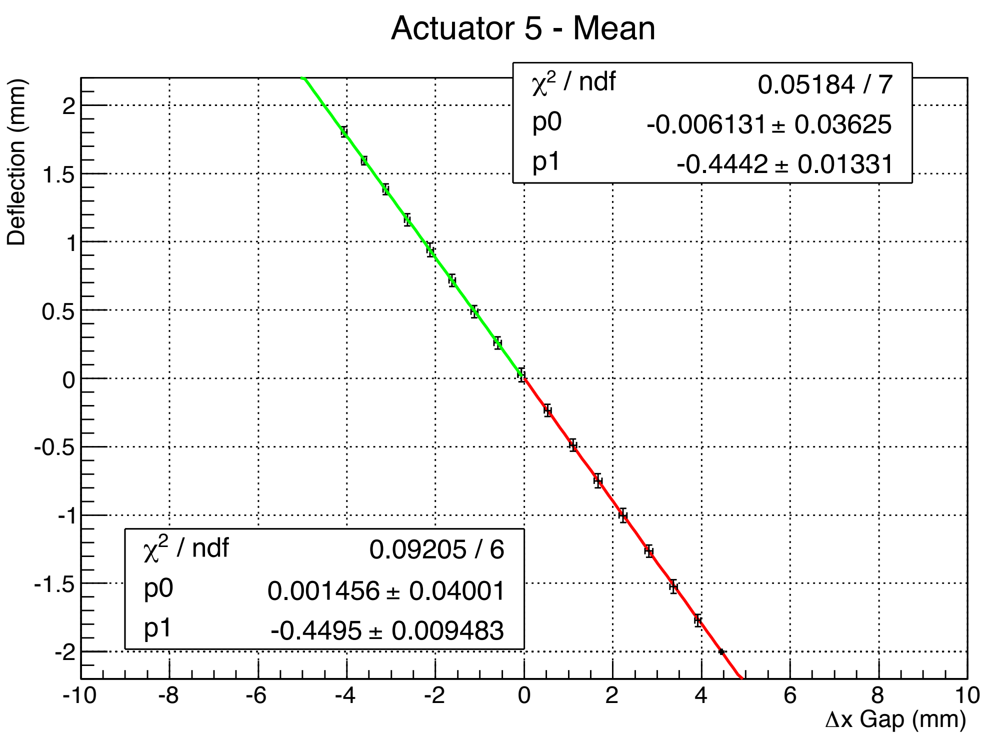
Single Actuator Analysis



Slopes:

- As expected also these two slopes are slightly different
- 12% of difference

Single Actuator Analysis



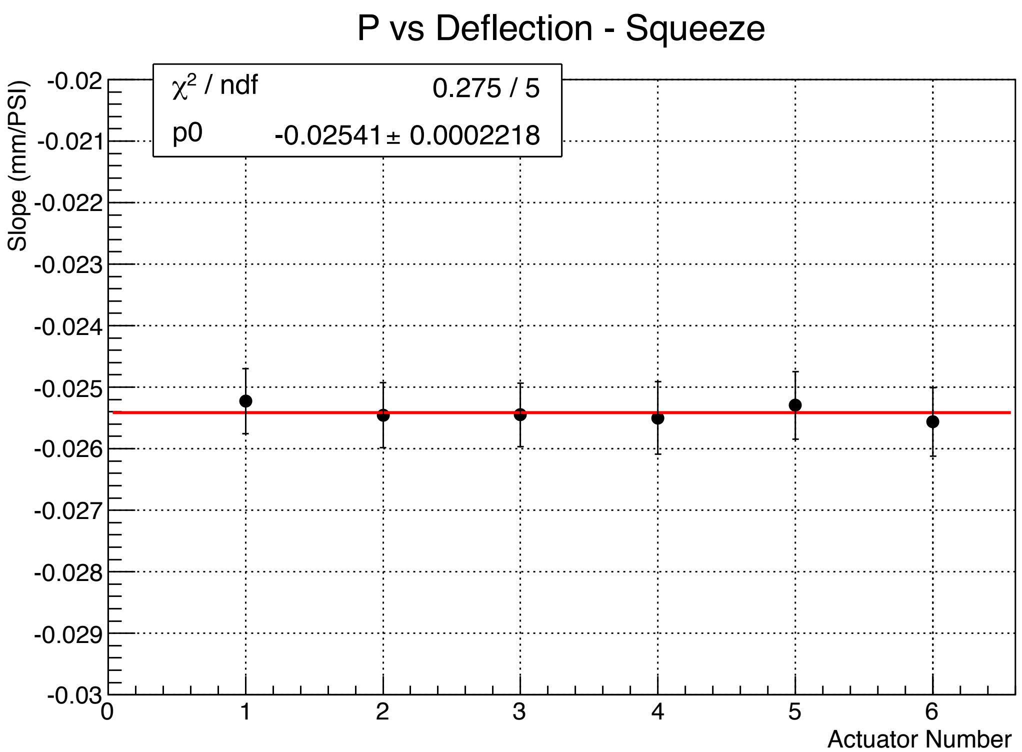
Slopes:

- Slopes are comparable
- 0.3% of difference
- Slope difference seems to depend on the actuators

Group Behaviour

Let's consider the overall behavior by comparing the slopes of all actuators

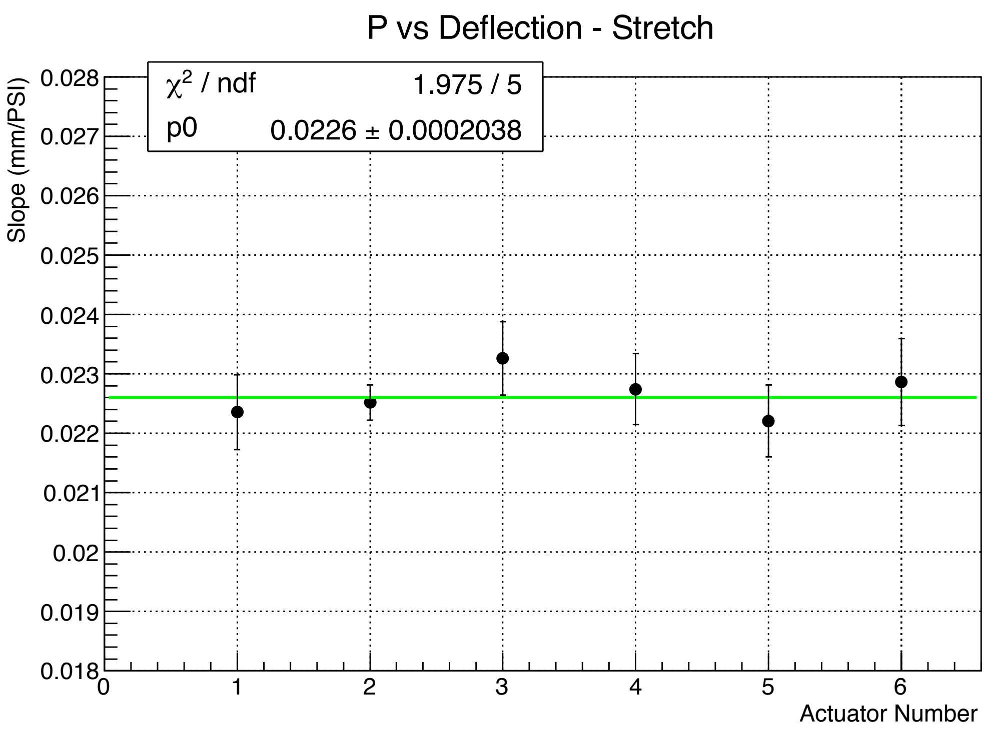
Group Behaviour



Squeeze:

- Pistons behave VERY uniformly

Group Behaviour



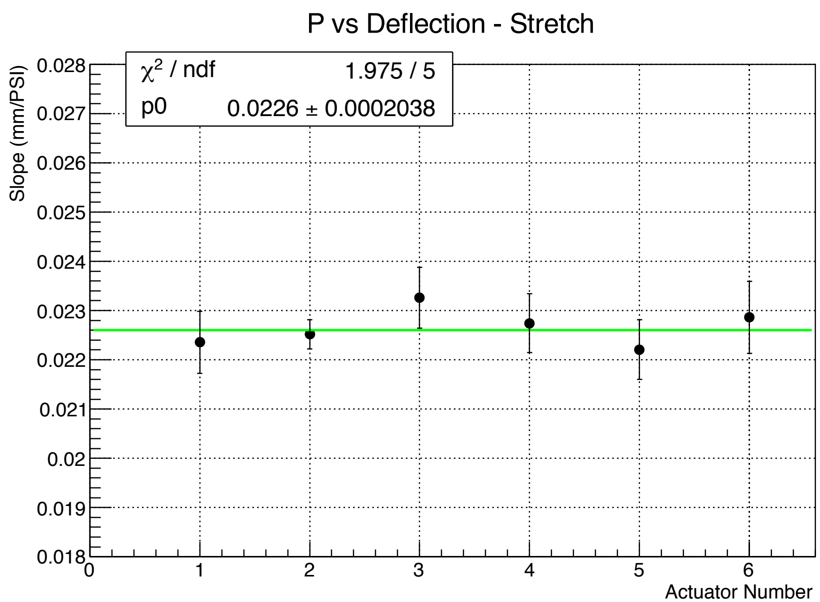
Stretch:

- Pistons do not behave so uniformly
- PropValves have been swapped -> doesn't depend on valves

How bad is this difference?

Let's have a closer look

Group Behaviour



$$\Delta S = S_{max} - S_{min} \approx 0.0011 mm / PSI$$

$$\Delta Deflecton = 0,11 mm \ \ @100\, PSI$$

$$\Delta Deflecton = 5\%$$

Group Behaviour

Squeezing Slope: 0.02541 mm/PSI

Stretching Slope: 0.0226 mm/PSI

Slopes are different but it's not a problem

These are obtained with two different pneumatic circuits

We simply need to use two different calibrations when squeezing or stretching

Next Step: RF Test

Control system will be equipped with electronic pressure gauges

Next Step: RF Test

Contro ... ic
pressu

Next Step: RF Test

Test in Lab 6:

Measurements

- RF Parameters: f, Q, S11, S21 (Network Analyser)
- Pressure (Remote Pressure gauges)
- Fork gap variation (Linear Potentiometers)

With copper and beryllium windows

Next Step: RF Test

Test in Lab 6:

- All actuators will be connected to the same proportional valves.
- We will obtain F vs P curve for the tuning system
- This calibration curve will be used for the tuning feedback loop in the MTA

Next Step: RF Test

Test in Lab 6:

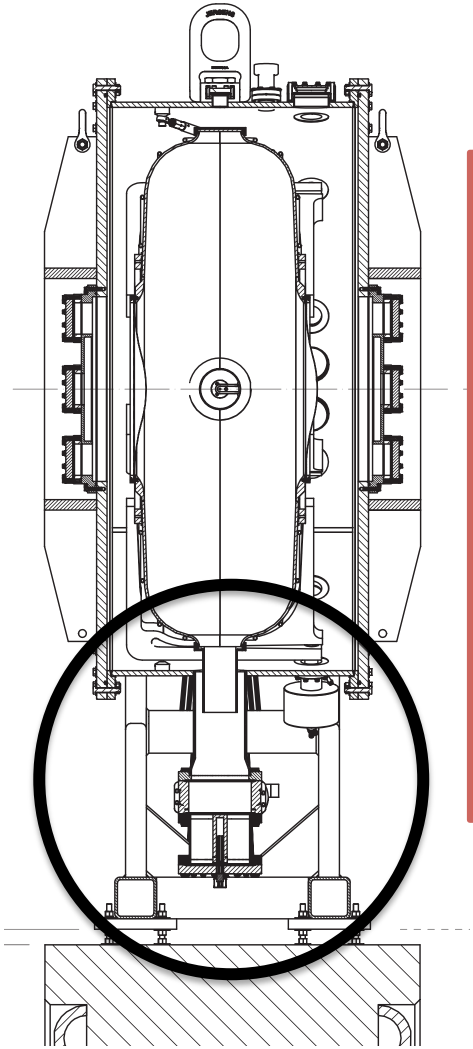
- Manual valves will allow to simulate the failure of one or more actuators.
- Tests will be performed with NO vacuum

Next Step: RF Test

Tuner instrumentation in the MTA

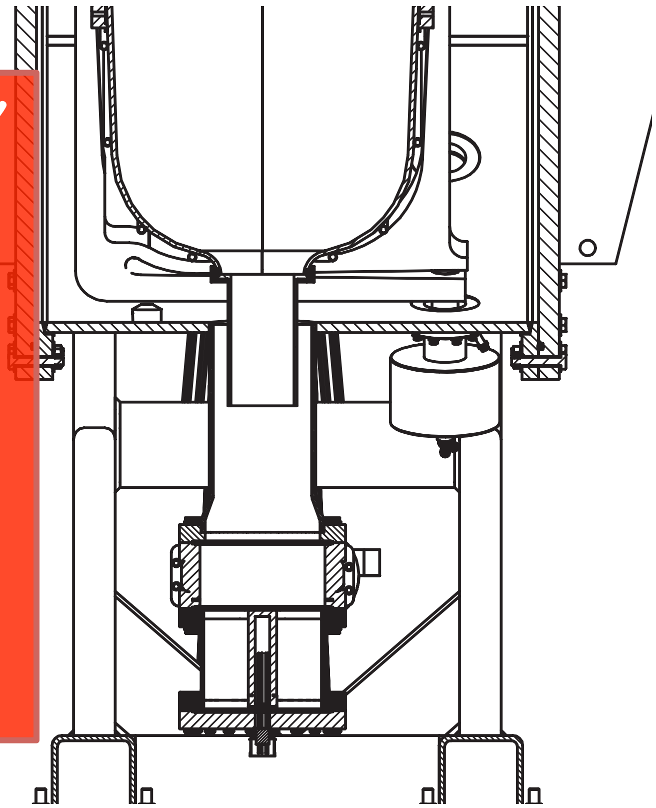
- Can we use the same instrumentation in the MTA?
- Can linear potentiometer sit inside vacuum vessel?

Next Step: RF Test

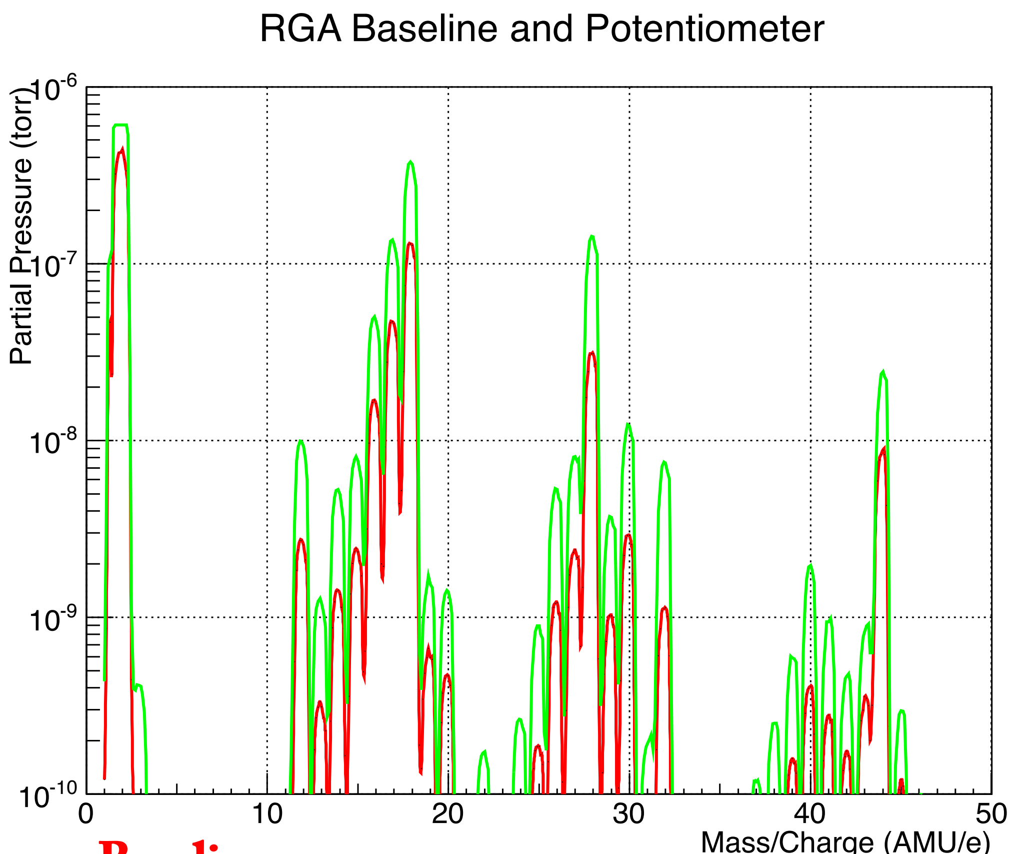


VESSEL AND CAVITY SHARE SAME VACUUM

PAY ATTENTION TO INSTRUMENT THE CAVITY



Next Step: RF Test

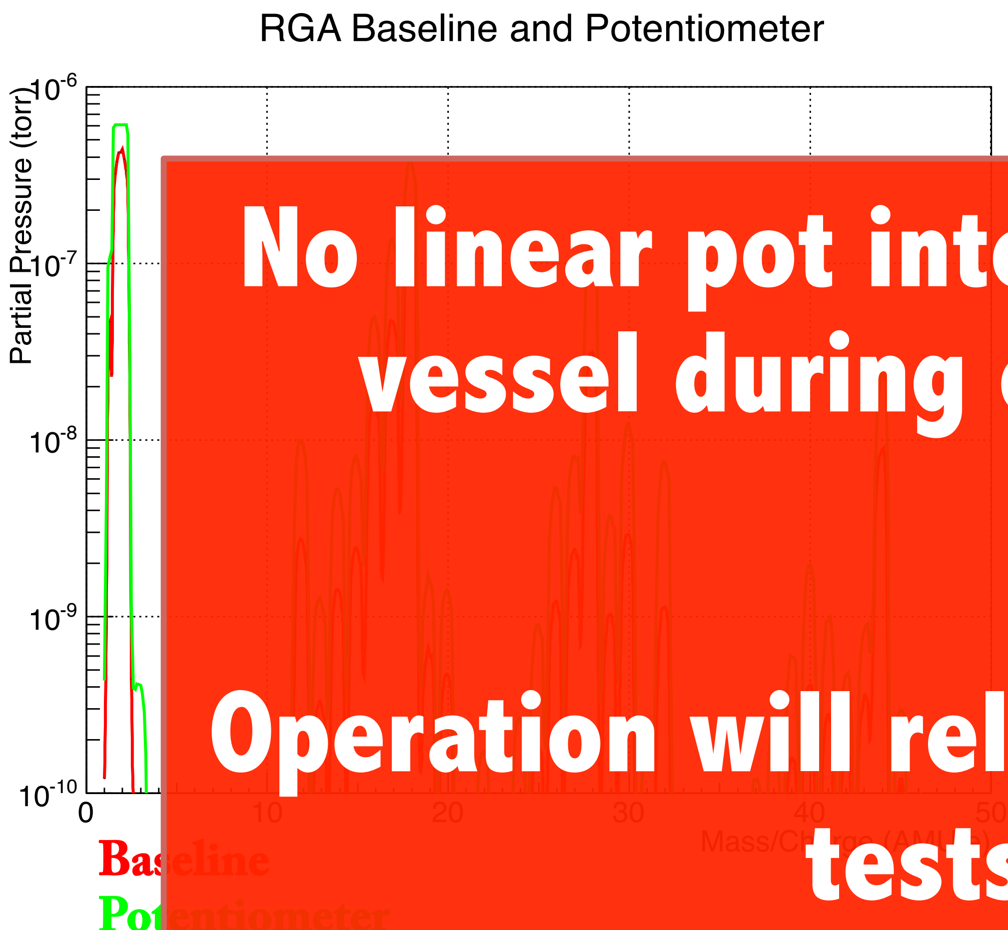


Baseline
Potentiometer

Potentiometer Vacuum test:

- Potentiometer placed in a vacuum test stand
- Vacuum is degraded from 10^{-7} torr to 10^{-6} torr with the potentiometer
- Pump down time much longer (Hours vs minutes)

Next Step: RF Test



Potentiometer Vacuum test:

- Potentiometer placed in a vacuum test stand
- Vacuum degraded from 10^{-7} to 10^{-6} with the pontentiometer
- Pump down time much longer (Hours vs minuets)

No linear pot into the vacuum vessel during operation.

Operation will rely on previous tests

Conclusion

- Actuators have been tested and have a good response
- RF measurements will be done early in August,in lab 6.
- Test in lab 6 will be done with linear potentiometers but no vacuum

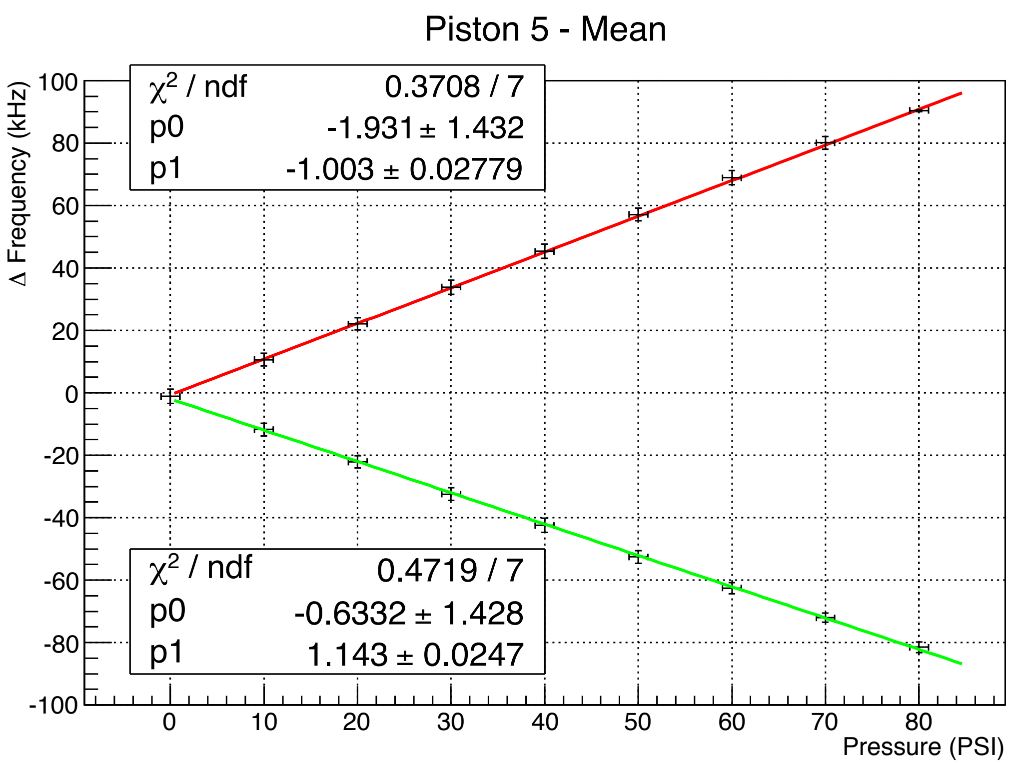
Many Thanks

To MAP and INFN for this opportunity

Thank you

For your attention!

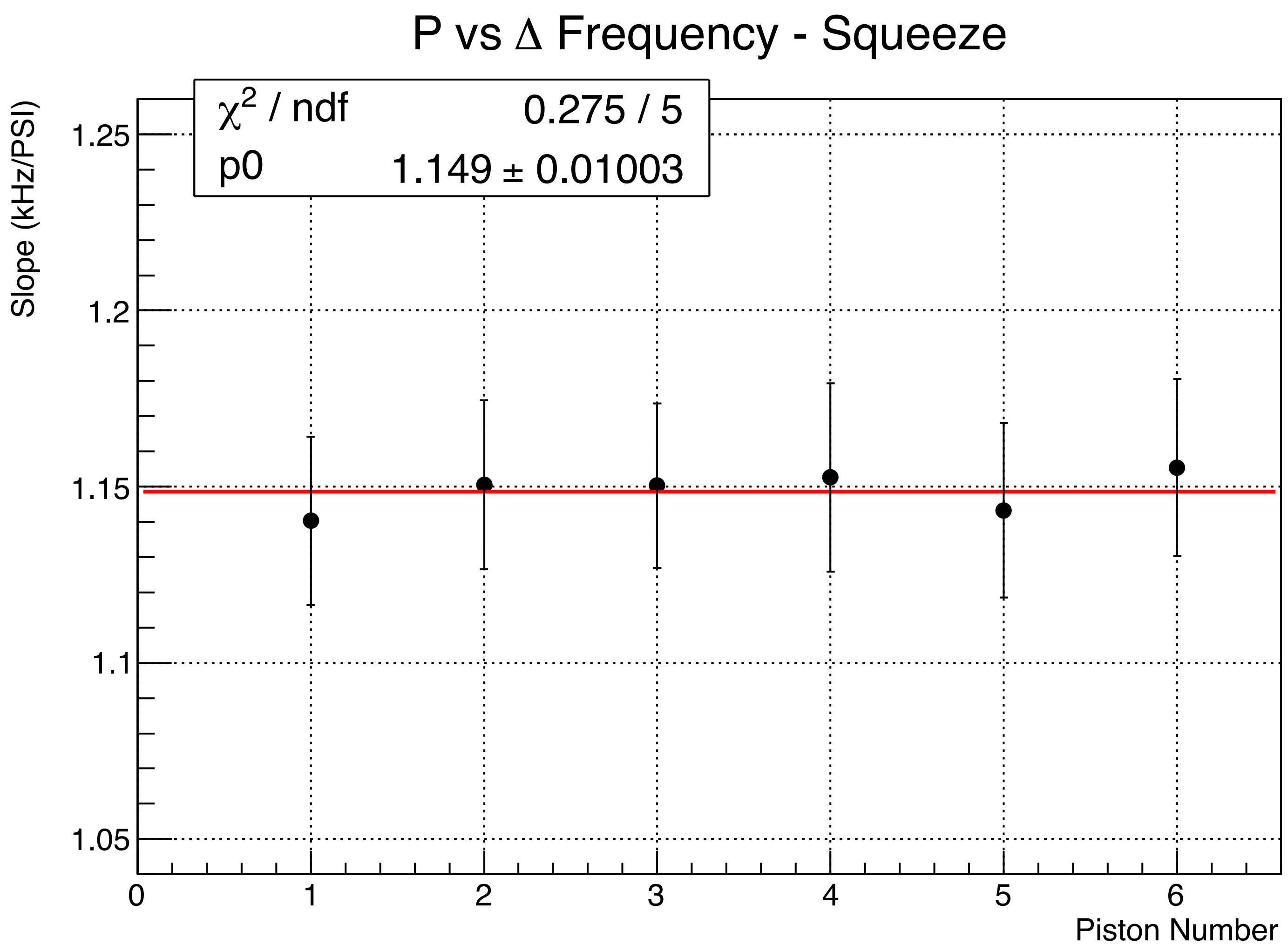
Single Actuator Analysis



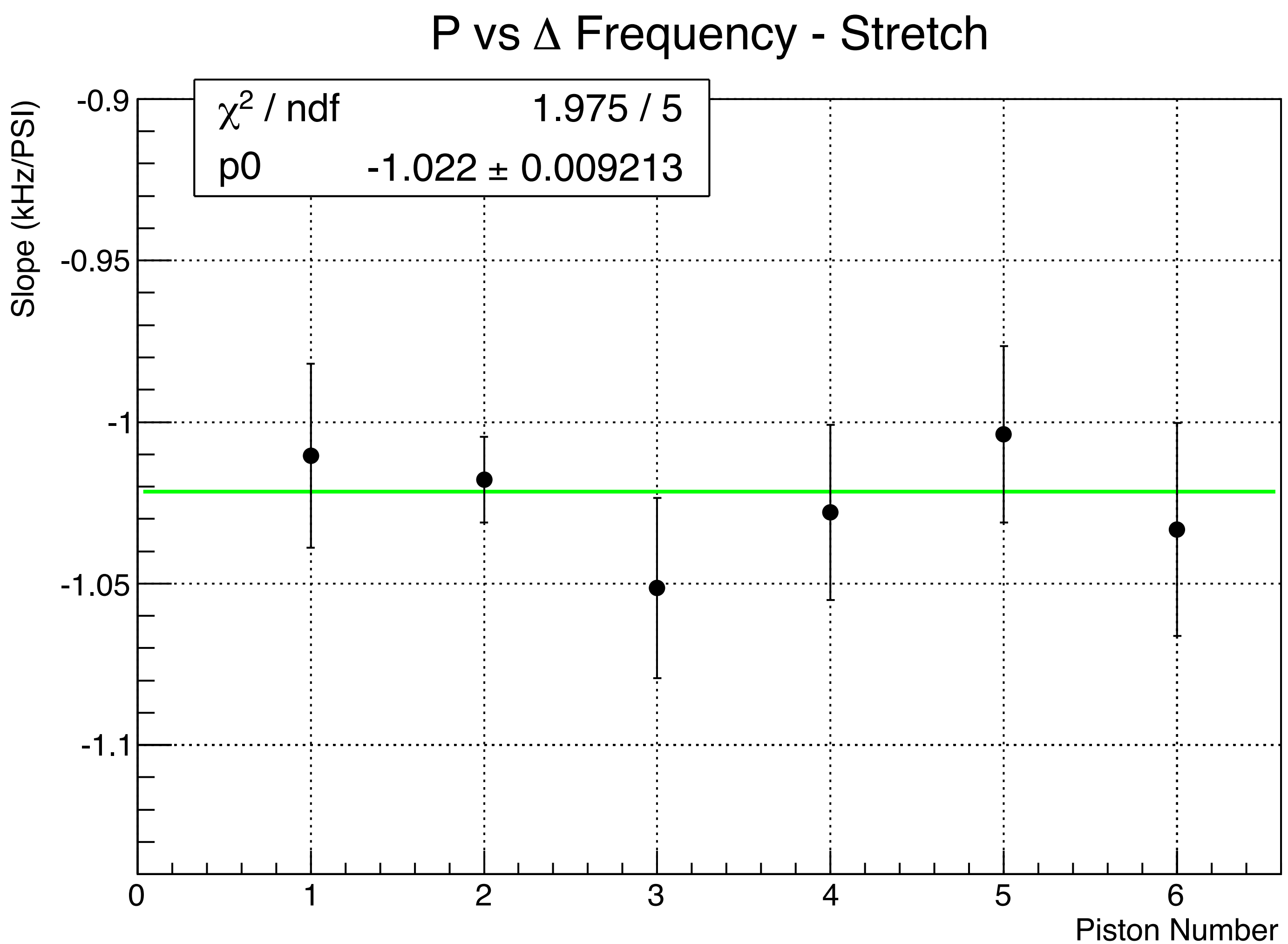
Frequency:

- Computed using the results of the OLD prototype
- 45.2 kHz/mm

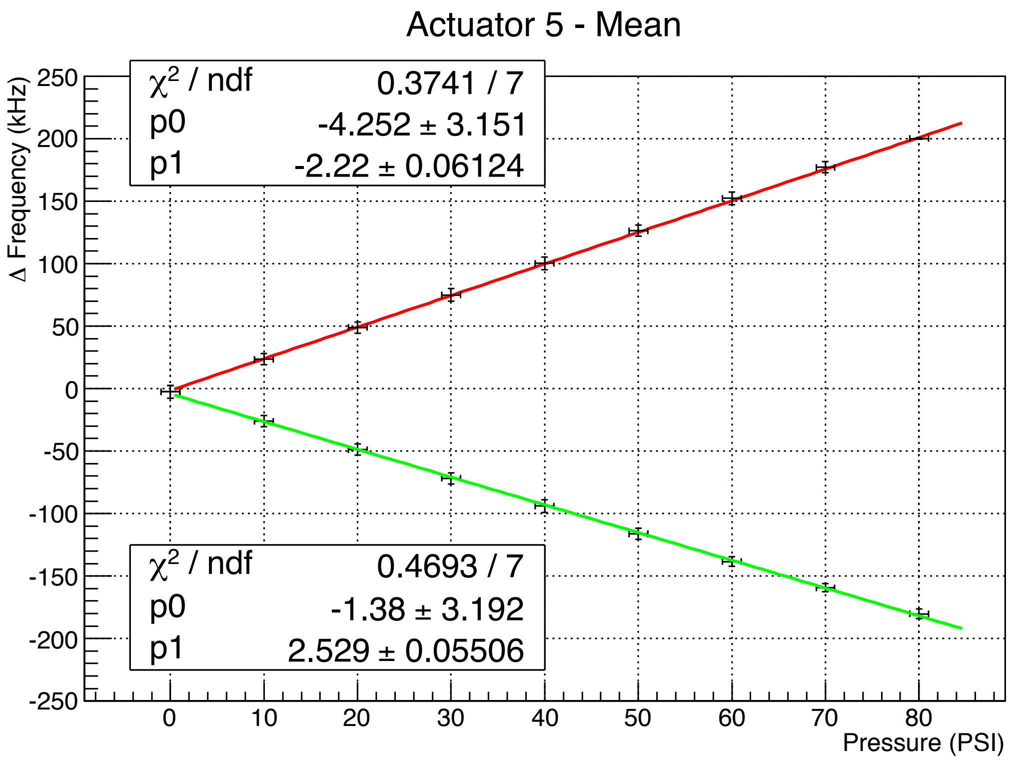
Group Behaviour



Group Behaviour



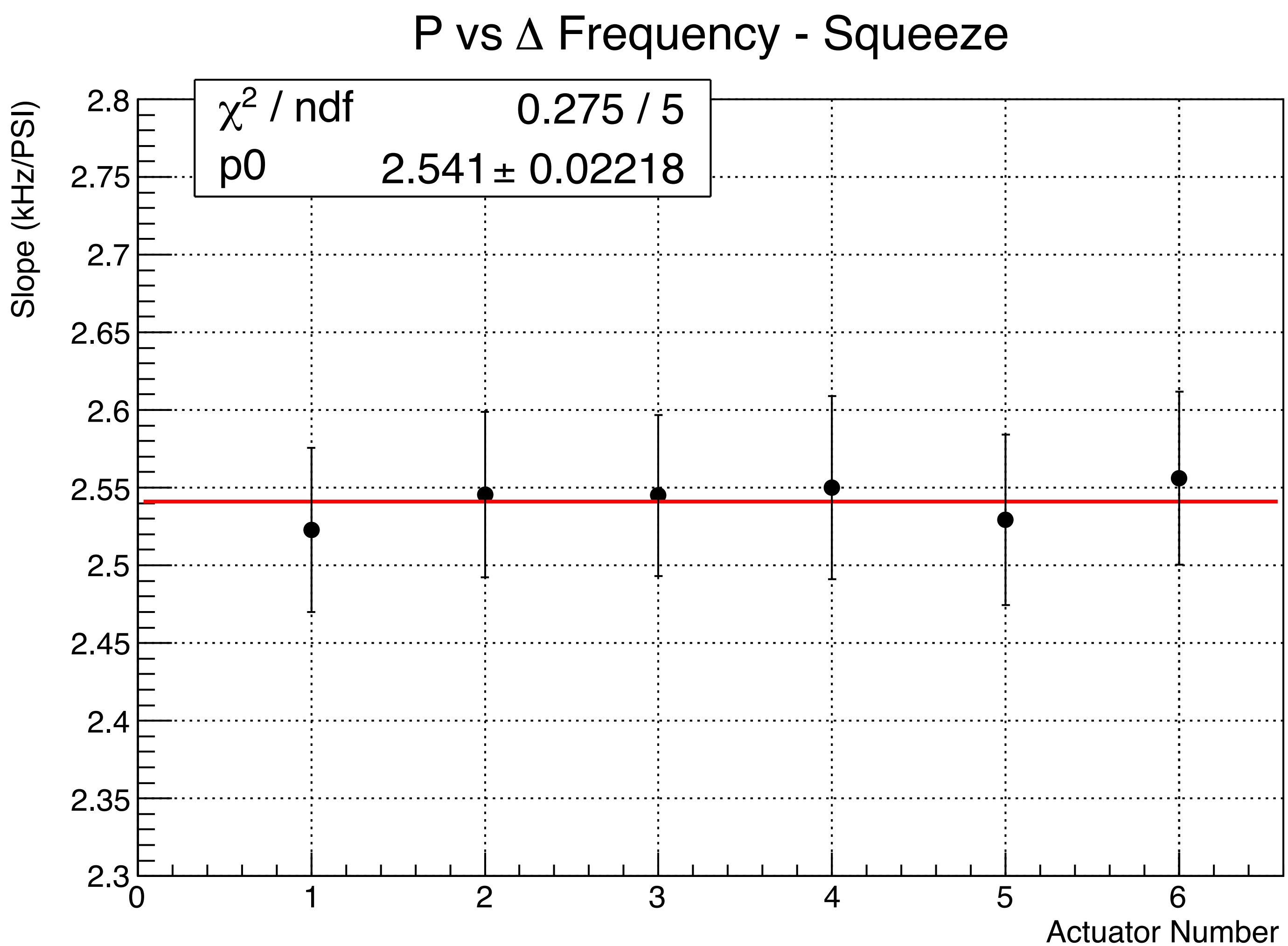
Single Actuator Analysis



Frequency:

100 kHz/mm

Group Behaviour



Group Behaviour