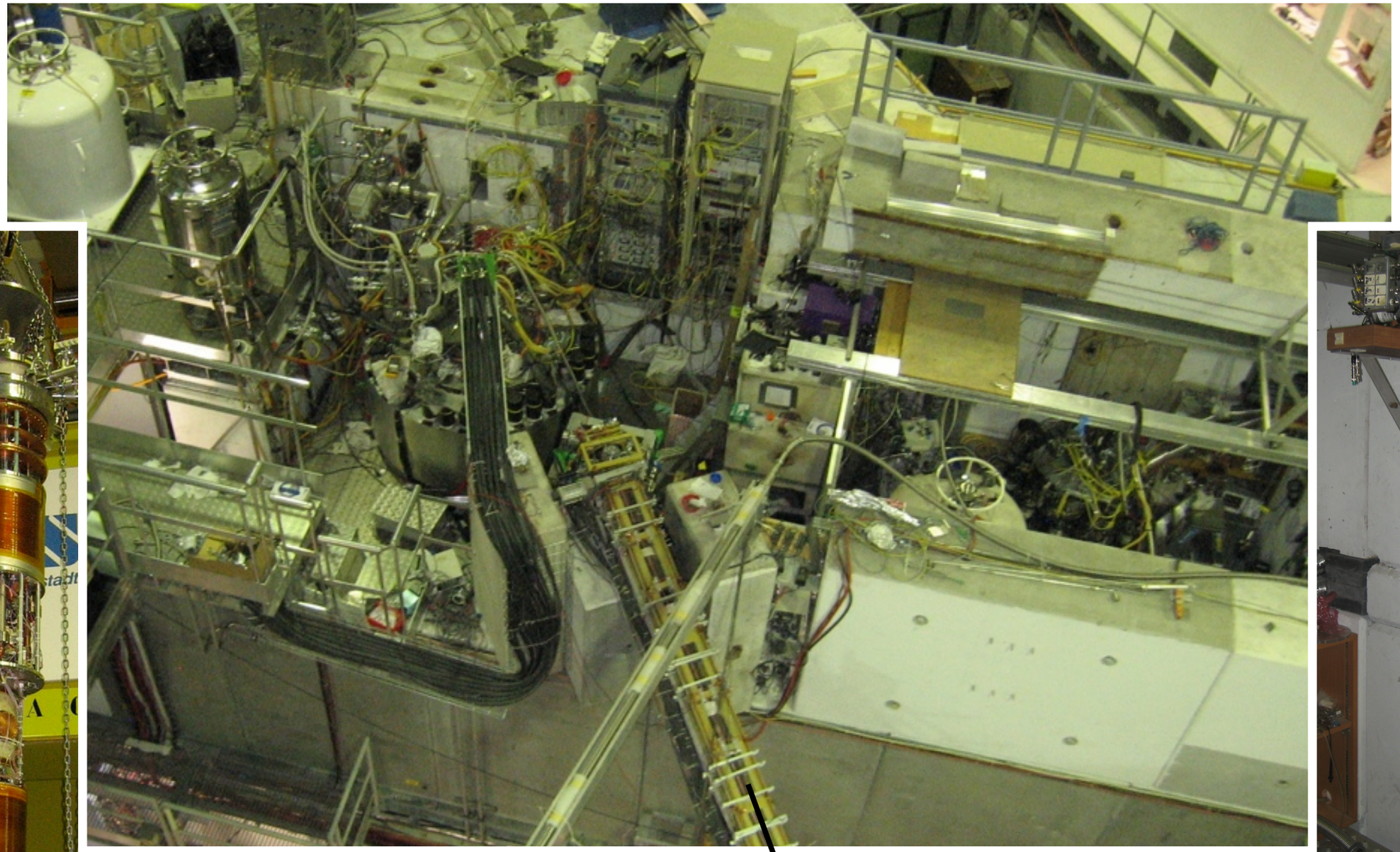
stephan ettenauer | Harvard University

The ATRAP experiment: Status 2012

two experimental zones

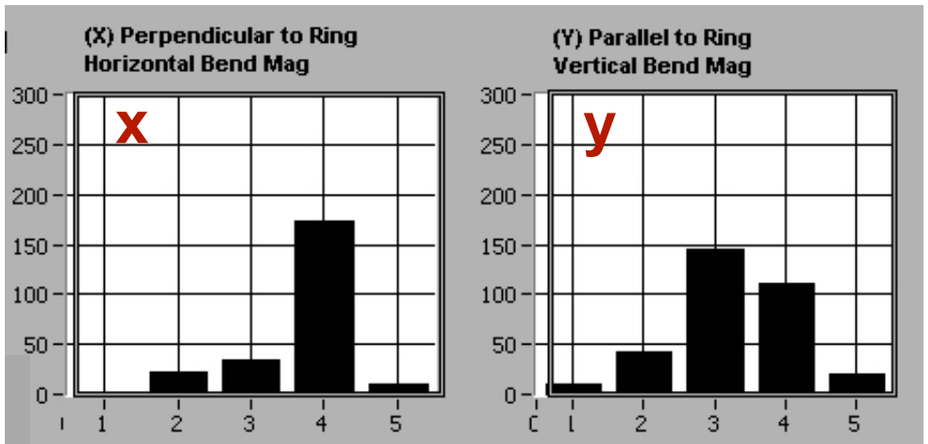
anti-hydrogen studies

anti-proton's magnetic moment

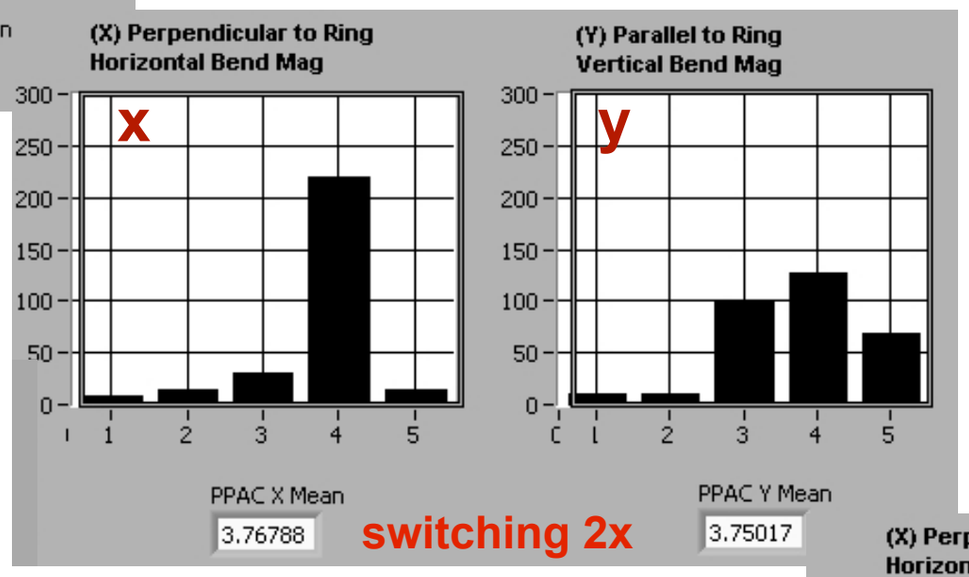


positron accumulator

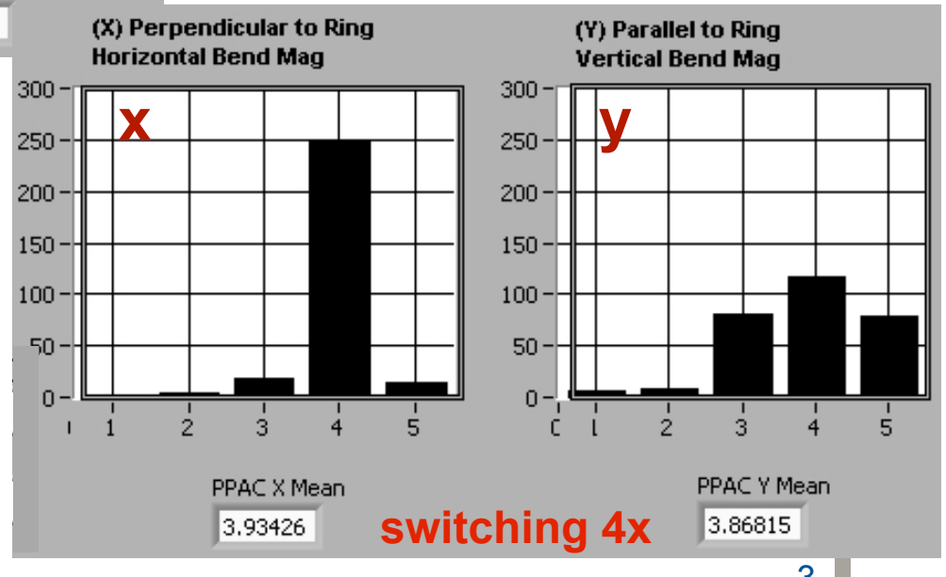
switching between zones



initial steering



switching 2x



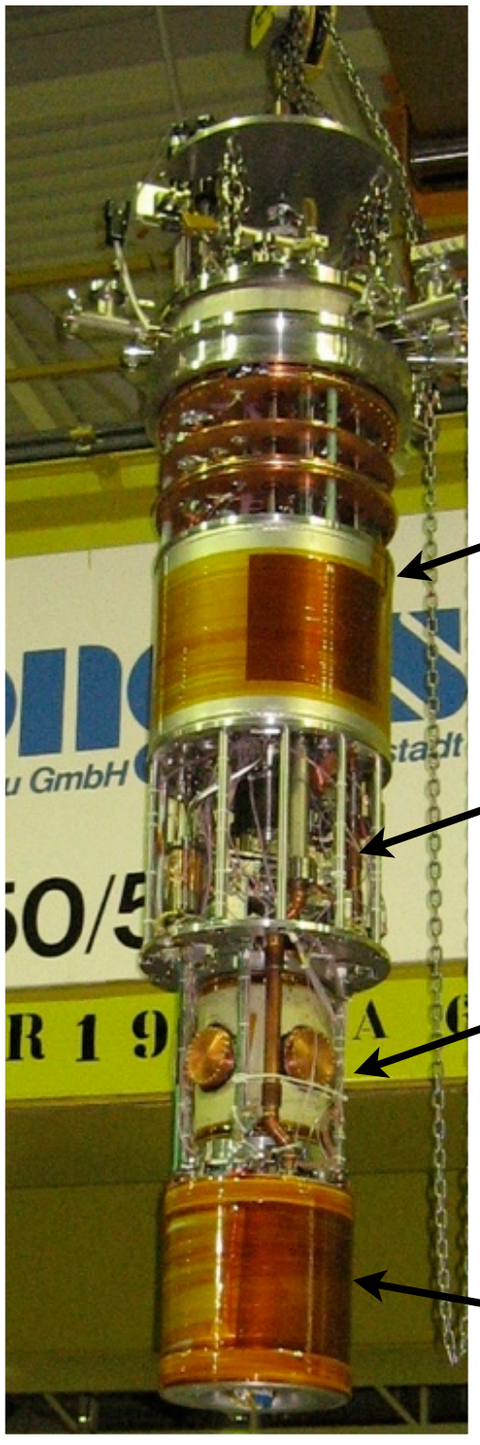
switching 4x

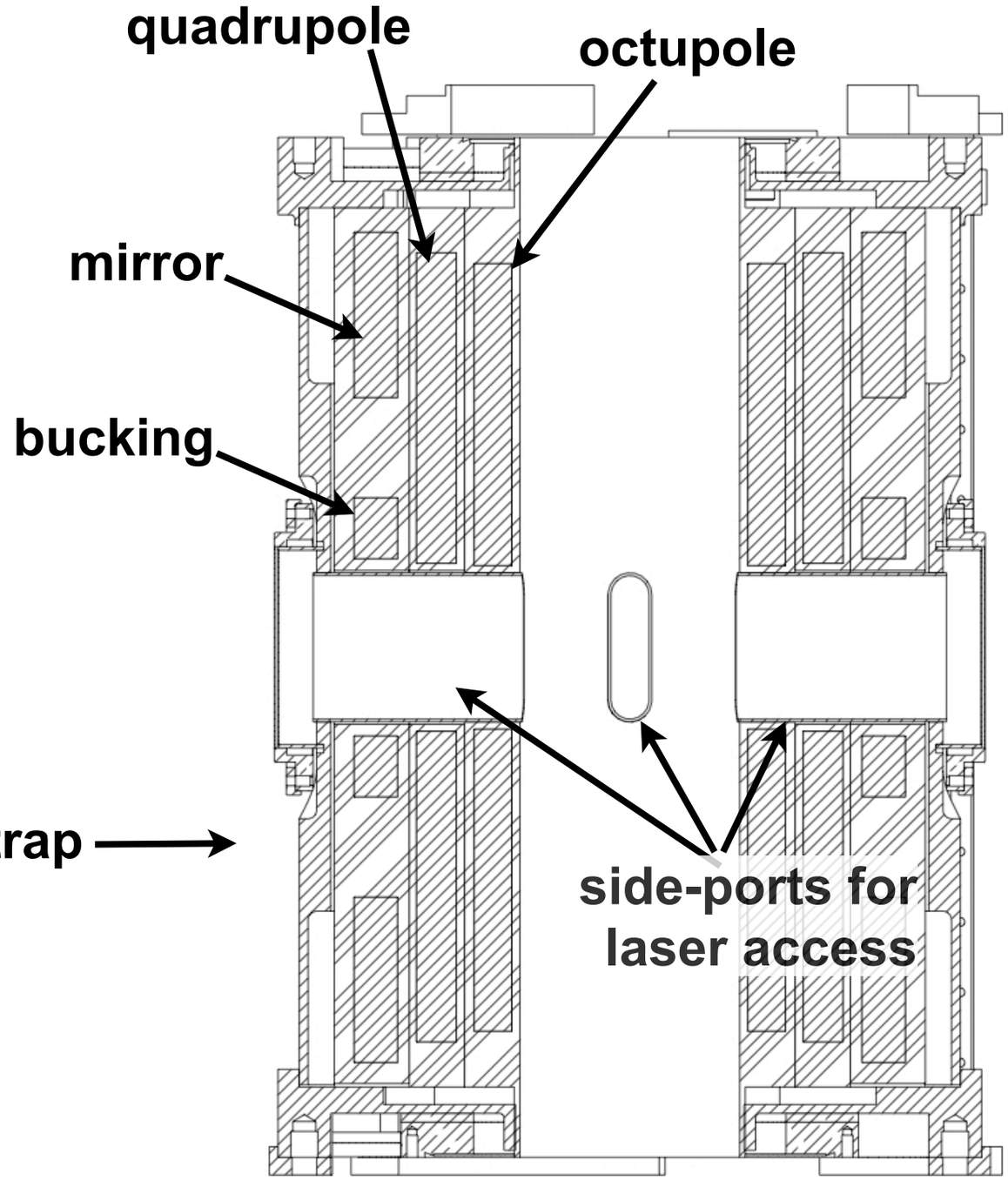
position sensitive detectors in front of anti-hydrogen apparatus

Thank you to AD team

for their help during implementation !

new apparatus for Hbar studies



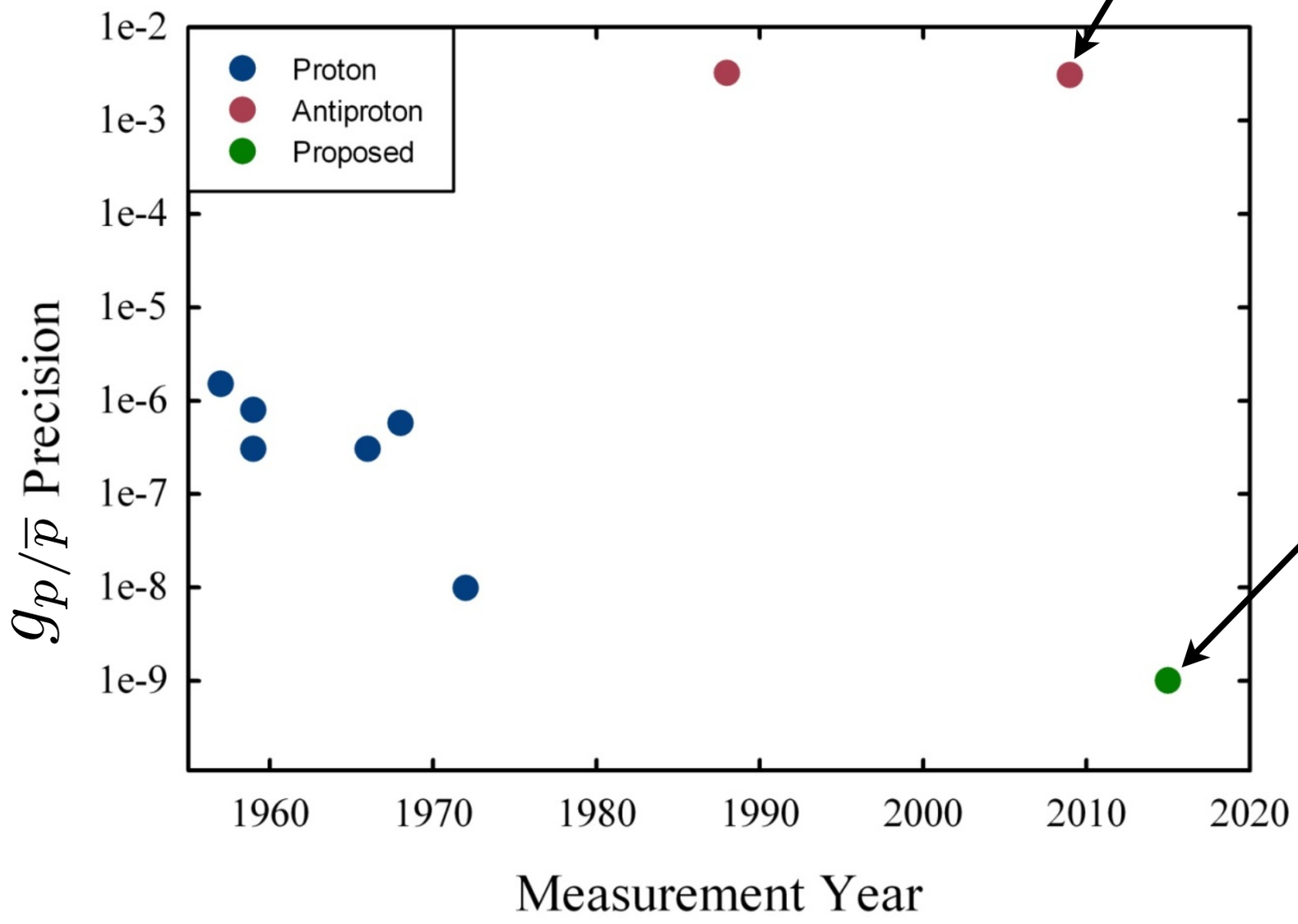


to be commissioned

anti-proton's magnetic moment

ASACUSA: anti-protonic He

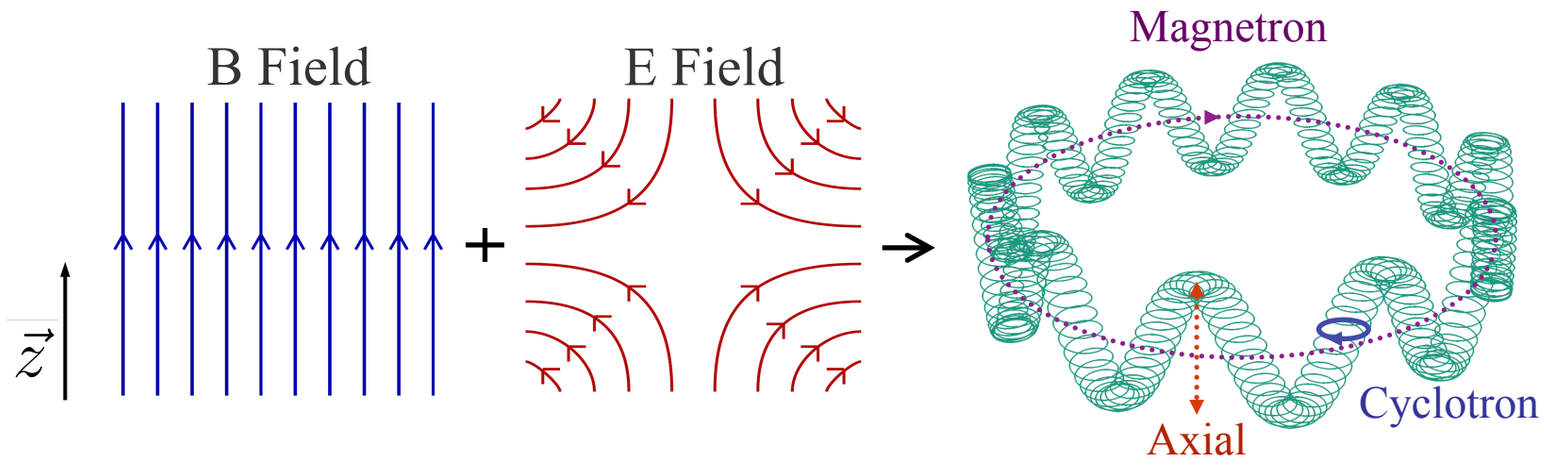
T. Pask et al., Physics Letters B 678, 55 (2009)



Proposal:

direct measurement in Penning trap

measurement principle

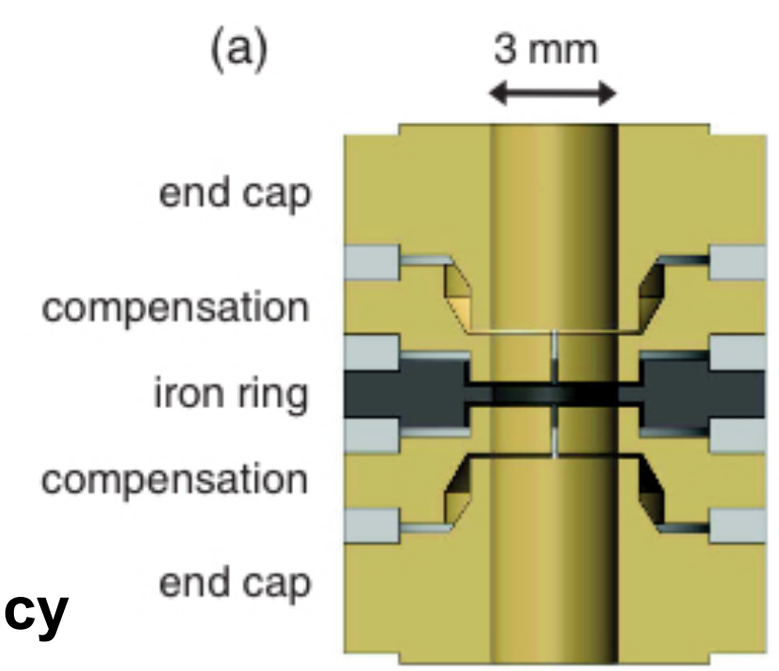


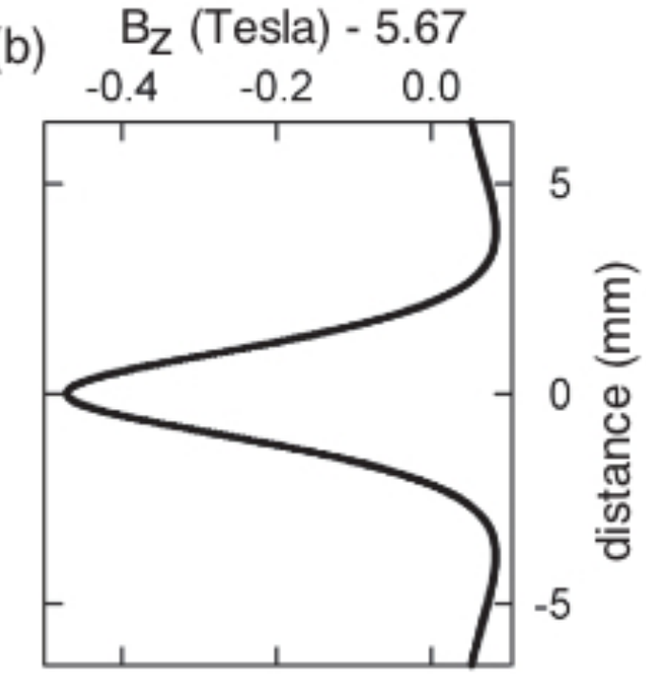
$$\vec{\mu} = g \frac{q\hbar}{2m} \frac{\vec{S}}{\hbar}$$

$$g = \frac{2\nu_s}{\nu_c}$$

spin-frequency

cyclotron-frequency





$$\Delta\omega_z = \Delta\tilde{\omega}_z \left(\frac{gs}{4} + n + \frac{1}{2} + \frac{\omega_m}{\omega_c'}(l + \frac{1}{2}) \right)$$

measurement principle

electron: 3 parts in 10^{13}

D. Hanneke et al., Phys. Rev. Lett. 100, 120801 (2008)

proton:

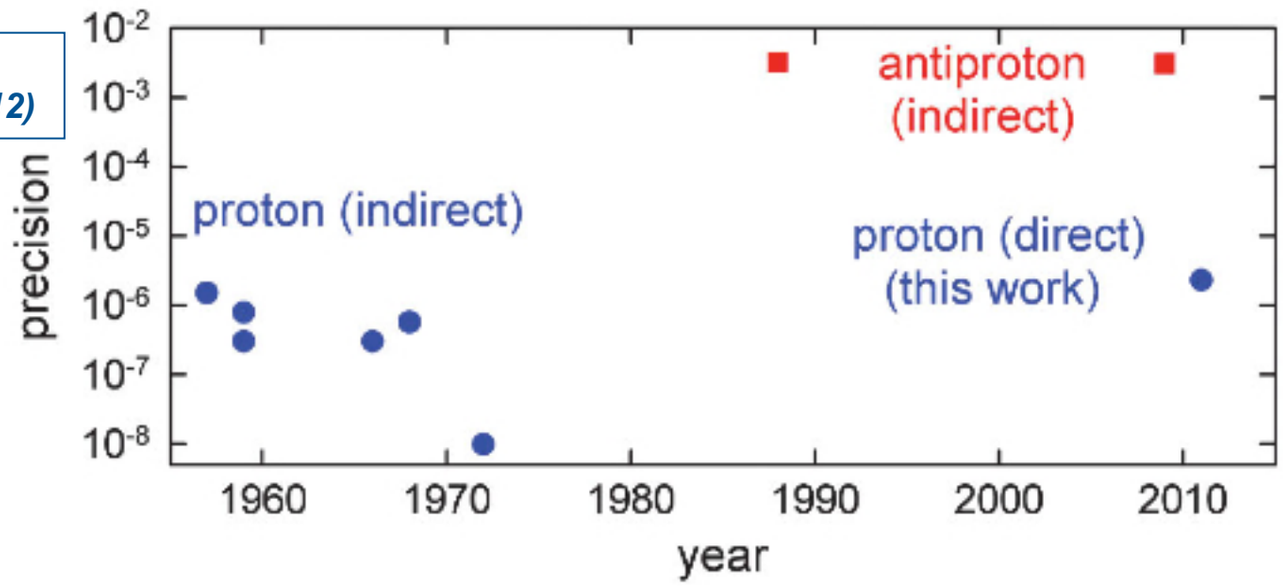
$$\mu_N/\mu_B = m_e/m_p \approx 1/2000$$

Mainz-Heidelberg

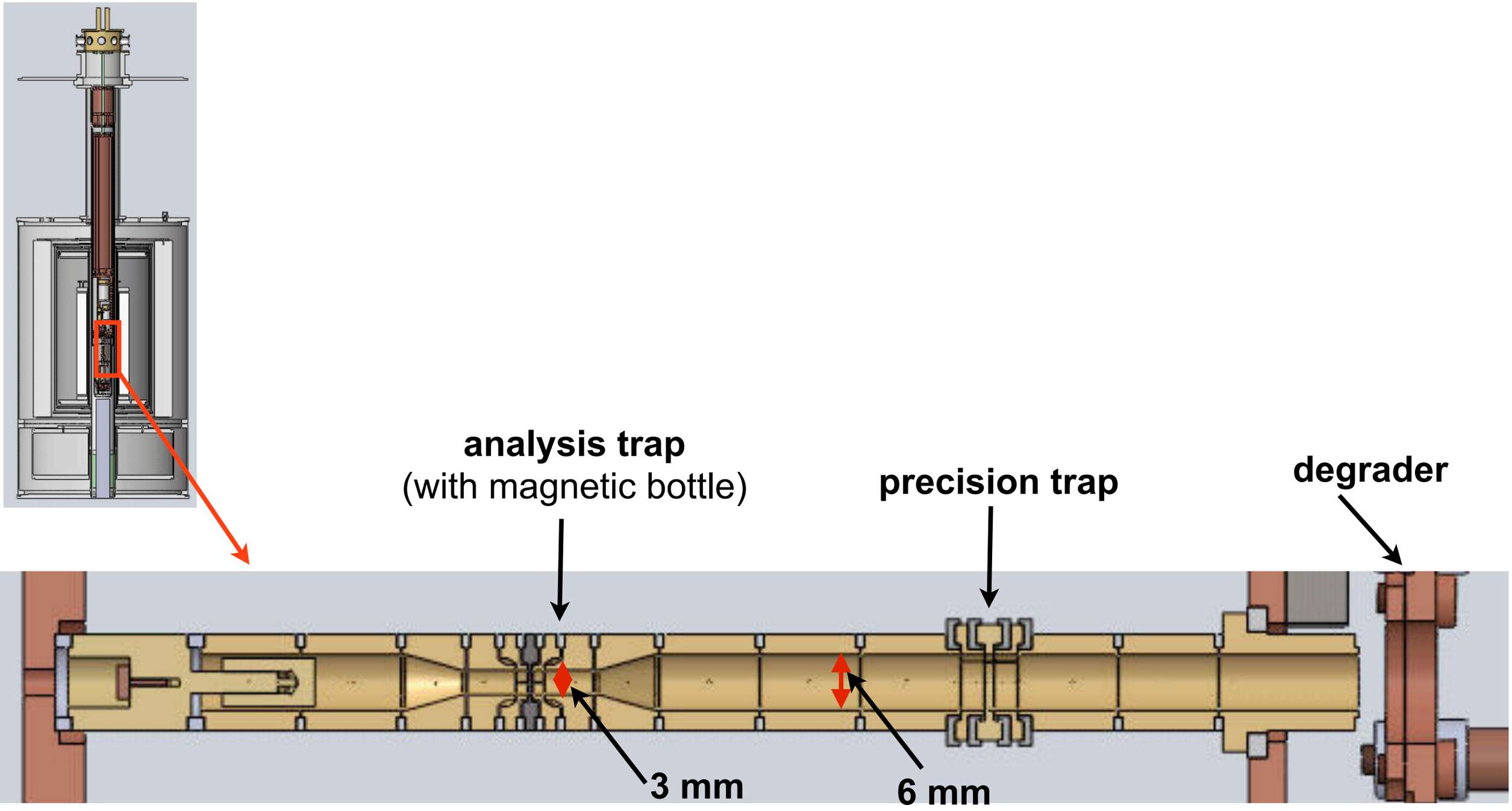
S. Ulmer et al., Phys. Rev. Lett. 106, 253001 (2011)
C C Rodegheri et al., New Journal of Physics 14, 063011 (2012)

Harvard

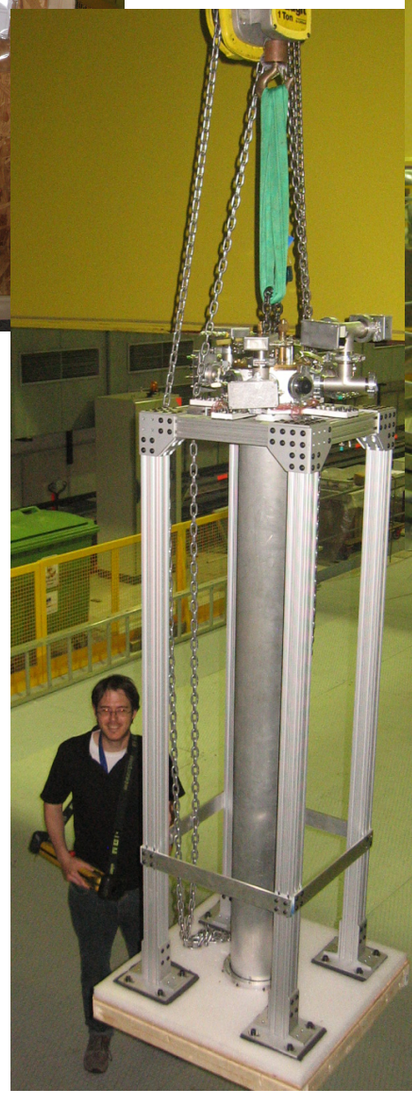
N. Guise et al., Phys. Rev. Lett. 104, 143001 (2010)
J. DiSciacca and G. Gabrielse, Phys. Rev. Lett. 108, 153001 (2012)

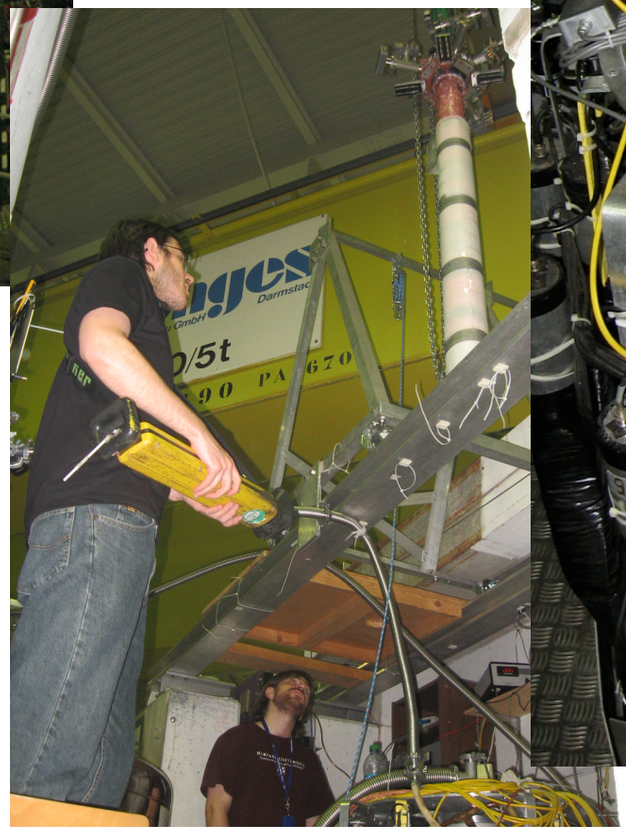


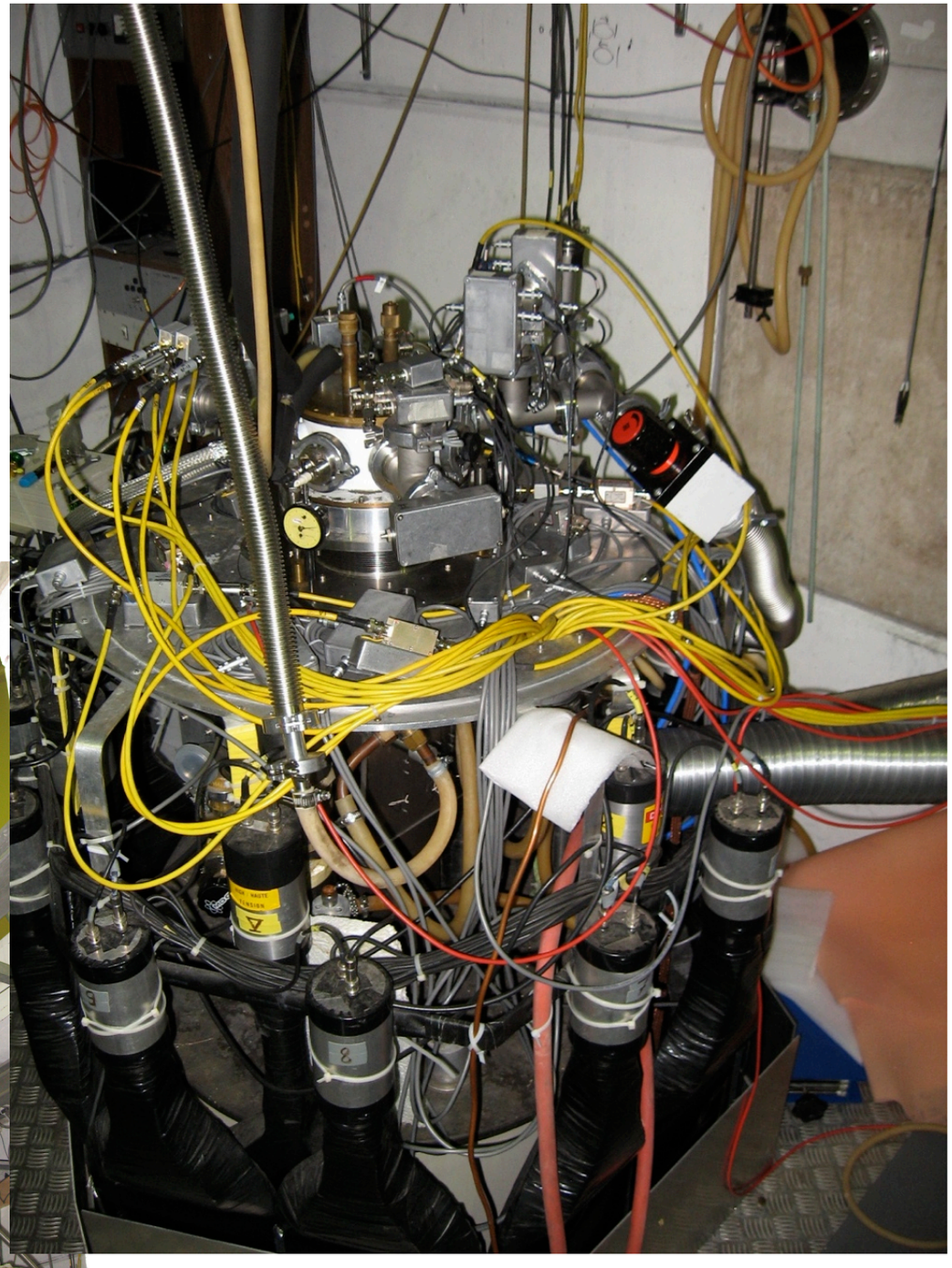
antiproton apparatus



shipping and installation



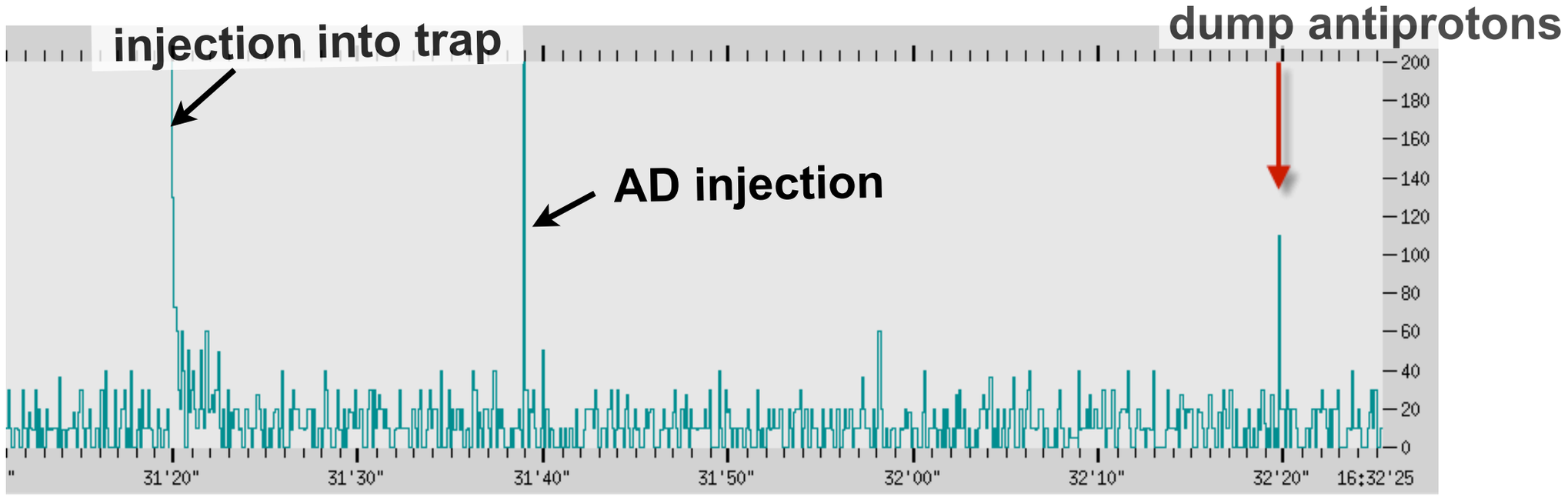


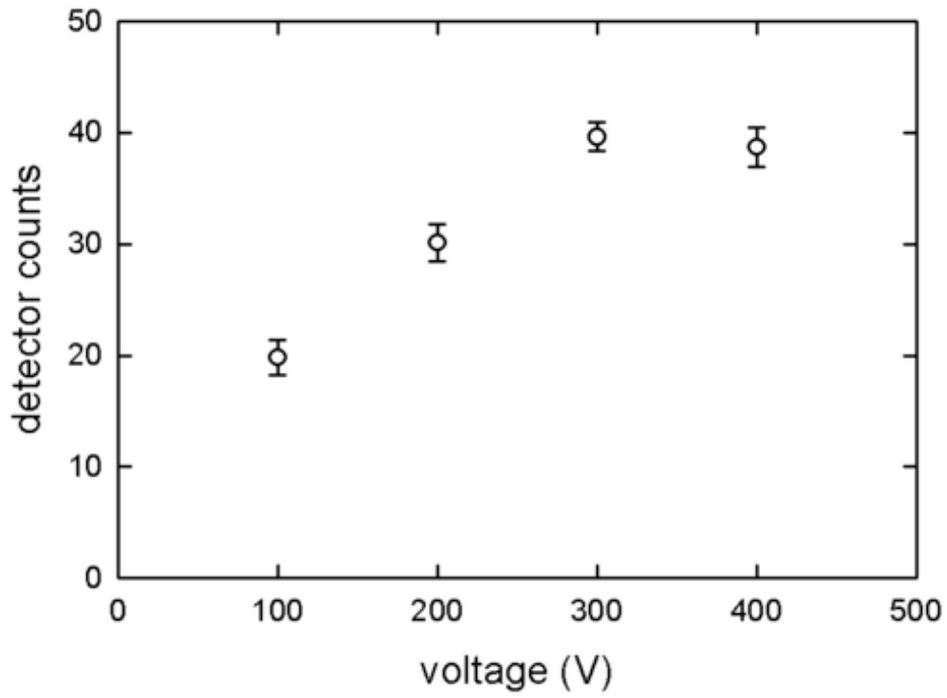


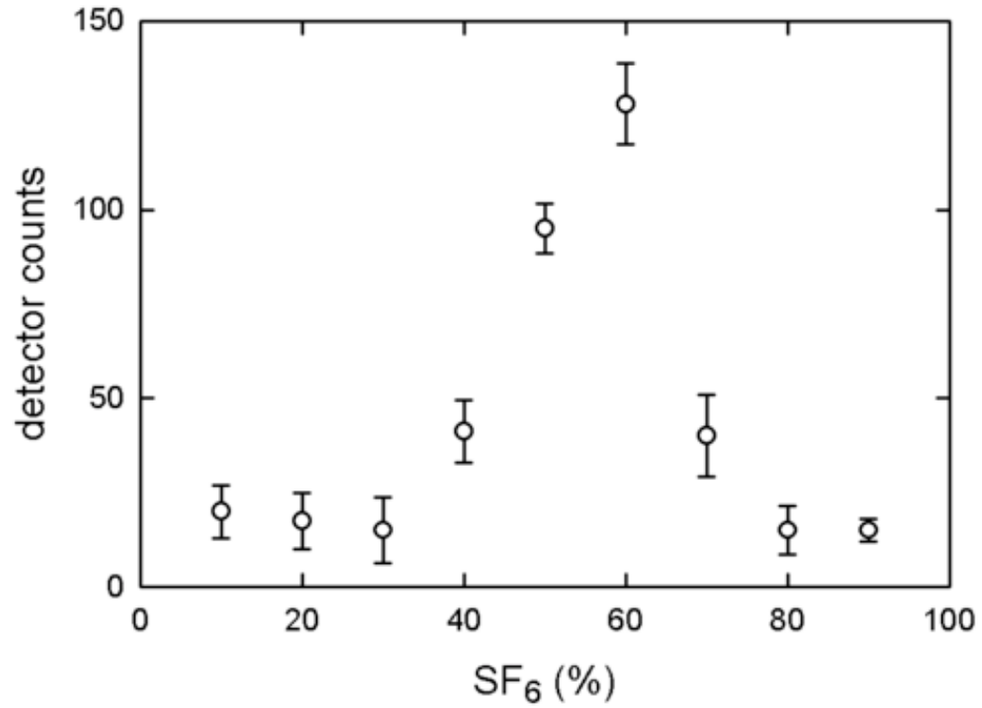
July 2012

trapping antiprotons

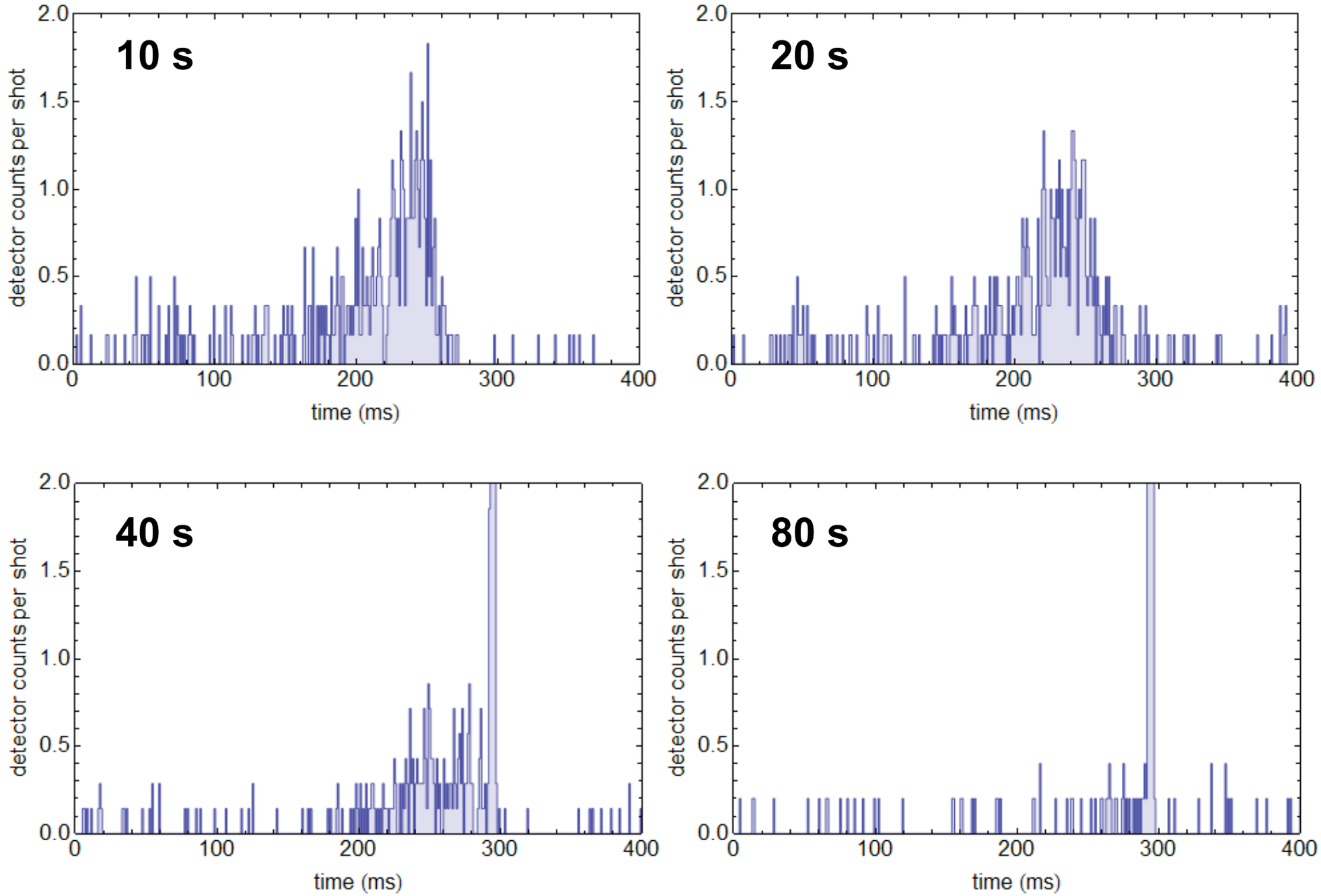
anti-protons dynamically trapped and released afterwards



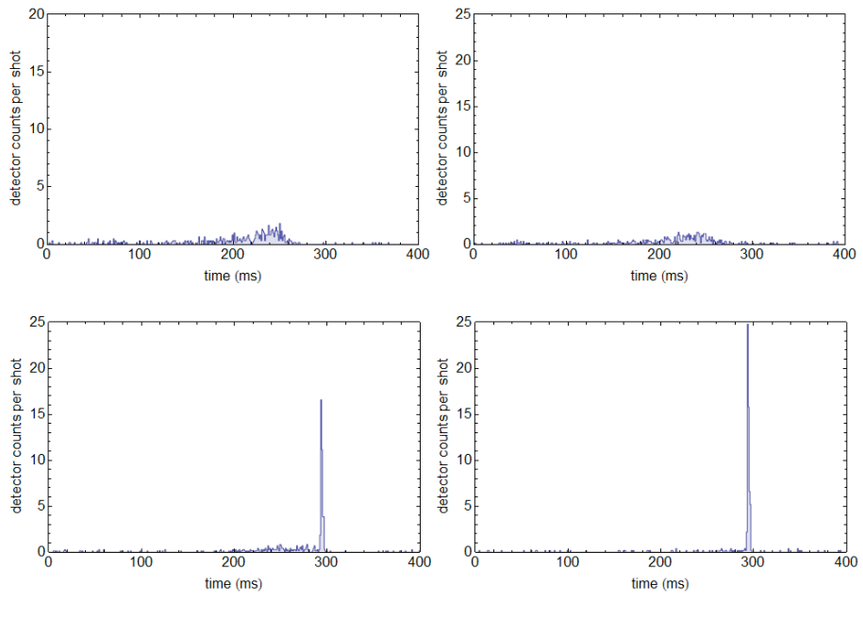


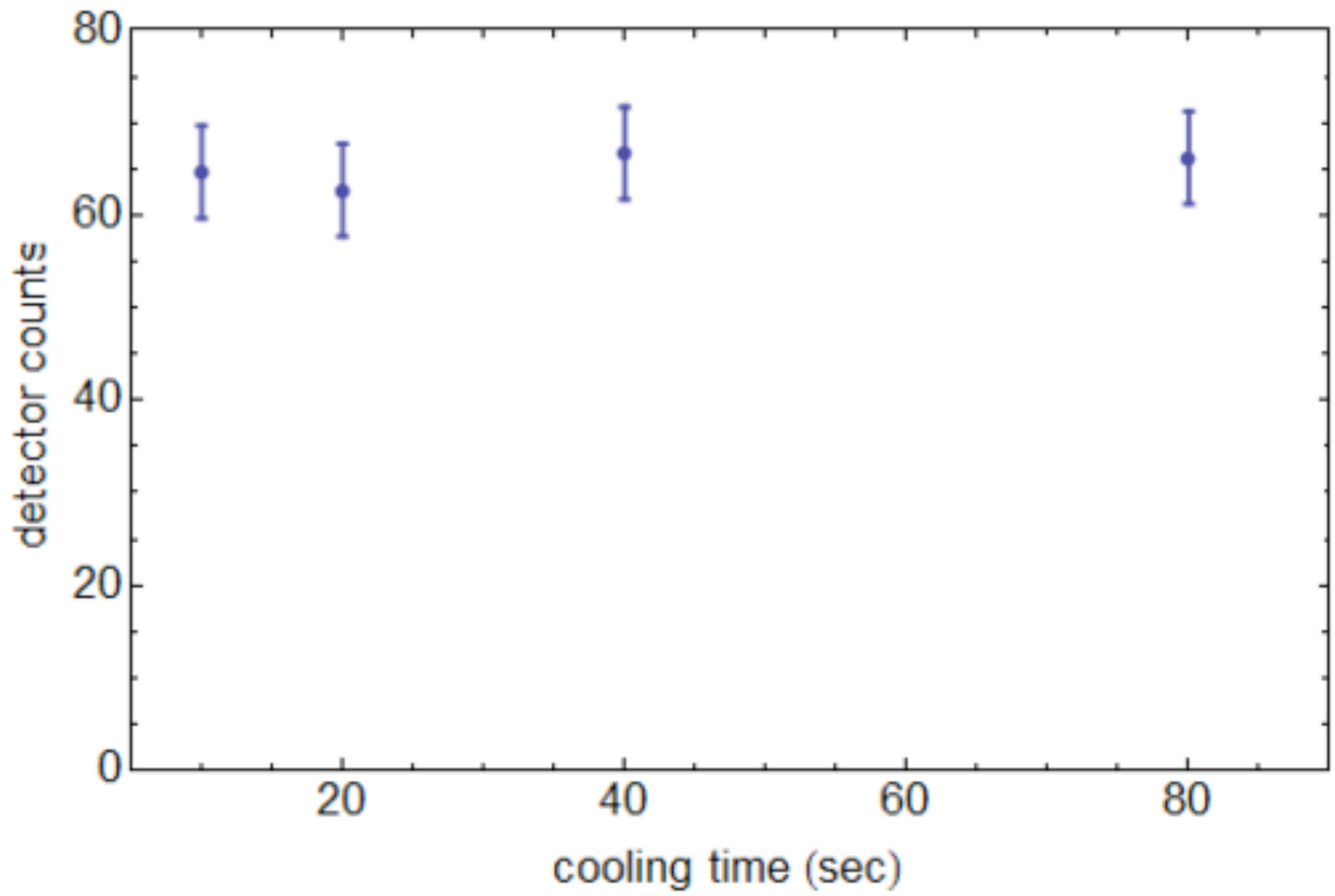


electron cooling



electron cooling

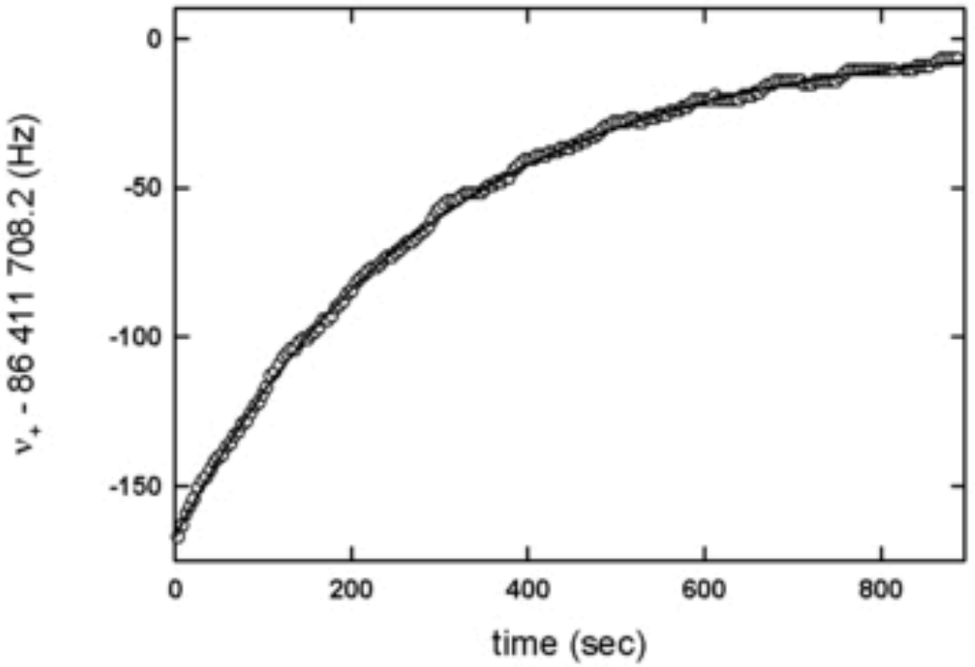




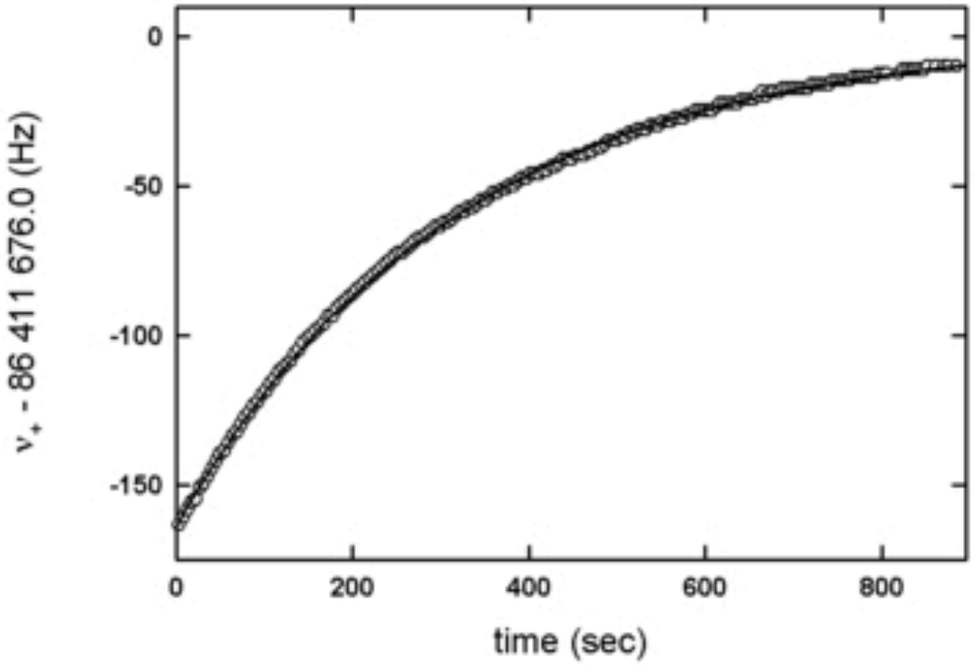
⇒ no losses during cooling

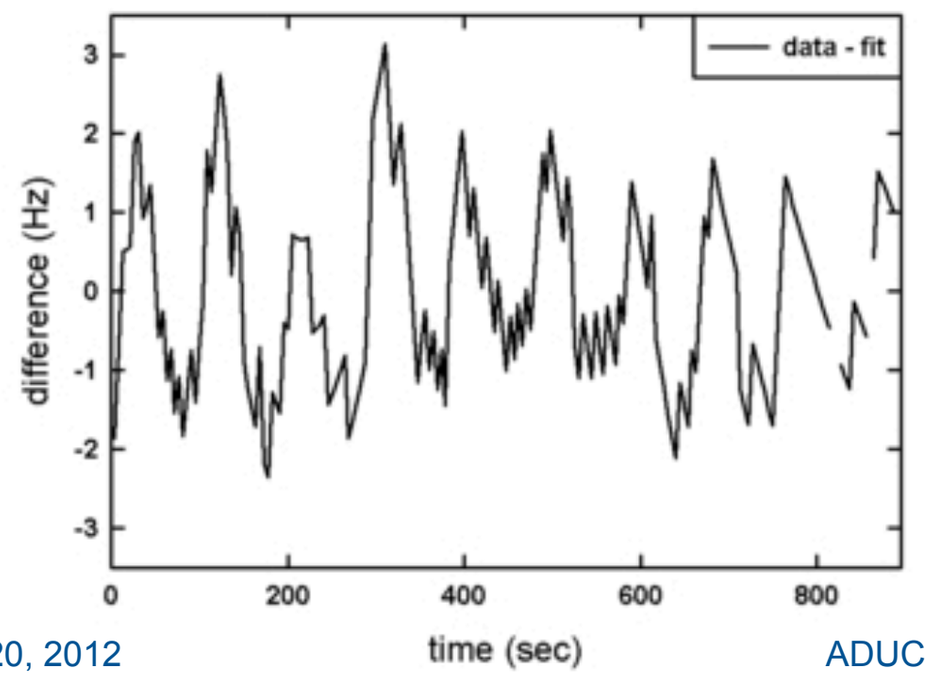
measurement of ν_+ in precision trap

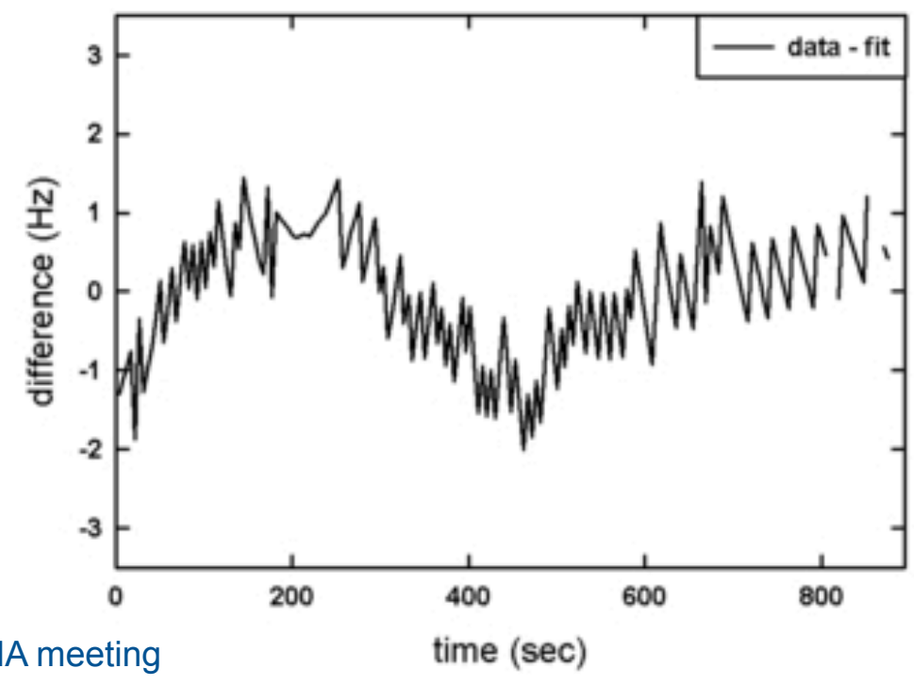
AD cycle on



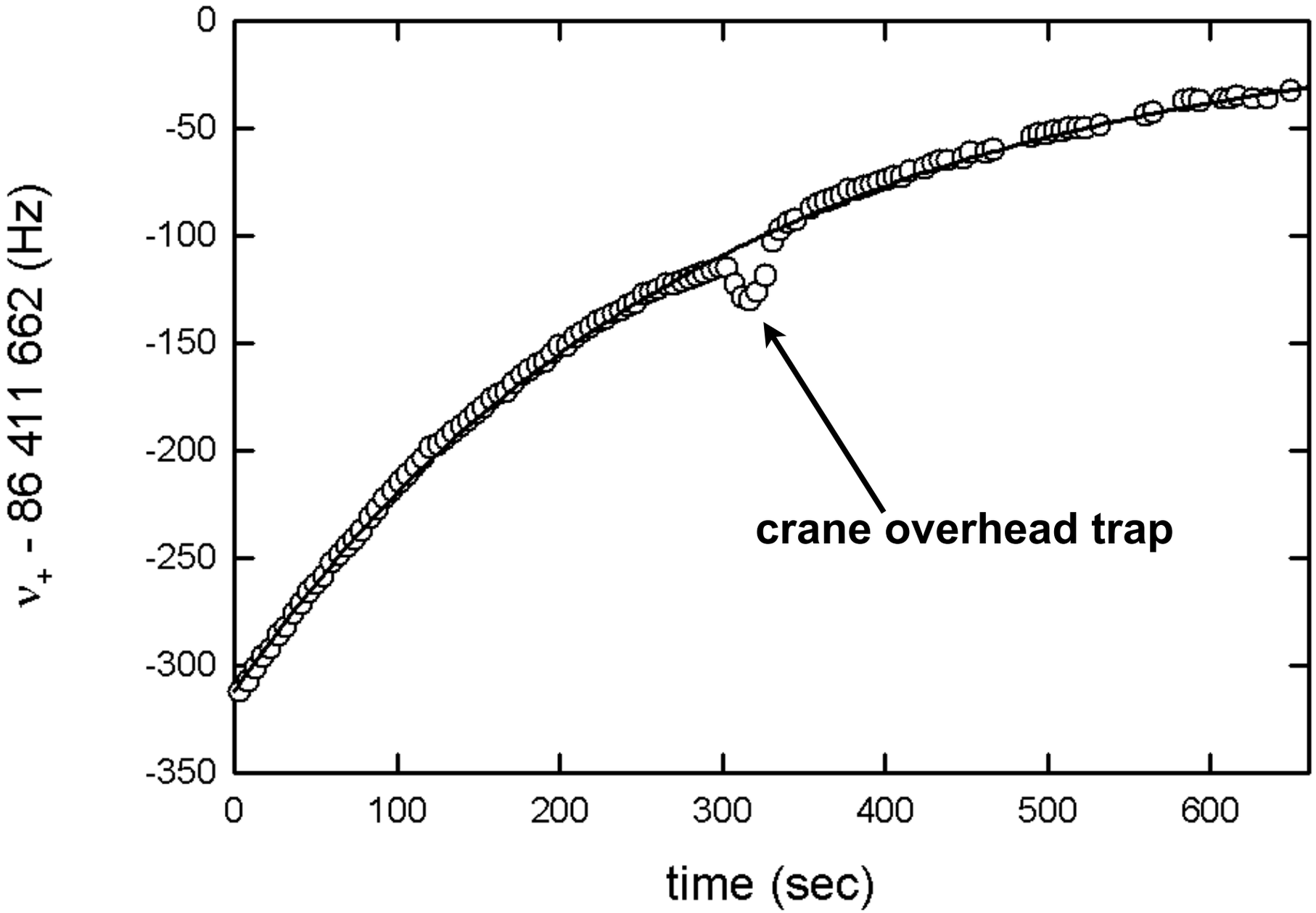
AD cycle off







influence of crane



Summary

- work on two experimental programs
- **Antihydrogen studies:** new experimental apparatus
- **magnetic moment of anti-proton**
  - proton apparatus modified and installed at CERN
  - successful trapping and cooling of anti-protons
  - successful application of Penning trap techniques in precision trap with a single anti-proton

Thank you!

J. DiSciacca
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G. Gabrielse

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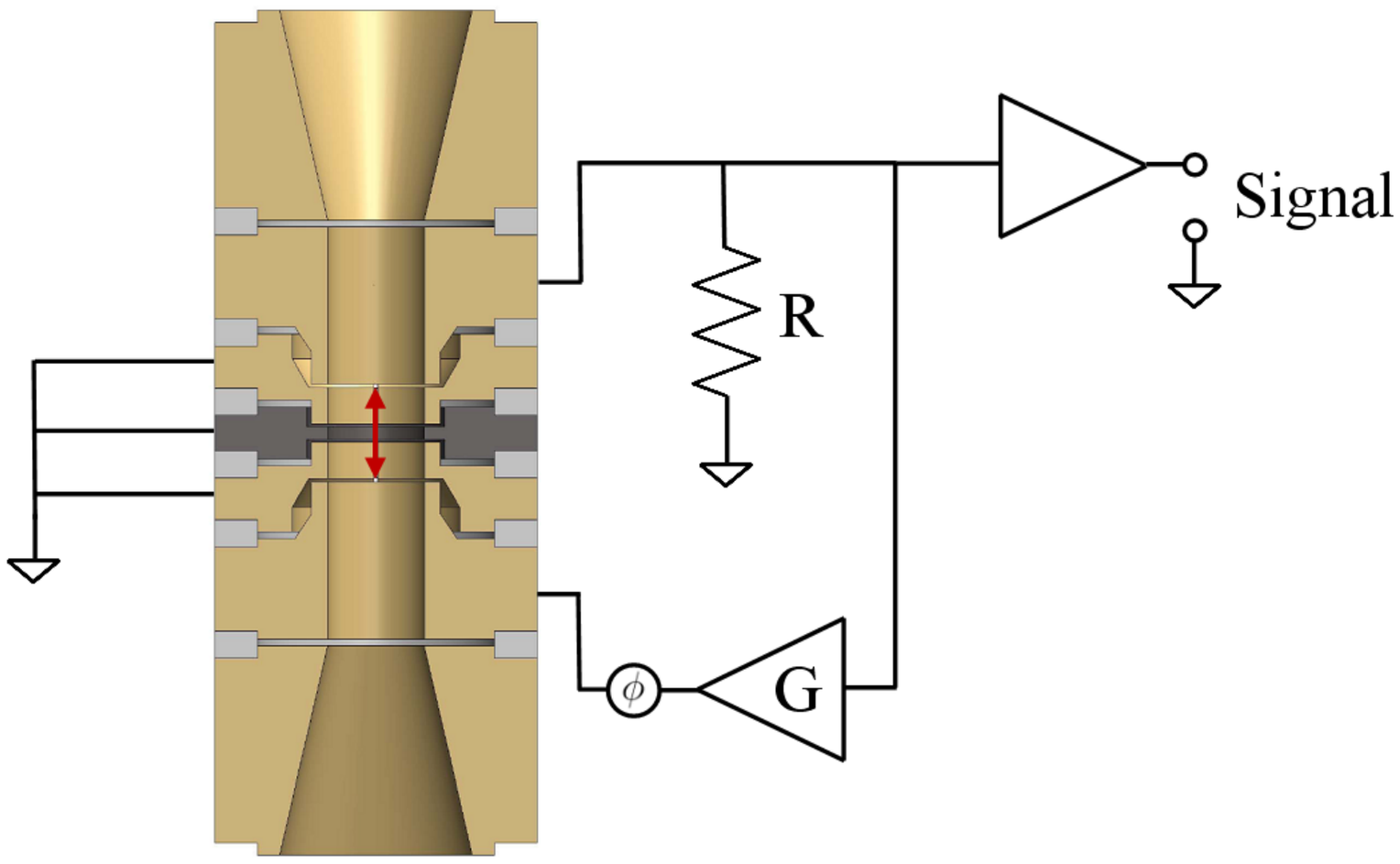
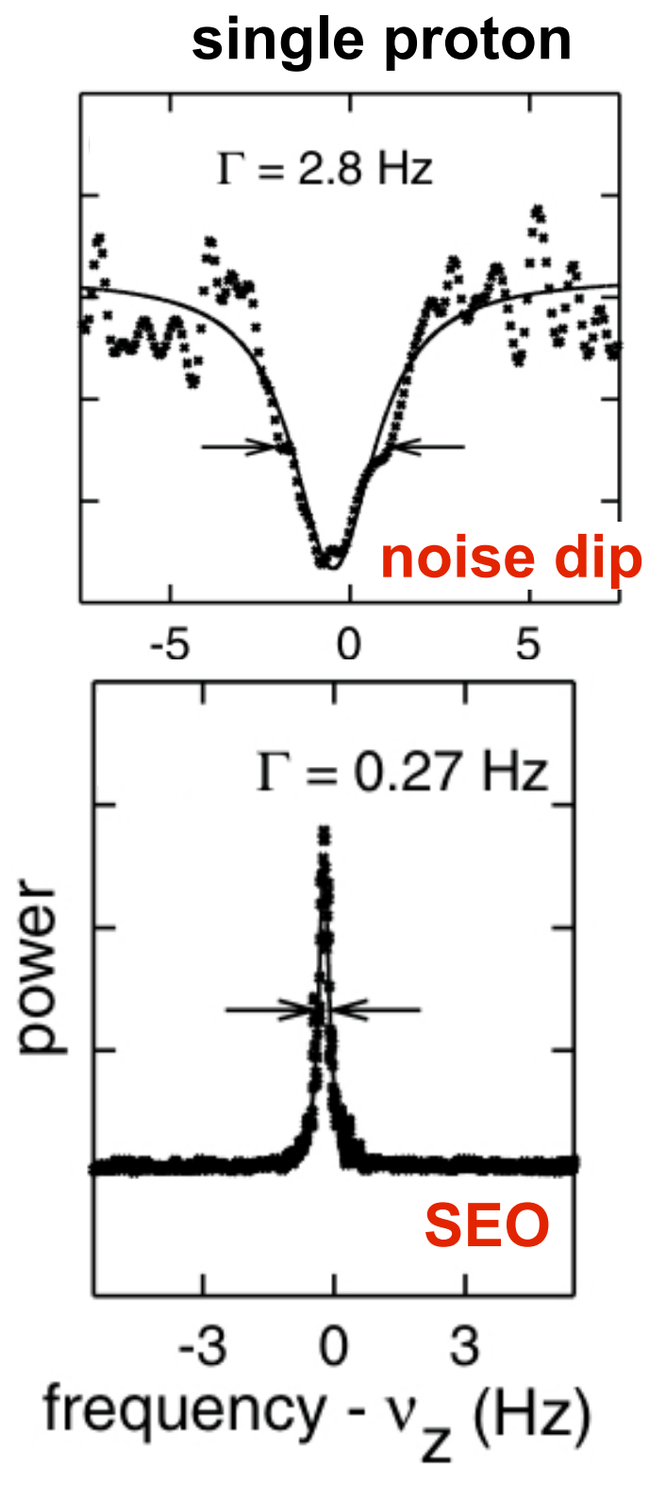
W. Oelert

D.W. Fitzakerley
M.C. George
M. Weel
E.A. Hessels
C.H. Storry

A. Müllers
J. Walz

The Self Excited Oscillator





N. Guise et al., Phys. Rev. Lett. 104, 143001 (2010)