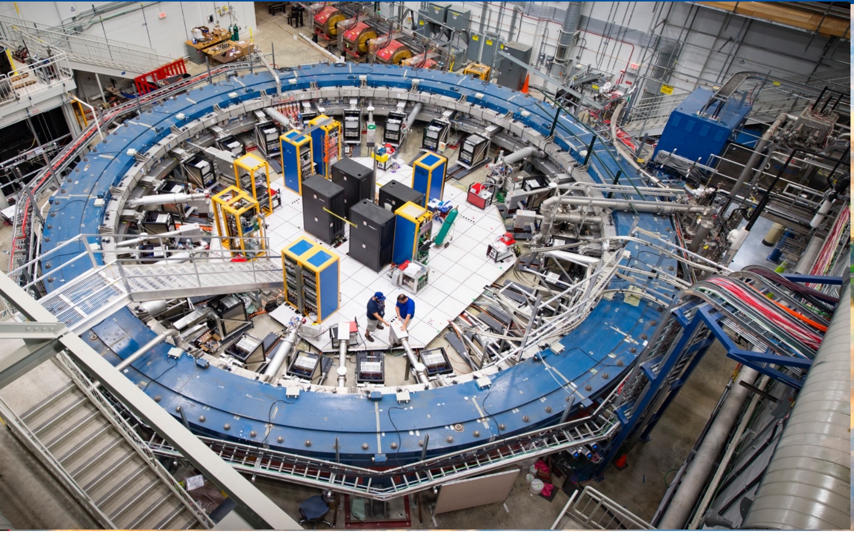
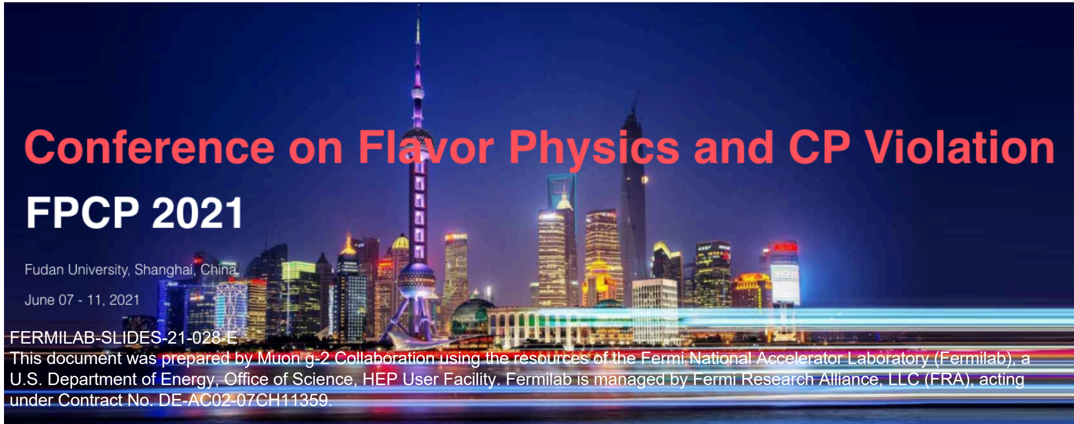


First results from the Muon g-2 Experiment at Fermilab

Brendan Kiburg

Fermi National Accelerator Laboratory



FERMILAB-SLIDES-21-028-E
This document was prepared by Muon g-2 Collaboration using the resources of the Fermi National Accelerator Laboratory (Fermilab), a U.S. Department of Energy, Office of Science, HEP User Facility. Fermilab is managed by Fermi Research Alliance, LLC (FRA), acting under Contract No. DE-AC02-07CH11359.

Exciting Spring for the Muon g-2 Experiment

PRAB
PRA
PRD
PRL

<u>Outline</u>

- Brief Motivation
- Experimental Technique
- Measurements
- Results
- Brief Outlook

Beam dynamics corrections to the Run-1 measurement of the muon anomalous magnetic moment at Fermilab

T. Albahri,[39] A. Anastasi,[11, a] K. Badgley,[7] S. Baeßler,[47, b] I. Bailey,[19, c] V. A. Baranov,[17] E. Barlas-Yucel,[37]

PHYSICAL REVIEW A **103**, 042208 (2021)

Featured in Physics

Magnetic-field measurement and analysis for the Muon $g-2$ Experiment at Fermilab

PHYSICAL REVIEW D **103,** 072002 (2021)

Editors' Suggestion   Featured in Physics

Measurement of the anomalous precession frequency of the muon in the Fermilab Muon $g-2$ Experiment

T. Albahri,[38] A. Anastasi,[11,a] A. Anisenkov,[4,b] K. Badgley,[7] S. Baeßler,[45,c] I. Bailey,[19,d] V. A. Baranov,[17] E. Barlas-Yucel,[36]

PHYSICAL REVIEW LETTERS **126,** 141801 (2021)

Editors' Suggestion   Featured in Physics

Measurement of the Positive Muon Anomalous Magnetic Moment to 0.46 ppm

B. Abi,[44] T. Albahri,[39] S. Al-Kilani,[36] D. Allspach,[7] L. P. Alonzi,[48] A. Anastasi,[11,a] A. Anisenkov,[4,b] F. Azfar,[44] K. Badgley,[7] S. Baeßler,[47,c] I. Bailey,[19,d] V. A. Baranov,[17] E. Barlas-Yucel,[37] T. Barrett,[6] E. Barzi,[7] A. Basti,[11,32] F. Bedeschi,[11] A. Behnke,[22] M. Berz,[20] M. Bhattacharya,[43] H. P. Binney,[48] R. Bjorkquist,[6] P. Bloom,[21] J. Bono,[7] E. Bottalico,[11,32] T. Bowcock,[39] D. Boyden,[22] G. Cantatore,[13,34] R. M. Carey,[2] J. Carroll,[39] B. C. K. Casey,[7] D. Cauz,[35,8] S. Ceravolo,[9] R. Chakraborty,[38] S. P. Chang,[18,5] A. Chapelain,[6] S. Chappa,[7] S. Charity,[7] R. Chislett,[36] J. Choi,[5] Z. Chu,[26,e] T. E. Chupp,[42] M. E. Convery,[7] A. Conway,[41] G. Corradi,[9] S. Corrodi,[1] L. Cotrozzi,[11,32] J. D. Crnkovic,[3,37,43] S. Dabagov,[9,f] P. M. De Lurgio,[1] P. T. Debevec,[37] S. Di Falco,[11] P. Di Meo,[10] G. Di Sciascio,[12] R. Di Stefano,[10,30] B. Drendel,[7]

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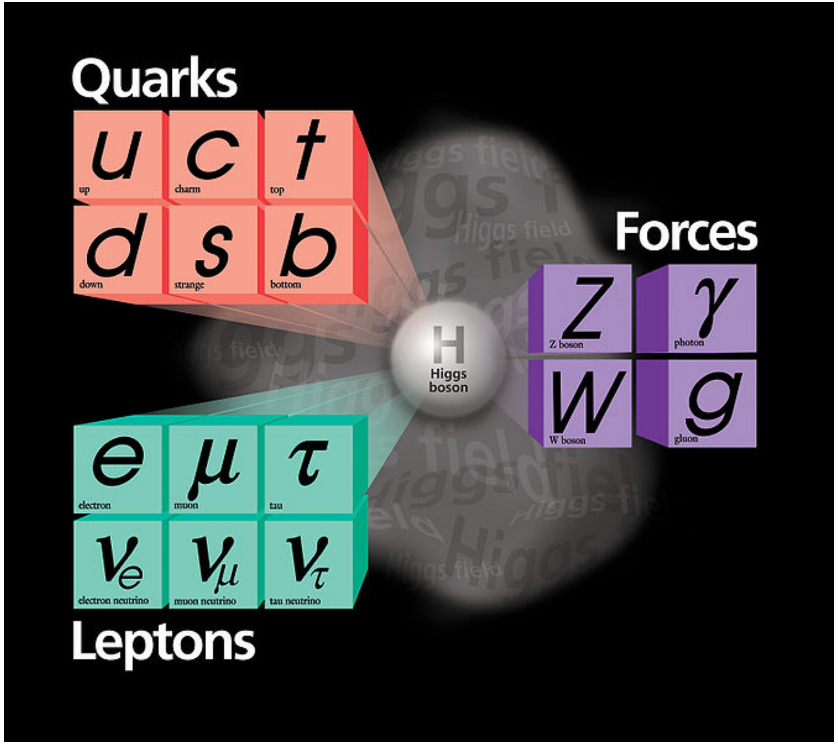
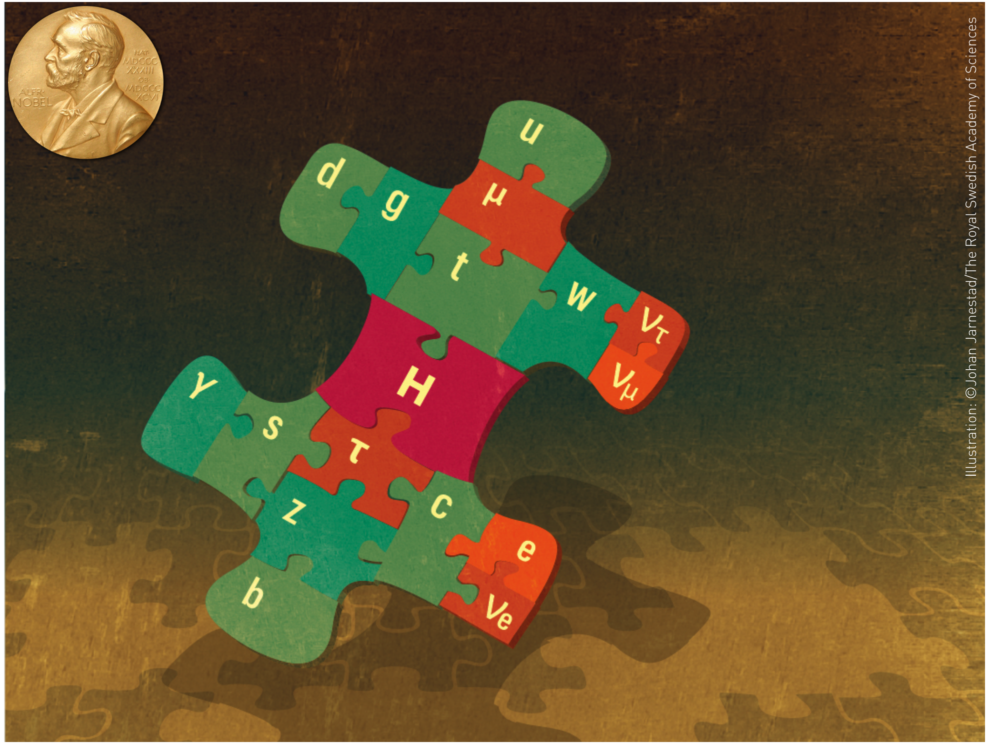
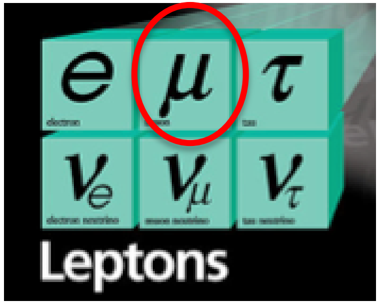
The Standard Model: Great success, many open questions!





Our favorite probe: The muon



- Fortuitous lifetime = 2.2 μs
- Spin 1/2 particle
- Encodes information about spin in its decay

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

- This g-factor is the “g” in “g-2”

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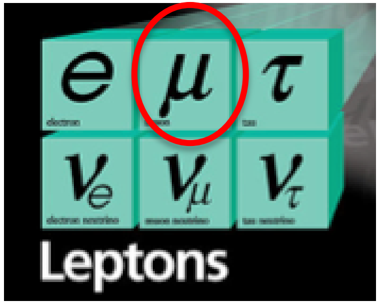
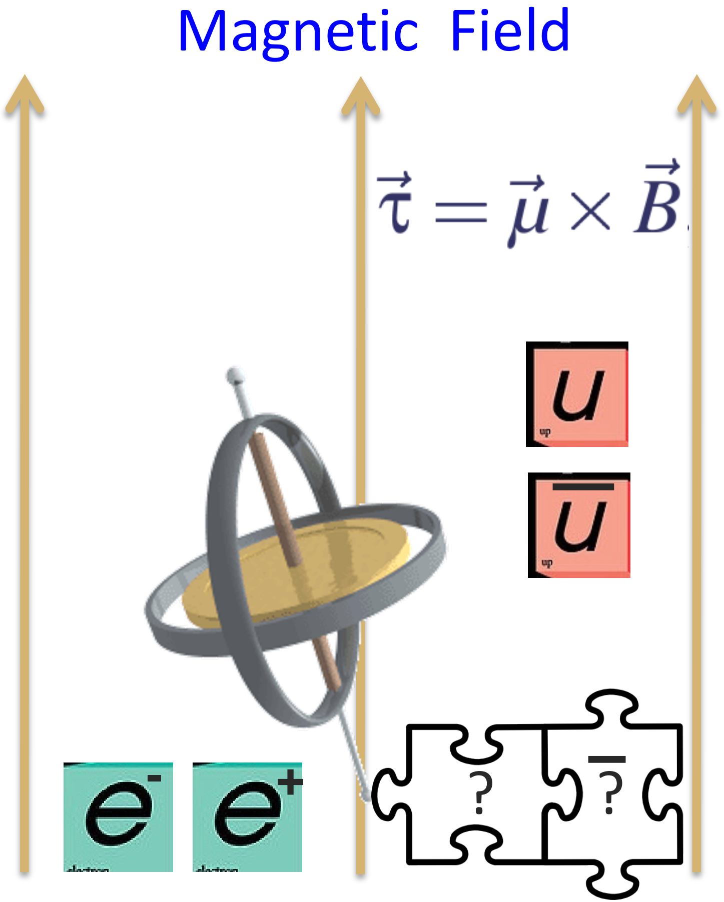
Our favorite probe: The muon



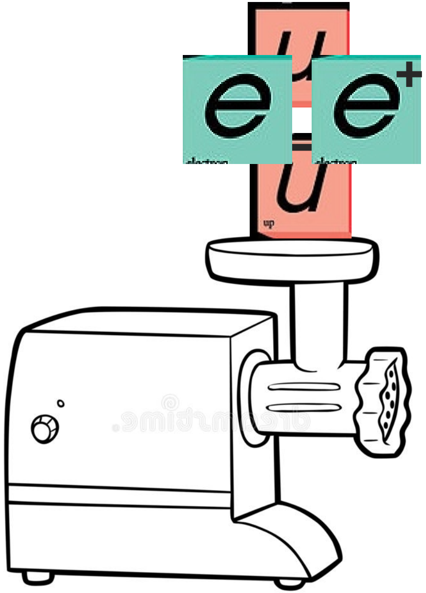
- Fortuitous lifetime = 2.2 μs
- Spin 1/2 particle
- Encodes information about spin in its decay

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

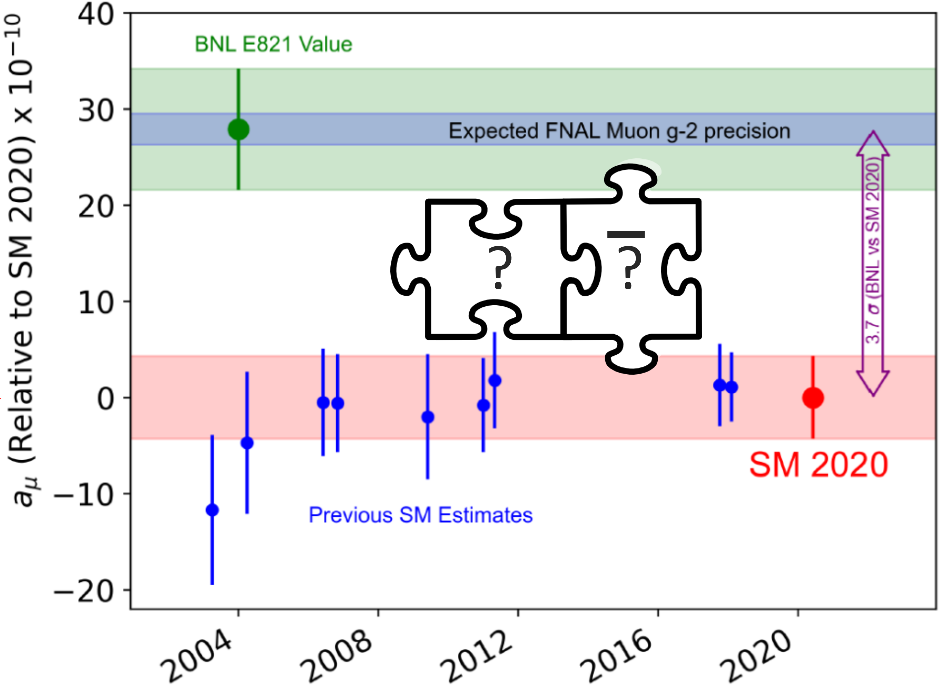
- This g-factor is the "g" in "g-2"
- g= 2 + contributions from virtual particles



Motivation: Status of the muon anomaly before Fermilab Experiment



$a_\mu = (g-2)/2$



- Martin Hoferichter's talk: SM & BSM physics, and possible interpretations

T. Aoyama, N. Asmussen, M. Benayoun et al., The anomalous magnetic moment of the muon in the Standard Model, Physics Reports (2020), https://doi.org/10.1016/j.physrep.2020.07.006.

Muon g-2 basics in a storage ring

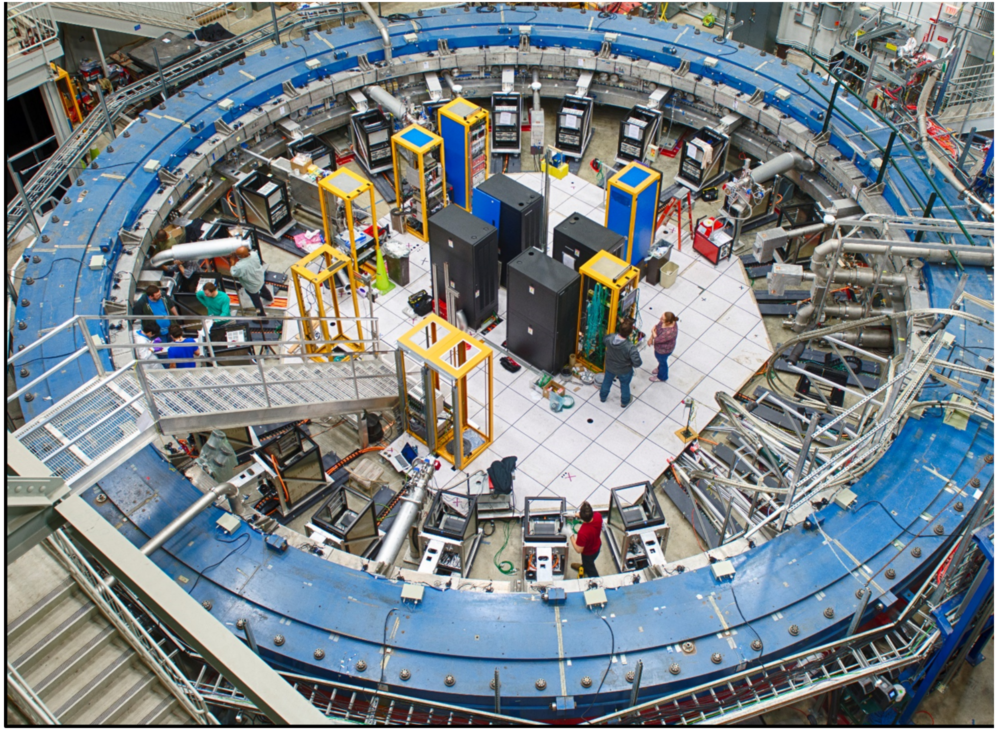
$$\omega_a = \frac{eB}{m} a_\mu$$

A precision measurement of the muon's anomalous spin-precession frequency in a well-measured magnetic field will tell us how muons see the universe.

What are the main experimental steps to get a_μ ?

$$\omega_a = \frac{eB}{m} a_\mu$$

1. Build a racetrack for the muons
2. Inject and store polarized muons
3. Measure the decay positrons to determine the muons' properties
4. Map and track the magnetic field



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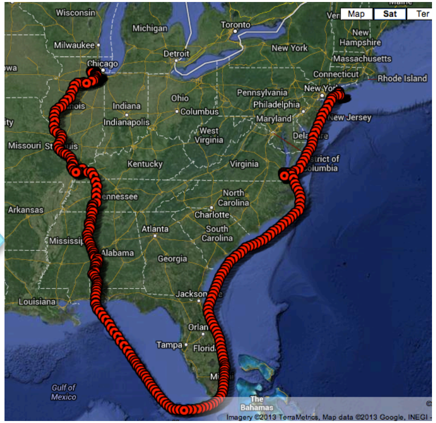
1. Build a racetrack for the muons: Bring the magnet to Fermilab

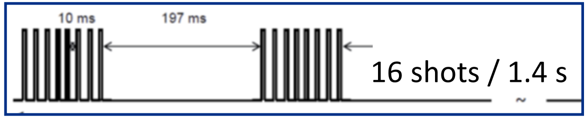
2013



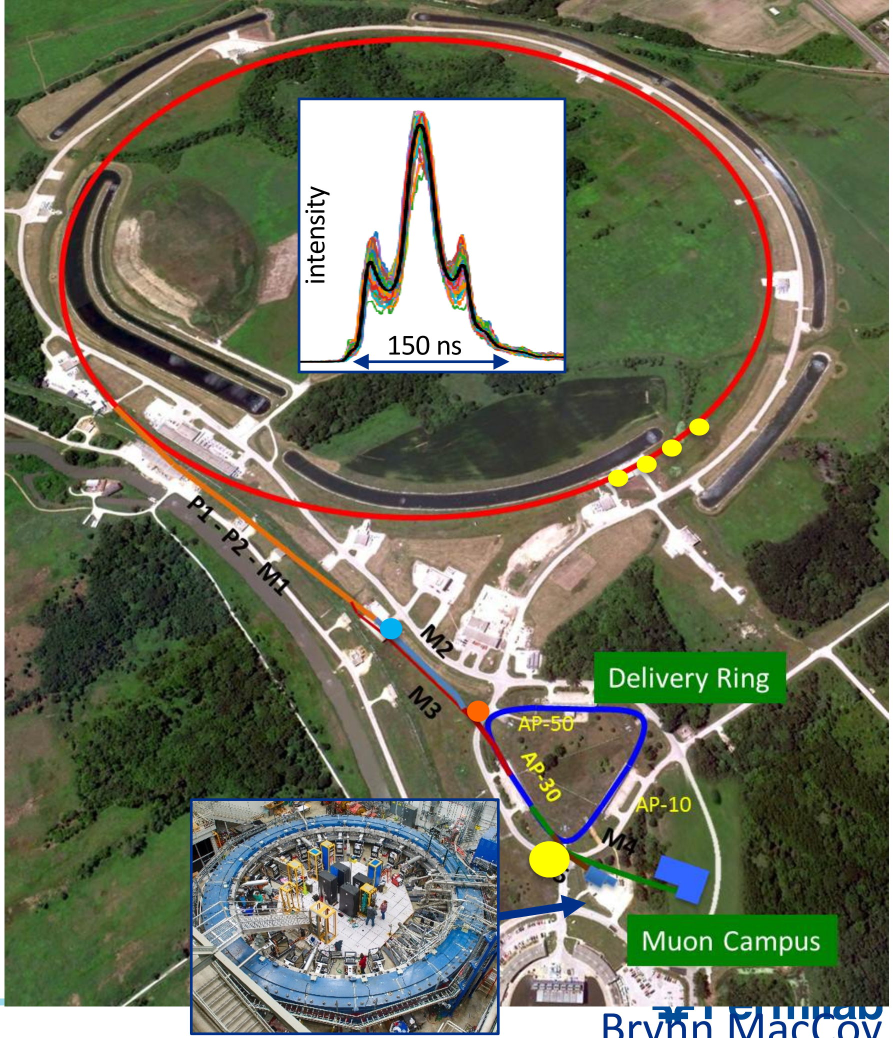
2014

2. Inject and store polarized muons

- 8 GeV protons
- Use RF to create bunches
- Create pions on a target
- Transfer and decay $\pi \rightarrow \mu\nu$, creating a polarized muon beam
- Delivery Ring kicks out remaining protons, muons are extracted
- **~5000 stored muons per pulse**

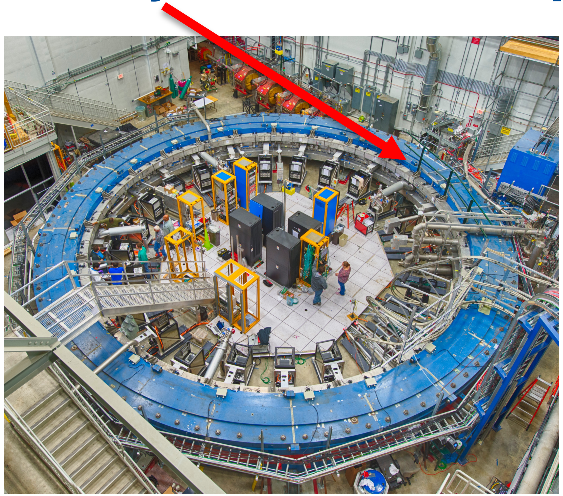


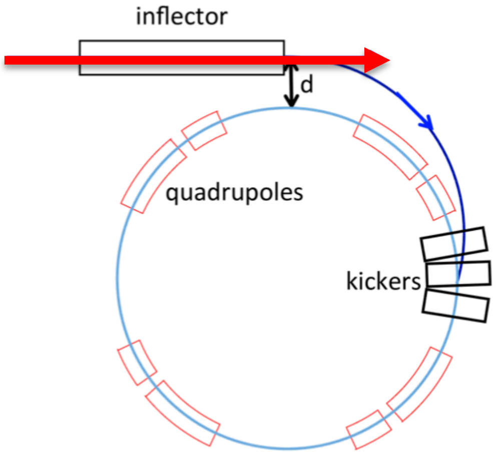
- Repeat!



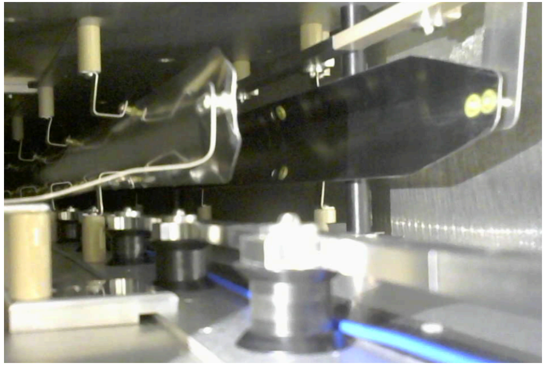
Brynn MacCoy

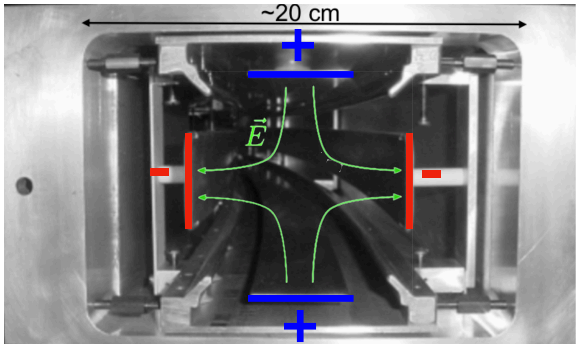
2. Inject and store polarized muons





Fast **kicker** pulse transfers muons to central orbit





Pulsed **quads** provide vertical focusing (restoring force)

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2. Inject and store polarized muons

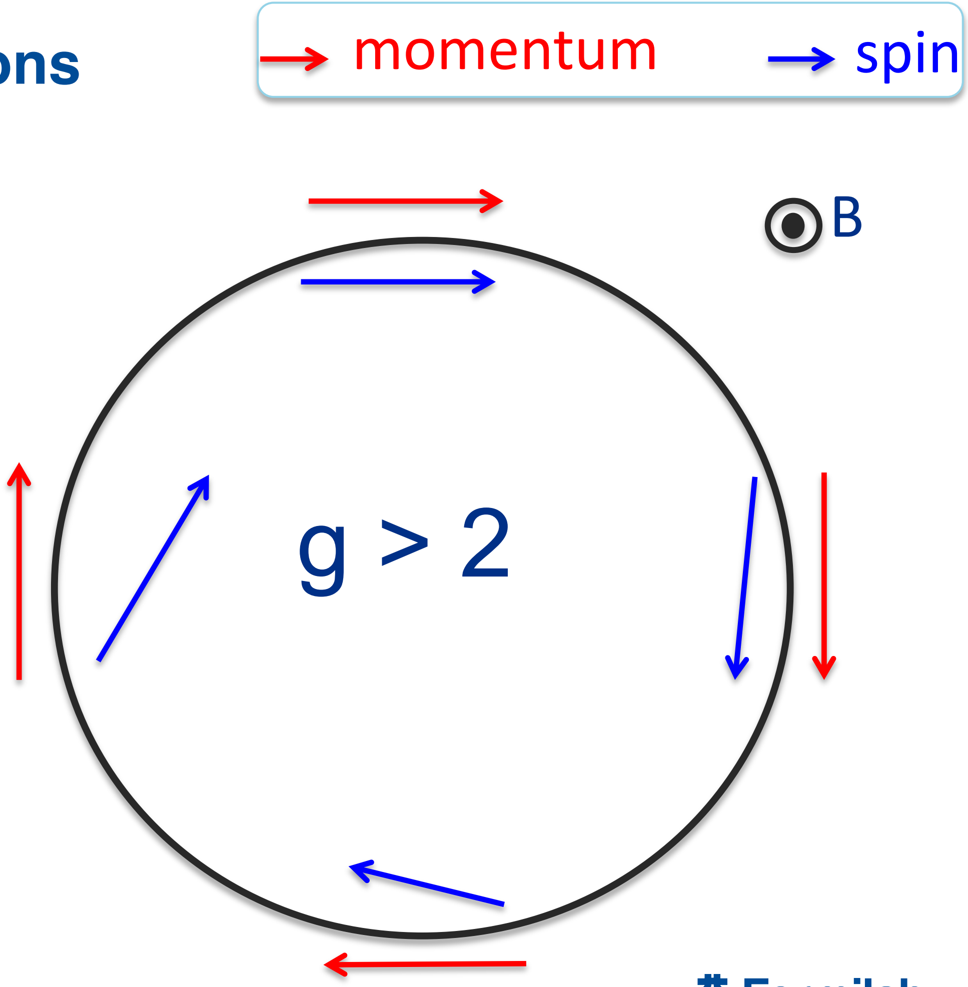
1. Cyclotron frequency:

$$\omega_c = \frac{e}{m\gamma} B$$

2. Spin precession frequency

$$\omega_s = \frac{e}{m\gamma} B \left(1 + \gamma \frac{g-2}{2}\right)$$

$$\omega_s - \omega_c \equiv \omega_a = \frac{eB}{m}\frac{g-2}{2} = \frac{eB}{m} a_\mu$$



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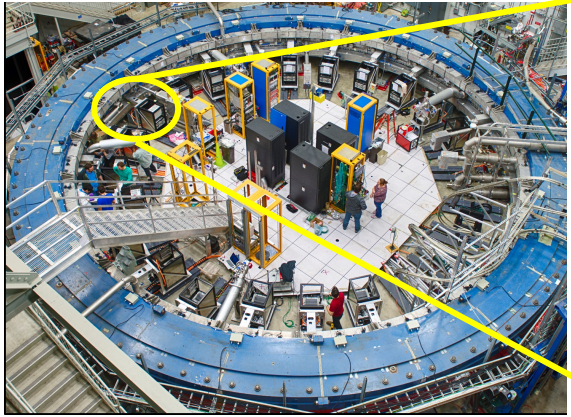
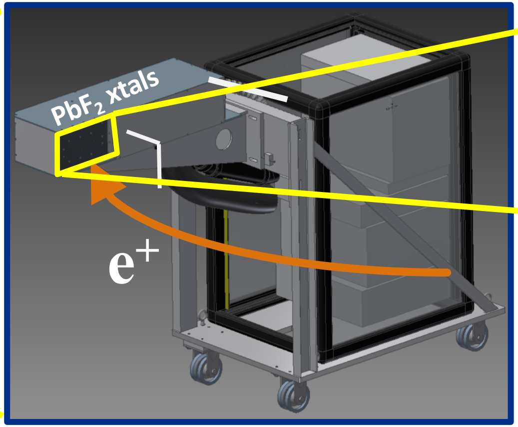
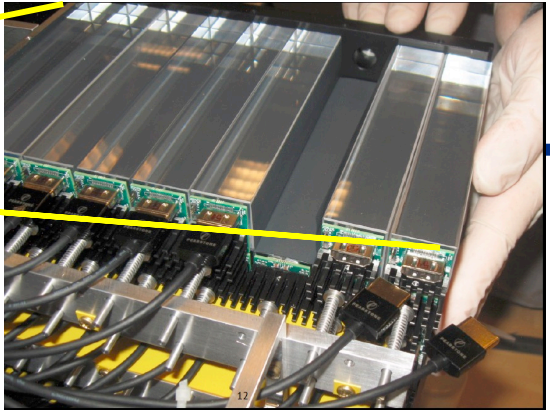
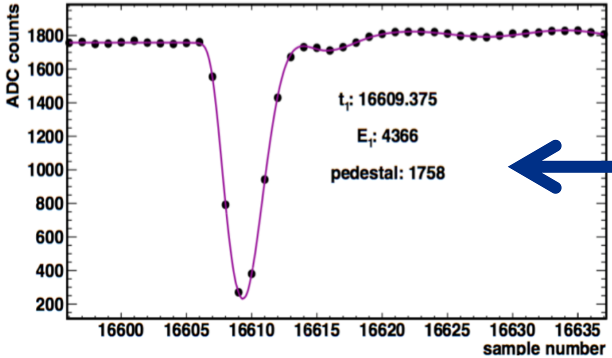
3. Measure decay positrons to determine the muons' properties









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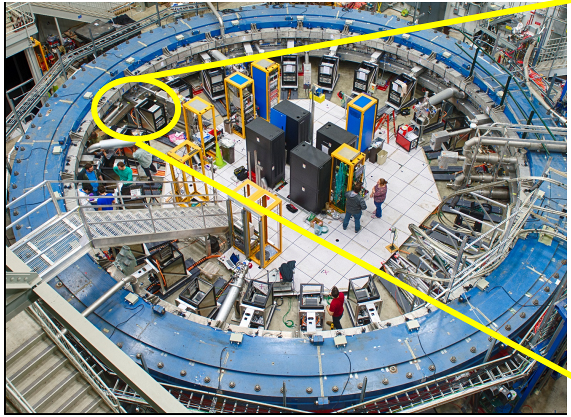
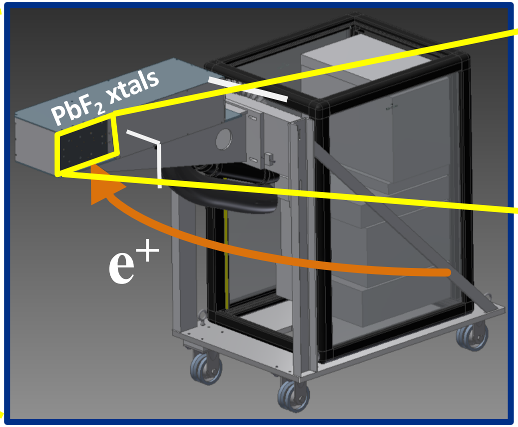
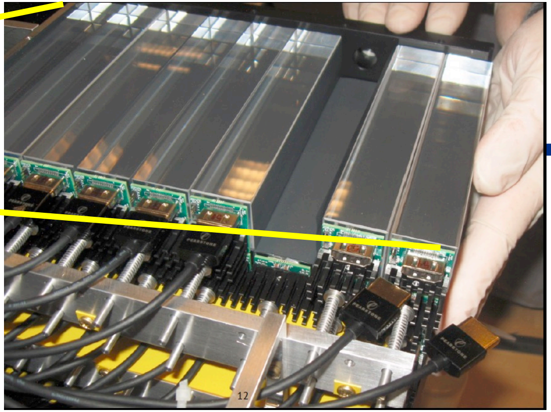
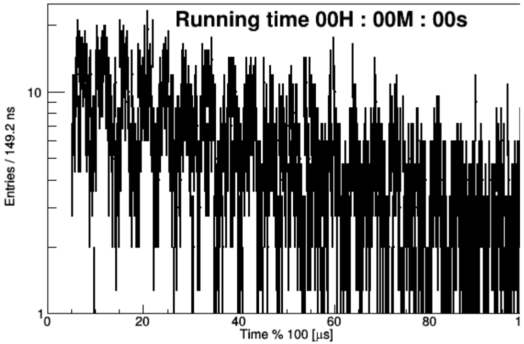


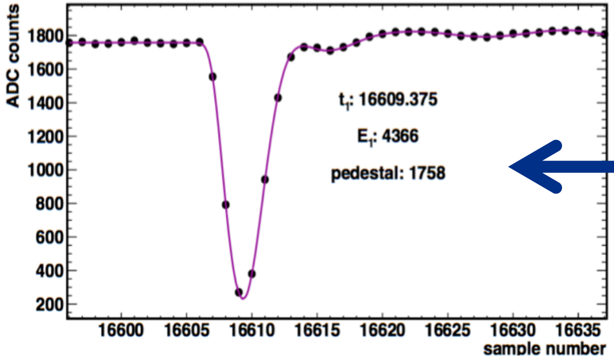




Events above threshold



- Weak decay of muon
- Emitted e^+ carries spin info
- Positrons with E> 1.8 GeV selected, exhibit difference frequency, ω_a



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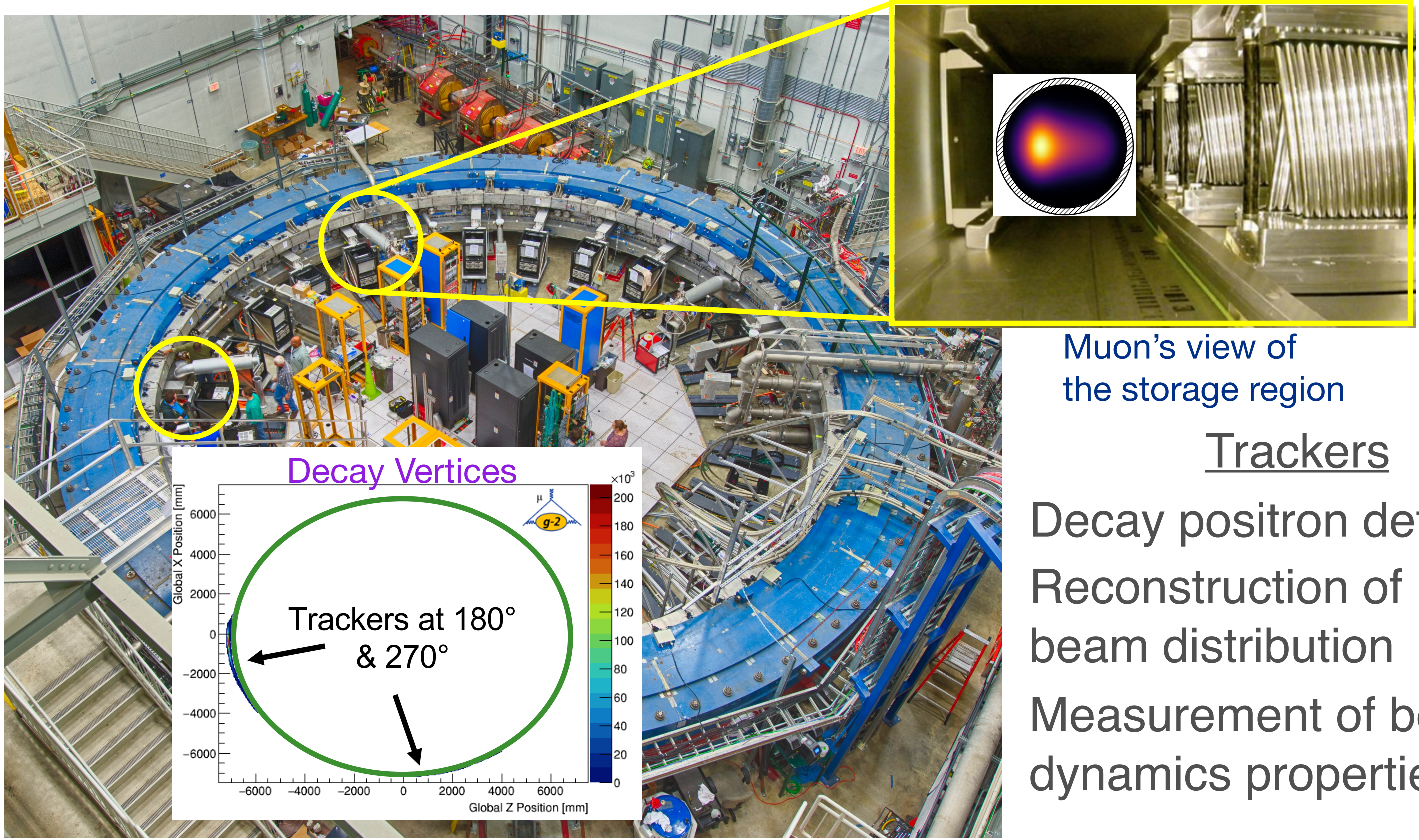
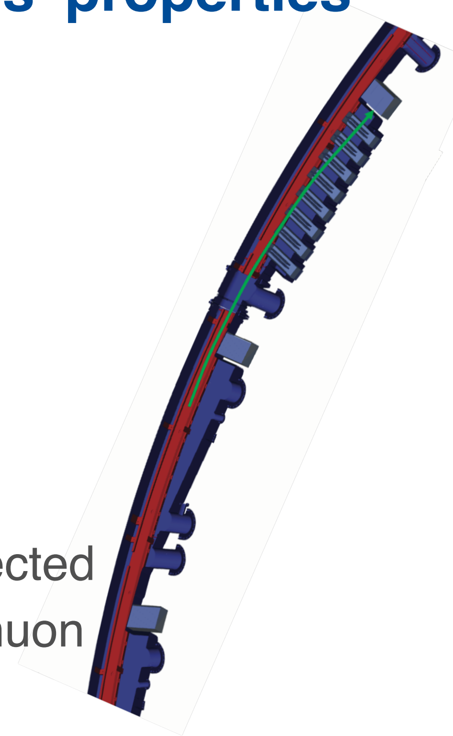
3. Measure decay positrons to determine the muons' properties



Muon's view of
the storage region



Trackers

Decay positron detected

Reconstruction of muon beam distribution

Measurement of beam dynamics properties

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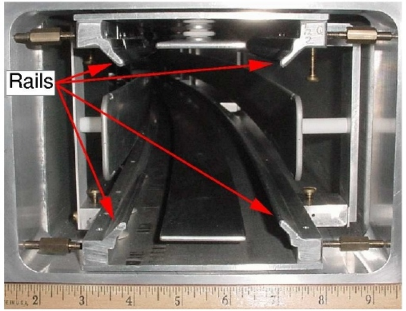
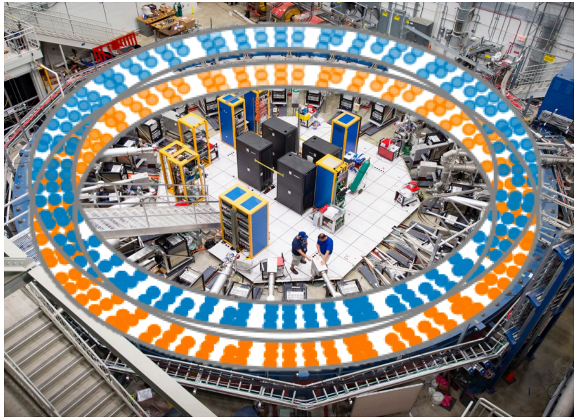
4. Map and track the magnetic field

- Use Nuclear Magnetic Resonance (NMR)
  - Tip spins of NMR probe sample's protons
  - Determine the field in terms of the proton precession frequency ω_p

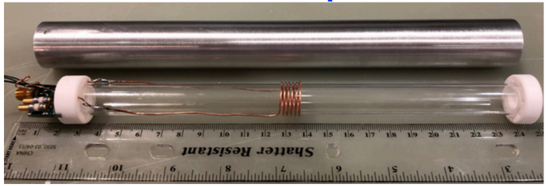
NMR trolley **maps** field every 3 days



378 fixed probes **monitor** continuously



Trolley cross-**calibrated** to absolute probes



We can rewrite a_μ : our observables plus external measurements

$$a_\mu = \frac{\omega_a}{\tilde{\omega}'_p(T_r)} \frac{\mu'_p(T_r)}{\mu_e(H)} \frac{\mu_e(H)}{\mu_e} \frac{m_\mu}{m_e} \frac{g_e}{2}$$

Quantities we measure

ω_a : the muon anomalous spin precession frequency

$\tilde{\omega}'_p(T_r)$: precession of protons in a water sample, mapping the field and weighted by the muon distribution

Ultimate Goal: 140 ppb =
100 ppb (stat) ⨁ 100 ppb (syst)

Determined externally to 25 ppb

$\tilde{\omega}'_p(T)$ Proton Larmor precession frequency in a spherical water sample. Temperature dependence known to < 1ppb/°C.
Metrologia **13**, 179 (1977), Metrologia **51**, 54 (2014), Metrologia **20**, 81 (1984)

$\frac{\mu_e(H)}{\mu'_p(T)}$ Measured to 10.5 ppb accuracy at T = 34.7°C
Metrologia **13**, 179 (1977)

$\frac{\mu_e}{\mu_e(H)}$ Bound-state QED (exact)
Rev. Mod. Phys. **88** 035009 (2016)

$\frac{m_\mu}{m_e}$ Known to 22 ppb from muonium hyperfine splitting
Phys. Rev. Lett. **82**, 711 (1999)

$\frac{g_e}{2}$ Measured to 0.28 ppt
Phys. Rev. A **83**, 052122 (2011)

We relate our observables to the quantities that determine a_μ

$$a_\mu \propto \frac{\omega_a}{\tilde{\omega}'_p} = \frac{f_{\text{clock}}\, \omega_a^{\text{meas}} (1 + C_e + C_p + C_{ml} + C_{pa})}{f_{\text{calib}} \langle \omega_p(x,y,\phi) \times M(x,y,\phi) \rangle (1 + B_k + B_q)}$$

- f_{clock} • Blinded clock
- ω_a^m • Measured precession frequency
- C_e • Electric field correction
- C_p • Pitch correction
- C_{ml} • Muon loss correction
- C_{pa} • Phase-acceptance correction
- f_{calib} • Absolute magnetic field calibration
- $\omega_p(x,y,\phi)$ • Tracked field map distribution
- $M(x,y,\phi)$ • Tracked muon spatial distribution
- B_k • Transient field from the kicker
- Bq • Transient field from the quad charging

<u>Systems used</u>

Calorimeters

Trackers and simulations

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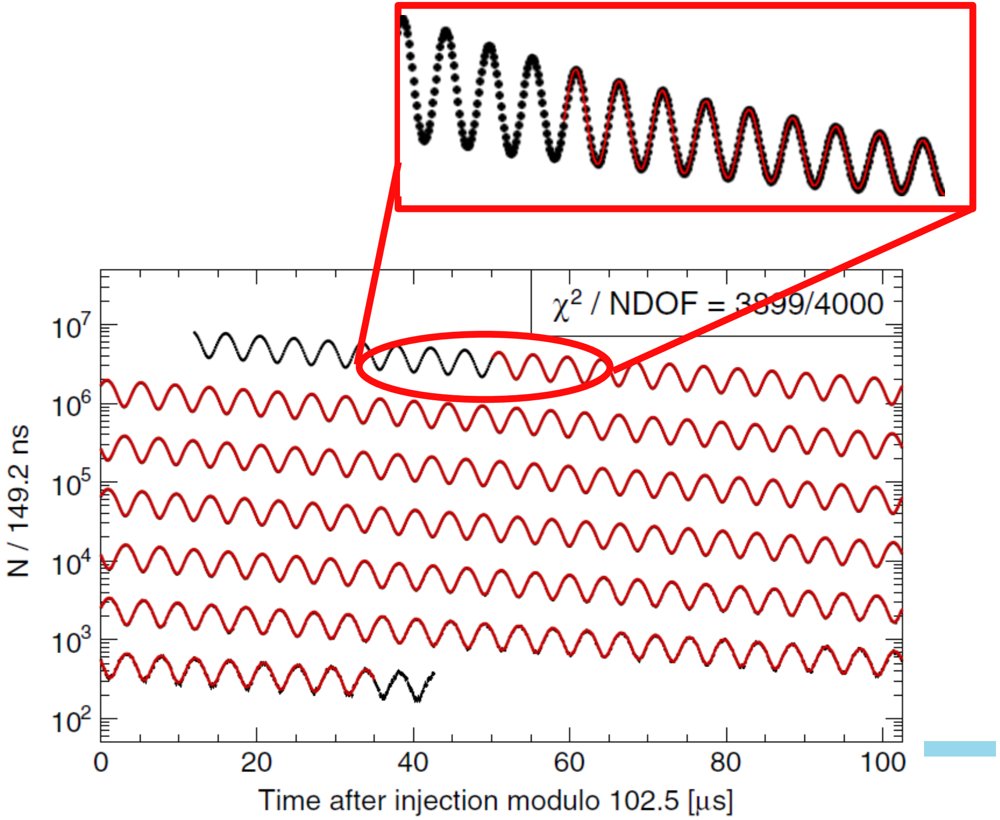
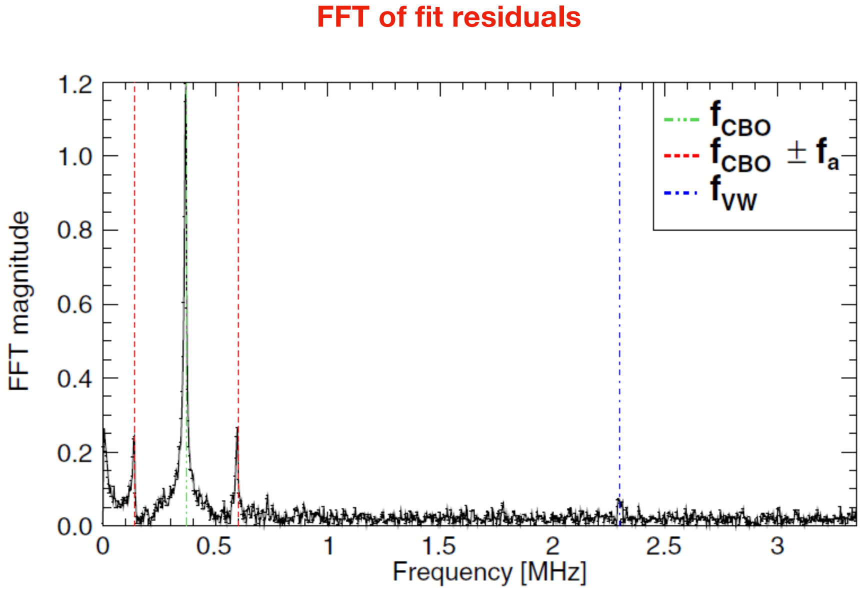
Muon Precession Frequency

Start with simple 5 parameter fit: $F(t) = N_0 e^{-t/\gamma\tau_\mu} \left[1 + A_0 \cos(\omega_a^m t + \phi_0)\right]$





Muon Precession Frequency

- Account for
  - beam dynamics effects (transverse oscillations)
  - muons that escape in a time-dependent manner, etc..

22 parameter fit

$$N_0\, e^{-\frac{t}{\gamma\tau}}\left(1 + A \cdot A_{BO}(t)\cos(\omega_a t + \phi \cdot \phi_{BO}(t))\right) \cdot N_{\text{CBO}}(t) \cdot N_{\text{VW}}(t) \cdot N_y(t) \cdot N_{2\text{CBO}}(t) \cdot J(t)$$

$$A_{\text{BO}}(t) = 1 + A_A \cos(\omega_{\text{CBO}}(t) + \phi_A)e^{-\frac{t}{\tau_{\text{CBO}}}}$$

$$\phi_{\text{BO}}(t) = 1 + A_\phi \cos(\omega_{\text{CBO}}(t) + \phi_\phi)e^{-\frac{t}{\tau_{\text{CBO}}}}$$

$$N_{\text{CBO}}(t) = 1 + A_{\text{CBO}} \cos(\omega_{\text{CBO}}(t) + \phi_{\text{CBO}})e^{-\frac{t}{\tau_{\text{CBO}}}}$$

$$N_{2\text{CBO}}(t) = 1 + A_{2\text{CBO}} \cos(2\omega_{\text{CBO}}(t) + \phi_{2\text{CBO}})e^{-\frac{t}{2\tau_{\text{CBO}}}}$$

$$N_{\text{VW}}(t) = 1 + A_{\text{VW}} \cos(\omega_{\text{VW}}(t)t + \phi_{\text{VW}})e^{-\frac{t}{\tau_{\text{VW}}}}$$

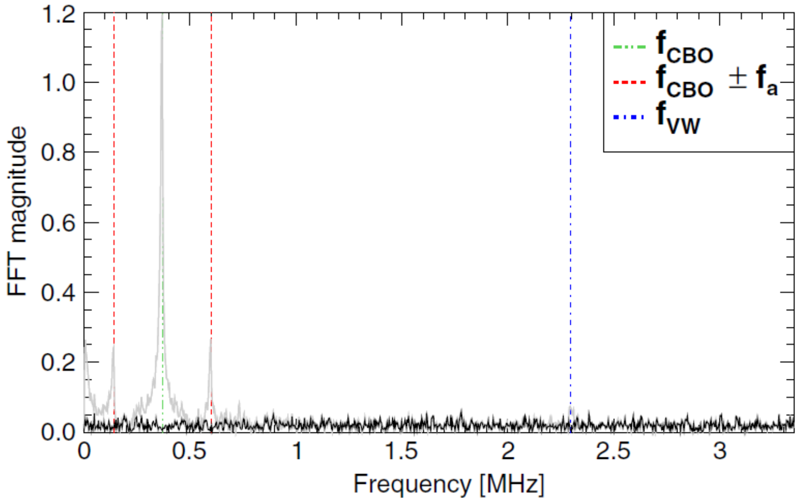
$$N_y(t) = 1 + A_y \cos(\omega_y(t)t + \phi_y)e^{-\frac{t}{\tau_y}}$$

$$J(t) = 1 - k_{LM}\int_{t_0}^{t}\Lambda(t)dt$$

$$\omega_{\text{CBO}}(t) = \omega_0 t + Ae^{-\frac{t}{\tau_A}} + Be^{-\frac{t}{\tau_B}}$$

$$\omega_y(t) = F\omega_{\text{CBO}(t)}\sqrt{2\omega_c/F\omega_{\text{CBO}}(t) - 1}$$

$$\omega_{\text{VW}}(t) = \omega_c - 2\omega_y(t)$$



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What can go wrong? $F(t) = N_0 e^{-t/\gamma\tau_\mu}\left[1 + A_0 \cos(\omega_a^m t + \phi_0)\right]$

- What happens if the *phase* of the muon population changes as a function of time?

$$\begin{aligned} cos(\omega_a t + \phi(t)) &= cos(\omega_a t + \phi_0 + \phi' t + ...) \\ &= cos((\omega_a + \phi')t + \phi_0 + ...) \end{aligned}$$

The extracted ω_a is shifted by ϕ'

What can go wrong?

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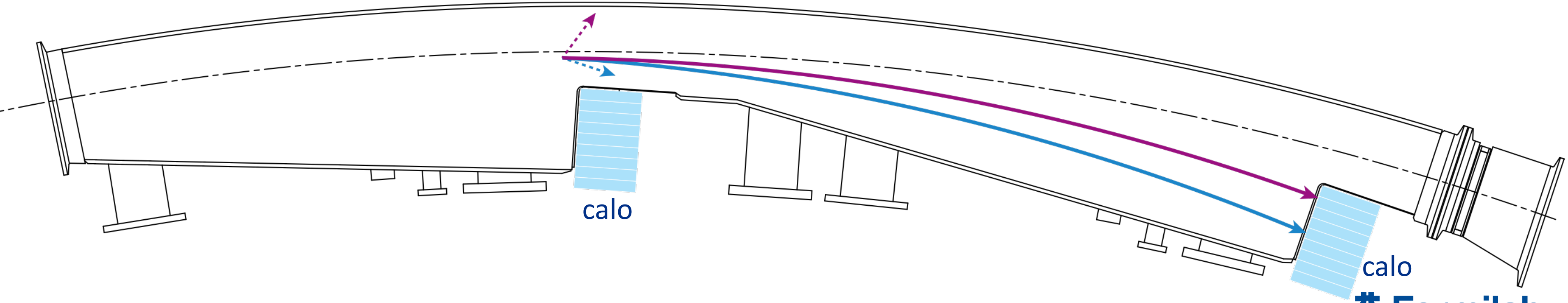
The extracted ω_a is shifted by ϕ'

- The decay positrons carry phase information
- Positrons that are in the calorimeter's acceptance will have a phase that depends on the muon's energy and decay position, (x,y)



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$$cos(\omega_a t + \phi(t)) = cos(\omega_a t + \phi_0 + \phi' t + ...)$$
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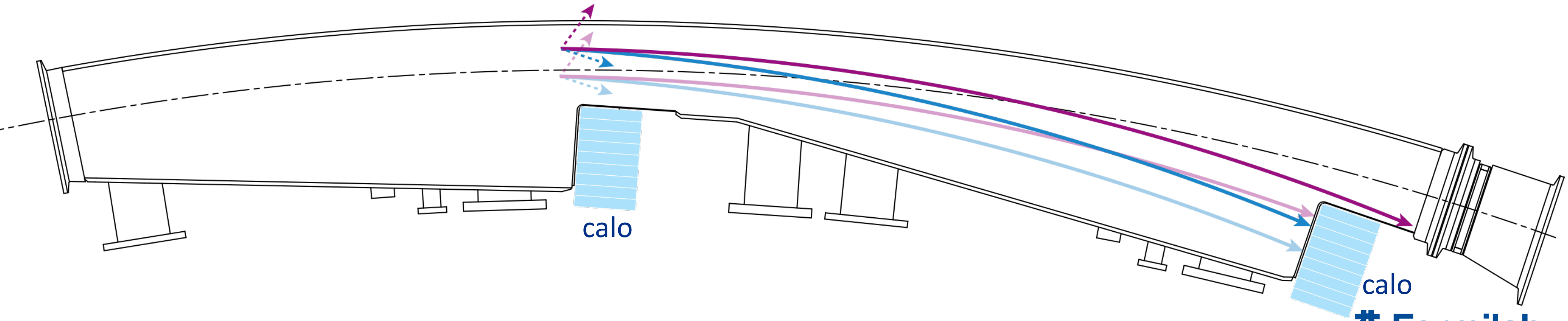
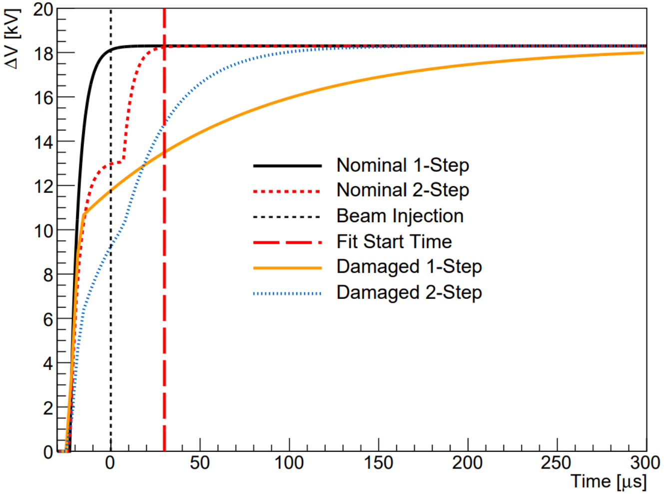
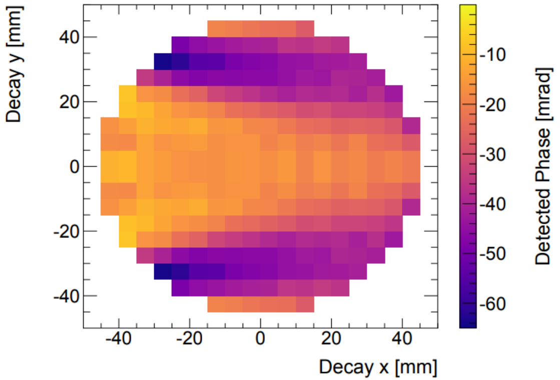
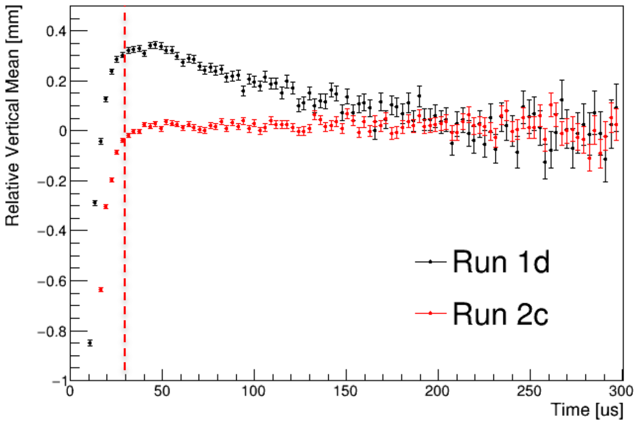


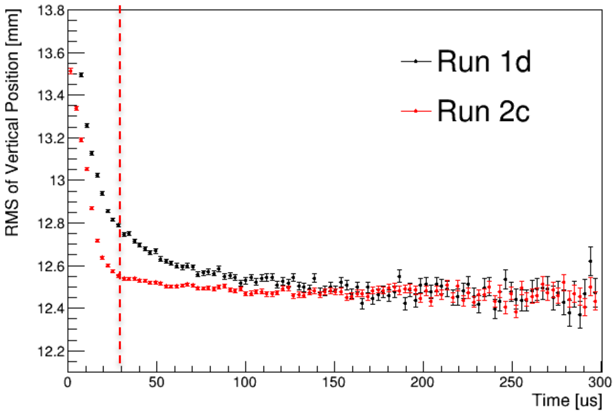
C_{PA} – Phase Acceptance error

- The spatial muon distribution *should* be stable during the measurement period. However…
- 2 out of 32 Quad HV resistors were damaged which led to unstable beam conditions
  - The electric field changed during the measurement
  - The mean vertical position and width changed
  - Results in a -158 ppb correction with 75 ppb unc.
  - Resistors fixed prior to Run2 → much more stable









Fermilab

Muon Precession Frequency ω_a and Beam Dynamics Results

Quantity	Correction terms (ppb)	Uncertainty (ppb)
ω_a^m (statistical)	···	434
ω_a^m (systematic)	···	56
C_e	489	53
C_p	180	13
C_{ml}	−11	5
C_{pa}	−158	75
$f_{\text{calib}}\langle\omega_p(x,y,\phi)\times M(x,y,\phi)\rangle$	···	56
B_k	−27	37
B_q	−17	92
$\mu'_p(34.7°)/\mu_e$	···	10
m_μ/m_e	···	22
$g_e/2$	···	0
Total systematic	···	157
Total fundamental factors	···	25
Totals	544	462

- Statistically dominated (434 ppb)
- Muon precession systematic effects (56 ppb)
- Some large corrections (< 500 ppb) from beam dynamics effects, as well as large uncertainties (50-75 ppb) understood and will improve in subsequent runs

- Beam Dynamics: https://arxiv.org/abs/2104.03240
- Muon Precession: https://journals.aps.org/prd/abstract/10.1103/PhysRevD.103.072002

Fermilab

We relate our observables to the quantities that determine a_μ

$$a_\mu \propto \frac{\omega_a}{\tilde{\omega}'_p} = \frac{f_{\text{clock}}\, \omega_a^{\text{meas}} (1 + C_e + C_p + C_{ml} + C_{pa})}{f_{\text{calib}} \langle \omega_p(x,y,\phi) \times M(x,y,\phi) \rangle (1 + B_k + B_q)}$$

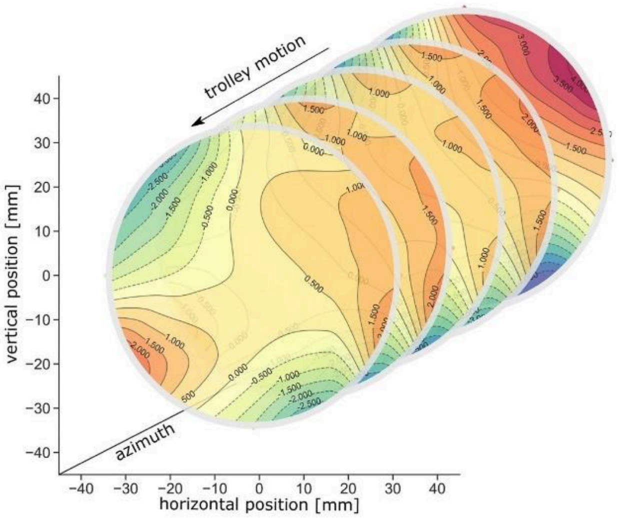
Systems used

- f_{clock} • Blinded clock
- ω_a^m • Measured precession frequency
- C_e • Electric field correction
- C_p • Pitch correction
- C_{ml} • Muon loss correction
- C_{pa} • Phase-acceptance correction
- f_{calib} • Absolute magnetic field calibration — NMR
- $\omega_p(x,y,\phi)$ • Tracked field map distribution
- $M(x,y,\phi)$ • Tracked muon spatial distribution — Trackers
- B_k • Transient field from the kicker — Magnetometer
- Bq • Transient field from the quad charging — & dedicated NMR

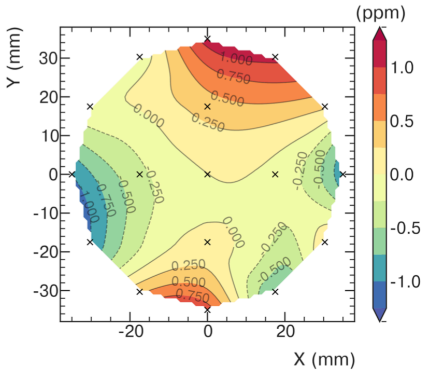
Trolley Magnetic Field Maps

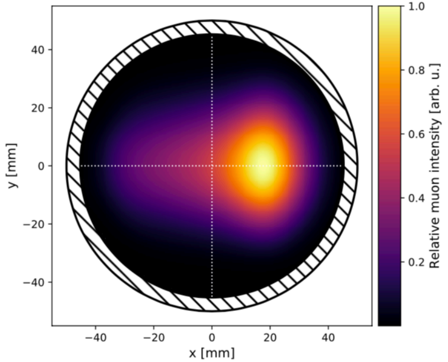
- Create a highly uniform field
- Trolley has 17 probes, produces map at 8000 azimuthal locations
- Determines strength of the field in space
- Fixed probes track changes of field in time

- Field maps are weighted by muon distribution
- Gradients shift the < B > by ~ 100 ppb, uncertainties ~ 20 ppb



Produce azimuthally averaged field

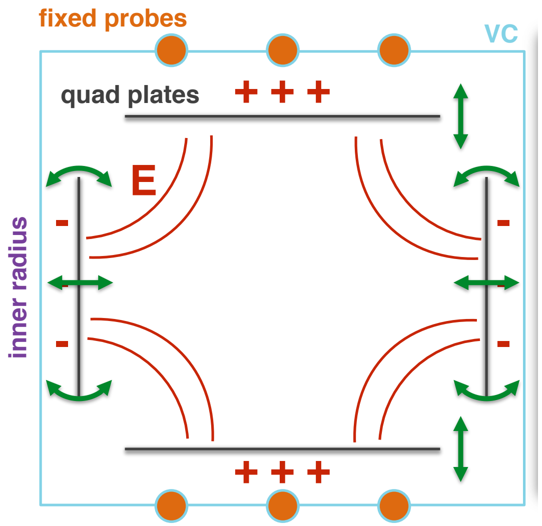




Fermilab

Transient Fields affect the muons

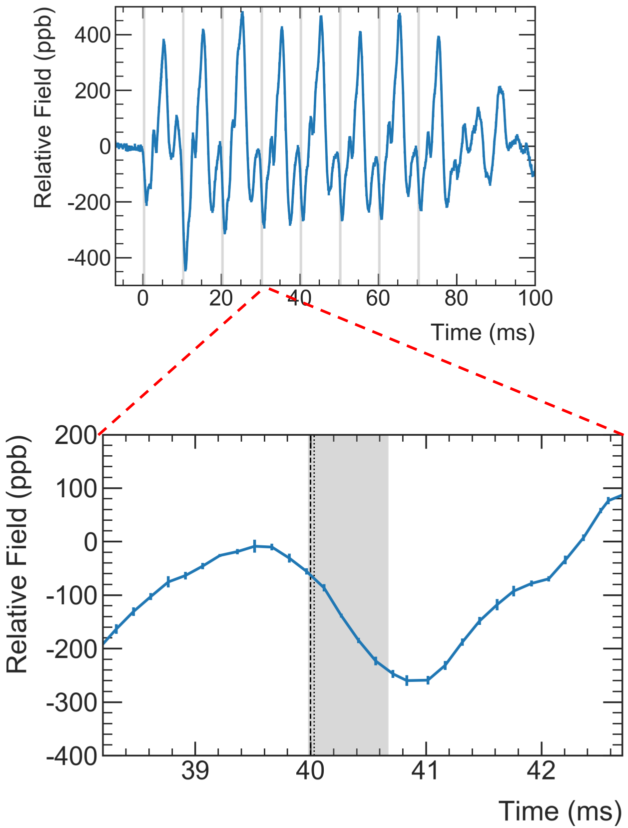
- Quads are pulsed synchronously with muon injection
- We observed a motion of the quad plates associated with these pulses
- Affects field observed by muons, but **not** the field mapped by trolley (quads off)



Pulsing Quads
- Side plates oscillate radially
- Oscillating conductor perturbs B-field
- **Fixed probes** sensitive to oscillation

Dedicated measurement

B_q – Quad transients



- Map effect along the quad for all beam pulses and account for the quad
- Correction = -17 ppb
- Conservative Uncertainty 82 ppb
- More detailed maps exist →
  - Will quantify long term stability
  - Further map quad region

Systematic Source	Uncertainty (ppb)
Time and Azimuthal Structure	77
Second Pulse Train	14
Repeatability	13
Skin Depth	13
Field Drift	10
Frequency Extraction	5
Radial Dependence	4
Probe Positioning	2
Total ESQ-Transient Uncertainty	82

Fermilab

Magnetic Field Results

Quantity	Correction terms (ppb)	Uncertainty (ppb)
ω_a^m (statistical)	$\cdots$	434
ω_a^m (systematic)	$\cdots$	56
C_e	489	53
C_p	180	13
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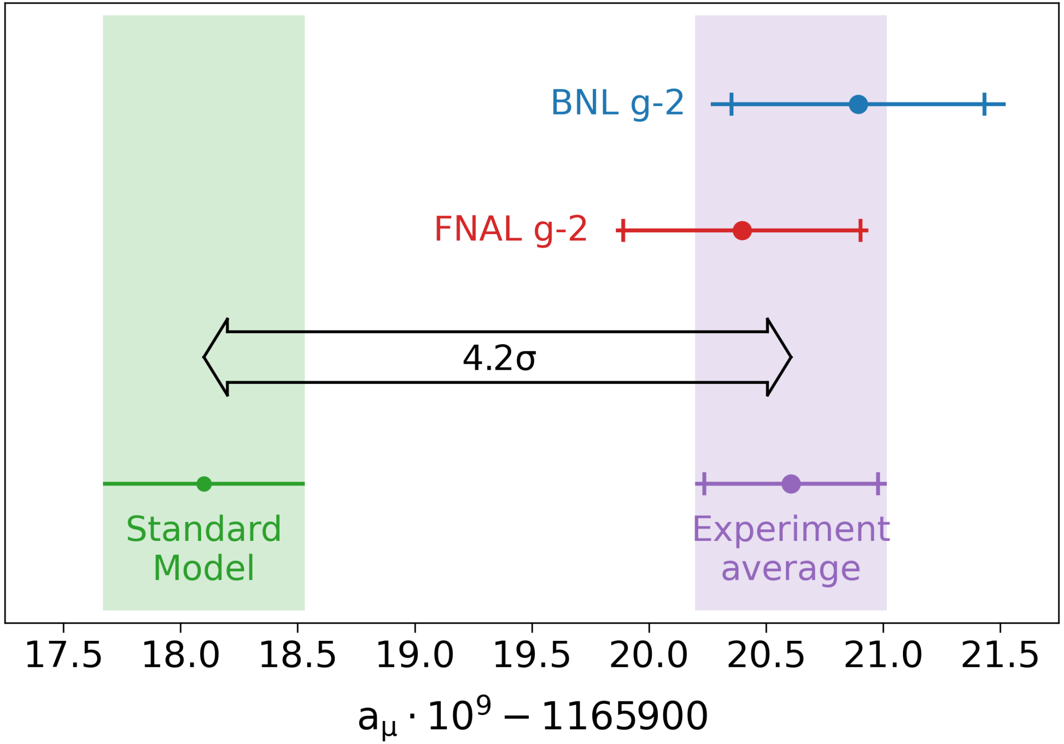
$f_{\text{calib}} \langle \omega_p(x, y, \phi) \times M(x, y, \phi) \rangle$	$\cdots$	56
B_k	−27	37
B_q	−17	92
$\mu_p'(34.7°)/\mu_e$	$\cdots$	10
m_μ/m_e	$\cdots$	22
$g_e/2$	$\cdots$	0
Total systematic	$\cdots$	157
Total fundamental factors	$\cdots$	25
Totals	544	462

- Magnetic field measurement 56 ppb includes field mapping, tracking, weighting absolute calibration
- Dedicated measurements for transient field yield 99 ppb → improvements for future runs

- Magnetic Field Analysis: https://journals.aps.org/pra/abstract/10.1103/PhysRevA.103.042208

Fermilab

First Results / Implications



Quantity	Correction terms (ppb)	Uncertainty (ppb)
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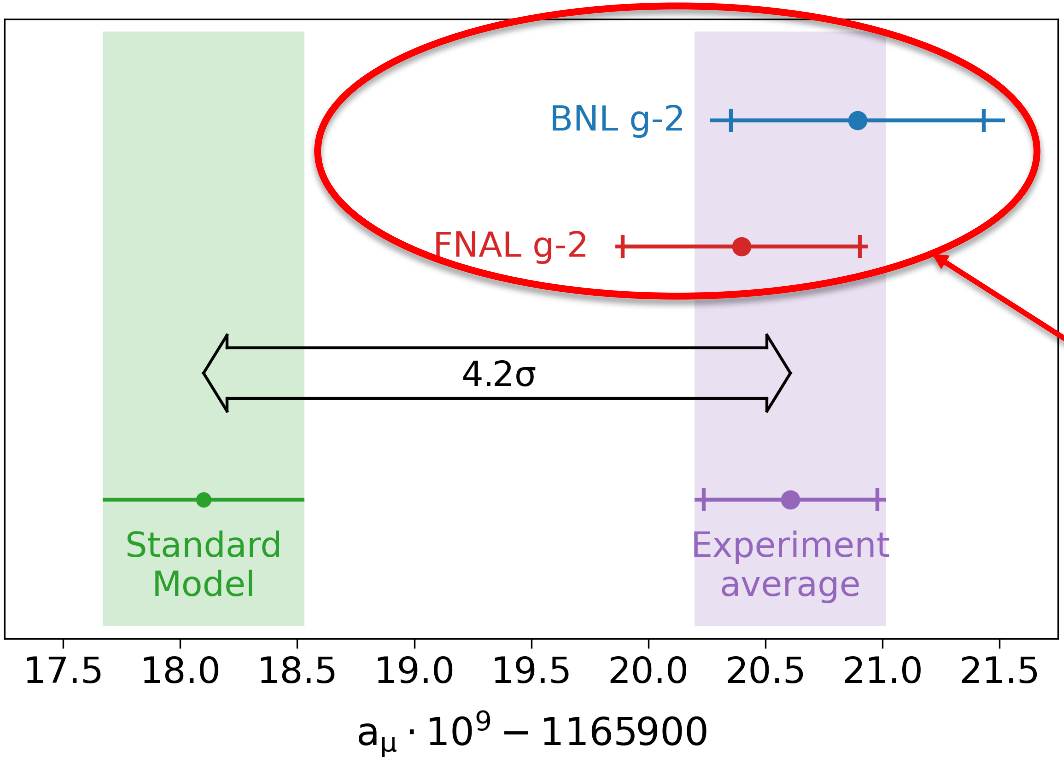
m_μ/m_e	···	22
$g_e/2$	···	0
Total systematic	···	157
Total fundamental factors	···	25
Totals	544	462

$$a_\mu(\text{FNAL}) = 116\,592\,040(54)\times 10^{-11} \quad (0.46 \text{ ppm})$$

$$a_\mu(\text{Exp}) = 116\,592\,061(41)\times 10^{-11} \quad (0.35 \text{ ppm})$$

$$a_\mu(\text{Exp}) - a_\mu(\text{SM}) = (251 \pm 59)\times 10^{-11}$$

First Results / Implications

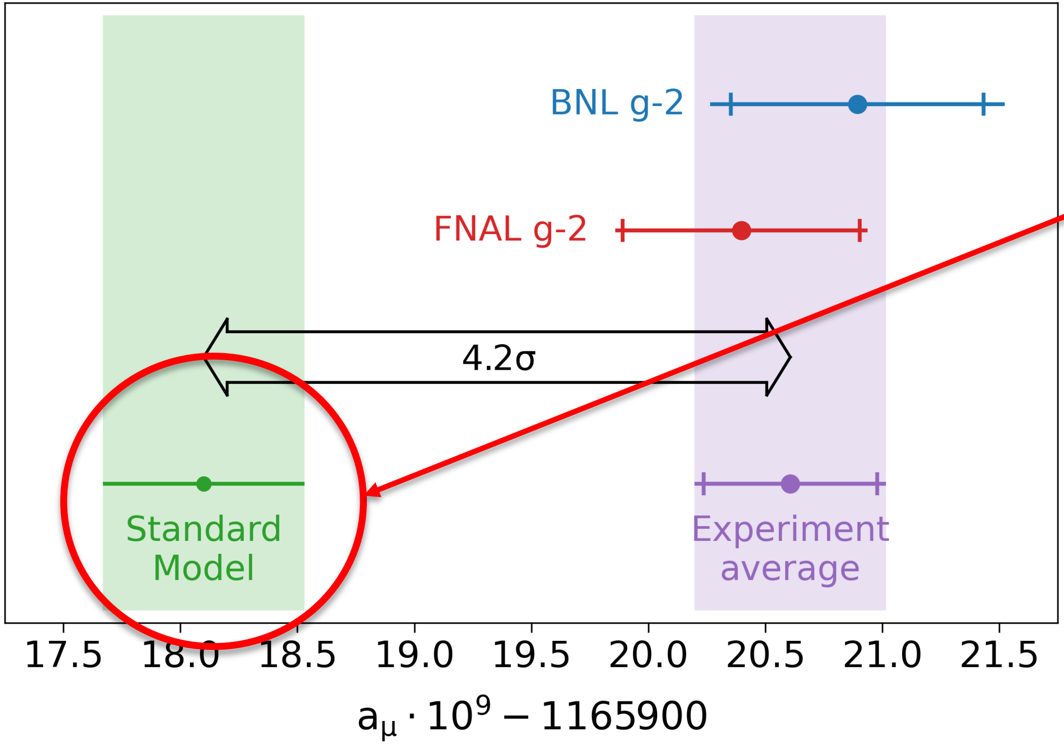


- What can explain the difference?
  (a) Experimental Error
  (b) Theory Error
  (c) New Physics
  (d) Some combination of the above

Excellent agreement between BNL and FNAL efforts

This hypothesis is much less likely now

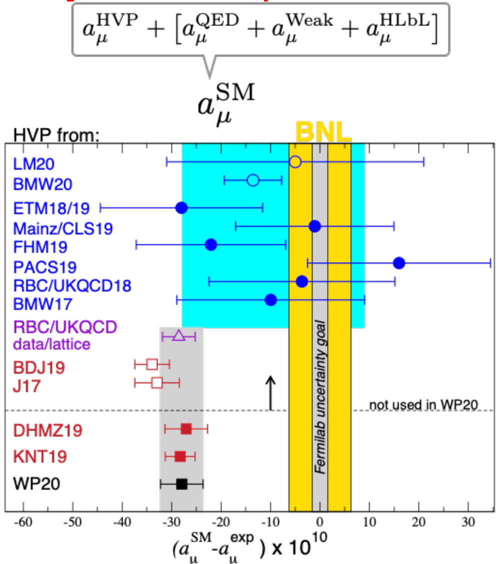
First Results / Implications



- What can explain the difference?
  (a) Experimental Error
  (b) Theory Error
  (c) New Physics
  (d) Some combination of the above

Well-established dispersive calc

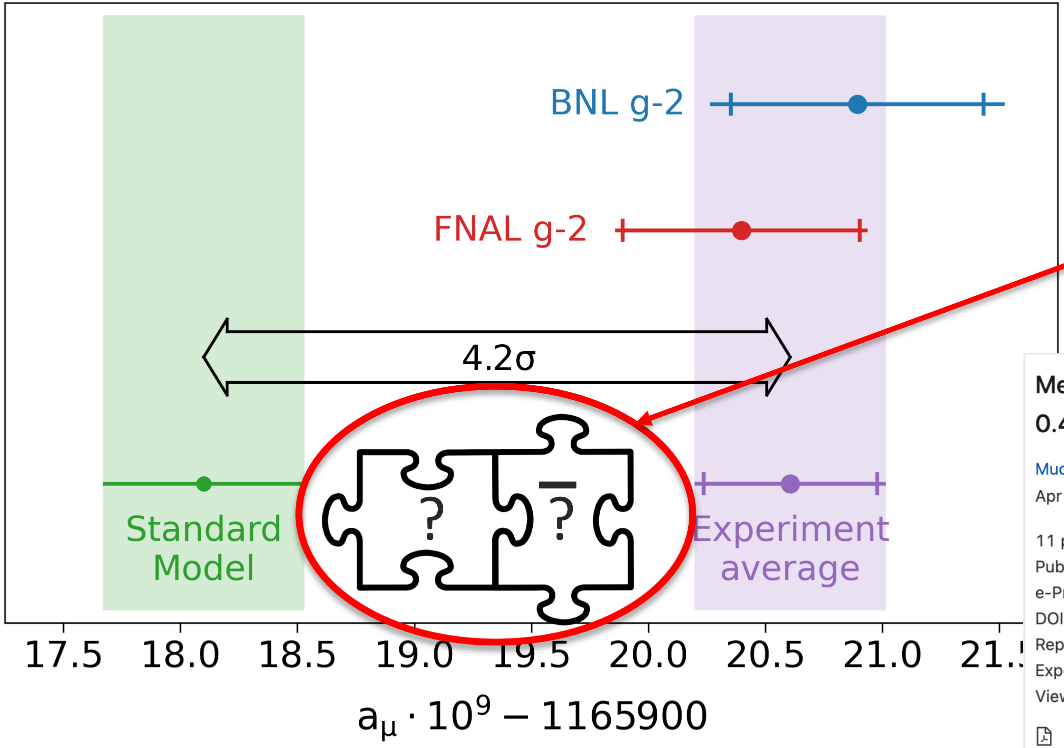
New lattice QCD approach, needs further study and comparisons

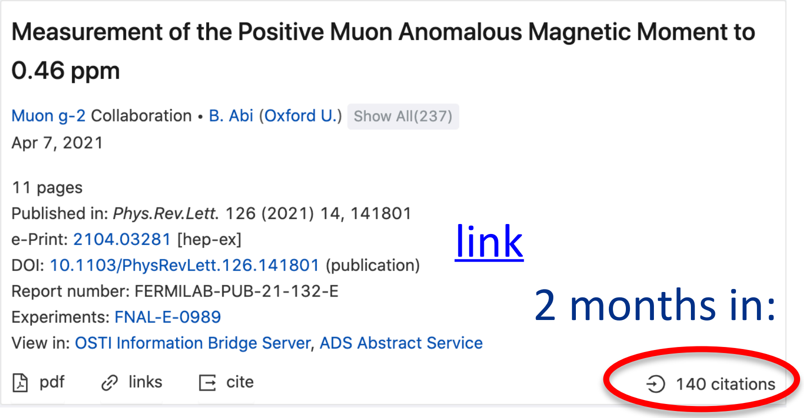


First Results / Implications

- What can explain the difference?
  (a) Experimental Error
  (b) Theory Error
  (c) New Physics
  (d) Some combination of the above

Many Exciting theory possibilities





Measurement of the Positive Muon Anomalous Magnetic Moment to 0.46 ppm

Muon g-2 Collaboration • B. Abi (Oxford U.) Show All(237)

Apr 7, 2021

11 pages

Published in: *Phys.Rev.Lett.* 126 (2021) 14, 141801

e-Print: 2104.03281 [hep-ex]

DOI: 10.1103/PhysRevLett.126.141801 (publication)

Report number: FERMILAB-PUB-21-132-E

Experiments: FNAL-E-0989

View in: OSTI Information Bridge Server, ADS Abstract Service

pdf links cite 140 citations

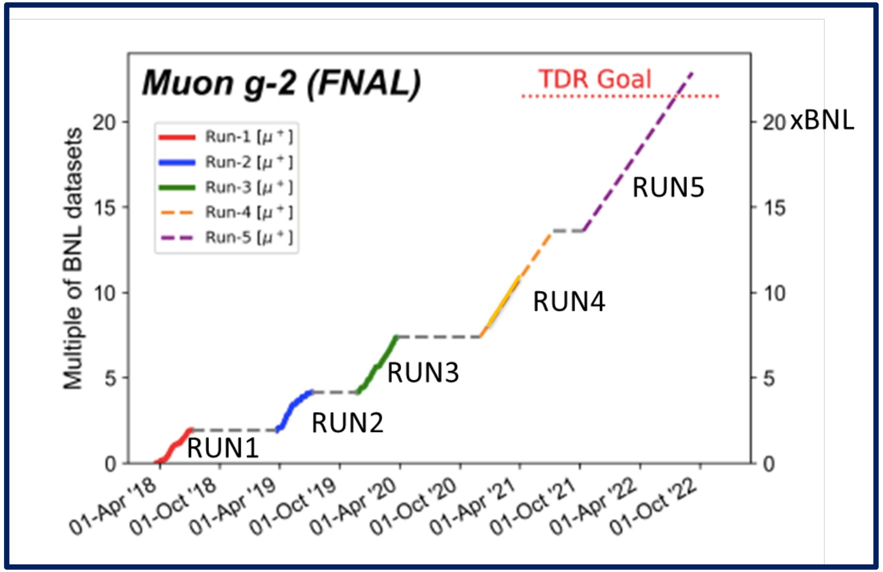
link

2 months in:

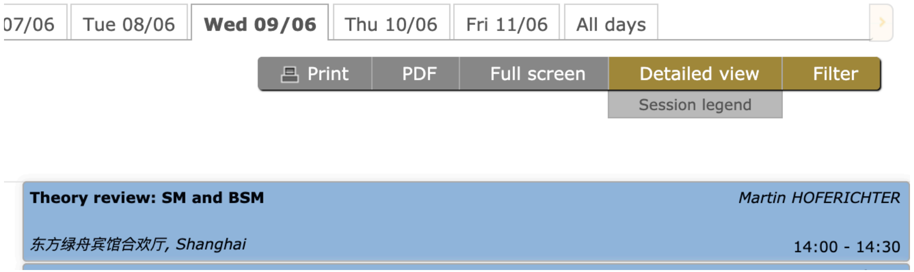
Fermilab

Summary and Outlook

- FNAL measurement confirms BNL result
- Analyzed 6% of the planned data
  - Statistically limited: 434 ppb
  - Systematics: 157 ppb
- Collected more than 50% of our planned data
  - Aim to analyze Run 2-3 for summer of 2022



- Meanwhile … theory steps in: What could it all mean? Please see talk on Muon g-2 SM and BSM theory review by Martin Hoferichter, Wednesday at 14:00



Fermilab

Backup

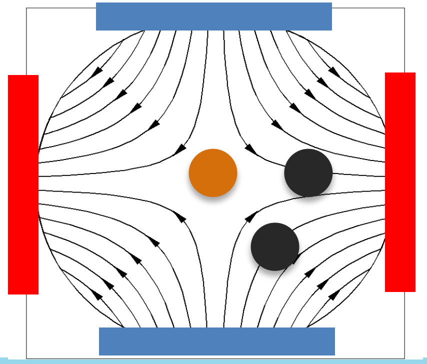
Beam Dynamics: E-field

Quads E-field transforms as motional B

$$\vec{\omega}_a = -\frac{e}{mc}\left[a_\mu \vec{B} - \left(a_\mu - \frac{1}{\gamma^2 - 1}\right)\vec{\beta} \times \vec{E}\right]$$

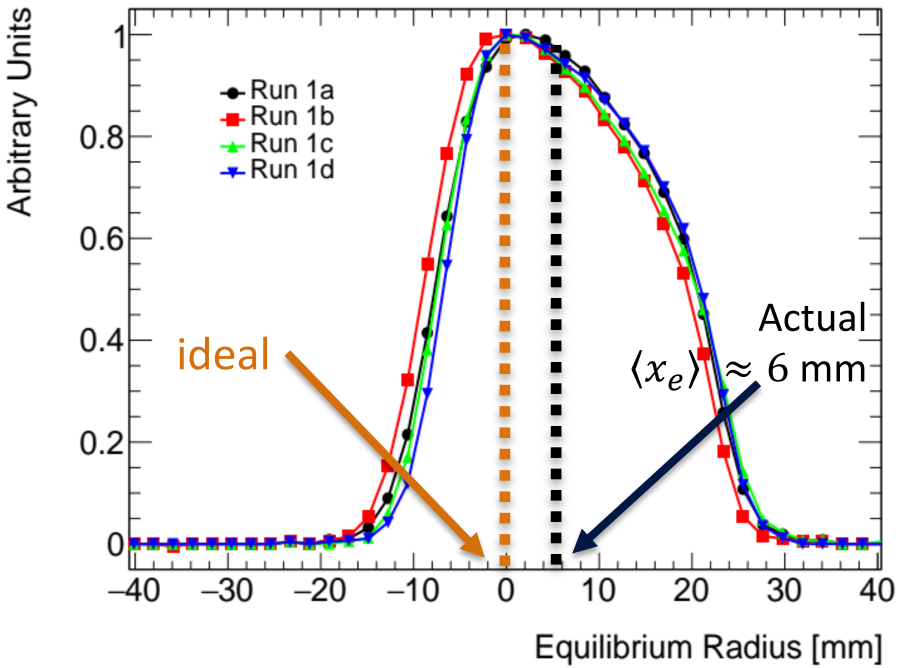
Term vanishes for appropriate choice of $\gamma = 29.3$

Momentum spread in beam of 0.15%



Ideal muon

Other muons

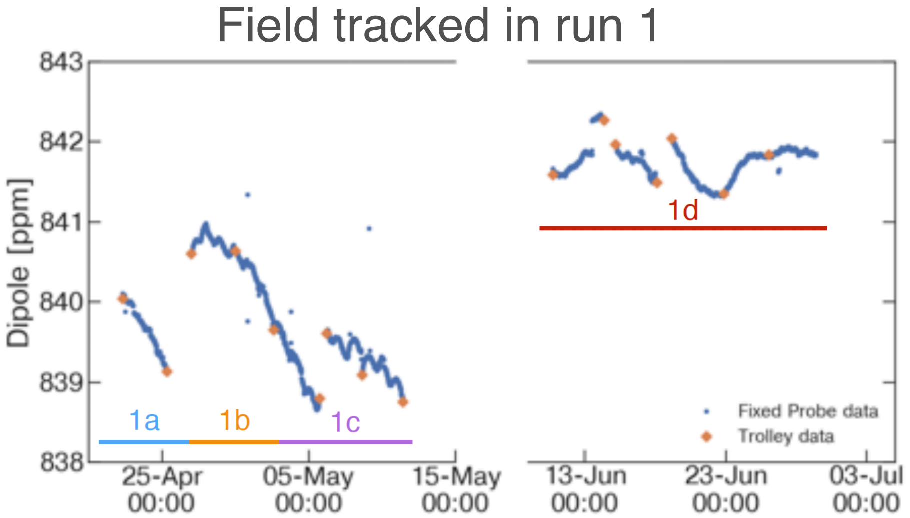


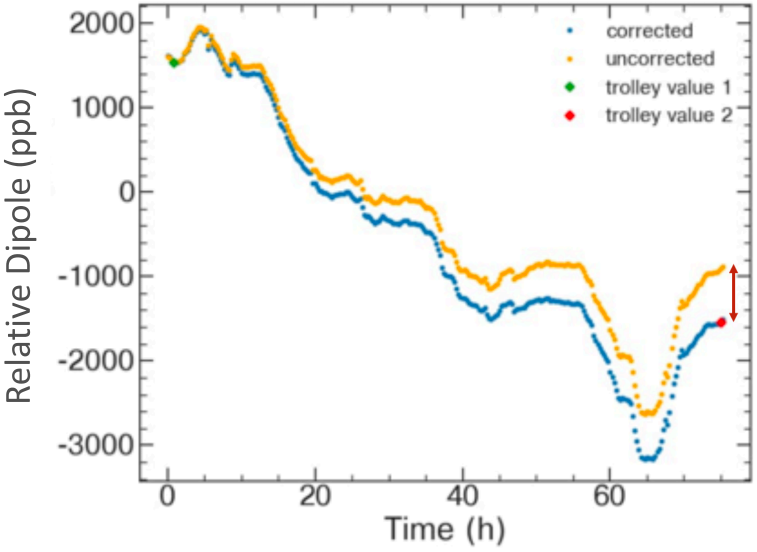
$$C_e \approx 2n(1-n)\beta_0^2 \frac{\langle x_e^2 \rangle}{R_0^2}$$

$$C_e = \mathbf{489\ ppb}, \delta_{C_e} = \mathbf{53\ ppb}$$

Field Tracking

- Trolley measures when beam is off
- Fixed probes monitor while beam is on
- Magnet temperature drifts
- Drifts in higher-order field gradients untracked → tracking error



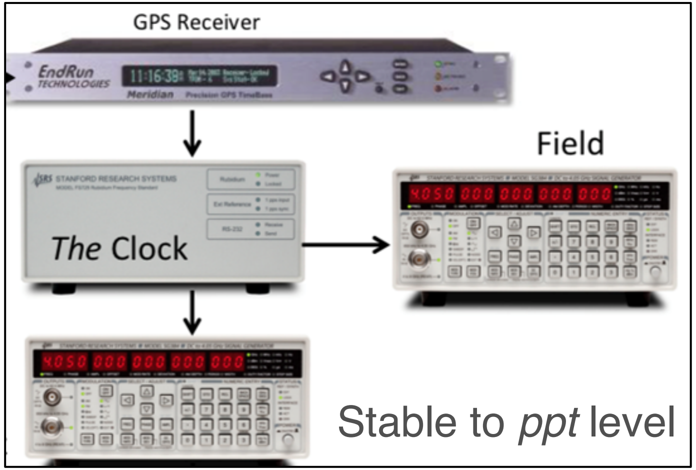


Data subset	Number of trolley pairs	Tracking Error Δ (ppb)
Run-1a	1	43
Run-1b	2	34
Run-1c	3	25
Run-1d	5	22

Clock and Unblinding

$$a_\mu \propto \frac{\omega_a}{\tilde{\omega}'_p} = \frac{f_{\text{clock}}\, \omega_a^{\text{meas}} \left(1 + C_e + C_p + C_{ml} + C_{pa}\right)}{f_{\text{calib}} \left\langle \omega_p(x,y,\phi) \times M(x,y,\phi) \right\rangle \left(1 + B_k + B_q\right)}$$

- Muon clock is hardware blinded +/- 25 ppm
- Sets the *metric* for the wiggle plot
- Once analysis was completed → collaboration unblinded and learned the clock frequency and a_μ



Axion-like particles resolve the $B \to \pi K$ and g-2 anomalies #85

Bhubanjyoti Bhattacharya (Lawrence Technol. U., Southfield), Alakabha Datta (Mississippi U.), Danny Marfatia (Hawaii U.), Soumitra Nandi (Indian Inst. Tech., Guwahati), John Waite (Mississippi U.) (Apr 8, 2021)

e-Print: 2104.03947 [hep-ph]

pdf cite 5 citations

A 2HDM for the g-2 and Dark Matter #82

Giorgio Arcadi (Rome III U.), Álvaro S. De Jesus (IIP, Brazil and Rio Grande do Norte U.), Téssio B. De Melo (IIP, Brazil), Farinaldo S. Queiroz (IIP, Brazil and Rio Grande do Norte U.), Yoxara S. Villamizar (IIP, Brazil and Rio Grande do Norte U.) (Apr 9, 2021)

e-Print: 2104.04456 [hep-ph]

pdf cite 6 citations

Muon $(g-2)$ and XENON1T Excess with Boosted Dark Matter in $L_\mu - L_\tau$ Model #77

Debasish Borah (Indian Inst. Tech., Guwahati), Manoranjan Dutta (Indian Inst. Tech., Hyderabad), Satyabrata Mahapatra (Indian Inst. Tech., Hyderabad), Narendra Sahu (Indian Inst. Tech., Hyderabad) (Apr 12, 2021)

e-Print: 2104.05656 [hep-ph]

pdf cite 2 citations

A vector leptoquark interpretation of the muon $g-2$ and B anomalies #72

Mingxuan Du (Nanjing U.), Jinhan Liang (Nanjing U.), Zuowei Liu (Nanjing U. and CAS, CEPP, Beijing), Van Que Tran (Nanjing U.) (Apr 12, 2021)

e-Print: 2104.05685 [hep-ph]

pdf cite 4 citations

Radiative neutrino masses, lepton flavor mixing and muon $g-2$ in a leptoquark model

Di Zhang (Beijing, Inst. High Energy Phys. and Beijing, GUCAS) (May 18, 2021)

e-Print: 2105.08670 [hep-ph]

pdf cite

Explaining $g_\mu - 2$ and $R_{K^{(*)}}$ using the light mediators of $U(1)_{T3R}$ #21

Bhaskar Dutta (Texas A-M), Sumit Ghosh (Texas A-M), Peisi Huang (Nebraska U.), Jason Kumar (Hawaii U.) (May 17, 2021)

e-Print: 2105.07655 [hep-ph]

pdf cite 1 citation

Collider Prospects for Muon $g-2$ in General Two Higgs Doublet Model #13

Wei-Shu Hou, Rishabh Jain, Chung Kao, Girish Kumar, Tanmoy Modak (May 24, 2021)

e-Print: 2105.11315 [hep-ph]

A common origin of muon g-2 anomaly, Galaxy Center GeV excess and AMS-02 anti-proton excess in the NMSSM #107

Murat Abdughani (Purple Mountain Observ.), Yi-Zhong Fan (Purple Mountain Observ. and USTC, Hefei), Lei Feng (Purple Mountain Observ. and Joint Ctr. Part. Nucl. Phys. Cosmol., Nanjing), Yue-Lin Sming Tsai (Purple Mountain Observ. and Taiwan, Natl. Tsing Hua U.), Lei Wu (Nanjing Normal U.) et al. (Apr 7, 2021)

e-Print: 2104.03274 [hep-ph]

Flavor Specific $U(1)_{B_q - L_\mu}$ Gauge Model for Muon $g-2$ and $b \to s\bar{\mu}\mu$ Anomalies #78

Jian-Yong Cen (Shanxi Normal U.), Yu Cheng (Tsung-Dao Lee Inst., Shanghai and Shanghai Jiaotong U. and Shanghai Jiao Tong U. and SKLPPC, Shanghai), Xiao-Gang He (Tsung-Dao Lee Inst., Shanghai and Shanghai Jiaotong U. and Shanghai Jiao Tong U. and SKLPPC, Shanghai and Taiwan, Natl. Taiwan U.), Jin Sun (Tsung-Dao Lee Inst., Shanghai and Shanghai Jiaotong U. and Shanghai Jiao Tong U. and SKLPPC, Shanghai) (Apr 11, 2021)

e-Print: 2104.05006 [hep-ph]

Leptoquarks and Matter Unification: Flavor Anomalies and the Muon $g-2$ #52

Pavel Fileviez Pérez (Case Western Reserve U., CERCA), Clara Murgui (Caltech), Alexis D. Plascencia (Case Western Reserve U., CERCA) (Apr 22, 2021)

e-Print: 2104.11229 [hep-ph]

Studying the $b \to s\ell^+\ell^-$ Anomalies and $(g-2)_\mu$ in RPV-MSSM Framework with Inverse Seesaw #22

Min-Di Zheng (Zhongshan U.), Hong-Hao Zhang (Zhongshan U.) (May 14, 2021)

e-Print: 2105.06954 [hep-ph]

pdf cite 0 citations

Light vector dark matter with scalar mediator and muon g-2 anomaly #4

Karim Ghorbani (Arak U.) (Apr 28, 2021)

e-Print: 2104.13810 [hep-ph]

pdf cite 1 citatio