Technical Developments for TITAN's Measurement Penning trap

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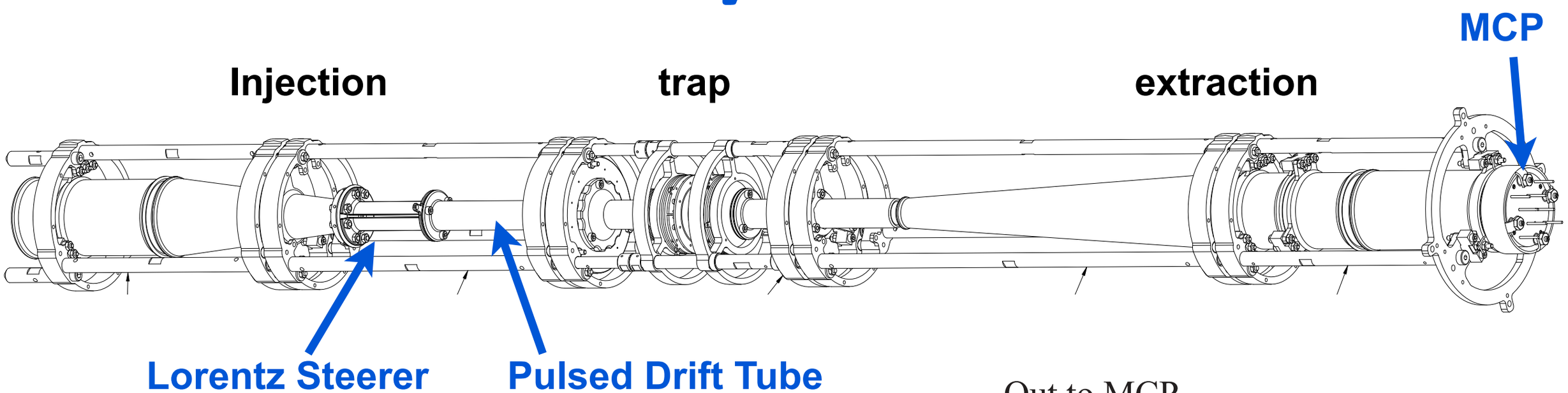
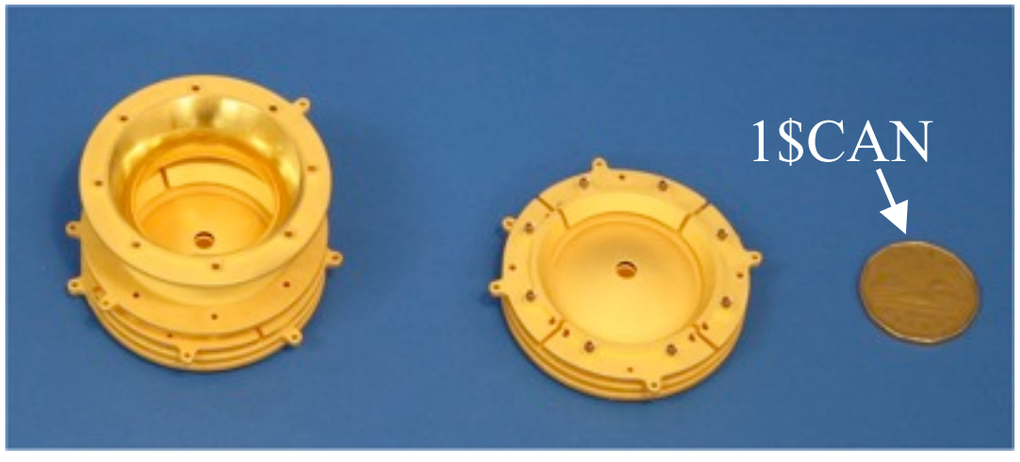
TITAN
ISAC-TRIUMF

UBC

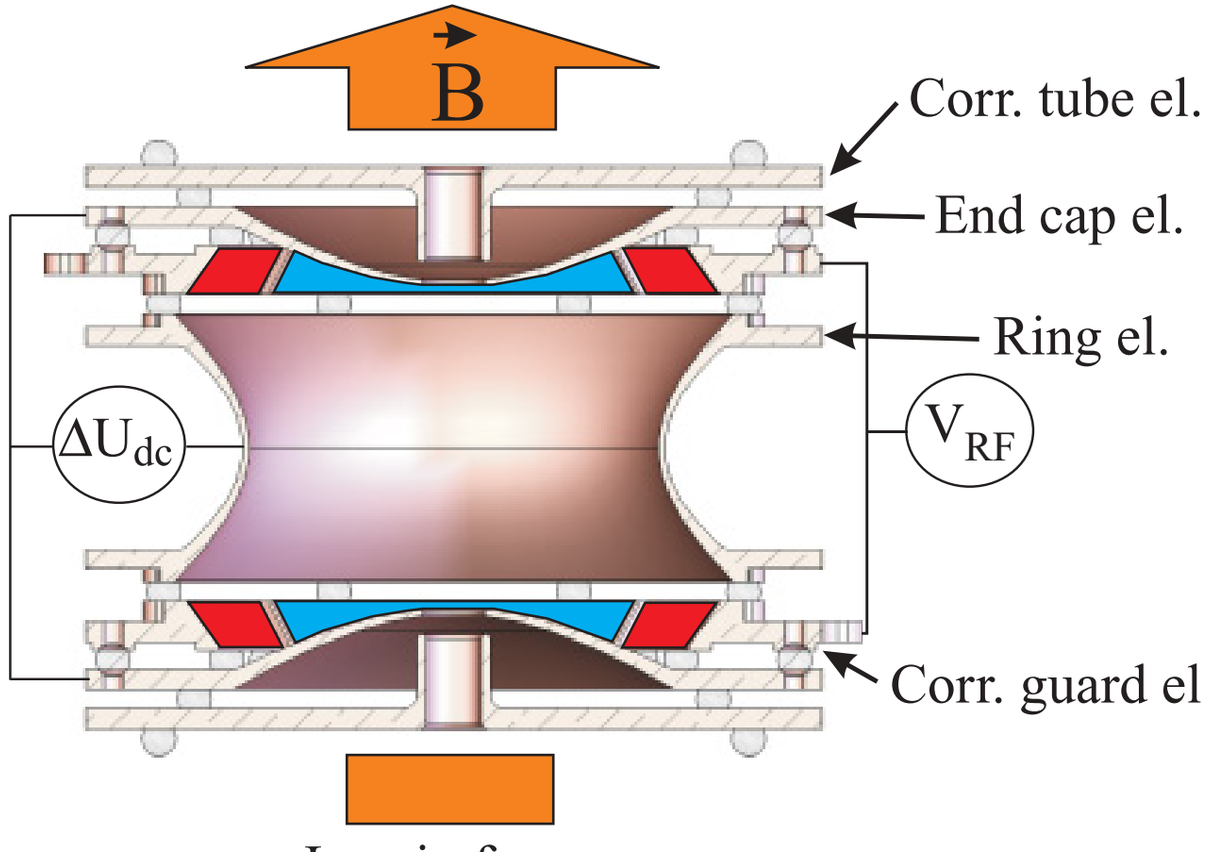
TITAN collaboration meeting, May 25th, 2010

MPET layout





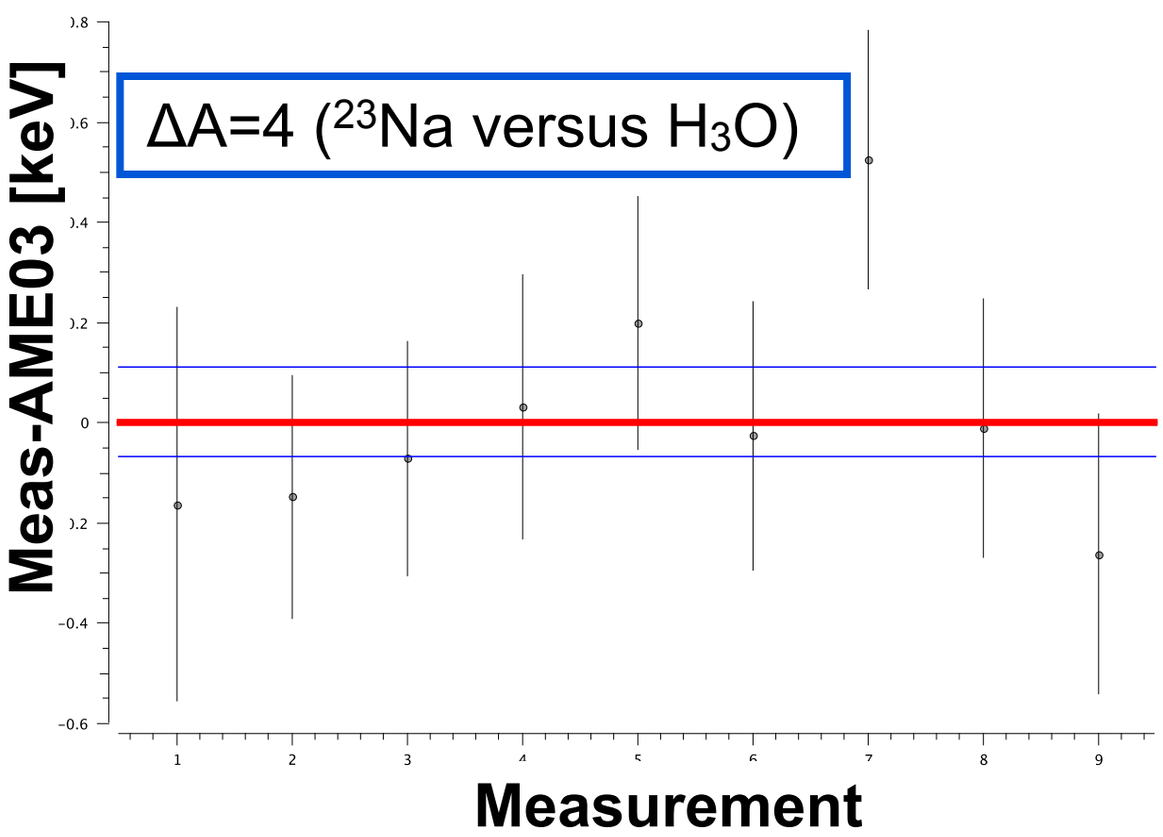
B-field	3.7 T
d_0	11.2 mm

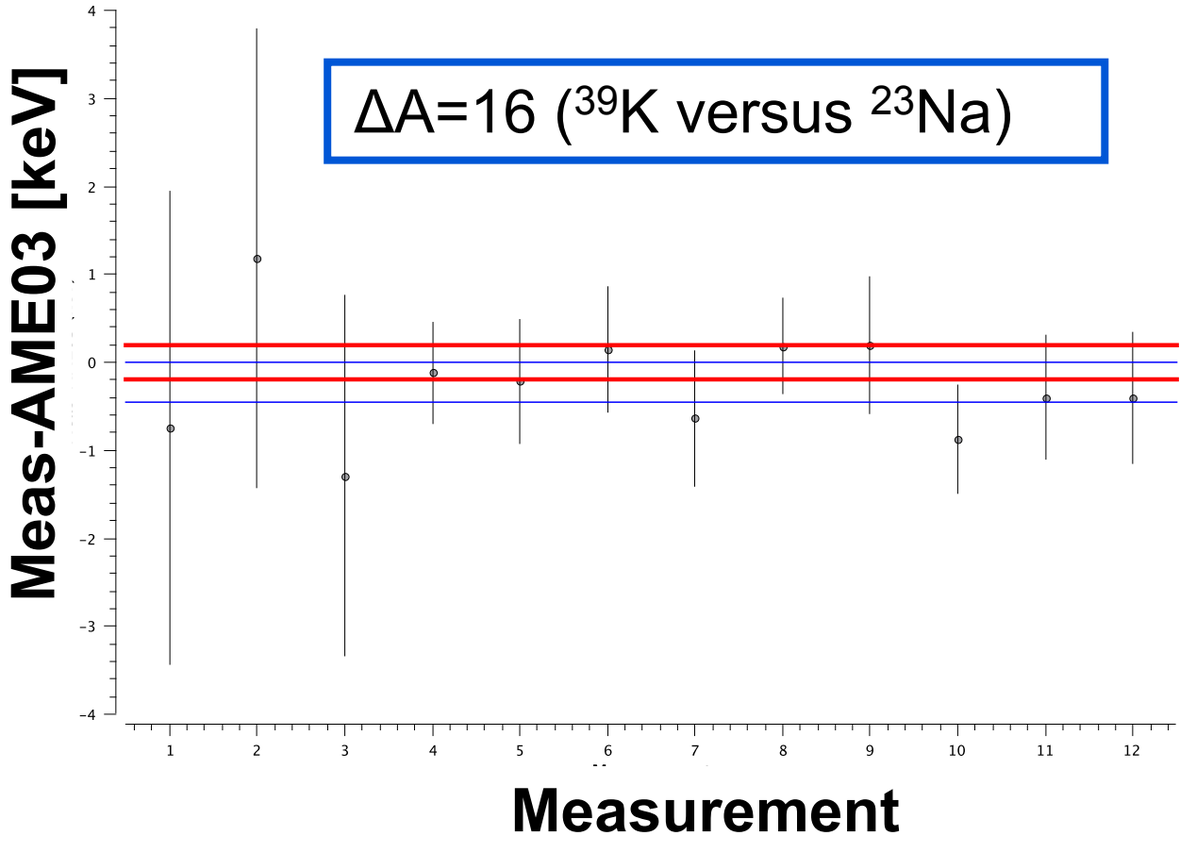


Systematic Errors

1) Test of Field Compensation

$$R = R_{meas}\left(1 + (\Delta R/R)_{mds}\Delta A\right)$$



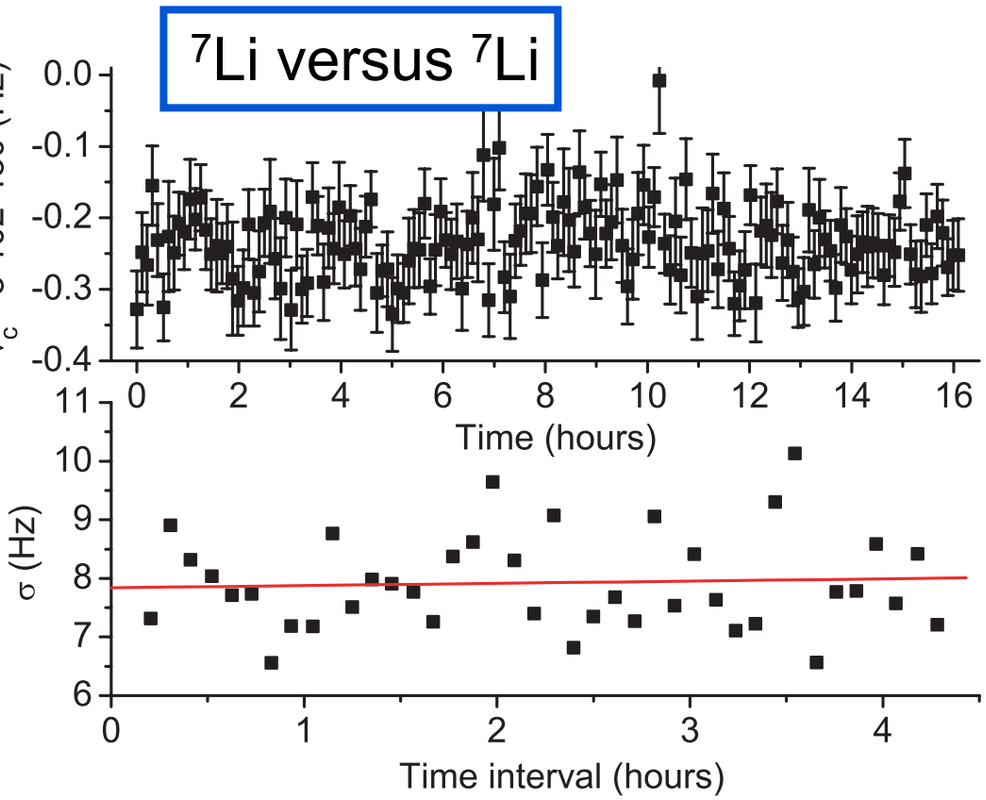


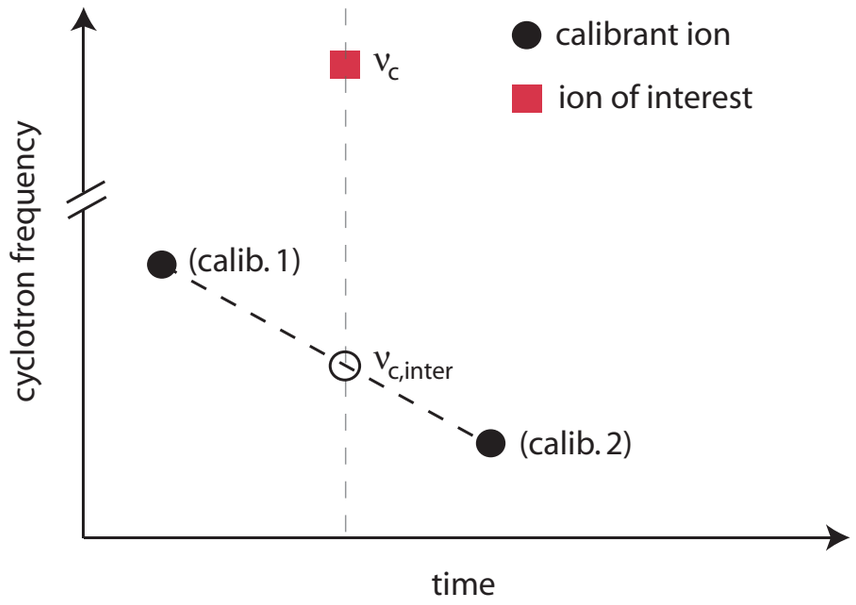
$$(\Delta R/R)_{mds} = 0.5(4)\ \ \mathrm{ppb/u}$$

M. Brodeur et al, PRC 80, 044318 (2009)

Systematic Errors

2) Nonlinear magnetic field fluctuations





0.04(11) ppb/h

3) Misalignment and harmonic distortion

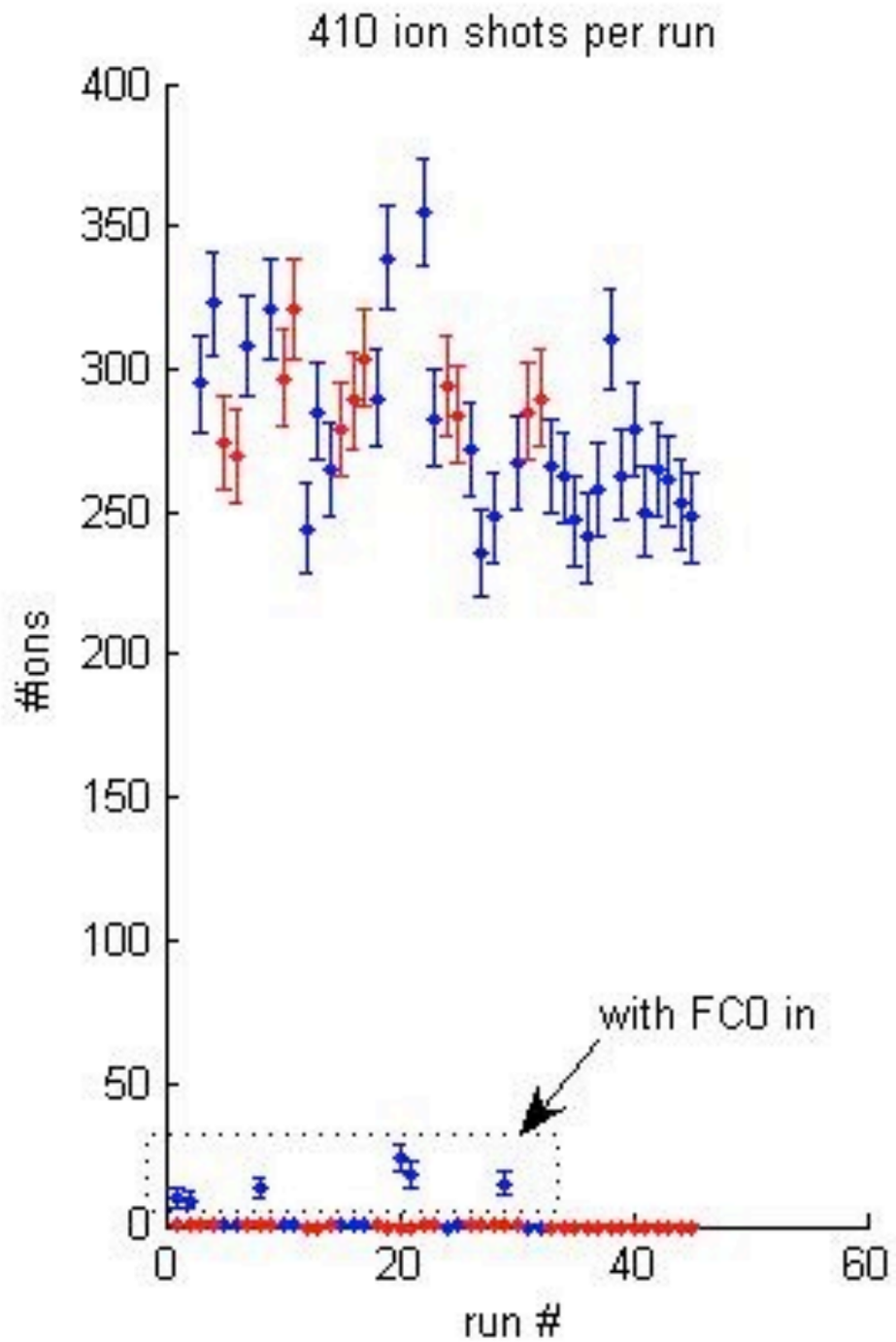
$$(\Delta R/R)_{\text{mis.}} = \left(\frac{9}{4}\theta^2 - \frac{1}{2}\epsilon^2\right) \times \left(\frac{\Delta A}{A_{\text{cal.}}}\right) \times \left(\frac{\overline{\nu}_-}{\overline{\nu}_{+,\text{cal.}}}\right)$$

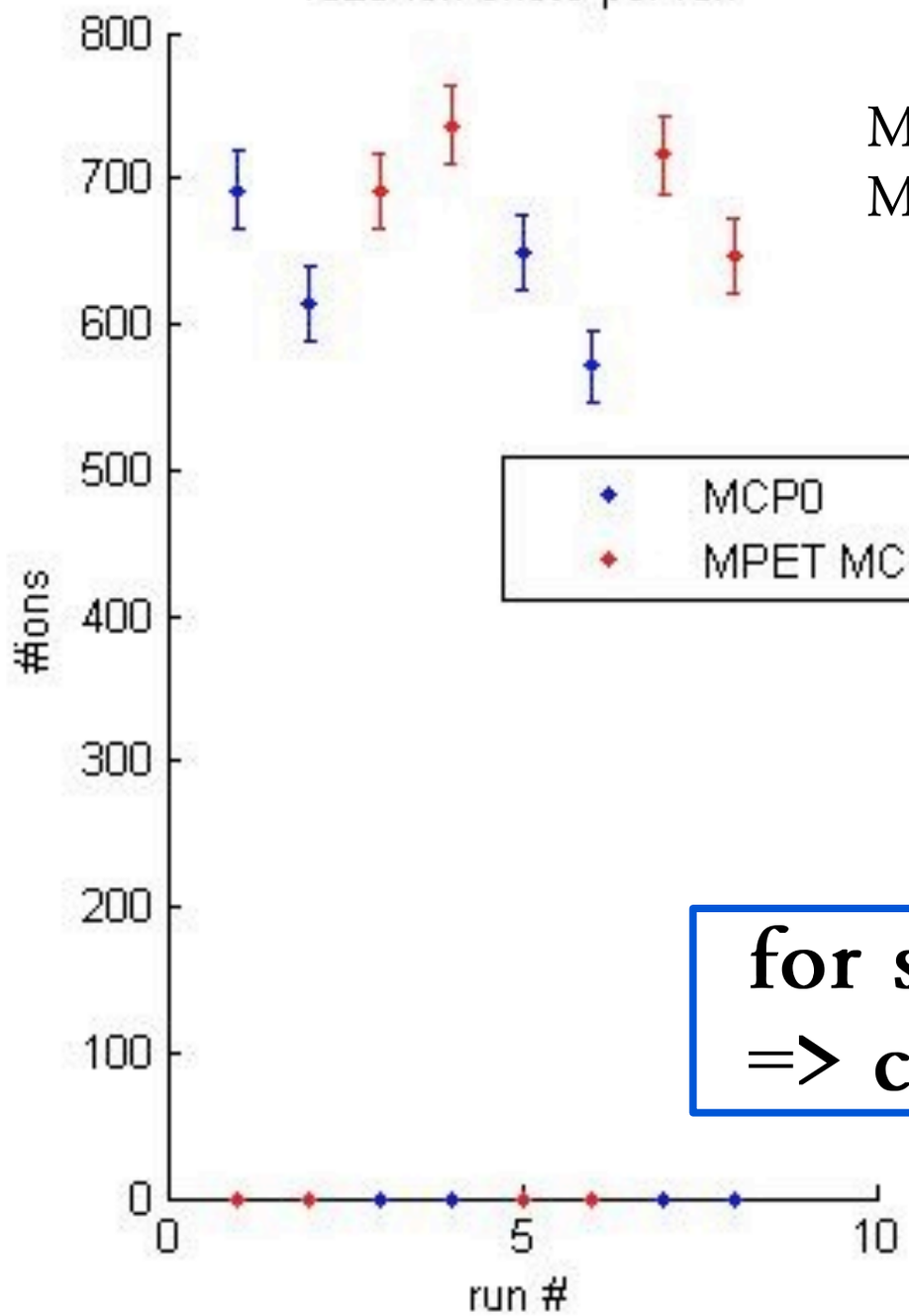
due to invariance theorem

TITAN: ε < 0.005 and θ < 0.004

M. Brodeur et al, PRC 80, 044318 (2009)

Trapping efficiency



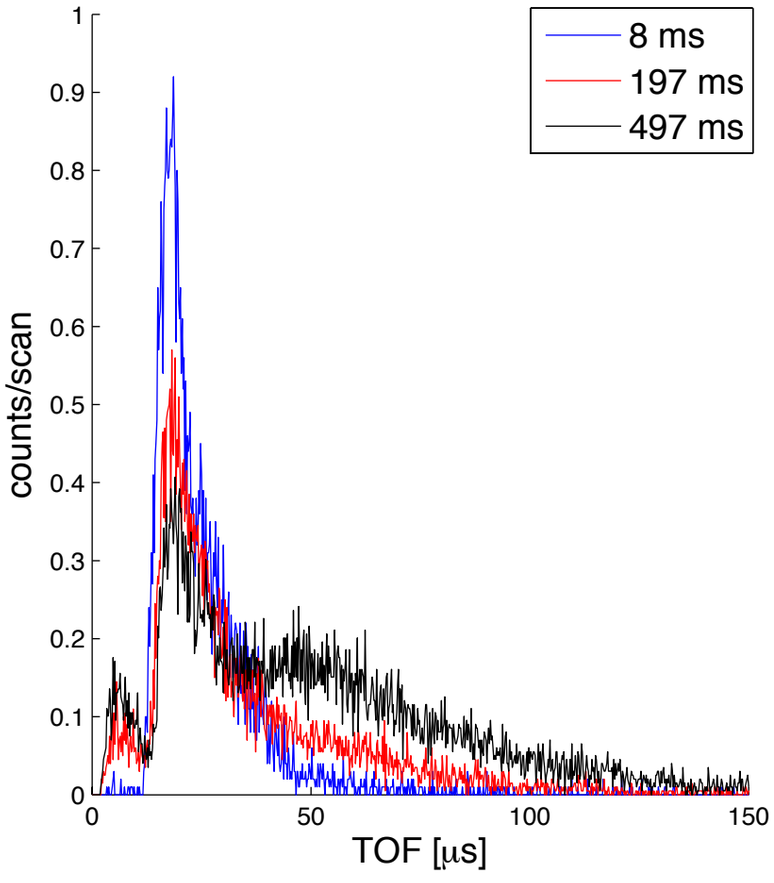


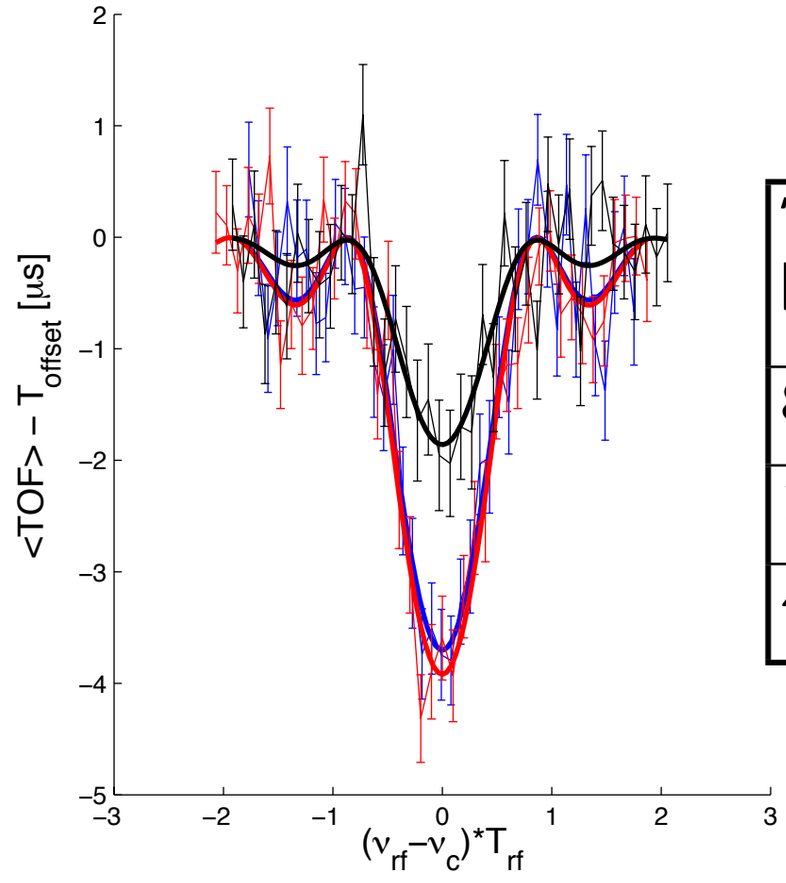
MCP0... in front of MPET
MPET MCP ... after MPET

for singly charged:
=> close to 100 %

MPET Vacuum for HCI

$^{39}K^{4+}$ @5.7·10^{-10} Torr (after in-situ ion-pump baking)



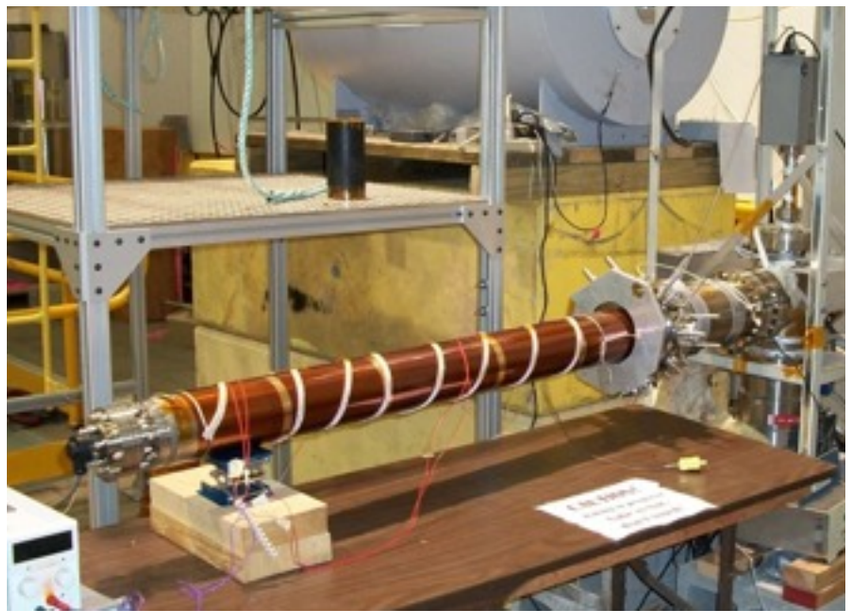


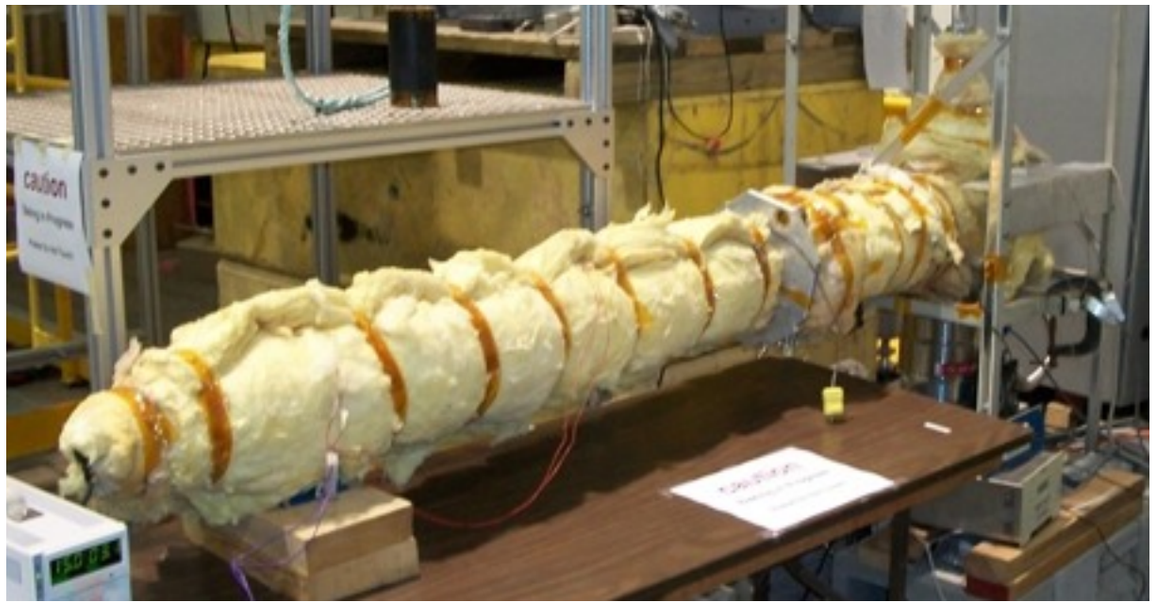
T_{rf} [ms]	scans	Δν [Hz]	exp Δν [Hz]
8	100	2.607	
197	200	0.096	0.074
497	199*	0.094<	0.030

did ion-pump baking actually help?

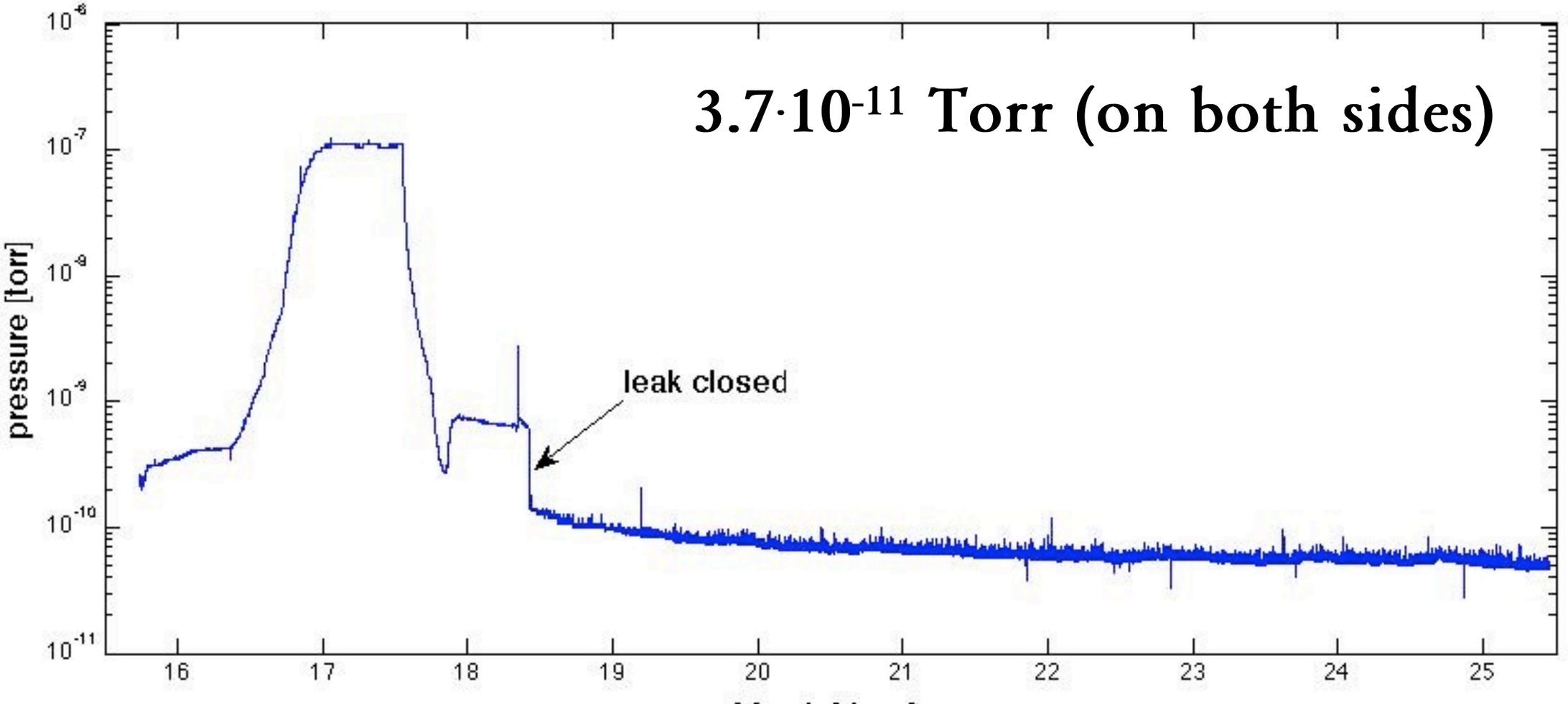
=>$^{44}K^{4+}$ done with T_{rf}=147 ms (47ms dipole cleaning)
=> for futher HCI: better vacuum required

MPET baking

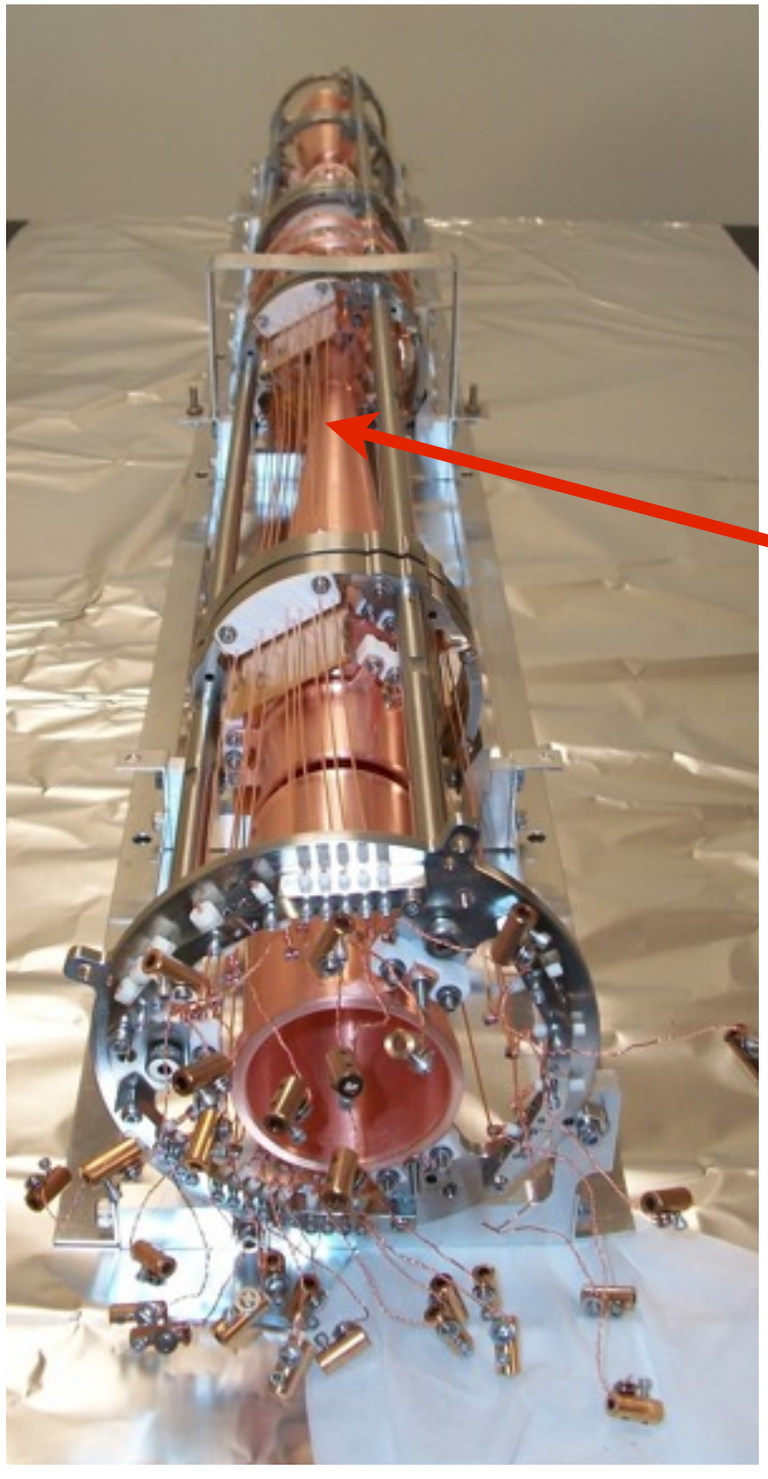


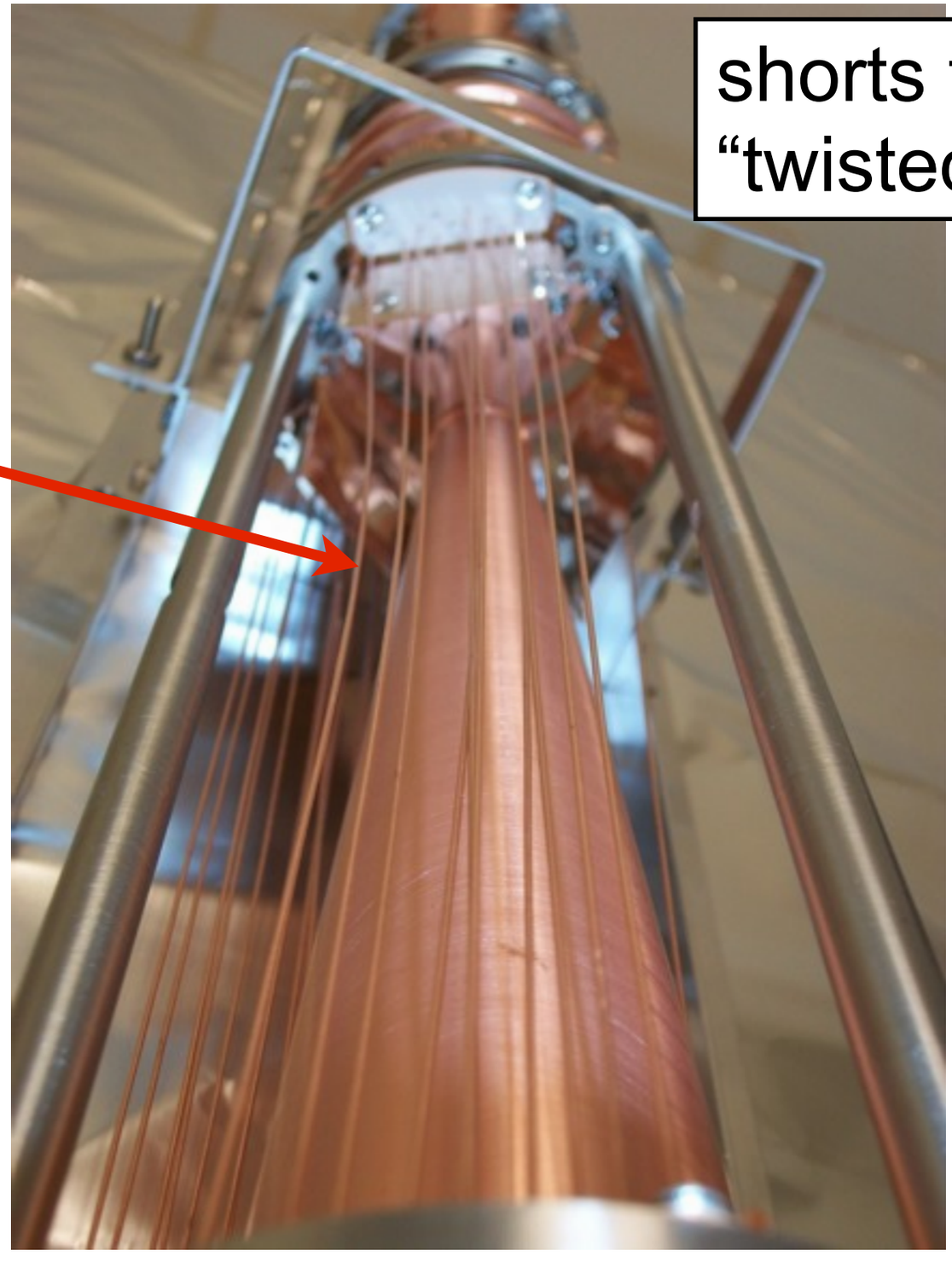


$3.7 \cdot 10^{-11}$ Torr (on both sides)



MPET repairs 1

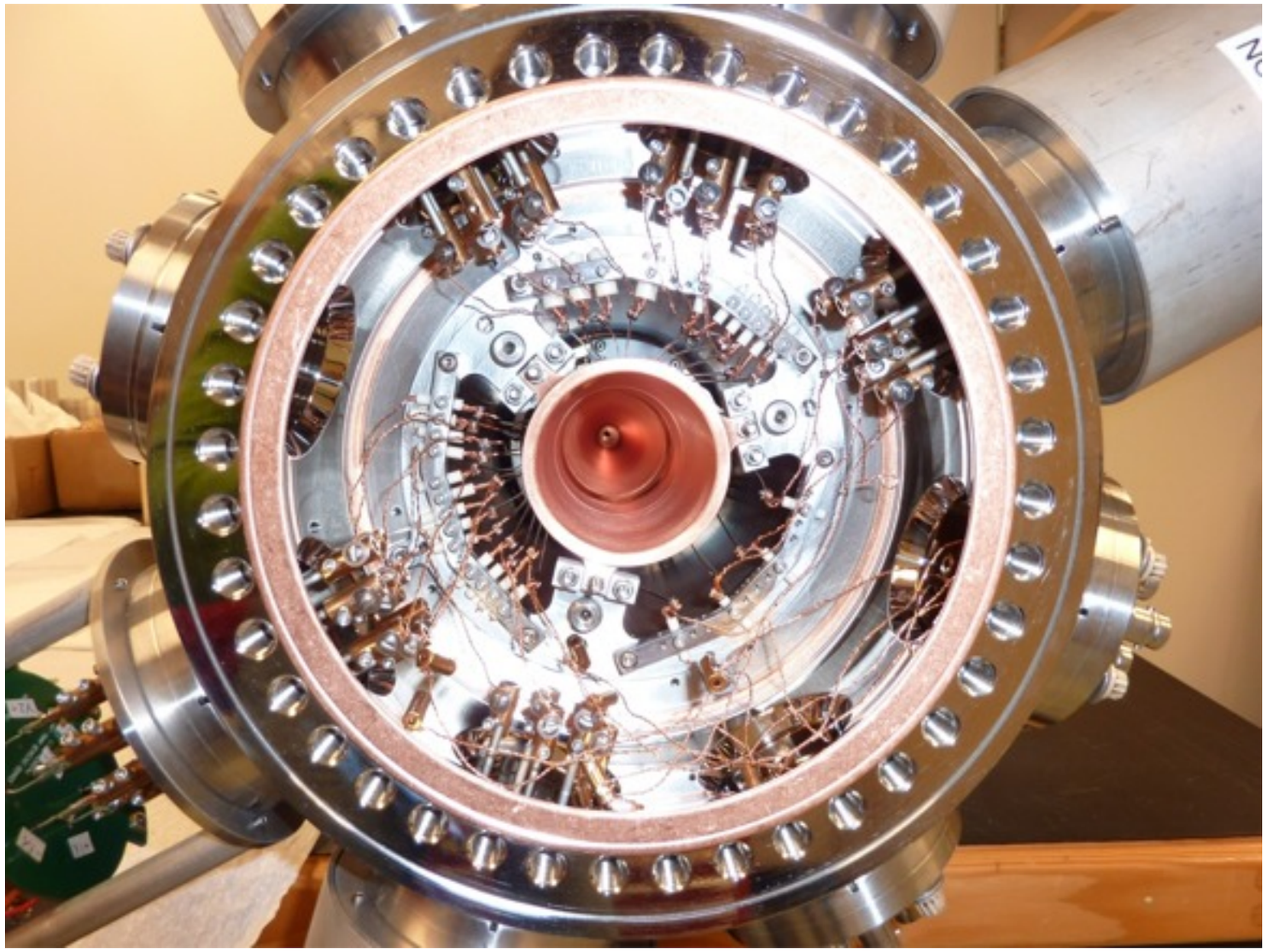




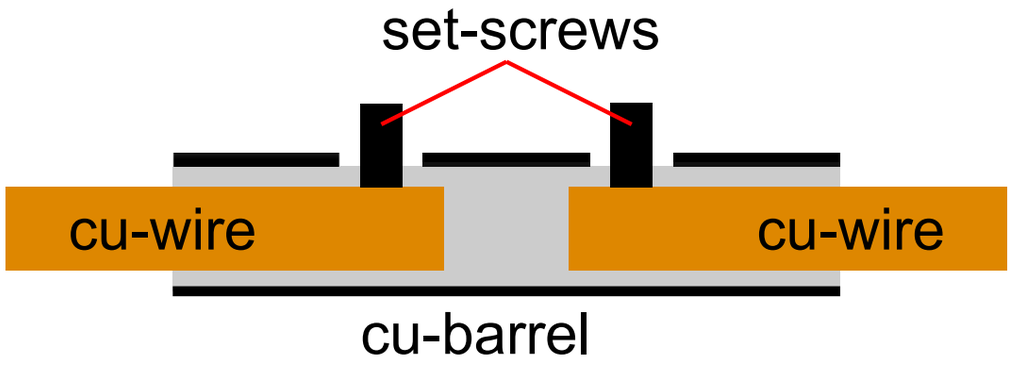
shorts through
“twisted” Cu-wires

Wiring Modification

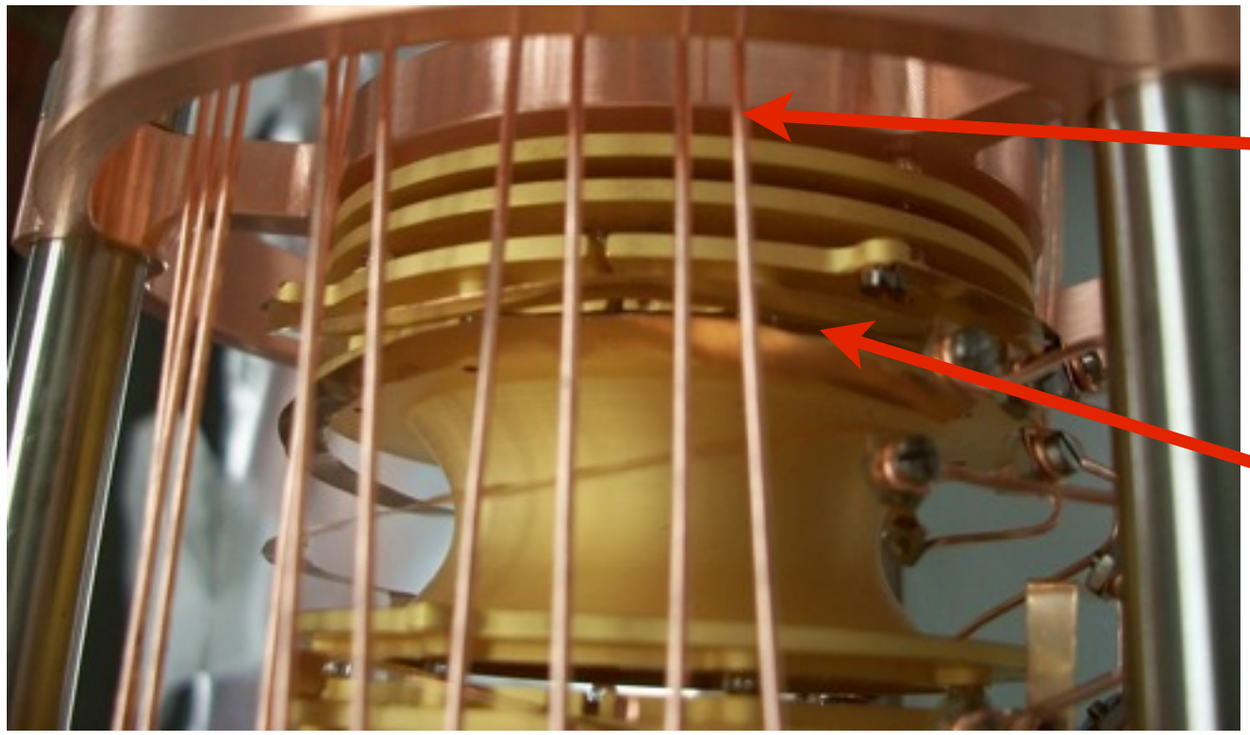
current wiring: feedthroughs to tube entrance:

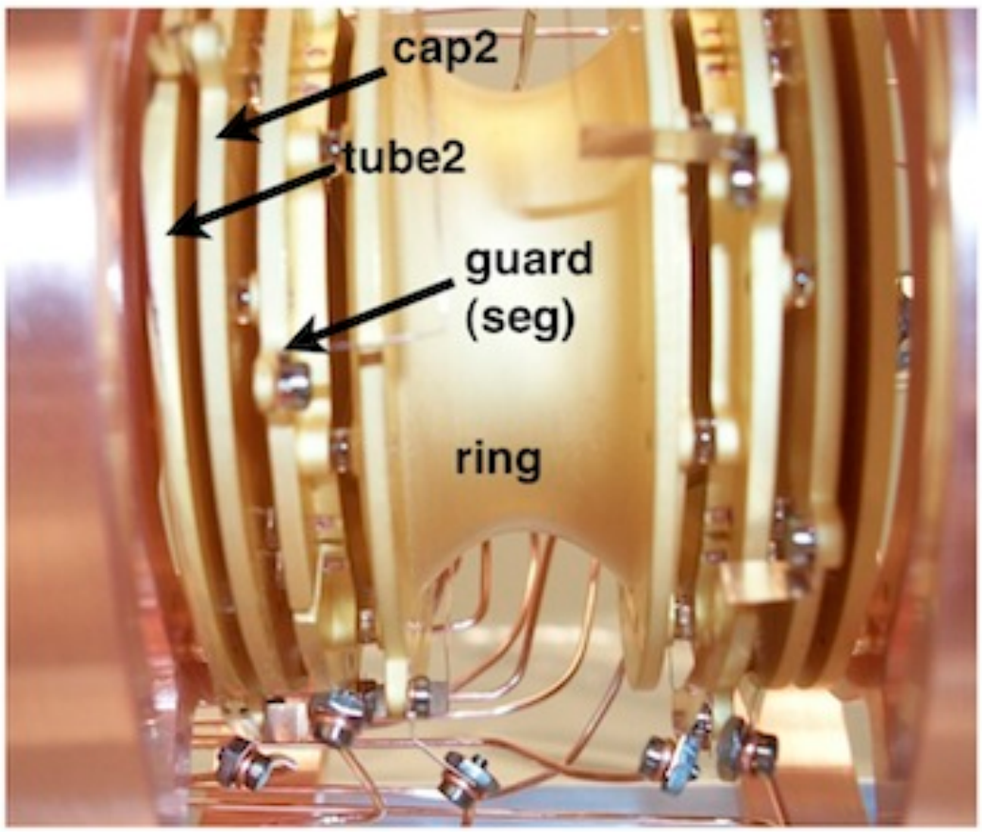


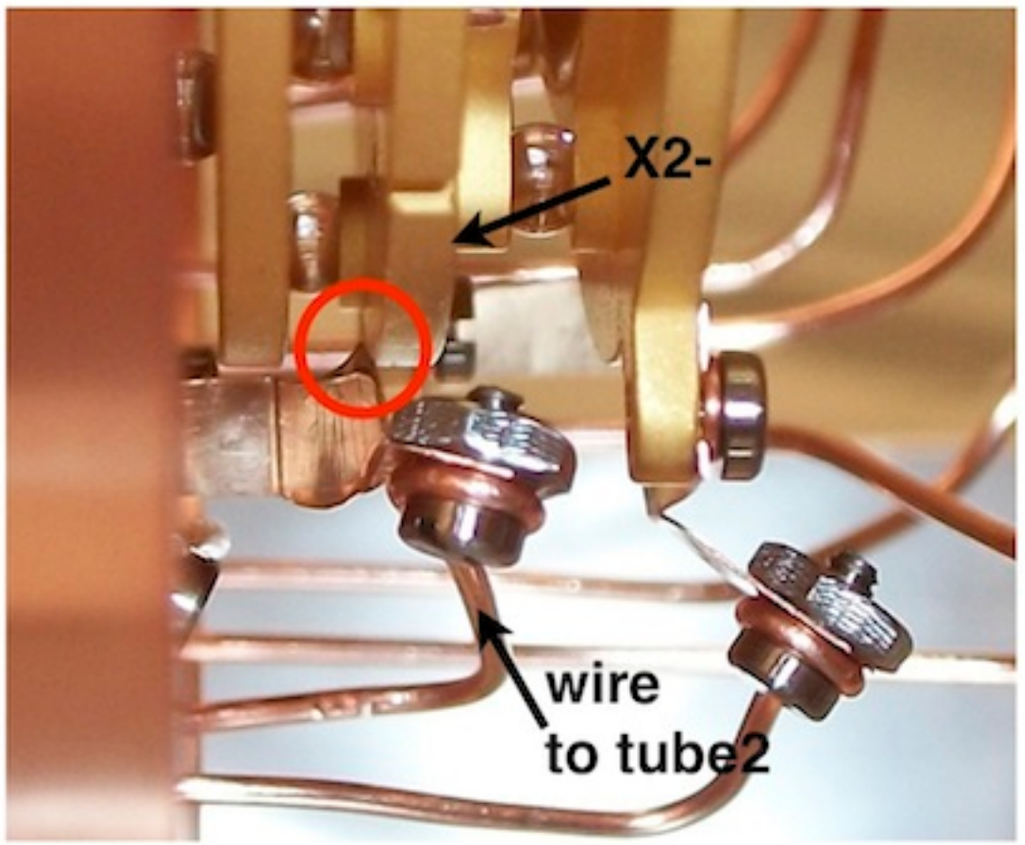
new wiring:



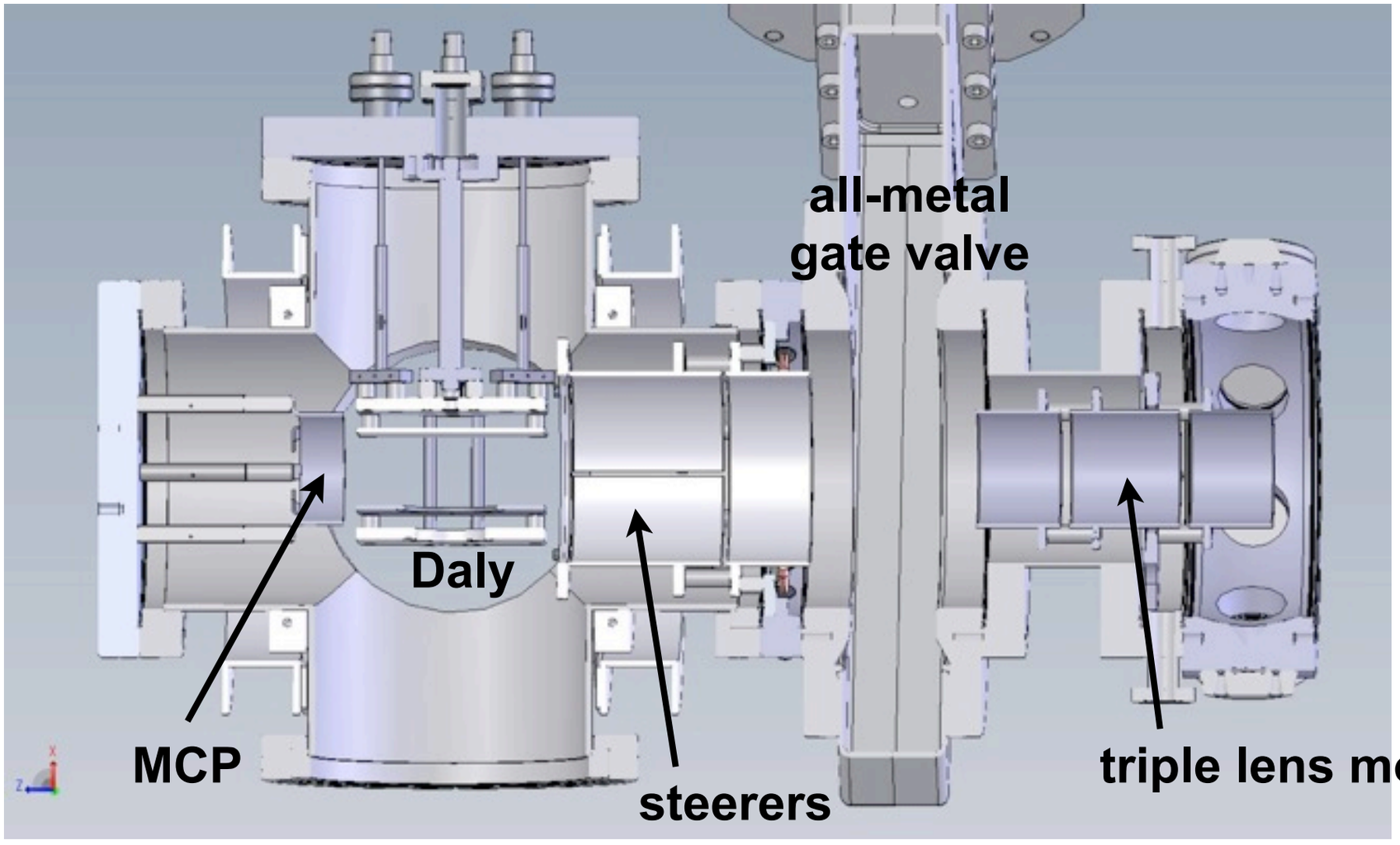
MPET repairs 2







Vacuum System and Detector Upgrade



MPET

Advantages:

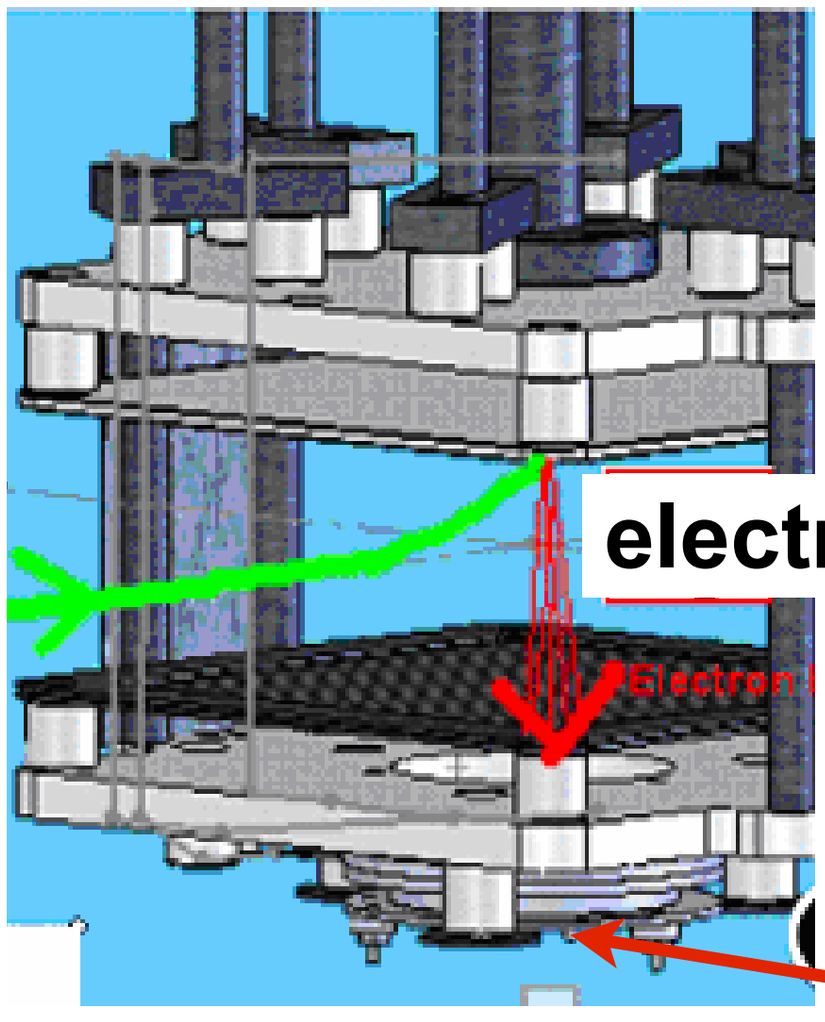
- 2 independent detection systems
- detector repair without venting MPET
- independent baking possible (temperature MPET!)
- MPET pumping

Daly Detector

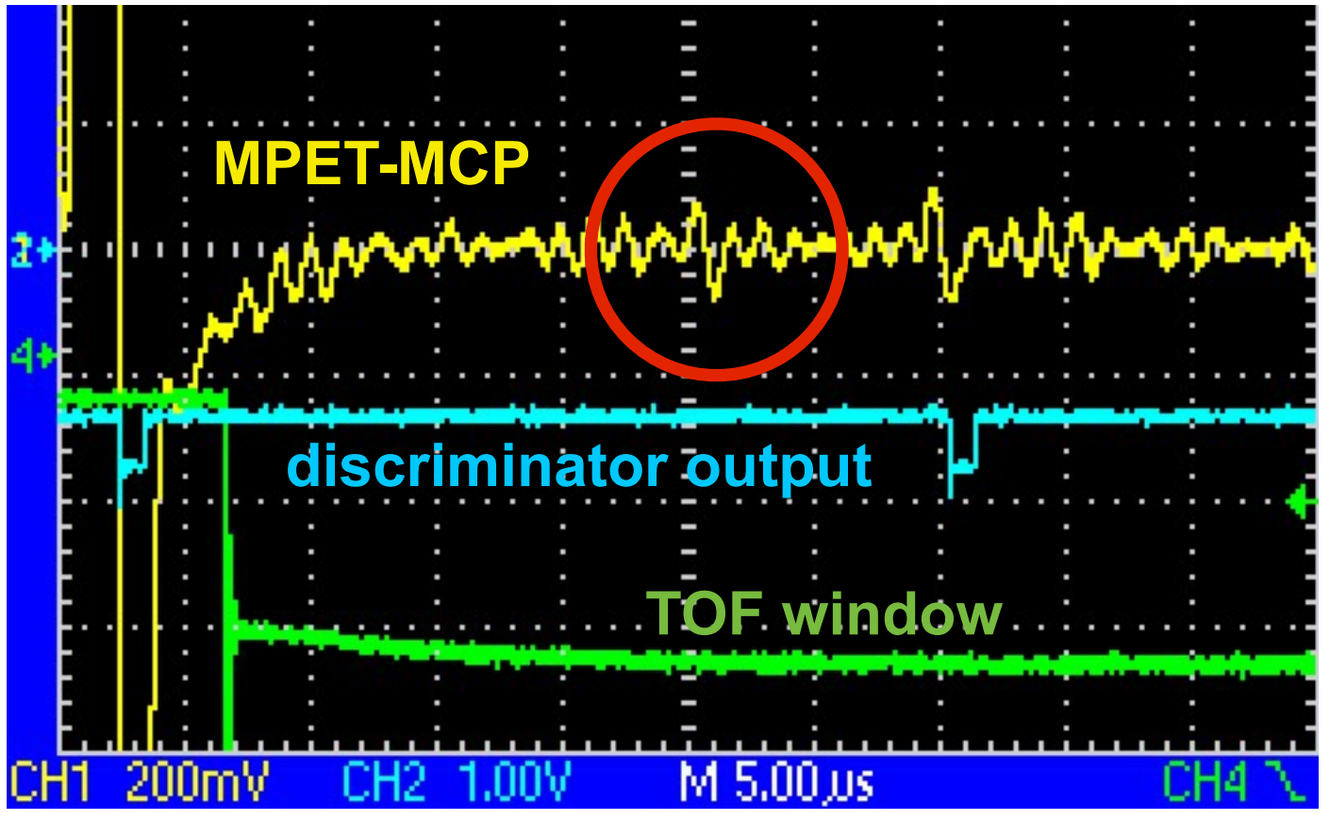
Motivation:

impact on MCP:

- radiation damage
- damage by heavy-ion impact

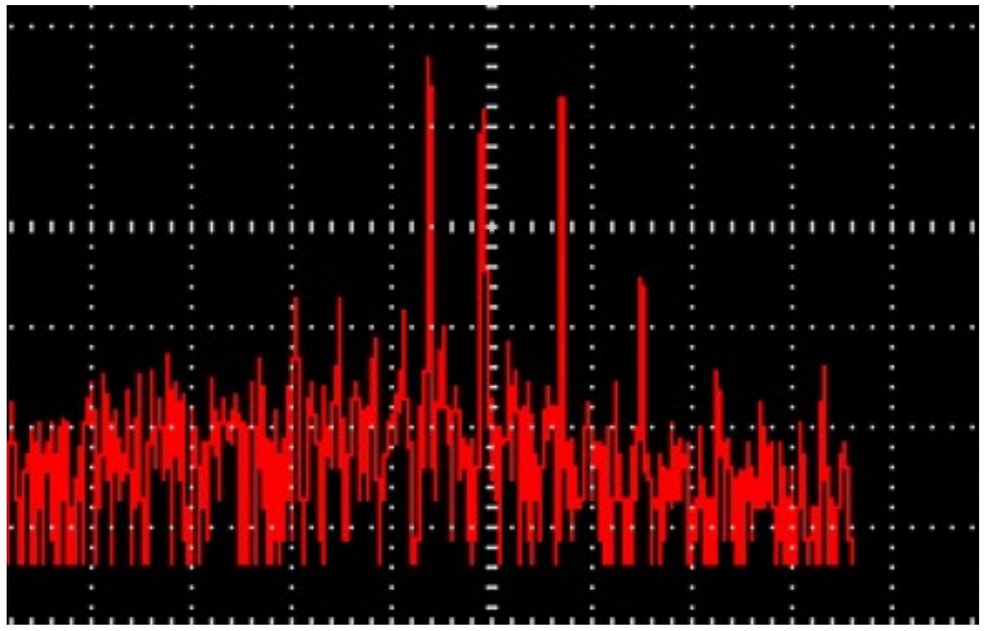


MCP disc. level & trap PS



Fourier Transform:

720 kHz, 790 kHz, and 890 kHz



same freq. found in trap voltage supply
(AWG / PMC_SOFTDAC + TRIUMF Amplifier)

=> programmable PS from GSI to be tested

(any voltage in range 0-200 V in < 1 µs)

Conclusions

- Systematics effects well understood
- Vacuum improved for HCI
- New Detection and Vacuum System
  - Daly detector
  - separate vacuum chamber for detectors

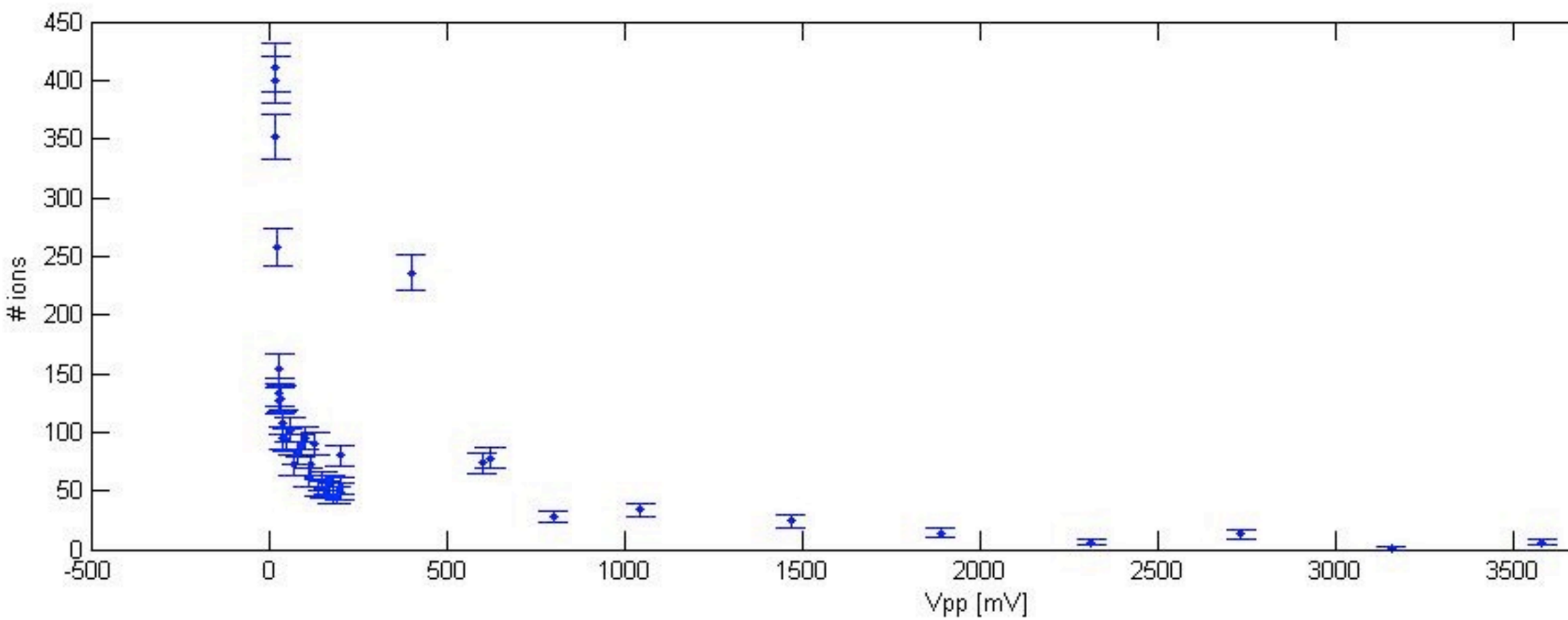
Outlook

- GSI programmable PS
- Ramsey excitation scheme
- investigation of dipole cleaning

Backup Slides

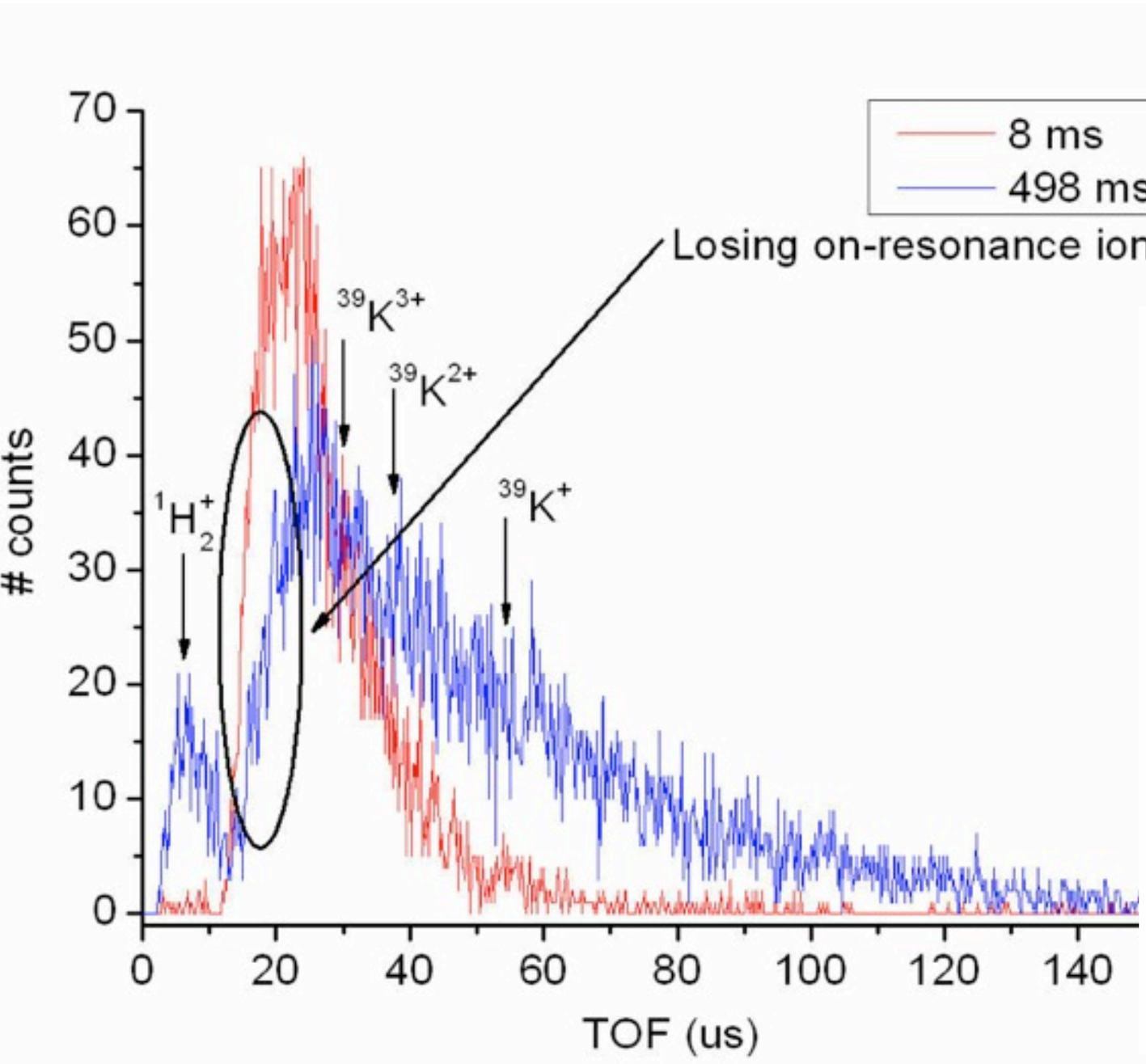
Dipole Cleaning

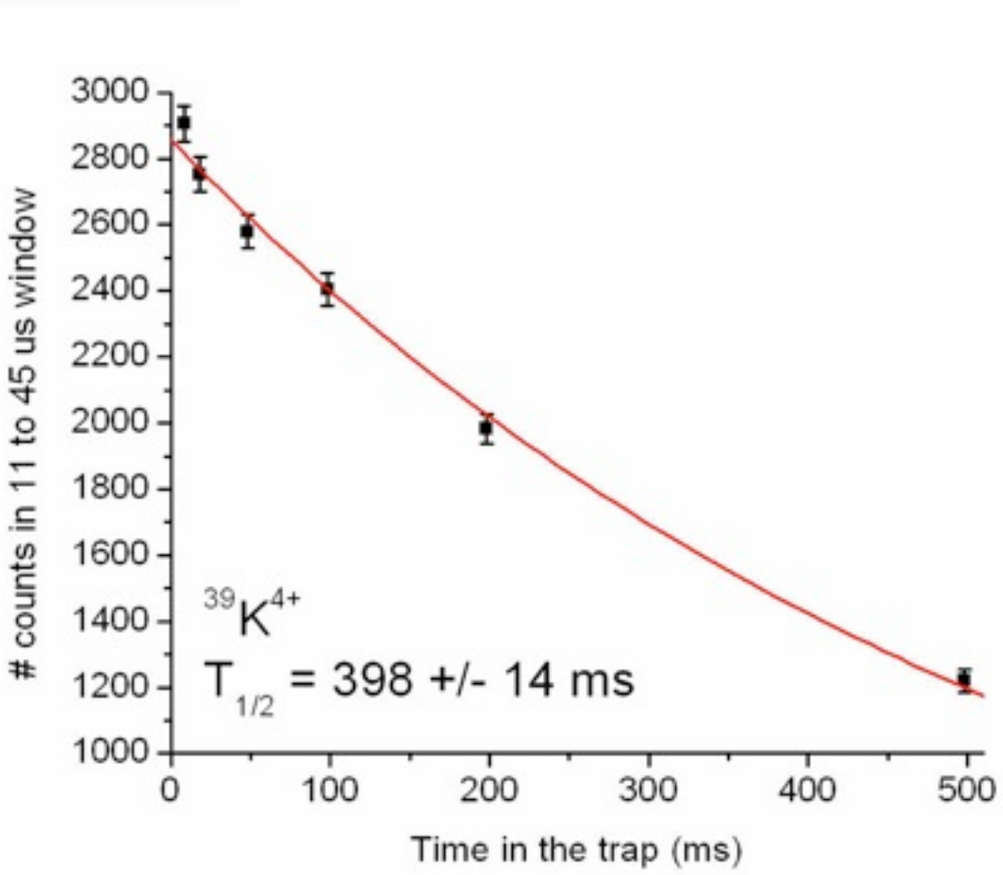
preliminary



MPET Vacuum for HCI

$^{39}K^{4+}$ @1.2·10^{-9} Torr





(after extraction)