Mass Measurements using TAMUTRAP and Upgrades to its Control System

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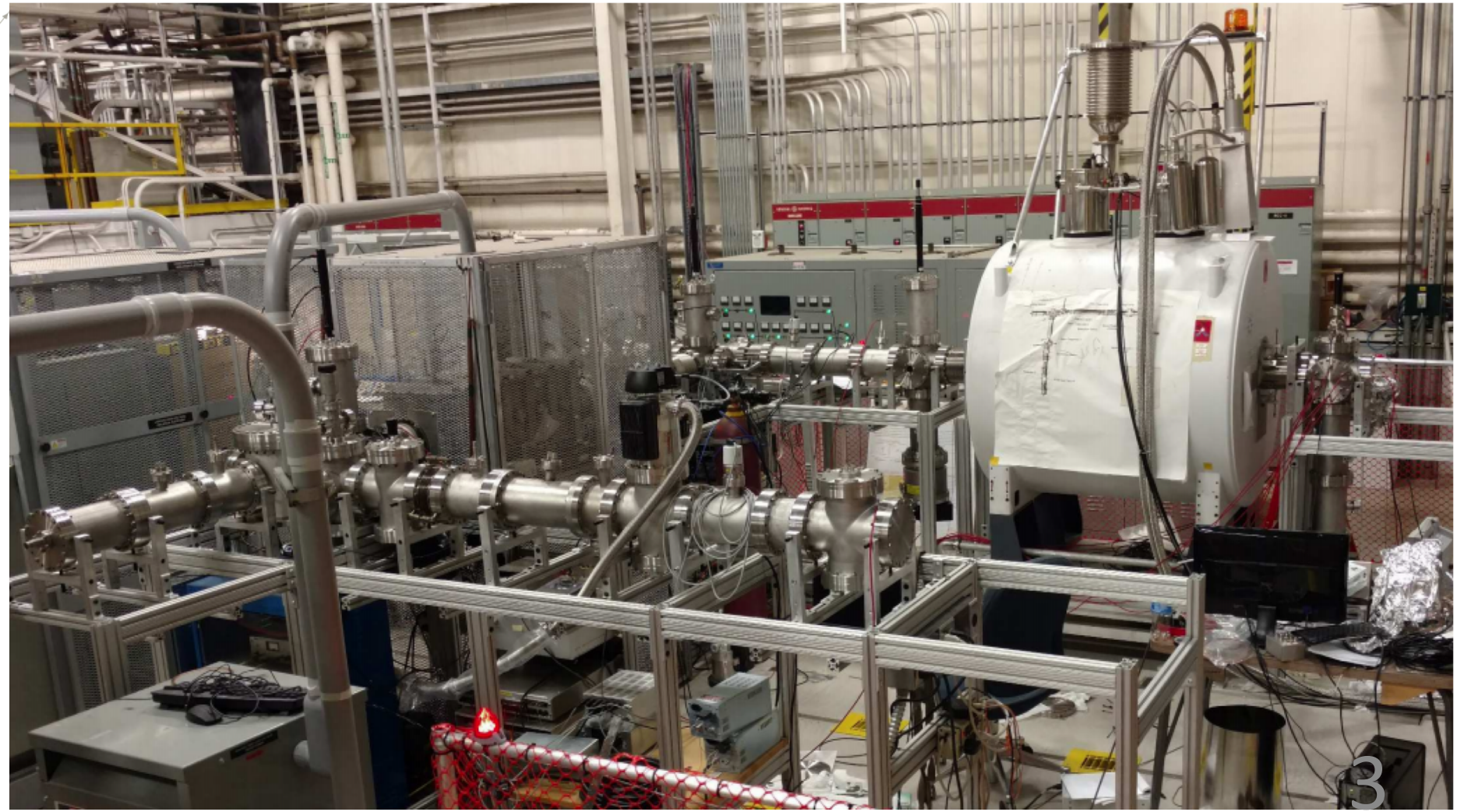
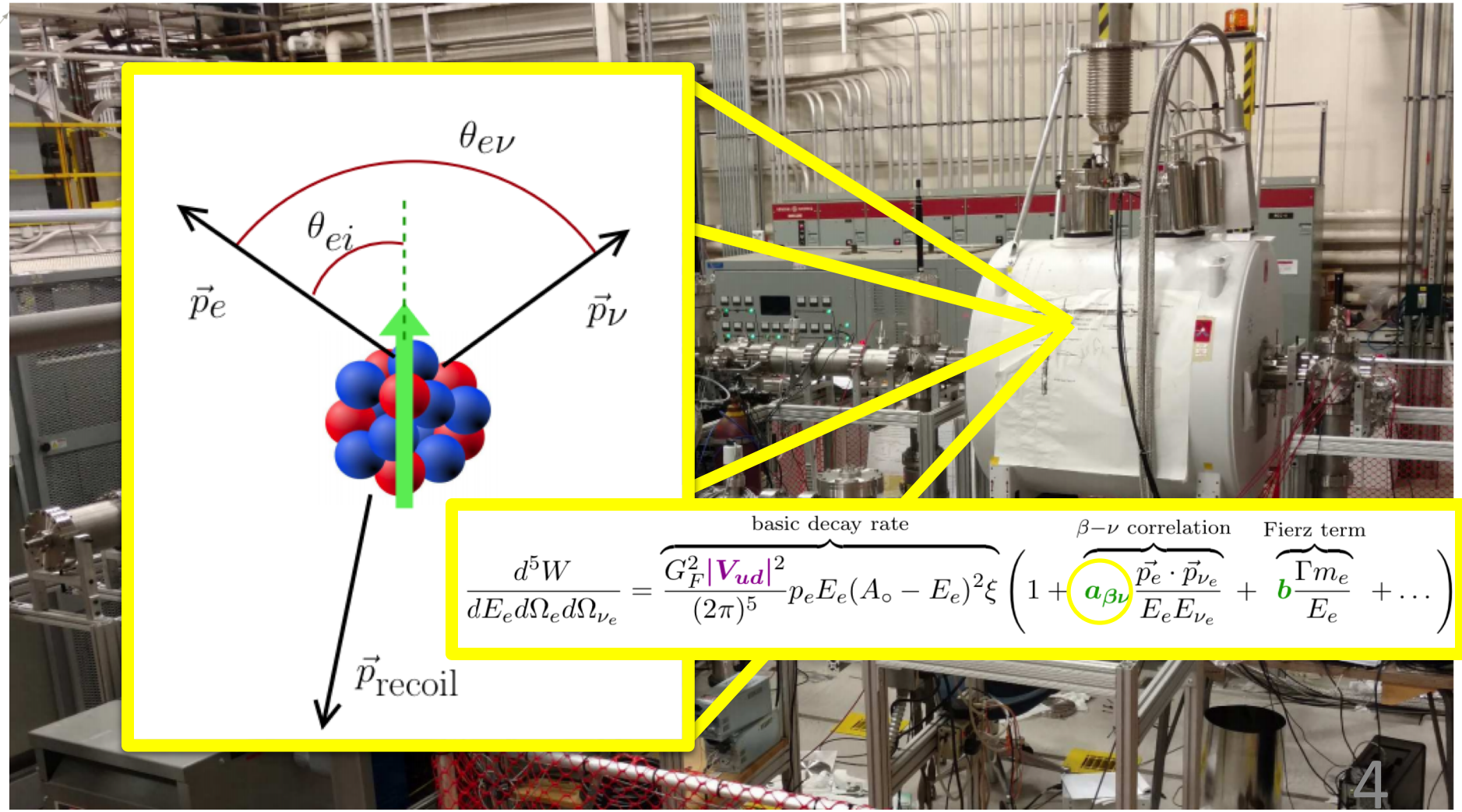
TAMUTRAP FACILITY



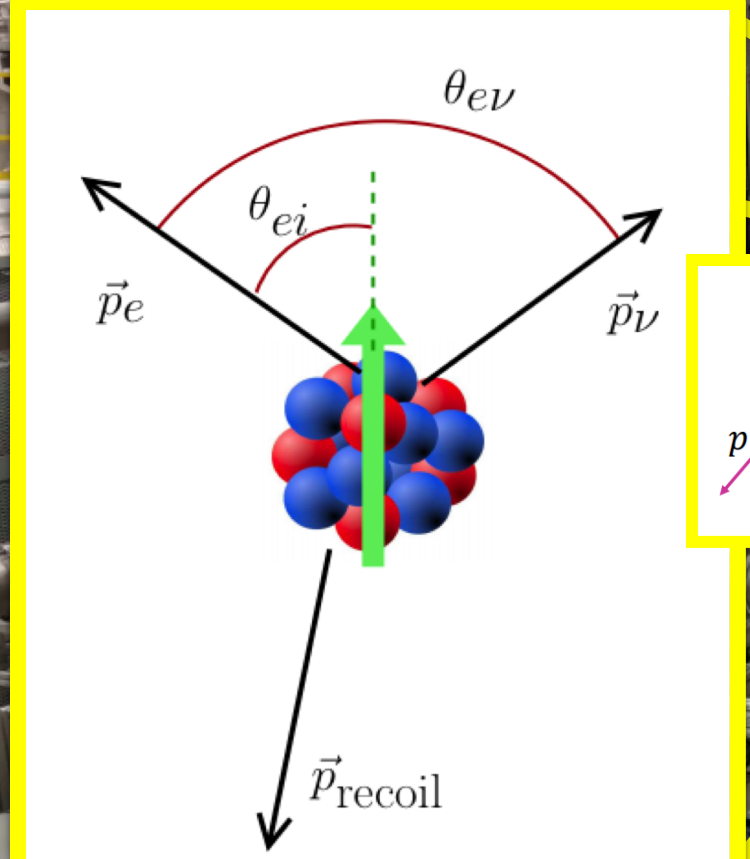
INTRODUCTION

TESTING THE STANDARD MODEL AT TAMUTRAP

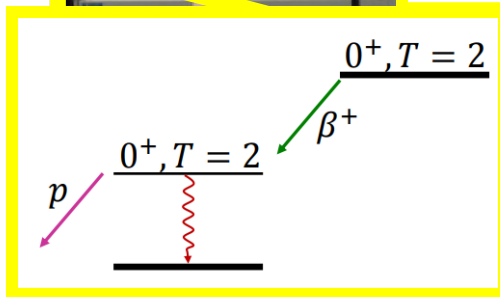


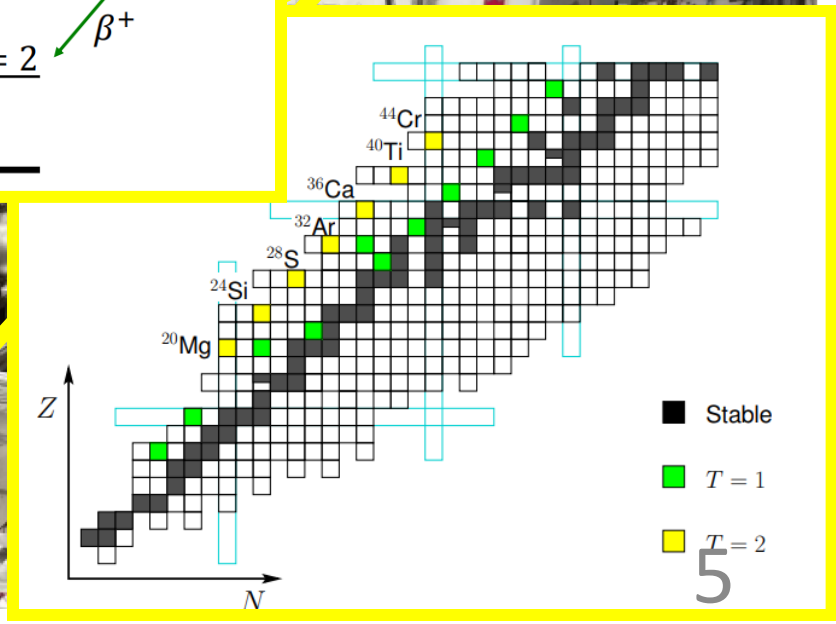
INTRODUCTION

SPECIAL TYPE OF IONS



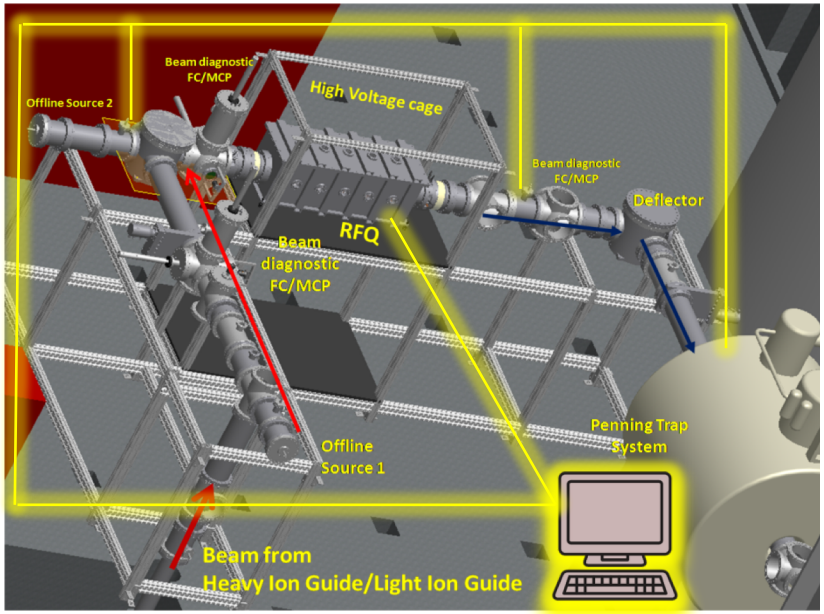
- ISOSPIN T=2 ($0^+ \rightarrow 0^+$)
- PURE FERMI DECAY
- PROTON-EMITTERS (DUE TO LOW RECOIL)
- PROTON RICH



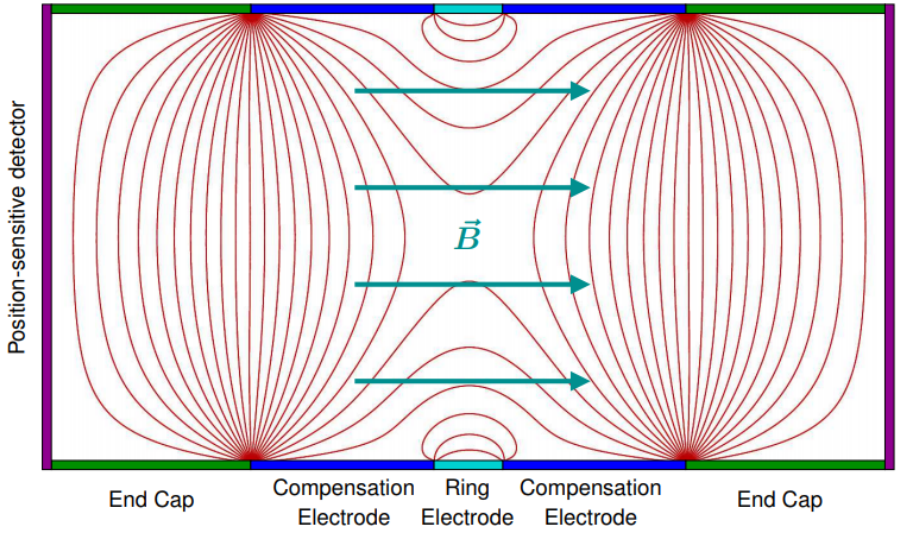


MOTIVATION

WHERE DOES MY PROJECT FIT AT TAMUTRAP?



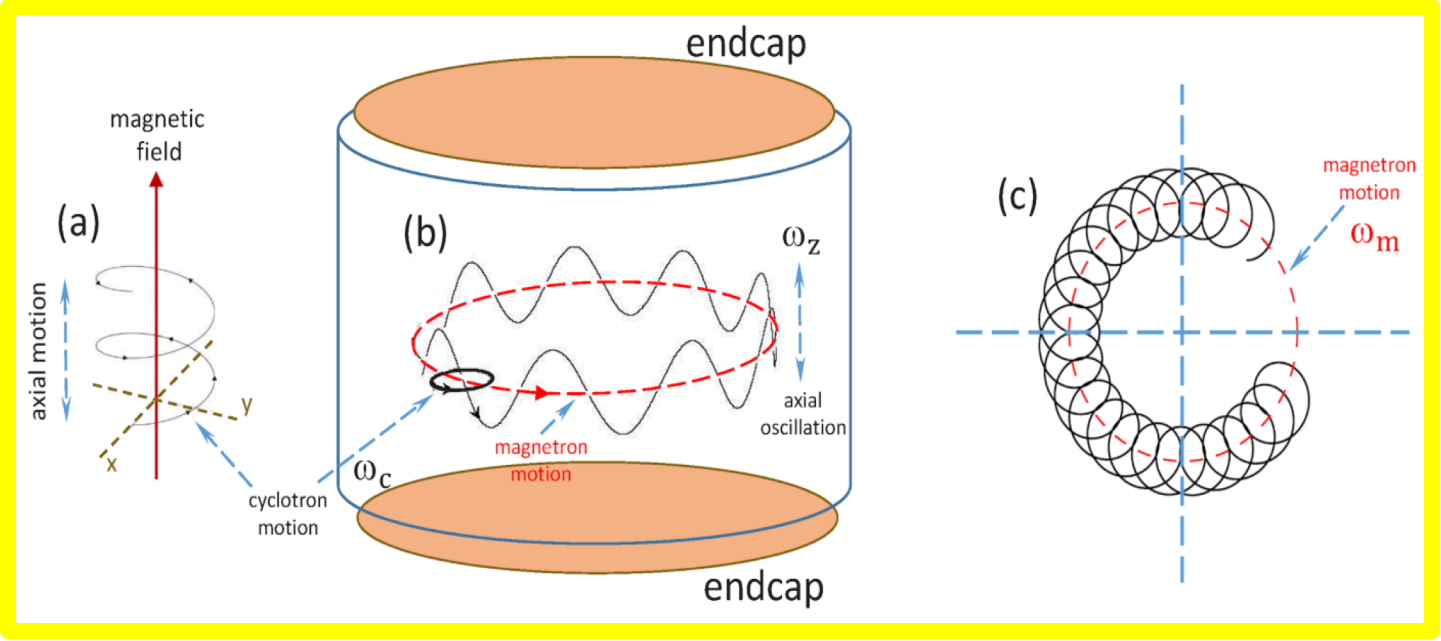
REMOTE CONTROL OF TAMUTRAP



MASS-MEASUREMENT CAPABILITIES OF THE PENNING TRAP (DEMONSTRATION)

MASS MEASUREMENTS

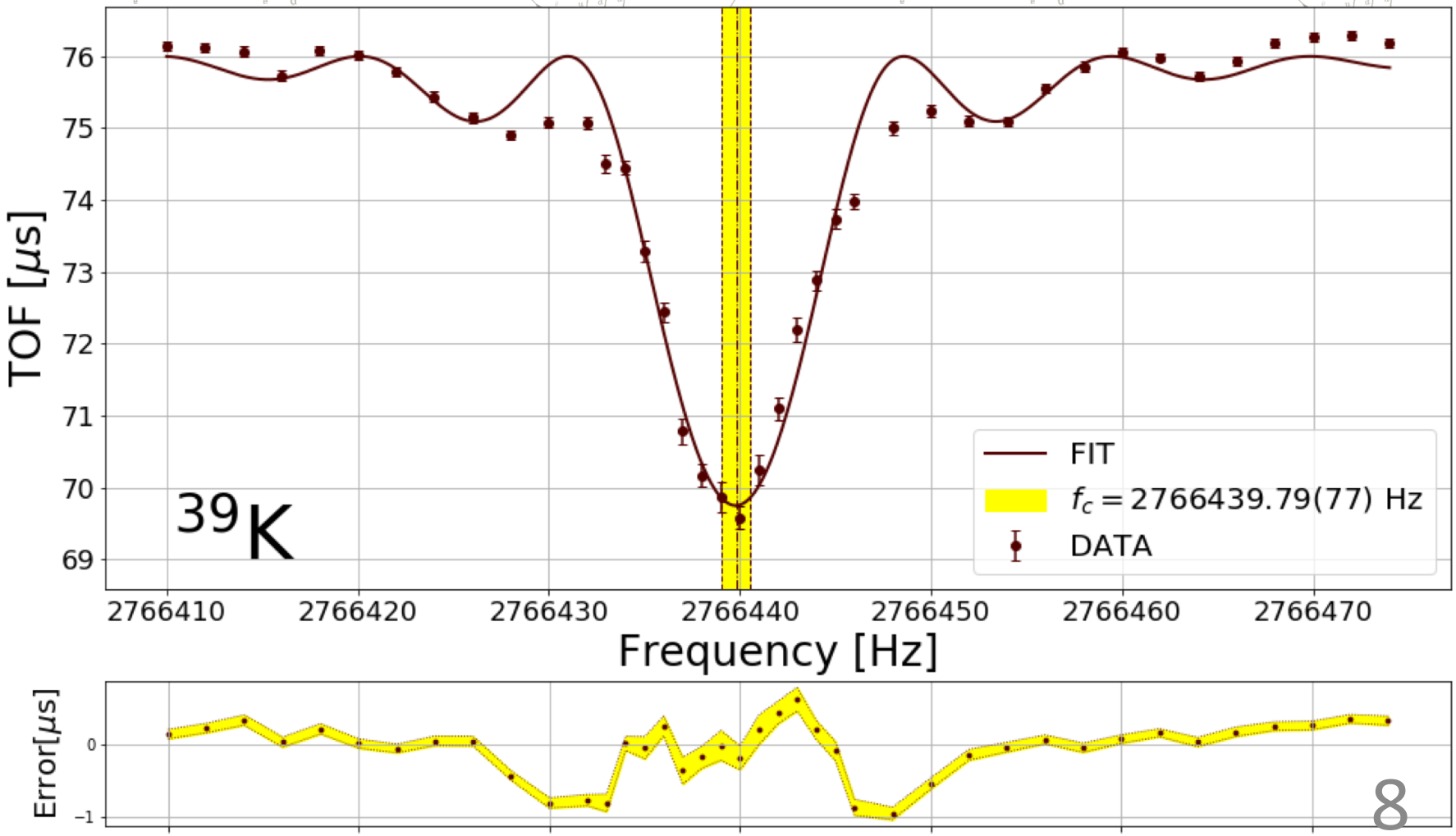
IONS' MOTION INSIDE THE TRAP



$$m_x = \frac{f_{c_{ref}}}{f_{c_x}}(m_{ref} - m_e) + m_e$$

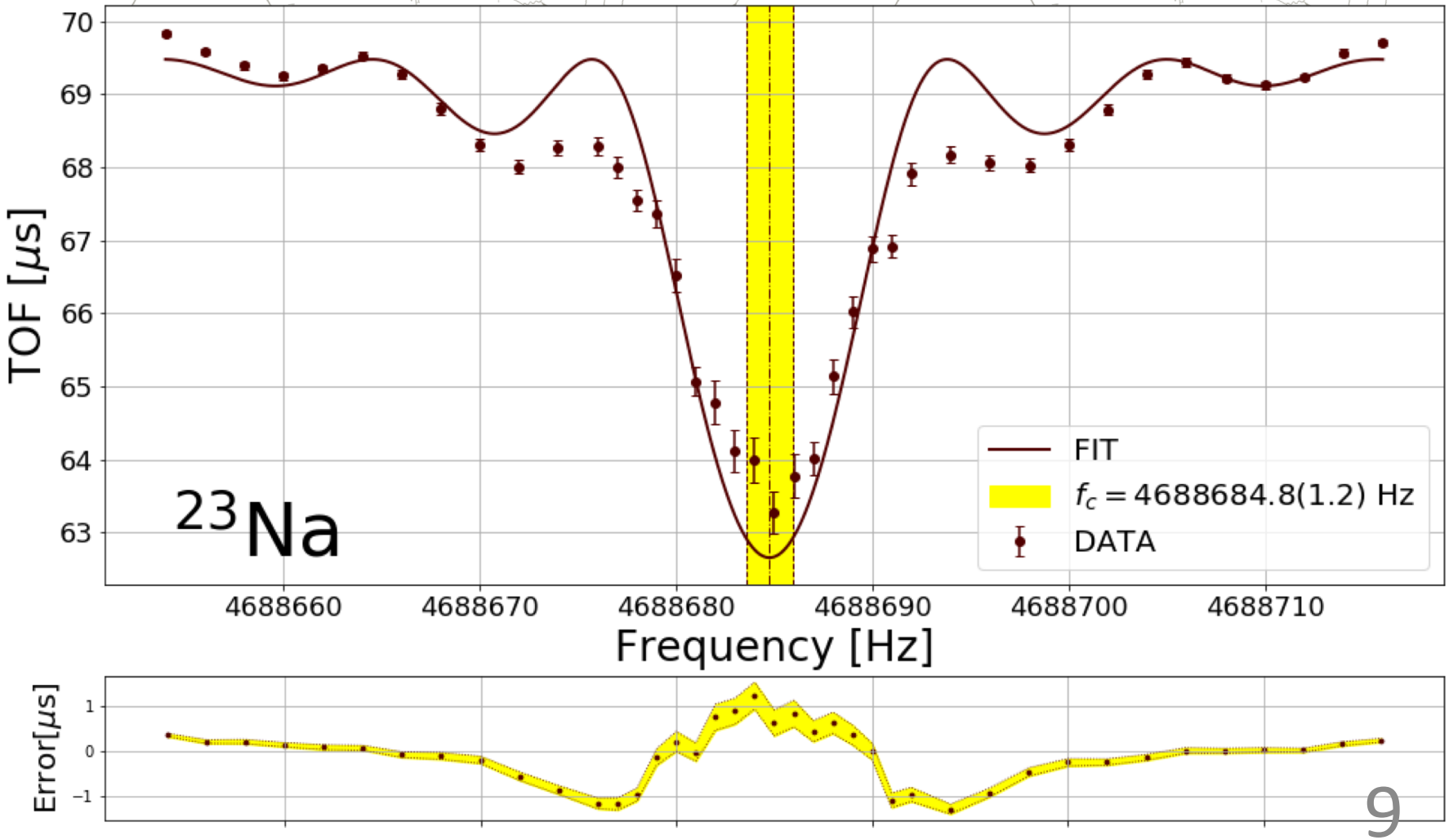
MASS MEASUREMENTS

TIME OF FLIGHT RESONANCE SCAN: ^{39}K



MASS MEASUREMENTS

TIME OF FLIGHT RESONANCE SCAN: ^{23}Na



MASS MEASUREMENTS

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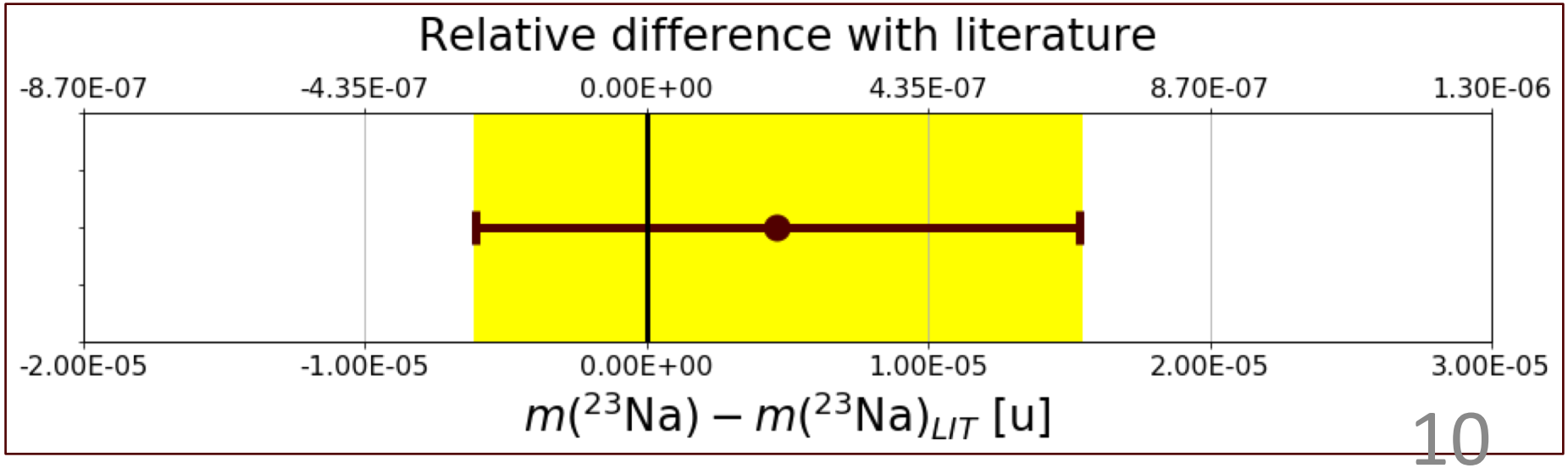
RESULTS

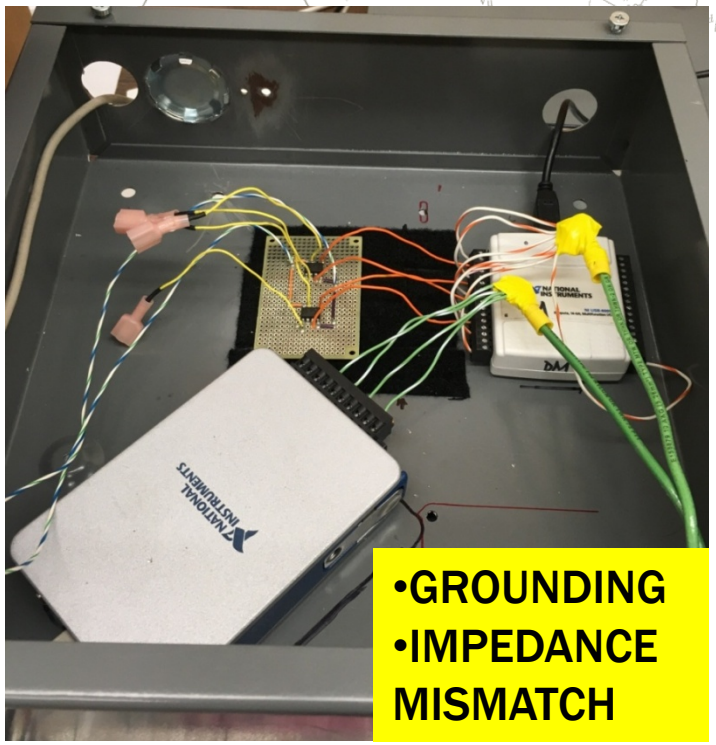
$$m_x = \frac{f_{c_{ref}}}{f_{c_x}}(m_{ref} - m_e) + m_e$$

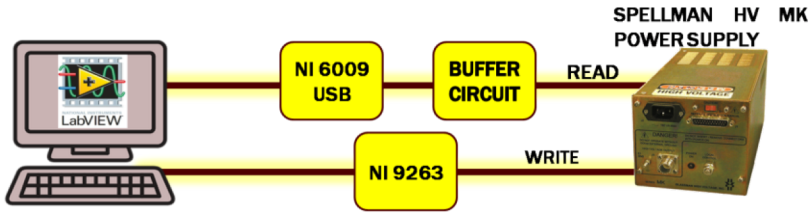
$$\mathrm{m}(^{23}\mathrm{Na}) = 22.989774(11)\ \mathrm{u}$$
$$\mathrm{m}(^{23}\mathrm{Na})_{LIT} = 22.9897692809(29)\ \mathrm{u}$$

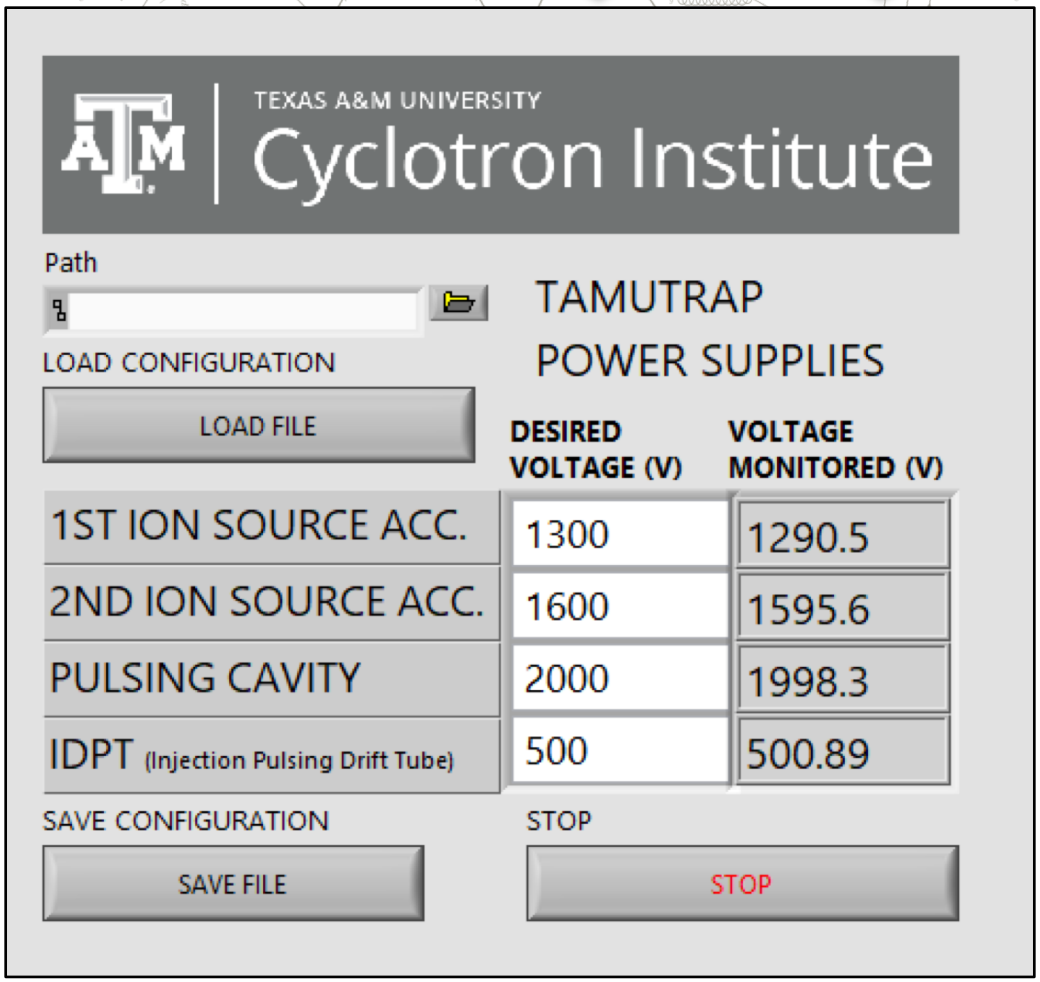


HV POWER SUPPLIES

HARDWARE AND SOFTWARE

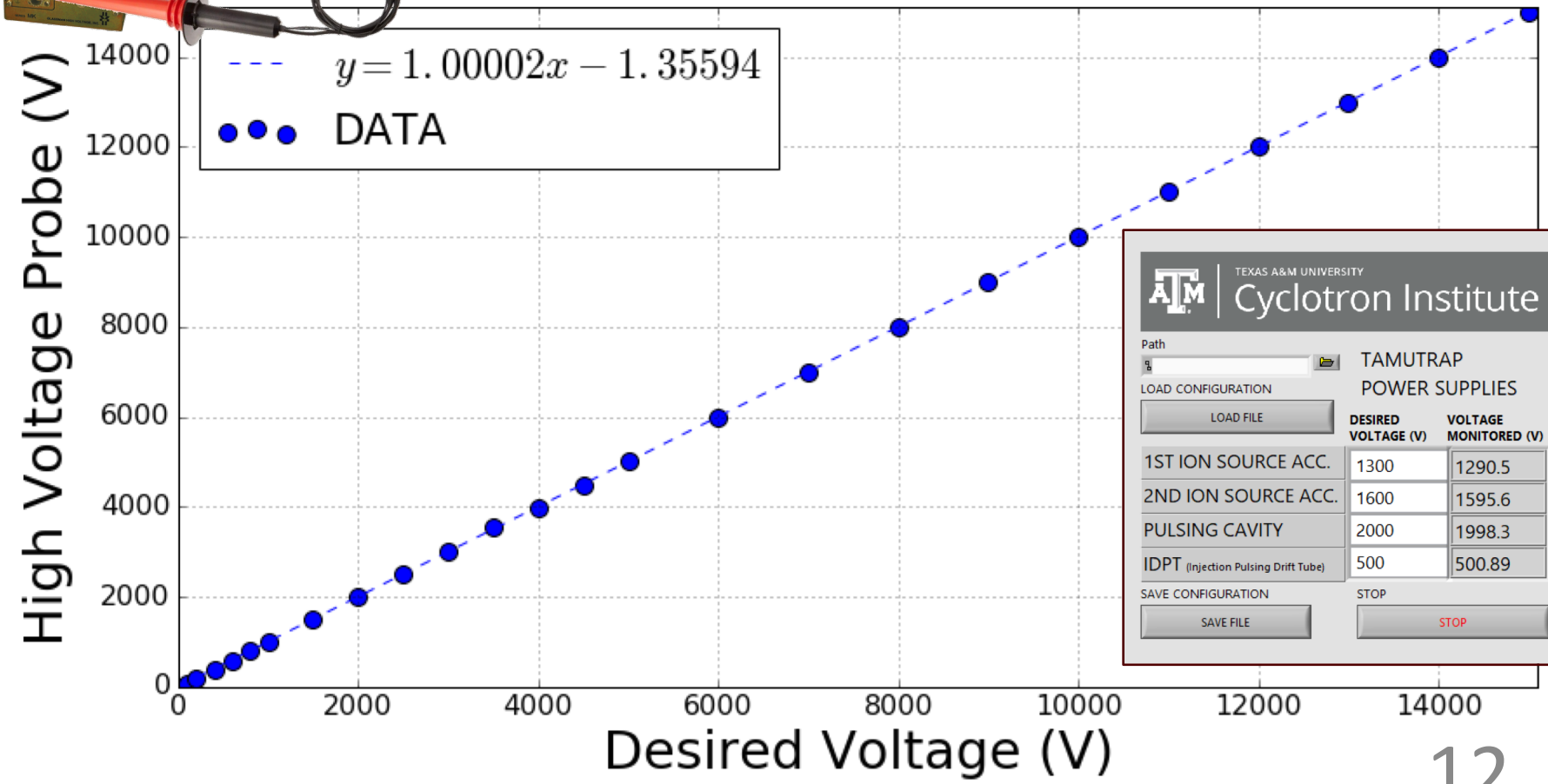






HV POWER SUPPLIES

So how do we know it works?



HV POWER SUPPLIES

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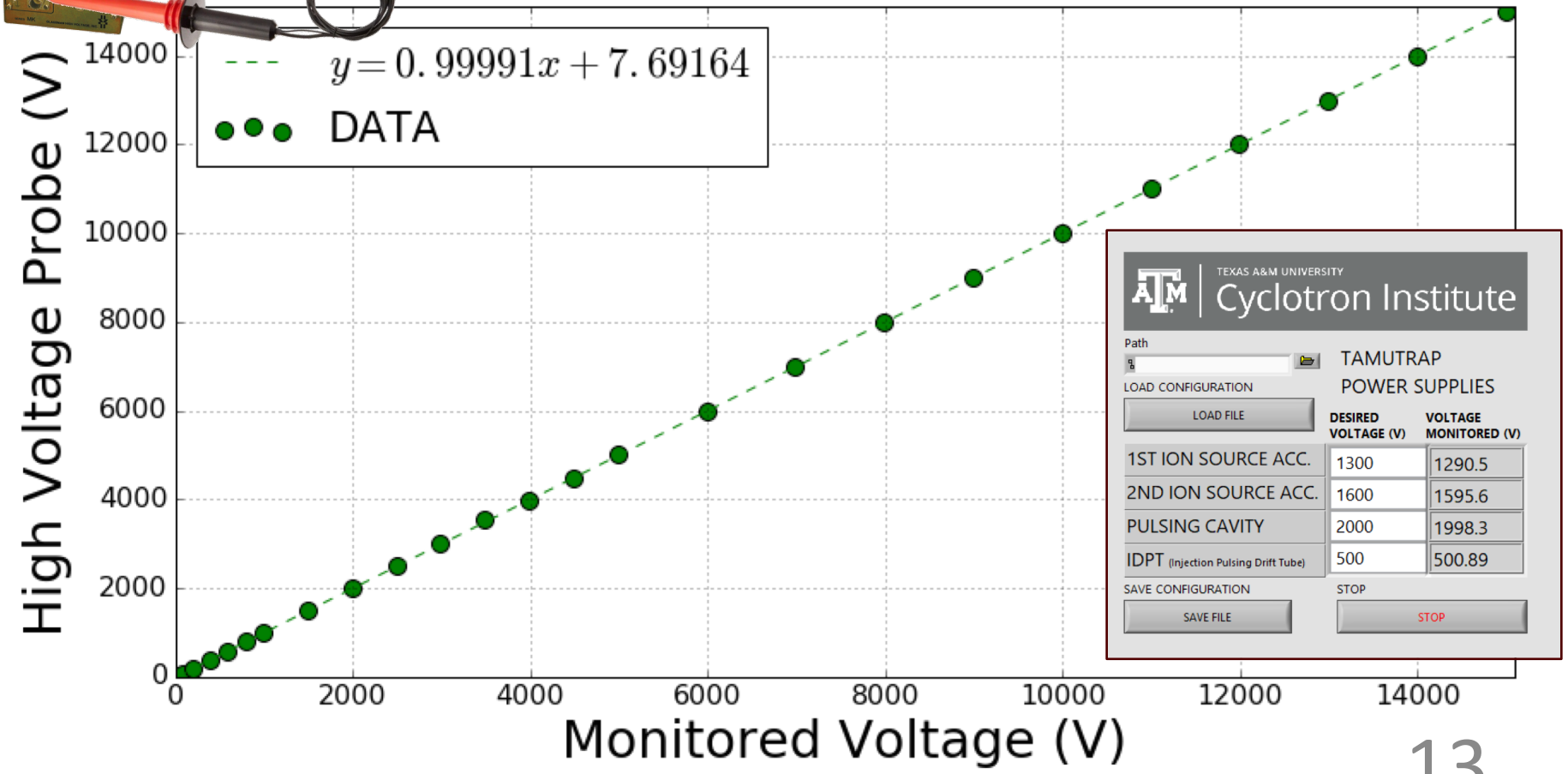
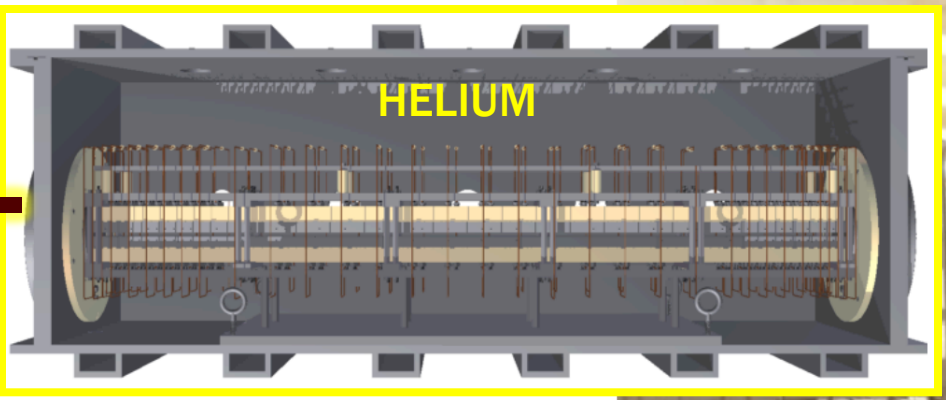
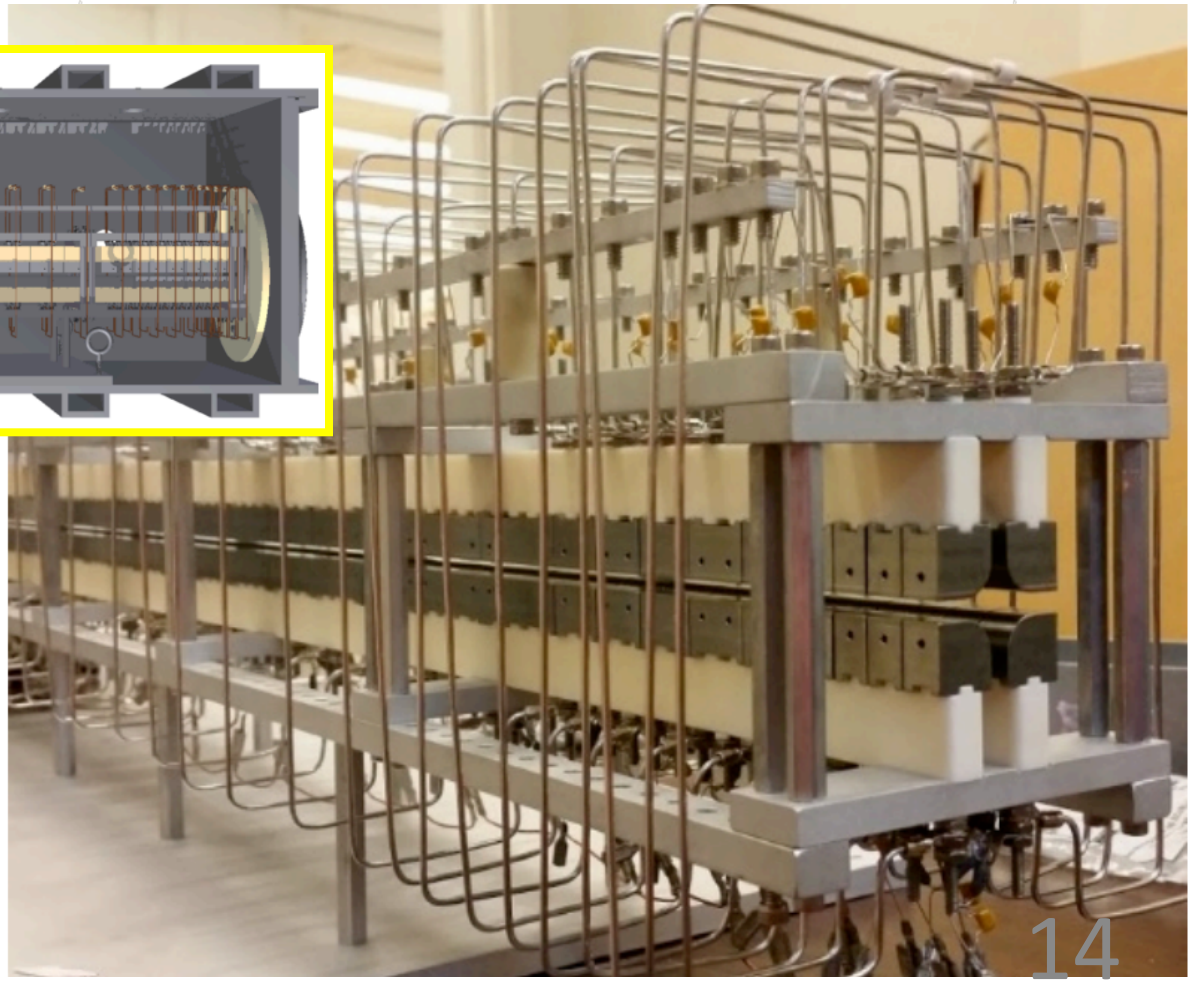


RFQ GAS COOLER/BUNCHER

OVERVIEW

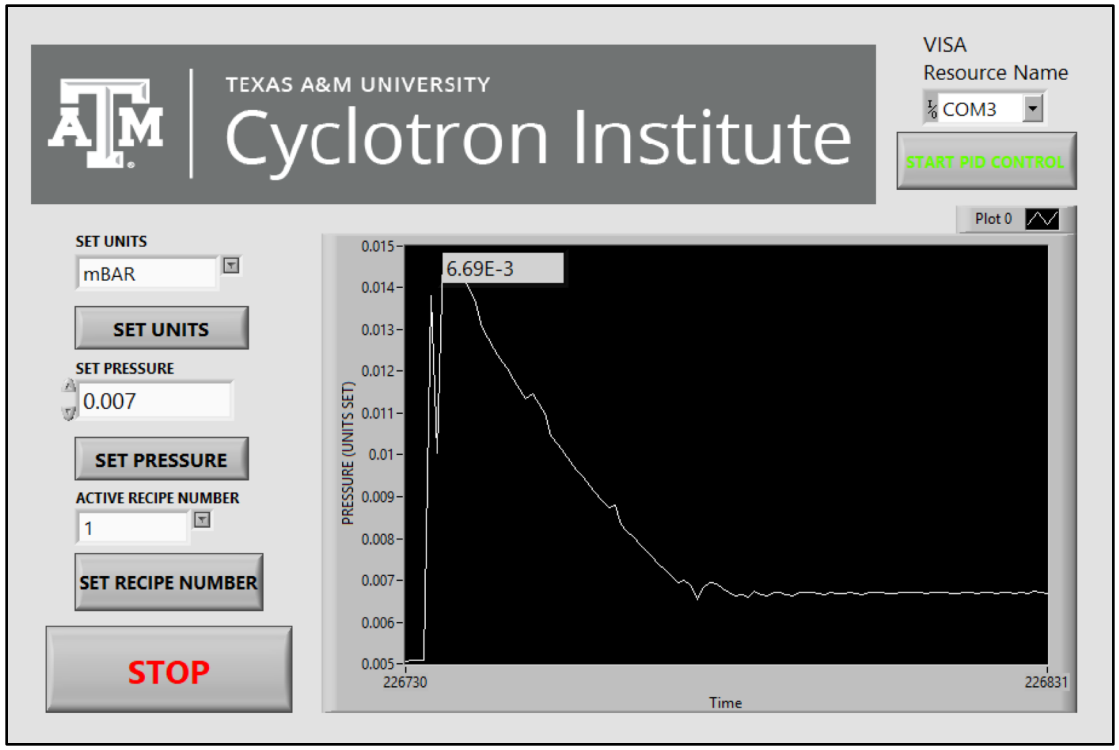


PRESSURE CONTROLLER



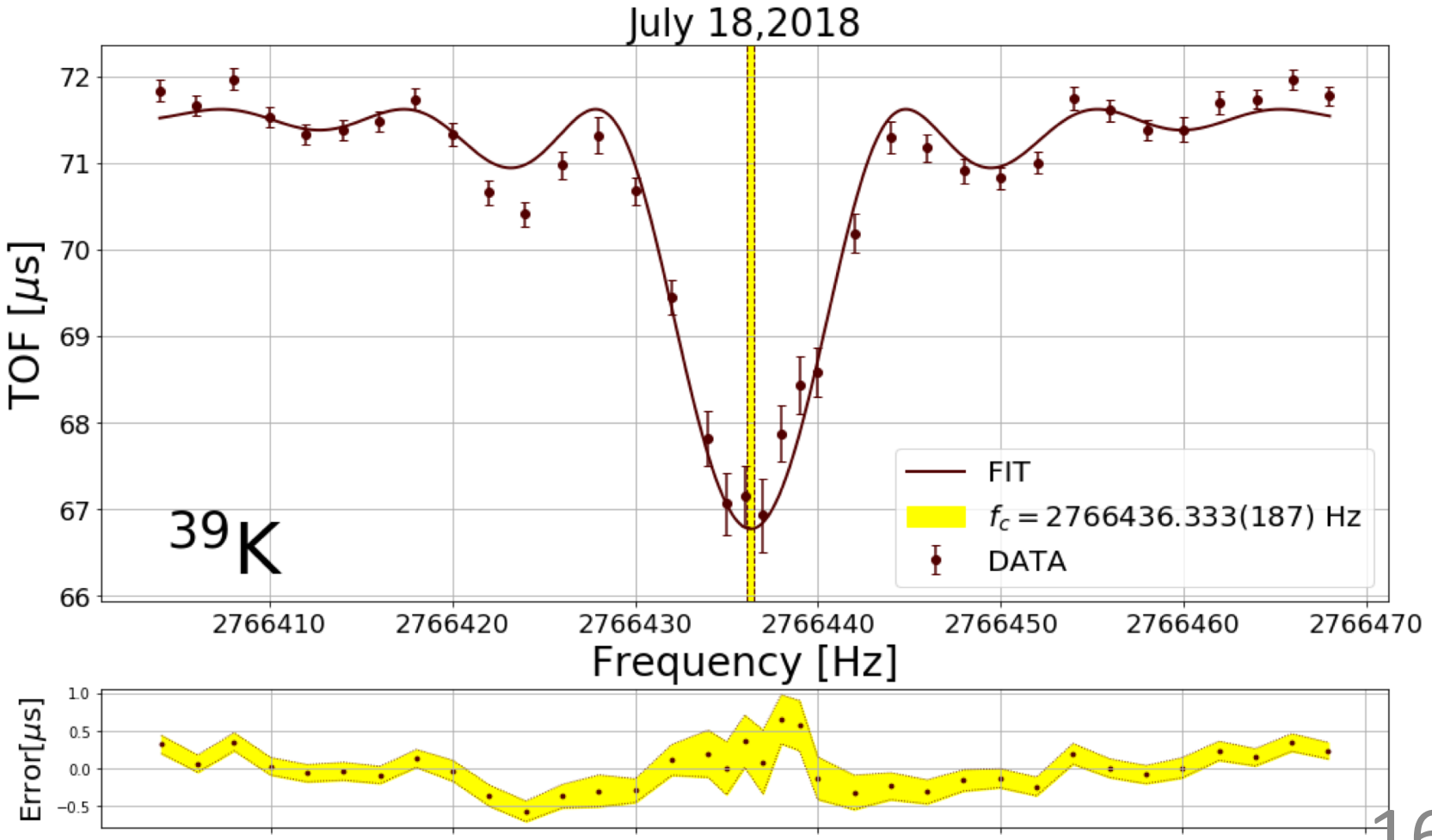
RFQ GAS COOLER/BUNCHER

PRESSURE CONTROL



CONCLUSIONS

So how do we know it works?



CONCLUSIONS

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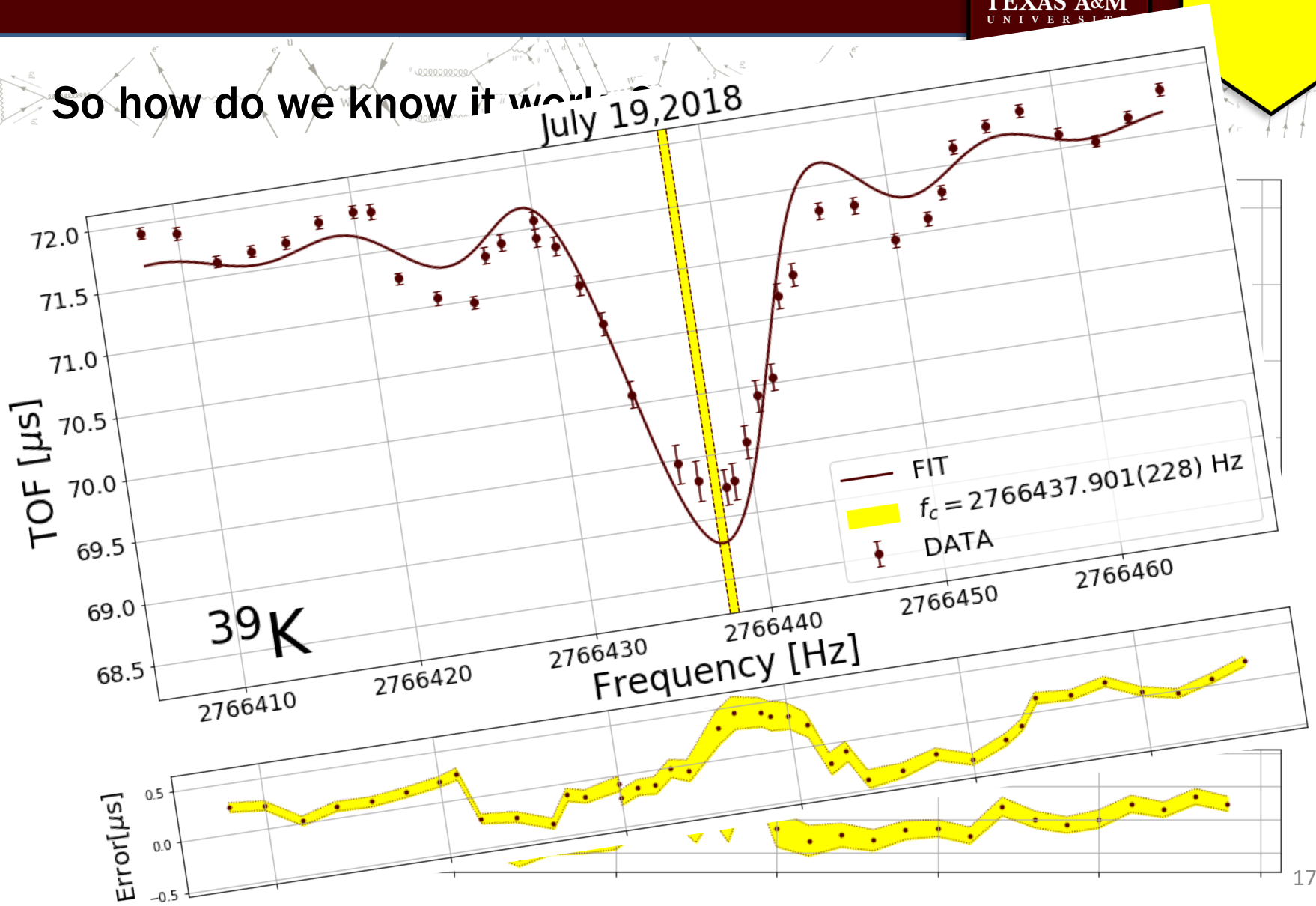
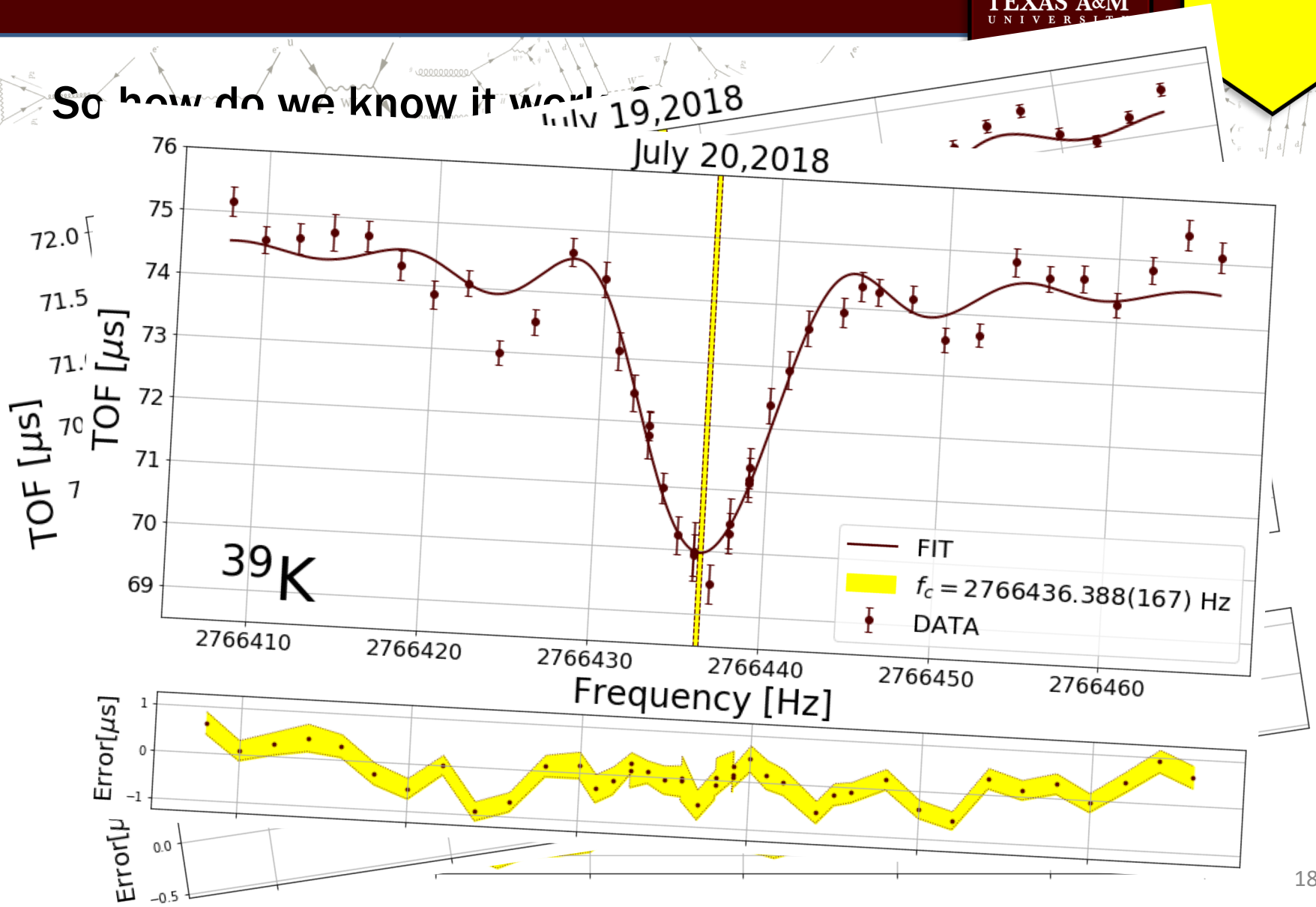
So how do we know it worked?



CONCLUSIONS

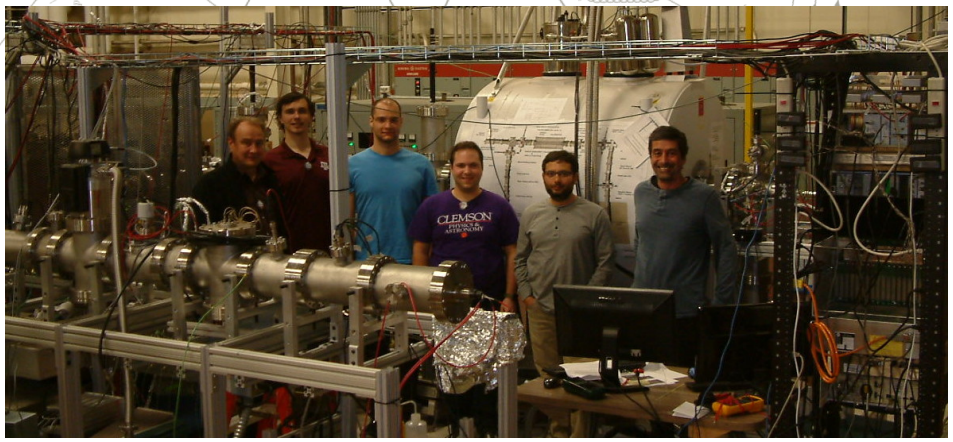
So how do we know it work



CONCLUSIONS

- At TAMUTRAP, mass measurements can be done with extremely high precision.
- The mass measurements performed let the TAMUTRAP group gain knowledge on the whole experiment.
- Grounding and impedance mismatch are important issues that have to be taken into account when designing electric devices.
- With my project done, TAMUTRAP is just a step away from being fully remote control.
- The full-size Penning trap should be ready to go, in the next months!

ACKNOWLEDEGEMENTS



TAMUTRAP GROUP: Dan Melconian, Praveen Shidling, Veli Kolhinen, Guadalupe Duran, Ben Schroeder, Morgan Nasser, Asim Ozmetin
REU PROGRAM, Mike and Eames!
Thanks!

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CYCLOTRON INSTITUTE
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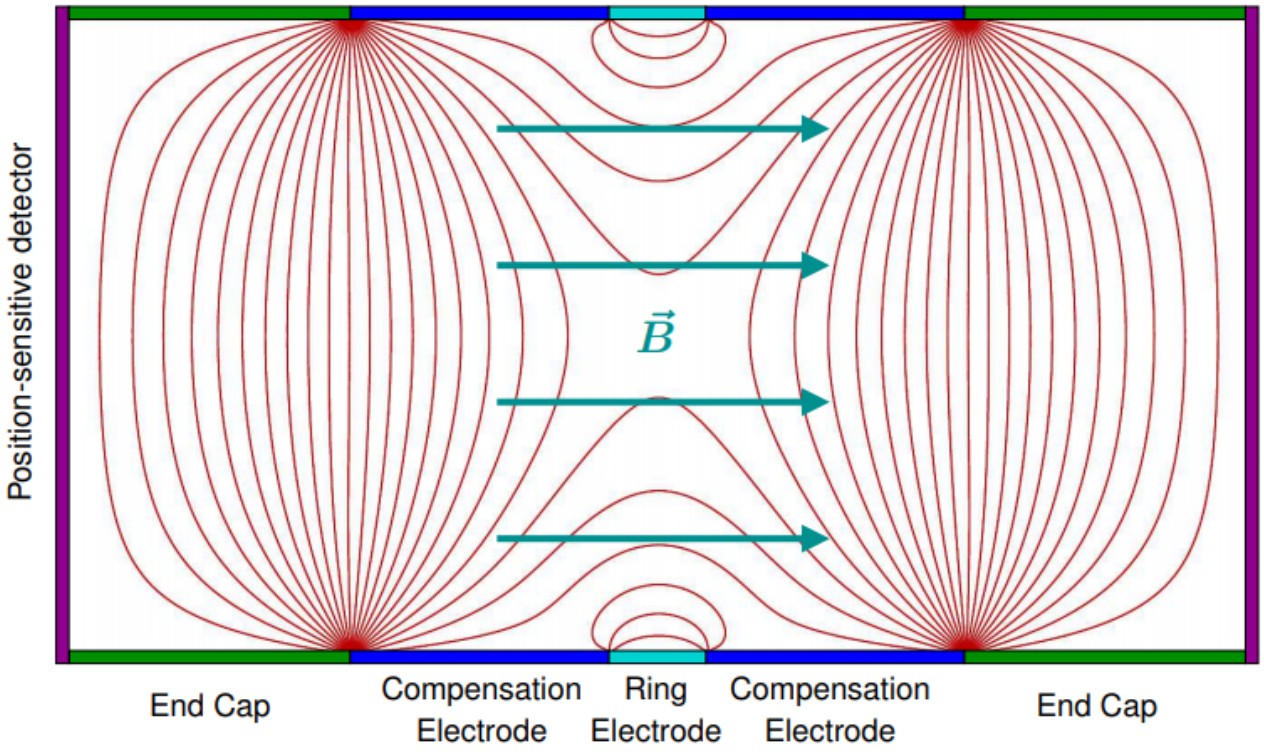
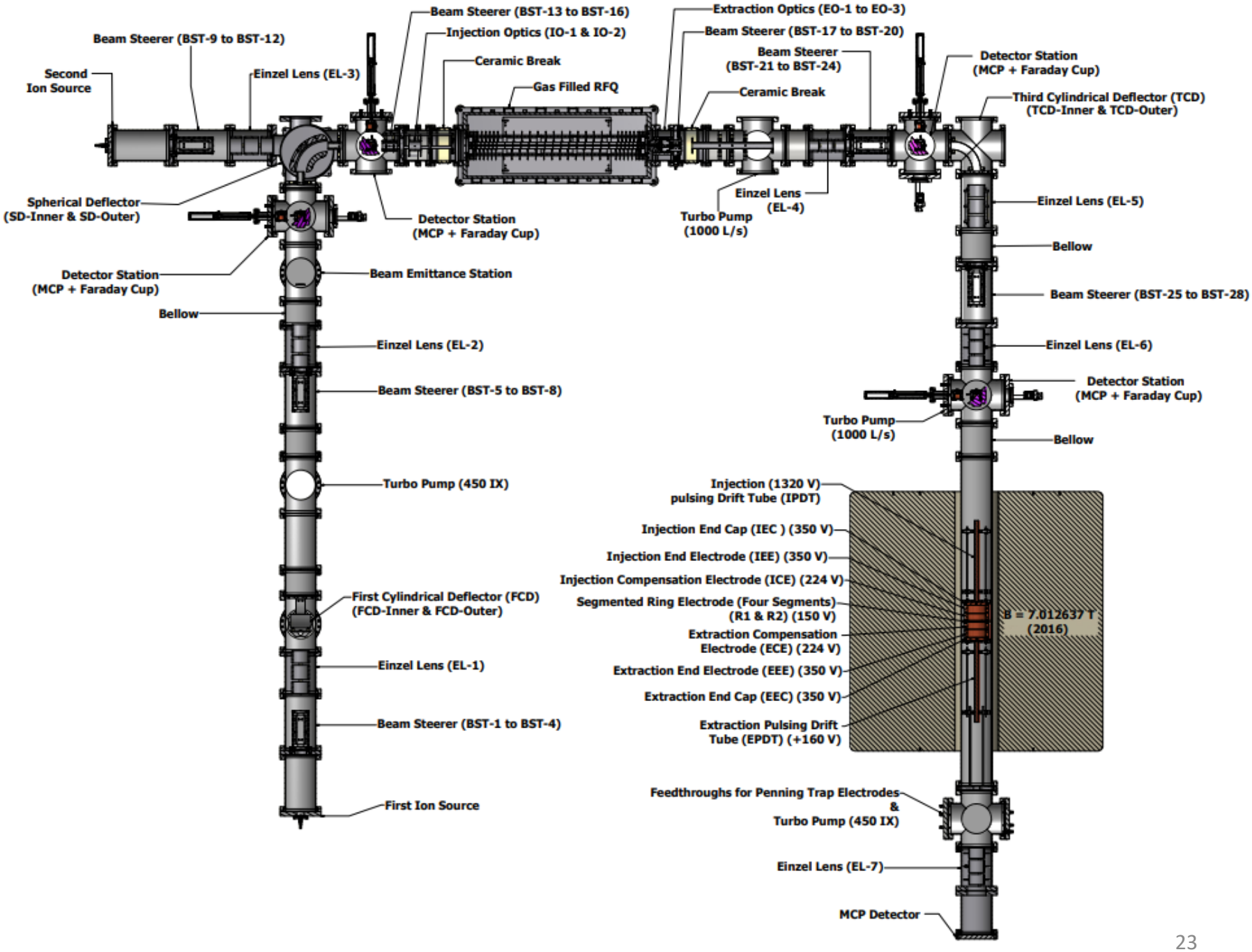
REFERENCES

[1] M.Mehlman et al., Nucl. Instrum. Methods Phys. Res. A712, 11 (2010)

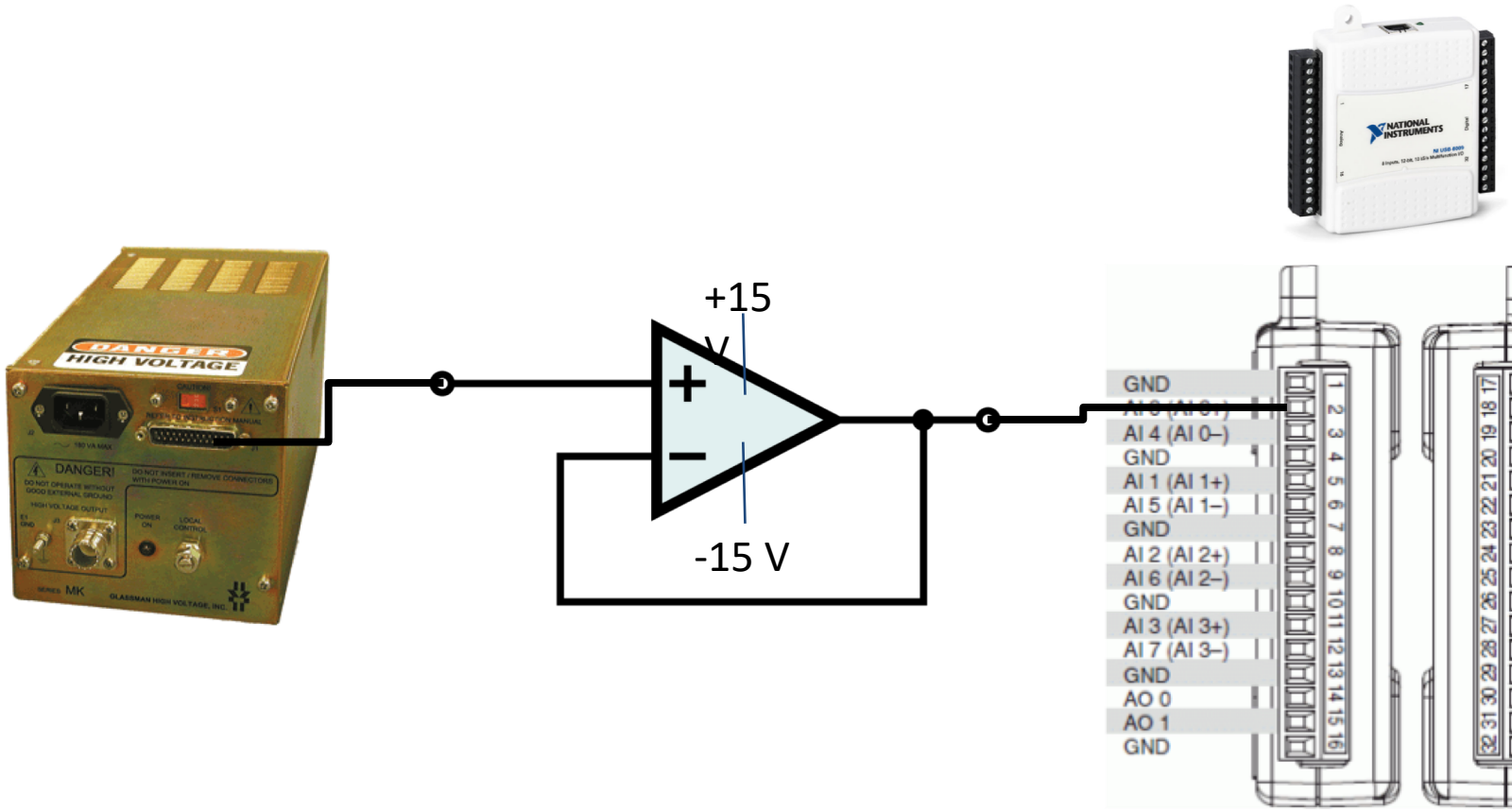
[2] D. Melconian — "*First mass measurement using TAMUTRAP*," Brown-bag lunch presentation, Cyclotron Institute, Texas A&M, College Station, TX (Aug 2017, invited)

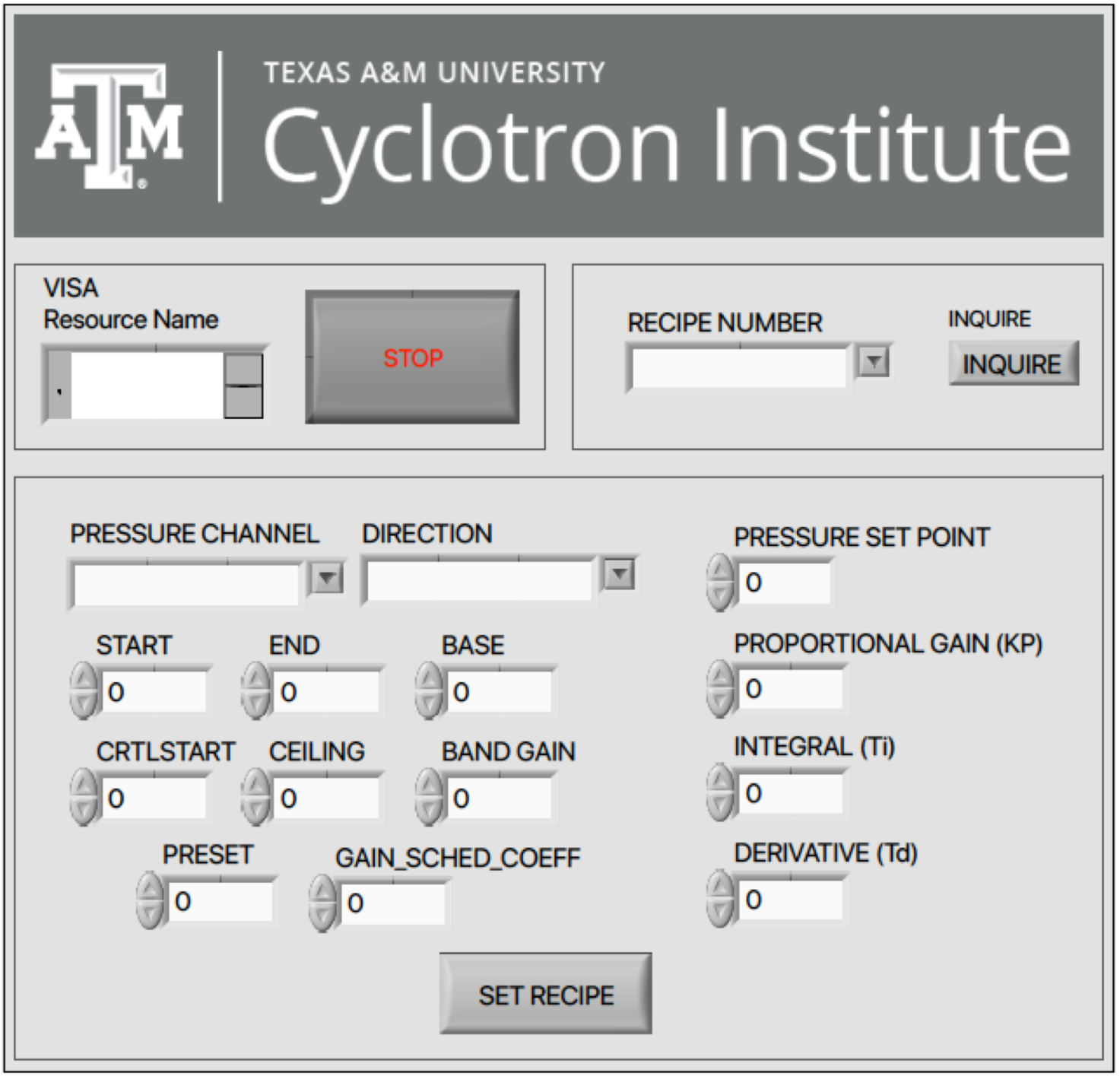
[3] P.D. Shidling — "*TAMUTRAP: Texas A&M University Penning trap facility*," Brown-bag lunch presentation, Cyclotron Institute, Texas A&M, College Station, TX (June 2018, invited)


Position-sensitive detector
$\vec{B}$
End Cap
Compensation Electrode
Ring Electrode
Compensation Electrode
End Cap



Texas A&M University Penning Trap Facility (TAMUTRAP)


DANGER
HIGH VOLTAGE
DANGER!
+15 V
-15 V
GND
AI 4 (AI 0–)
GND
AI 1 (AI 1+)
AI 5 (AI 1–)
GND
AI 2 (AI 2+)
AI 6 (AI 2–)
GND
AI 3 (AI 3+)
AI 7 (AI 3–)
GND
AO 0
AO 1
GND
P0.0
P0.1
P0.2
P0.3
P0.4
P0.5
P0.6
P0.7
P1.0
P1.1
P1.2
P1.3
PFI 0
+2.5 V
+5 V
GND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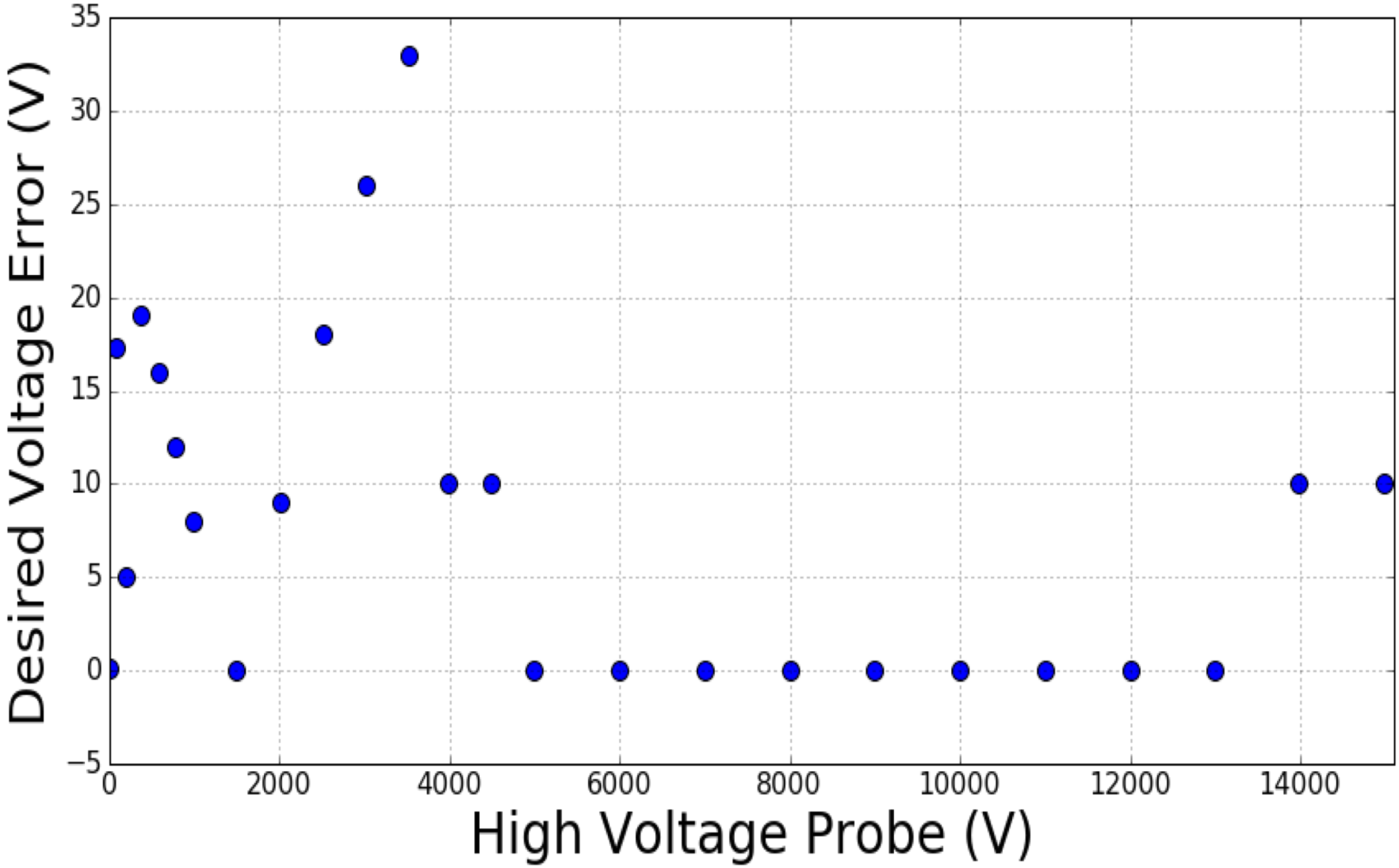
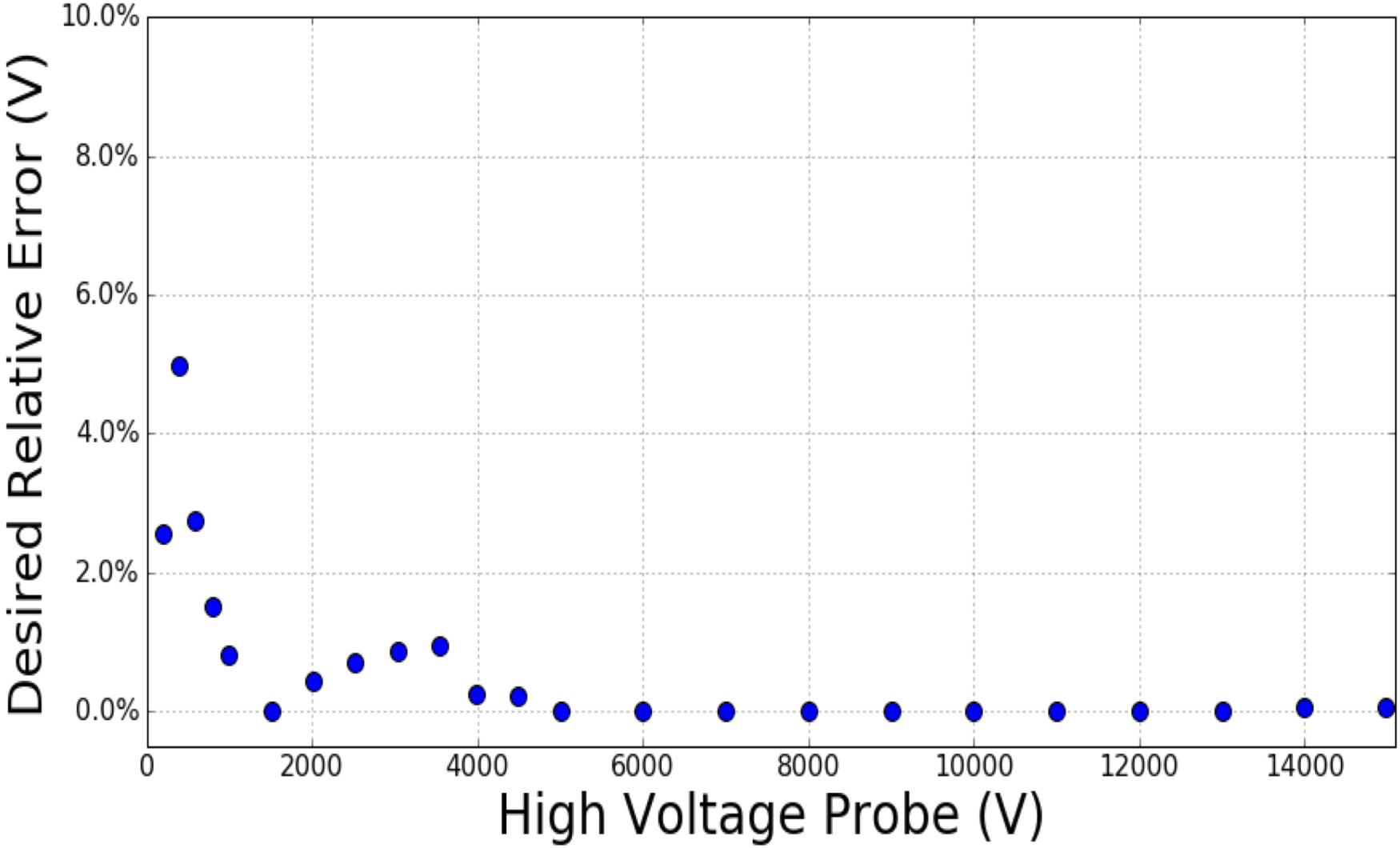
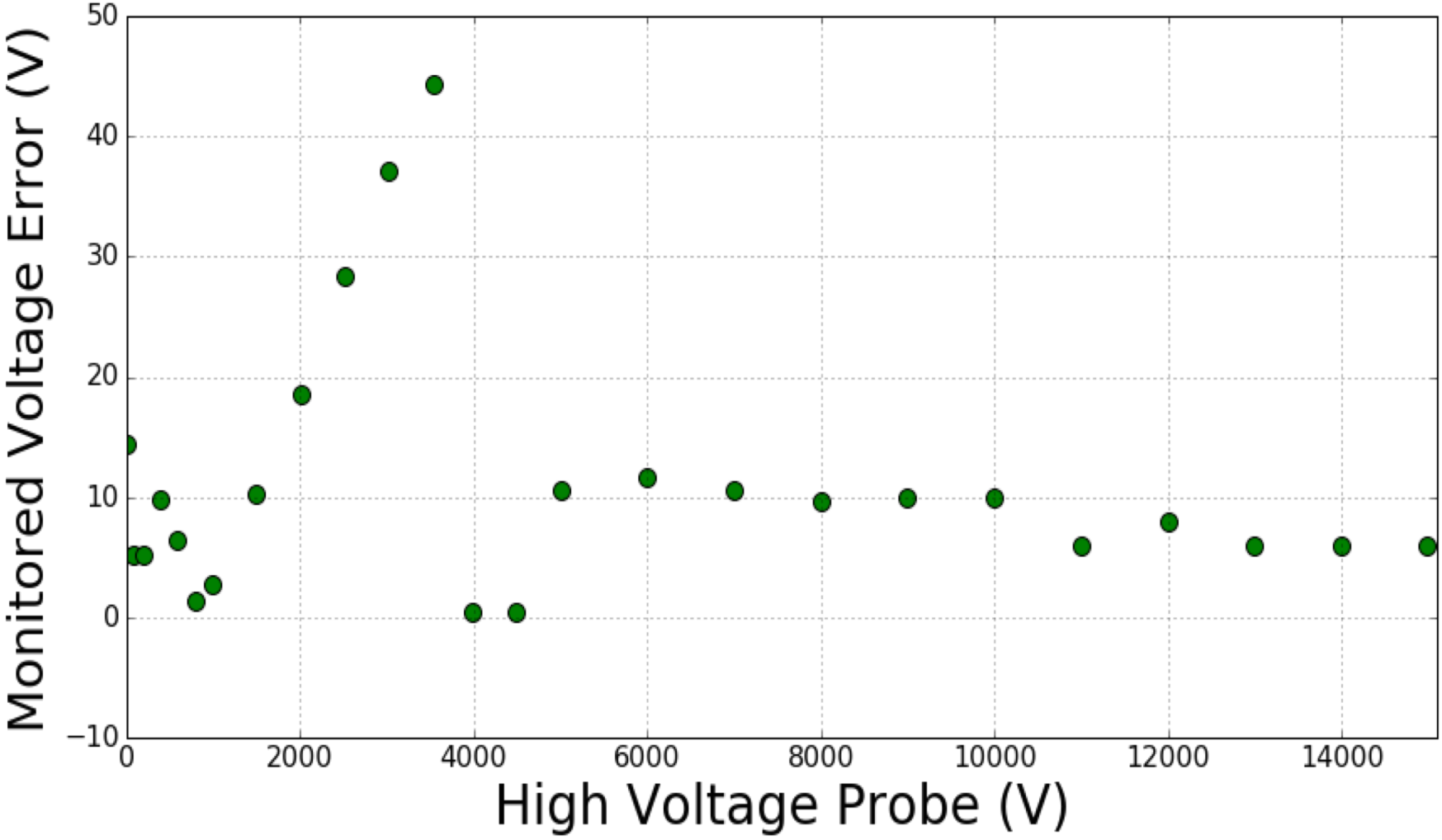
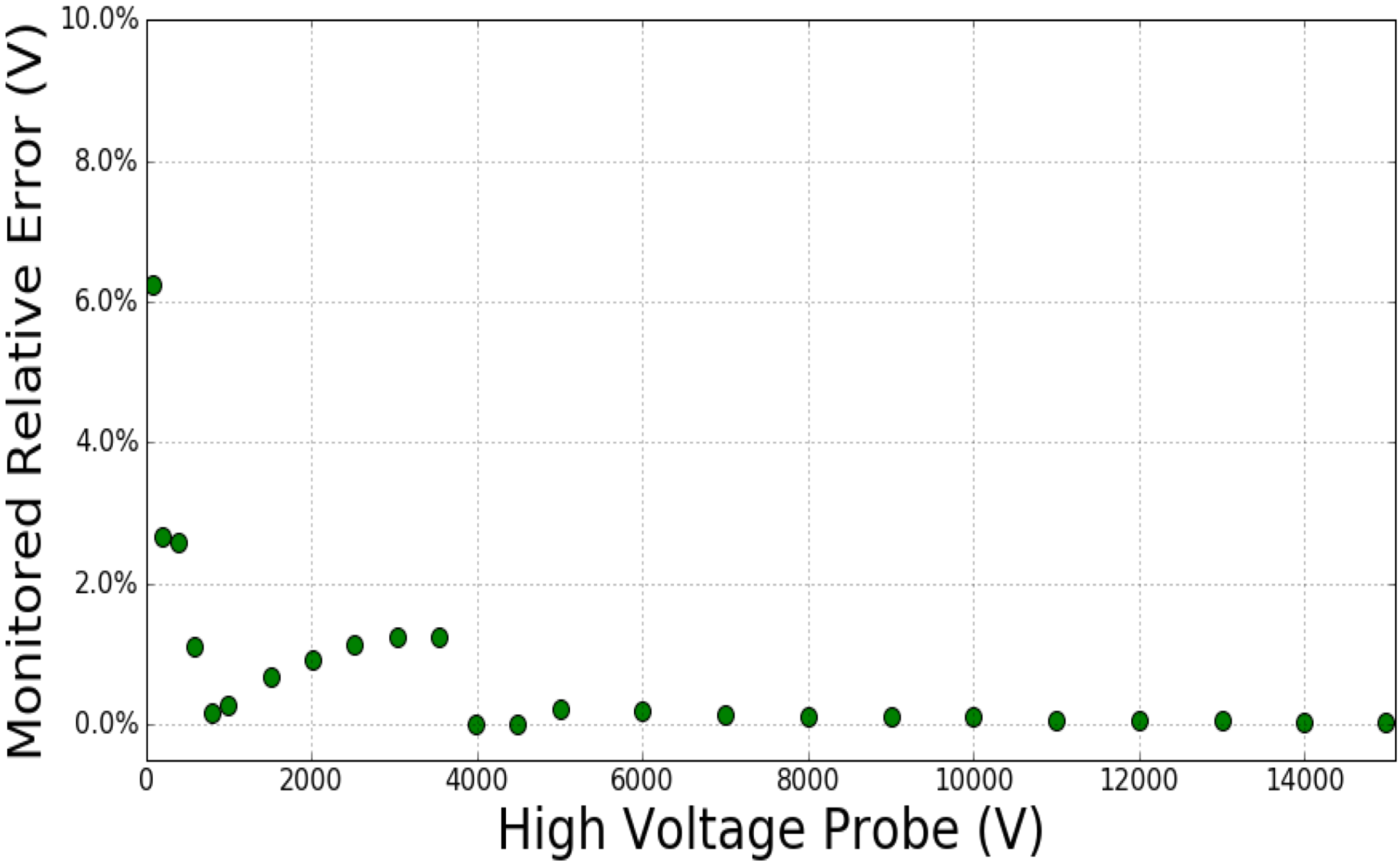
VISA
Resource Name
STOP
RECIPE NUMBER
INQUIRE
INQUIRE
PRESSURE CHANNEL
DIRECTION
PRESSURE SET POINT
0
START
END
BASE
0
0
0
PROPORTIONAL GAIN (KP)
0
CRTLSTART
CEILING
BAND GAIN
0
0
0
INTEGRAL (Ti)
0
PRESET
GAIN_SCHED_COEFF
0
0
DERIVATIVE (Td)
0
SET RECIPE


Desired Voltage Error (V)
35
30
25
20
15
10
5
0
−5
0
2000
4000
6000
8000
10000
12000
14000
High Voltage Probe (V)


10.0%
8.0%
6.0%
4.0%
2.0%
0.0%
Desired Relative Error (V)
0
2000
4000
6000
8000
10000
12000
14000
High Voltage Probe (V)


Monitored Voltage Error (V)
50
40
30
20
10
0
−10
0
2000
4000
6000
8000
10000
12000
14000
High Voltage Probe (V)


Monitored Relative Error (V)
10.0%
8.0%
6.0%
4.0%
2.0%
0.0%
0
2000
4000
6000
8000
10000
12000
14000
High Voltage Probe (V)


SerialComm