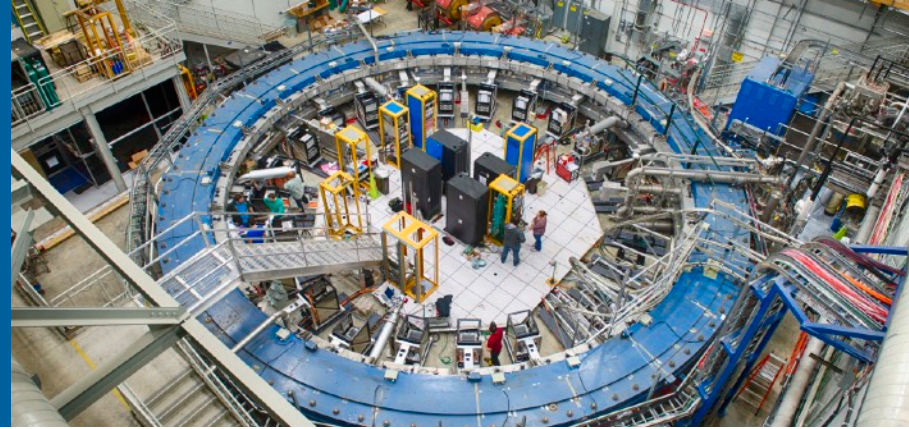
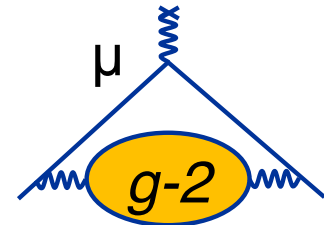


RESULTS FROM THE MUON G-2 EXPERIMENT AT FERMILAB



SIMON CORRODI
Argonne National Laboratory

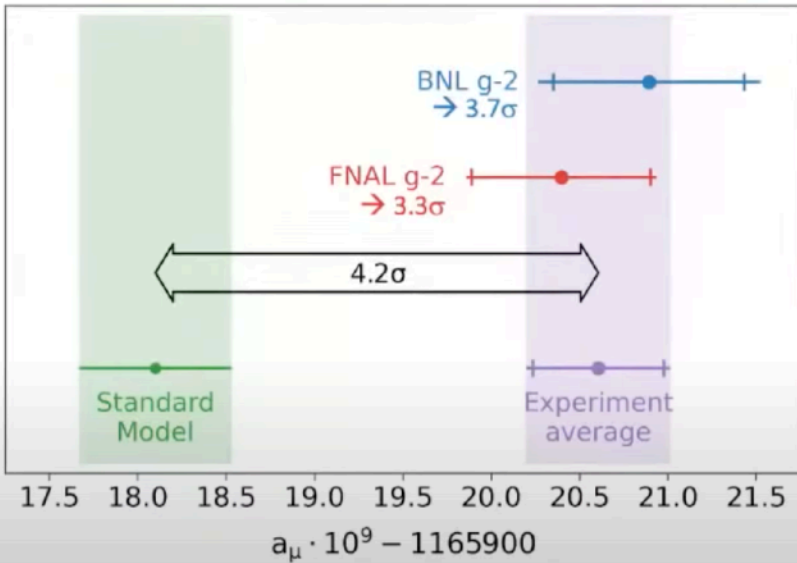
on behalf of the Muon g-2 collaboration
NuFact 2021
Sep 6 - 11, 2021



APRIL 7TH: FERMILAB MUON G-2 EXPERIMENT ANNOUNCED THE FIRST RESULT

Comparison to SM prediction

$$a_{\mu}(\text{SM}) = 0.00116591810(43) \rightarrow 368 \text{ ppb}$$



- Individual tension with SM
 - BNL: 3.7σ
 - FNAL: 3.3σ

$$a_{\mu}(\text{Exp}) - a_{\mu}(\text{SM}) = 0.00000000251(59) \rightarrow 4.2\sigma$$



is to compare it to the theory prediction.



APRIL 7TH: FERMILAB MUON G-2 EXPERIMENT ANNOUNCED THE FIRST RESULT

Beam dynamics corrections to the Run-1 measurement of the muon anomalous magnetic moment at Fermilab
 T. Albahari,³⁰ A. Anastasi,¹⁰ K. Badgley,⁷ S. Baefler,^{36, a} I. Bailey,^{17, b} V. A. Baranov,¹⁵ E. Barlas-Yucel,²⁸

Magnetic Field Measurement and Analysis for the Muon $g-2$ Experiment at Fermilab
 T. Albahari,³⁰ A. Anastasi,^{11, a} K. Badgley,⁷ S. Baefler,^{47, b} I. Bailey,^{19, c} V. A. Baranov,¹⁷ E. Barlas-Yucel,³⁷
 T. Barrett,⁶ F. Bedeschi,¹¹ M. Berz,³⁰ M. Bhattacharya,⁴³ H. P. Binney,⁴⁸ R. Bloom,²¹ J. Bono,⁷ E. Bottalico,^{11, 32}

Measurement of the anomalous precession frequency of the muon in the Fermilab Muon $g-2$ experiment
 T. Albahari,³⁰ A. Anastasi,^{11, a} A. Anisenkov,^{4, b} K. Badgley,⁷ S. Baefler,^{47, c} I. Bailey,^{19, d} V. A. Baranov,¹⁷

Measurement of the Positive Muon Anomalous Magnetic Moment to 0.46 ppm
 B. Abi,⁴⁴ T. Albahari,³⁰ S. Al-Kilani,³⁶ D. Allspach,⁷ L. P. Alonzi,¹⁸ A. Anastasi,^{11, a} A. Anisenkov,^{1, b} F. Azfar,⁴⁴
 K. Badgley,⁷ S. Baefler,^{47, c} I. Bailey,^{19, d} V. A. Baranov,¹⁷ E. Barlas-Yucel,³⁷ T. Barrett,⁶ E. Barzi,¹ A. Basti,^{11, 32}
 F. Bedeschi,¹¹ A. Behnke,²² M. Berz,³⁰ M. Bhattacharya,⁴³ H. P. Binney,⁴⁸ R. Bjorkquist,⁶ P. Bloom,²¹ J. Bono,⁷
 E. Bottalico,^{11, 32} T. Bowco, ²⁰ 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. Chapelin,⁹ S. Chappas,⁷ S. Charity,⁷
 R. Chislett,³⁶ J. Choi,⁵ Z. Chu,^{26, 6} T. E. Chupp,⁴² M. E. Couvry,⁷ A. Conway,⁴¹ G. Corradi,⁹ S. Corradi,¹
 L. Cotrozzi,^{11, 32} J. D. Crnkovic,^{3, 37, 43} S. Dabagov,^{9, 1} P. M. De Lurgio,^{1, 32} P. T. Debevec,³⁷ S. Di Falco,¹¹
 P. Di Meo,¹⁰ G. Di Scincio,¹² R. Di Stefano,^{10, 39} B. Drendel,¹ A. Driutti,^{35, 13, 38} V. N. Duglino,¹⁷ M. Eads,²²
 N. Eggert,⁶ A. Epps,²² J. Esquivel,⁷ M. Farooq,⁴² R. Fatemi,²⁸ C. Ferrari,^{11, 14} M. Ferti,^{48, 16} A. Fiedler,²²
 A. T. Fienberg,⁴⁸ A. Fioretti,^{11, 14} D. Flay,⁴³ S. B. Foster,⁷ H. Friedsam,⁷ E. Frlez,⁴⁷ N. S. Fromming,^{48, 22}
 J. Fry,⁴⁷ C. Fu,^{26, 9} C. Gabbiani,^{11, 14} M. D. Galati,^{11, 32} S. Ganguly,^{37, 7} A. Garcia,⁴⁹ D. E. Gastler,⁷ J. George,⁴¹
 L. K. Gibbons,⁶ A. Gioiosa,^{20, 11} K. L. Giovanetti,¹⁵ P. Girotti,^{11, 32} W. Goh,³⁸ T. Gorrings,³⁸ J. Grange,^{1, 42}
 S. Grant,³⁰ F. Gray,²⁴ S. Hacımeroglu,⁵ D. Hahn,⁷ T. Halewood-Leagas,³⁹ D. Hampai,⁹ F. Han,³⁸
 E. Hazen,⁷ J. Hempstead,⁴⁸ S. Henry,⁴⁴ A. T. Herrod,^{39, 4} D. W. Hertzog,⁴⁸ G. Hesketh,³⁶ A. Hilbert,³⁷
 Z. Hodge,⁴⁸ J. L. Holzauer,⁴³ K. W. Hong,⁴⁷ R. Hong,^{1, 38} M. Iacovacci,^{10, 31} M. Incagli,¹¹ C. Johnstone,⁷
 J. A. Johnstone,⁷ P. Kammel,⁴⁸ M. Kargiantoulakis,⁷ M. Karuza,^{19, 45} J. Kaspar,⁴⁸ D. Kawałl,⁴¹ L. Kelton,³⁸
 A. Keshavarzi,⁴⁰ D. Kessler,⁴¹ K. S. Khaw,^{27, 26, 48} Z. Khechadorian,⁶ N. V. Khomutov,¹⁷ B. Kiburg,⁷
 M. Kiburg,^{7, 23} O. Kim,^{18, 5} S. C. Kim,⁶ Y. L. Kim,⁵ B. King,^{39, a} N. Kinaird,¹ M. Korostelev,^{19, 1} I. Kourbanis,⁷
 E. Kraeghcloh,⁴² V. A. Krylov,¹⁷ A. Kuchibhotla,³⁷ N. A. Kuchinskiy,¹⁷ K. R. Labe,⁶ J. LaBounty,⁴⁸ M. Lancaster,⁴⁰
 M. J. Lee,⁵ S. Lee,³⁷ B. Li,^{26, 1, 6} D. Li,^{26, 6} L. Li,^{26, 6} J. Logushenko,^{4, 9} A. Lorente Campos,³⁸
 A. Luch,⁷ G. Lukicov,²⁶ G. Luo,²² A. Lusiani,^{11, 25} A. L. Lyon,⁷ B. MacCoy,⁴⁸ R. Madrak,⁷ K. Makino,²⁰
 F. Marinetti,³⁰ S. Mastroianni,¹⁰ S. Maxfield,³⁹ M. McEvoy,²² W. Merritt,⁷ A. A. Mikhailichenko,^{6, 8}
 J. P. Miller,² S. Mizzi,¹⁷ J. P. Morgan,⁷ W. M. Morse,³ J. Mott,^{2, 7} E. Motak,³⁶ A. Nath,^{10, 31} D. Newton,^{39, b}
 H. Nguyen,⁷ M. Oberling,⁷ R. Osofsky,⁴⁸ J.-F. Ostiguy,⁷ S. Park,⁵ G. Pauletta,^{35, 8} G. M. Piacentino,^{20, 12}
 R. N. Pilato,^{11, 32} K. T. Pitts,³⁷ B. Plaster,³⁸ D. Počanić,¹⁹ N. Pohlman,²² C. G. Polly,⁷ M. Popovic,⁷ J. Price,³⁹
 B. Quinn,⁴⁹ N. Raha,¹¹ S. Ramachandran,¹ E. Ramberg,⁷ N. T. Rider,⁶ J. L. Ritchie,⁴⁶ B. L. Roberts,²
 D. L. Rubin,⁹ L. Sauti,^{35, 8} D. Sathyan,⁴ H. Schellman,^{24, 1} C. Schlesier,³⁷ A. Schreckenberger,^{46, 2, 37}
 Y. K. Semertzidis,^{5, 18} Y. M. Shatunov,⁴ D. Shenyakin,^{4, 16} M. Shenk,²² D. Sim,³⁹ M. W. Smith,^{48, 11} A. Smith,³⁹
 A. K. Saha,⁷ M. Sorbara,^{12, 33} D. Stückinger,²⁸ J. Stapleton,⁷ D. Still,⁷ C. Stoughton,⁷ D. Stratakakis,⁷
 C. Strohm,⁶ T. Stuttard,³⁶ H. E. Swanson,⁴⁸ G. Sweetmore,⁴⁰ D. A. Sweigart,⁹ M. J. Syphers,⁴⁸
 D. A. Tarazona,³⁹ T. Teubner,³⁹ A. E. Tewsley-Booth,⁴² K. Thomson,³⁹ V. Tishchenko,³ N. H. Tran,² W. Turner,³⁹
 E. Valeov,^{20, 19, 27, d} D. Vasilikova,³⁶ G. Venanzoni,¹¹ V. P. Volnykh,¹⁷ T. Walton,⁷ M. Warren,³⁶ A. Weisskopf,²⁰
 L. Wely-Rieger,⁷ M. Whitley,³⁹ P. Winter,¹ A. Wolski,^{39, 4} M. Wormald,³⁹ W. Wu,⁴³ and C. Yoshikawa,⁷

(The Muon $g-2$ Collaboration)

PRAB

PRA

PRD

PRL

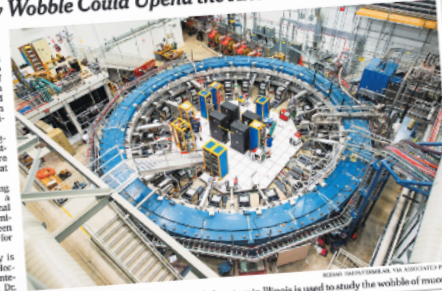
A Particle's Tiny Wobble Could Upend the Known Laws of Physics

By DENNIS OVERBYE

Evidence is mounting that a tiny subatomic particle seems to be defying the known laws of physics, scientists announced on Wednesday. A finding that would open a vast and tantalizing hole in our understanding of the universe.

The result, physicists say, suggests that there are forms of matter and energy that do not fit and evolution of the cosmos that are not yet known to science. "This is our Mars rover landing moment," said Chris Polly, a physicist at the Fermi National Accelerator Laboratory in Batavia, Ill., who has been working toward this finding for most of his career.

The particle under scrutiny is the muon, which is akin to an electron but far heavier, and is an integral element of the cosmos. The



A ring at the Fermi National Accelerator Laboratory in Illinois is used to study the wobbles of muons.

terrestrial team of 260 physicists from seven countries... found that muons did not behave as predicted when it came to the magnetic field at Fermilab. The aberrant behavior points to a firm challenge to the bedrock of modern physics known as the Standard Model, a suite of equations that encompasses the fundamental

conference on Wednesday. Dr. Polly posted to a graph displaying white space where the Fermilab findings deviated from the theoretical predictions. "We can say with fairly high confidence, there were slight..."

At a virtual seminar and news conference on Wednesday, Dr. Polly presented to a graph displaying white space where the Fermilab findings deviated from the theoretical predictions. "We can say with fairly high confidence, there were slight..."

電子反

電子反常磁矩的實驗發現

近日，在美國伊利諾伊州費米國家加速器實驗室，由中國科學家領銜的國際合作組宣佈，首次發現了μ子反常磁矩的實驗發現。

這項發現對標準模型提出了挑戰，因為μ子的反常磁矩與標準模型的預測值存在顯著偏差。

Alle Artikel & digitales Magazin

Neue Erkenntnisse in der Teilchenphysik

Kundschafter ins Ungebetene

Bei 100 Jahren werden die Grundlagen der Teilchenphysik in der Welt vorgestellt. 100 Jahre Teilchenphysik: Ein Überblick über die Grundlagen der Teilchenphysik. Ein Überblick über die Grundlagen der Teilchenphysik.

THE DAILY SOCIAL DISTANCING SHOW

GHOST GUNS AND SUBATOMIC PARTICLES

THE MUON g-2 ANOMALY EXPLAINED

THE MAGNETIC MOMENT OF THE MUON

$$\vec{\mu} = g \frac{e}{2m} \vec{s}$$

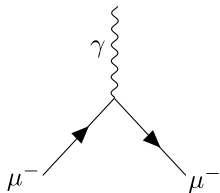
Magnetic moment connected to spin via dimensionless factor g : gyromagnetic ratio

$$a_{\mu} = \frac{g - 2}{2}$$

the anomalous magnetic moment

THE MAGNETIC MOMENT OF THE MUON: FROM THEORY

Dirac $g=2$ (1928)
for $s=1/2$ particles



Muon $g-2$ Theory Initiative

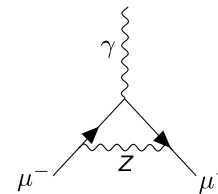
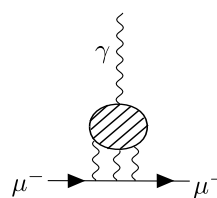
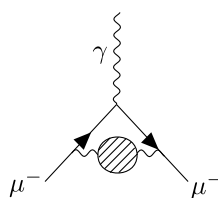
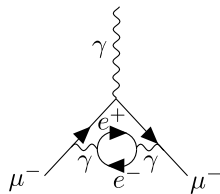
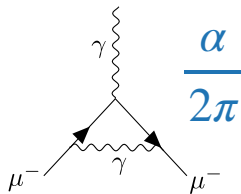
$$a_\mu(\text{SM}) = 116591810(43) \times 10^{-11}$$

Schwinger (1948)
1st order QED
uncertainty: 0.1×10^{-11}

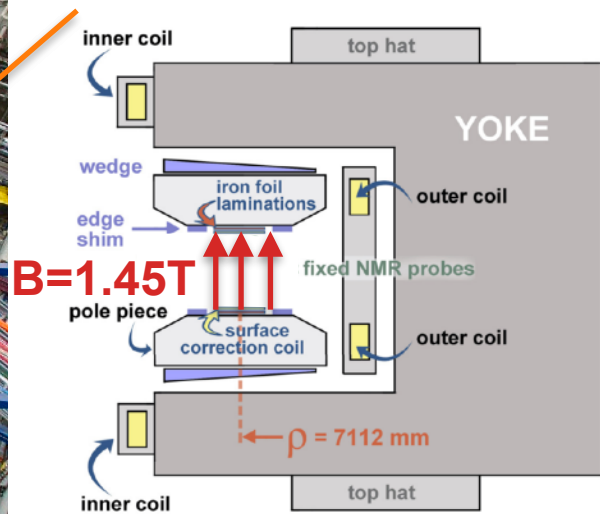
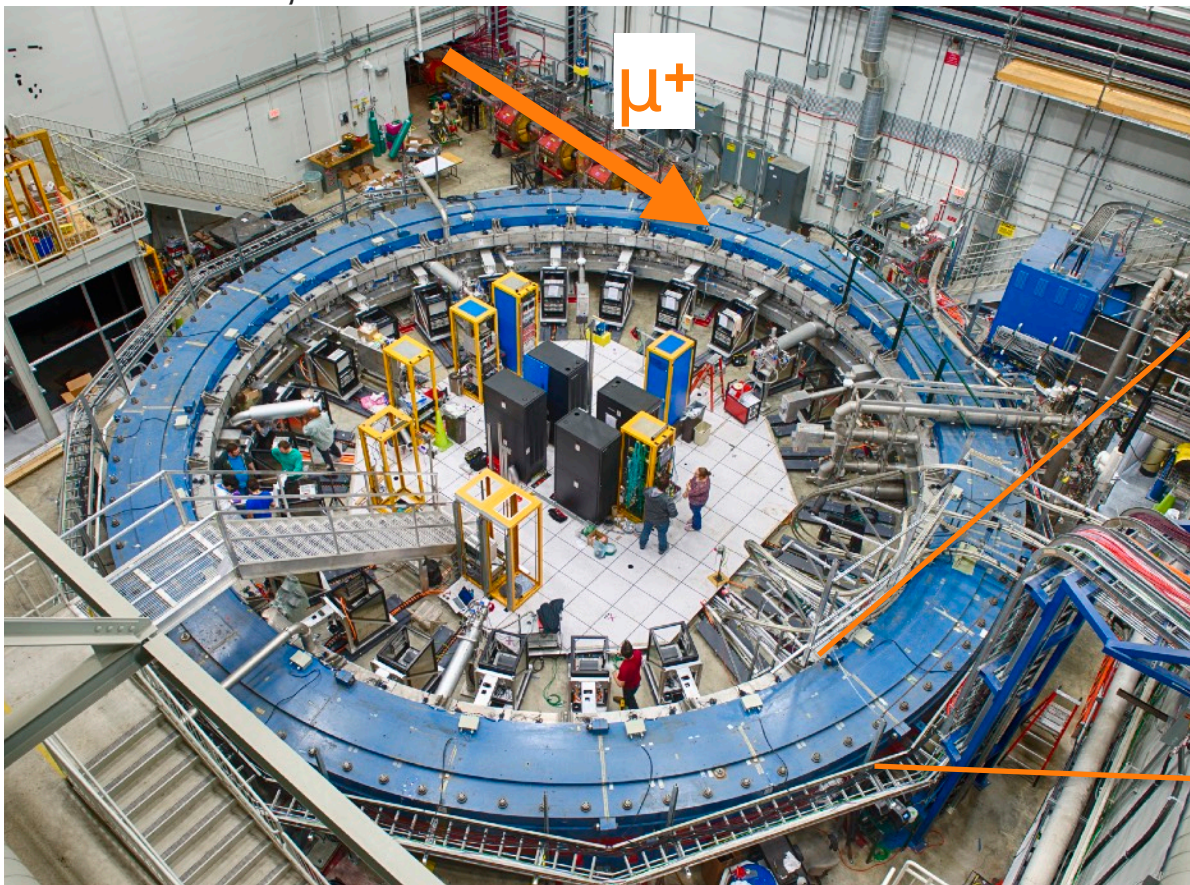
Vacuum polarizations
Higher order QED

Hadronic
HVP: $6845(40) \times 10^{-11}$
HLbL: $92(18) \times 10^{-11}$

Electroweak
 $153.6(1.0) \times 10^{-11}$



MEASURE a_μ IN A STORAGE RING



MEASURE a_μ IN A STORAGE RING

Cyclotron frequency

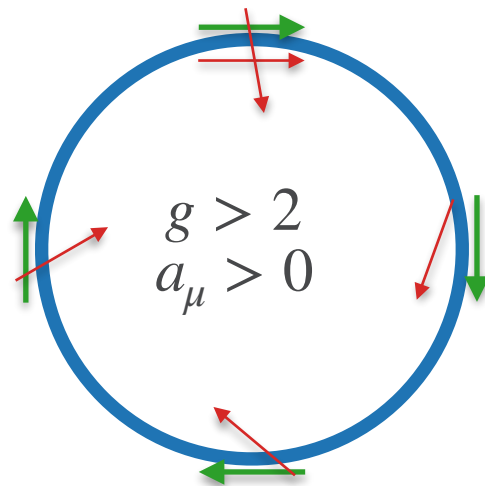
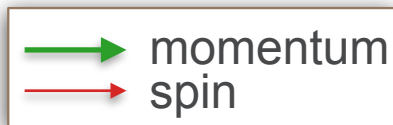
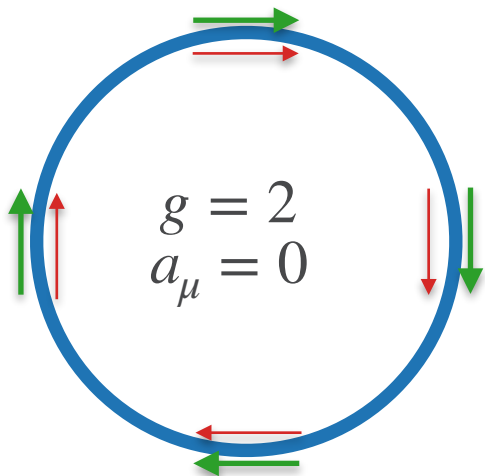
$$\omega_C = \frac{e}{m\gamma} B$$

Spin precession

$$\omega_S = \frac{e}{m\gamma} B(1 + \gamma a_\mu)$$

$$\omega_a \equiv \omega_S - \omega_C = \frac{eB}{m_\mu} a_\mu$$

NMR: $\hbar\omega'_p = 2\mu_p |B|$



STORAGE RING: HOW WE STORE THE MUONS

pitch corrections: C_p E-field corrections: C_e

$$\vec{\omega}_a = -\frac{q}{m} \left(a_\mu \vec{B} - a_\mu \frac{\gamma}{\gamma + 1} \underbrace{(\vec{\beta} \cdot \vec{B})}_{\sim 0} \vec{\beta} + \left(a_\mu - \frac{1}{\gamma^2 - 1} \right) \underbrace{\frac{\vec{\beta} \times \vec{E}}{c}}_{\sim 0} \right)$$

$p = p_{\text{magic}} = \frac{mc}{\sqrt{a_\mu}} = 3.094 \text{ GeV}/c$

MEASURE a_μ IN A STORAGE RING

10.5 ppb uncertainty (hydrogen maser)
Metrologia **13**, 179 (1977)

bound state QED calc., exact

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

0.28 ppb uncertainty
Phys. Rev. A **83**, 052122 (2011)

22 ppb uncertainty
(Muonium hyper fine split.)
Phys. Rev. Lett. **82**, 711 (1999)

TDR goal:
140 ppb
(4 fold improvement
over the BNL result)

$$\frac{\omega_a}{\tilde{\omega}'_p} \approx \frac{f_{\text{clock}} \omega_a^m (1 + C_e + C_p + C_{ml} + C_{pa})}{f_{\text{calib}} \langle \omega'_p(x, y, \phi) \times M(x, y, \phi) \rangle (1 + B_K + B_Q)}$$

MEASURE a_μ IN A STORAGE RING

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

unblinding factor

precession

beam dynamics corrections

$$\frac{\omega_a}{\tilde{\omega}'_p} \approx \frac{f_{\text{clock}} \omega_a^{\text{meas}} \left(1 + C_e + C_p + C_{ml} + C_{pa} \right)}{f_{\text{calib}} \left\langle \omega'_p(x, y, \phi) \times M(x, y, \phi) \right\rangle \left(1 + B_K + B_Q \right)}$$

absolute field
calibration

magnetic field sampled
by the muon distribution

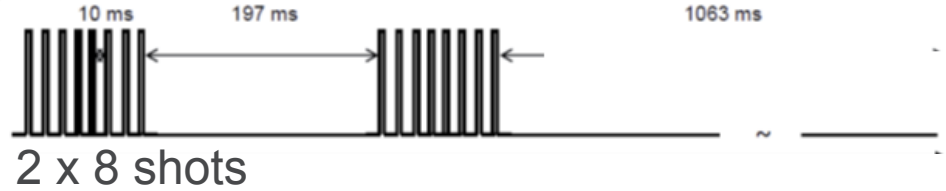
Magnetic transients
corrections

THE MUONS



8 GeV protons in recycler

Target



$p/\pi/\mu$ beam, p kicked away, π decay

$\pi^+ \rightarrow \mu^+ \nu_\mu$ 95% polarized muons

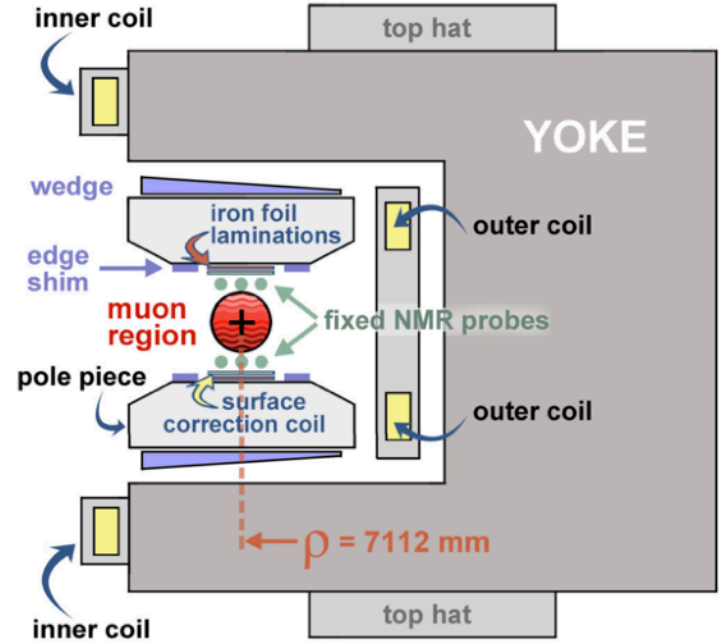
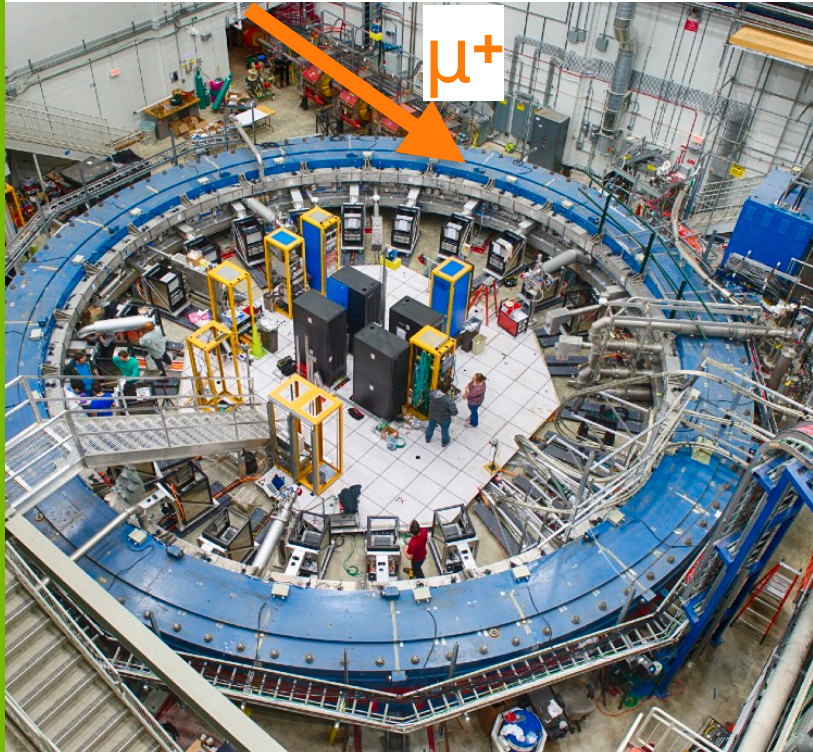
$$\vec{\omega}_a = -\frac{q}{m} \left(a_\mu \vec{B} - \left(a_\mu - \frac{1}{\gamma^2 - 1} \right) \frac{\vec{\beta} \times \vec{E}}{c} \right)$$

$$\text{fo } p = p_{\text{magic}} = \frac{mc}{\sqrt{a_\mu}} = 3.094 \text{ GeV}/c$$

Store muons for $\sim 700\mu\text{s}$ (~ 10 lifetimes)



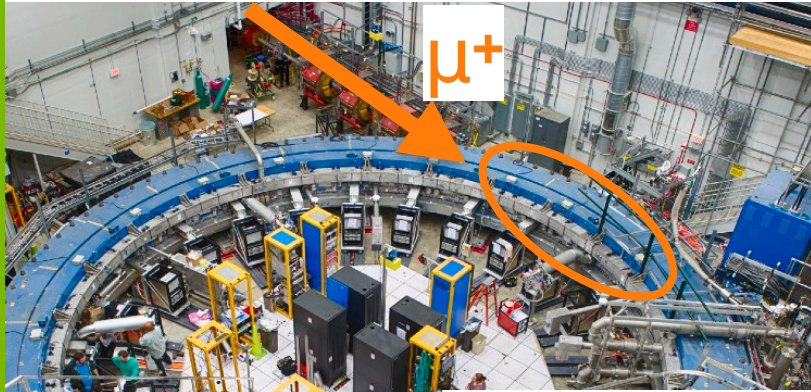
HOW TO STORE MUONS: MAGNETIC FIELD



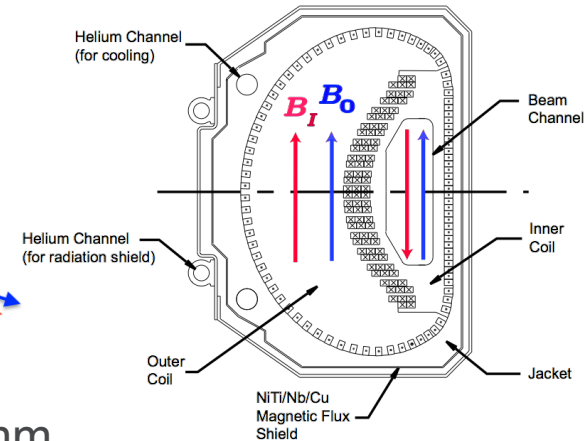
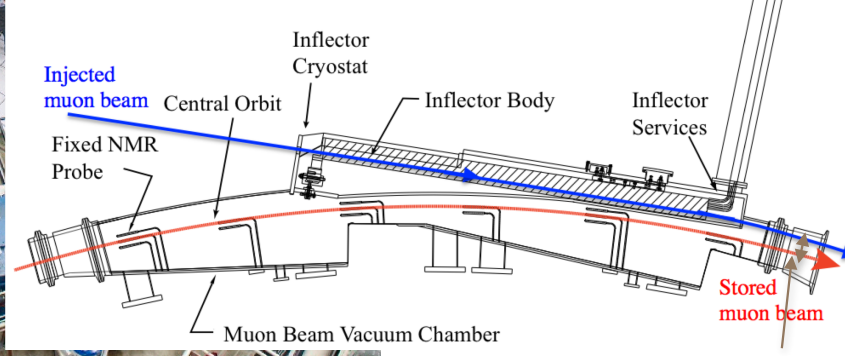
Fully-assembled lamination (10 degrees wide)



HOW TO STORE MUONS: THE INFLECTOR

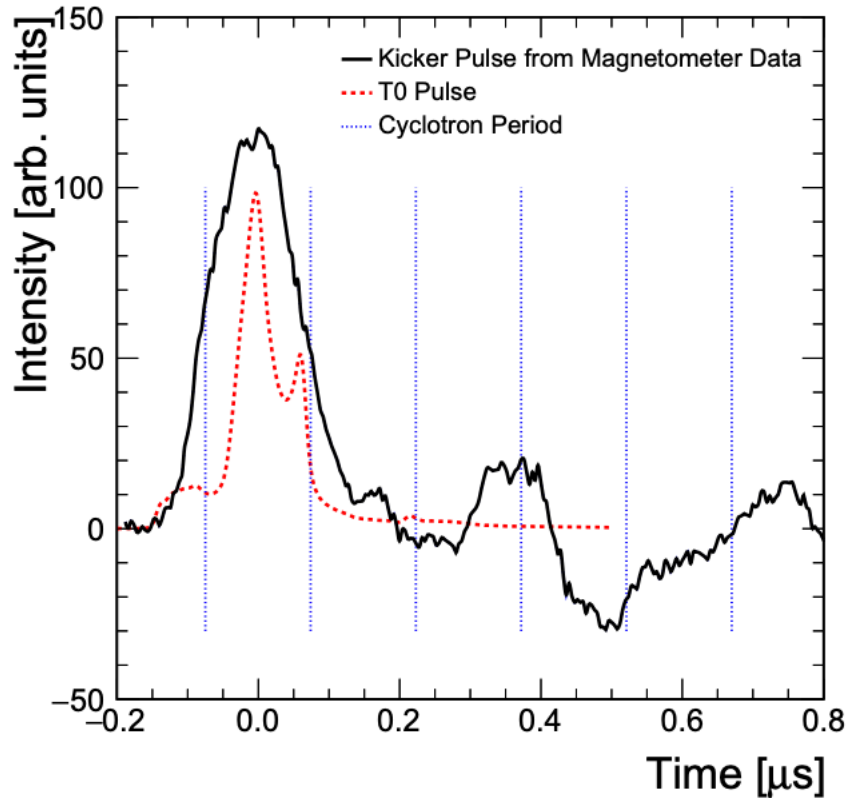


- Need to cancel field in beam channel
- prevents strong deflection of the beam

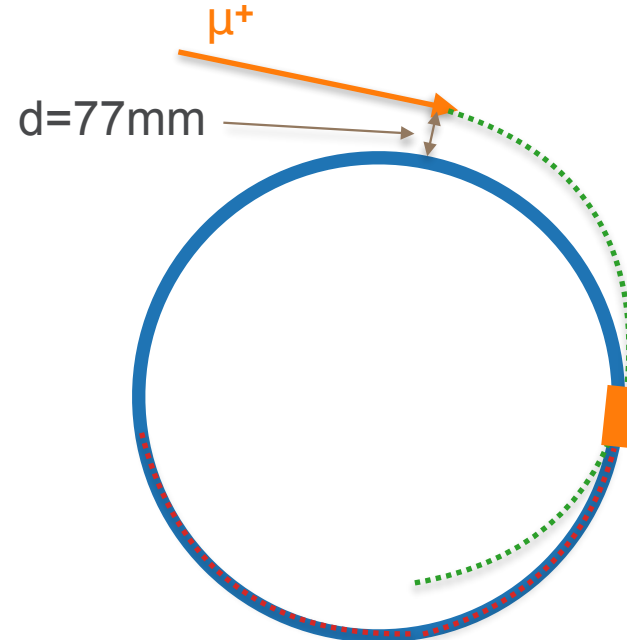


d=77mm

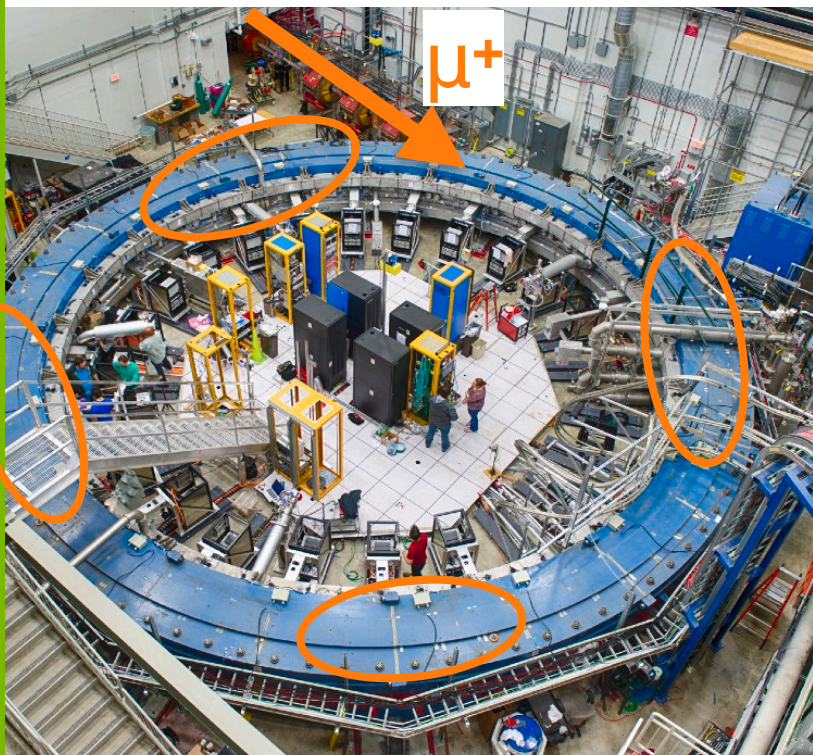
HOW TO STORE MUONS: THE KICKER



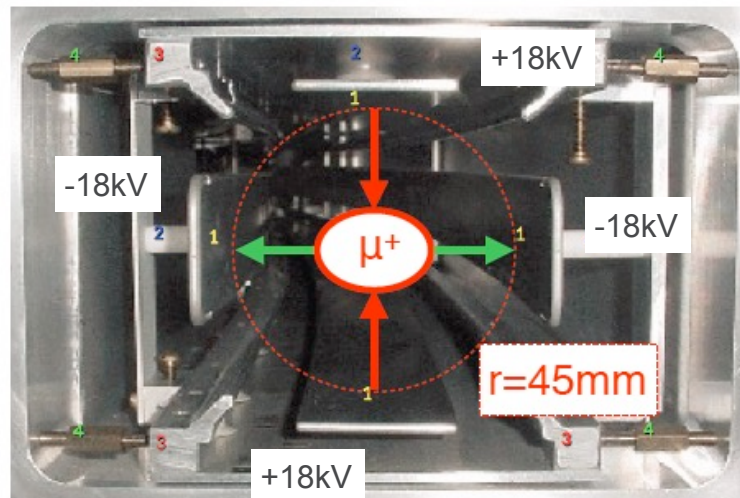
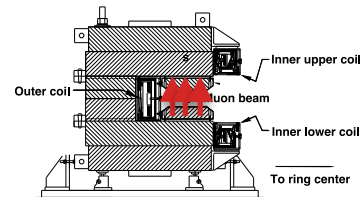
Incident beam center 77 mm off from center of storage region
tears muon onto store orbit



HOW TO STORE MUONS: FOCUSING



- Radial focus:
1.45T vertical B field
- Vertical focus:
electrostatic quadrupoles (43% of the ring)



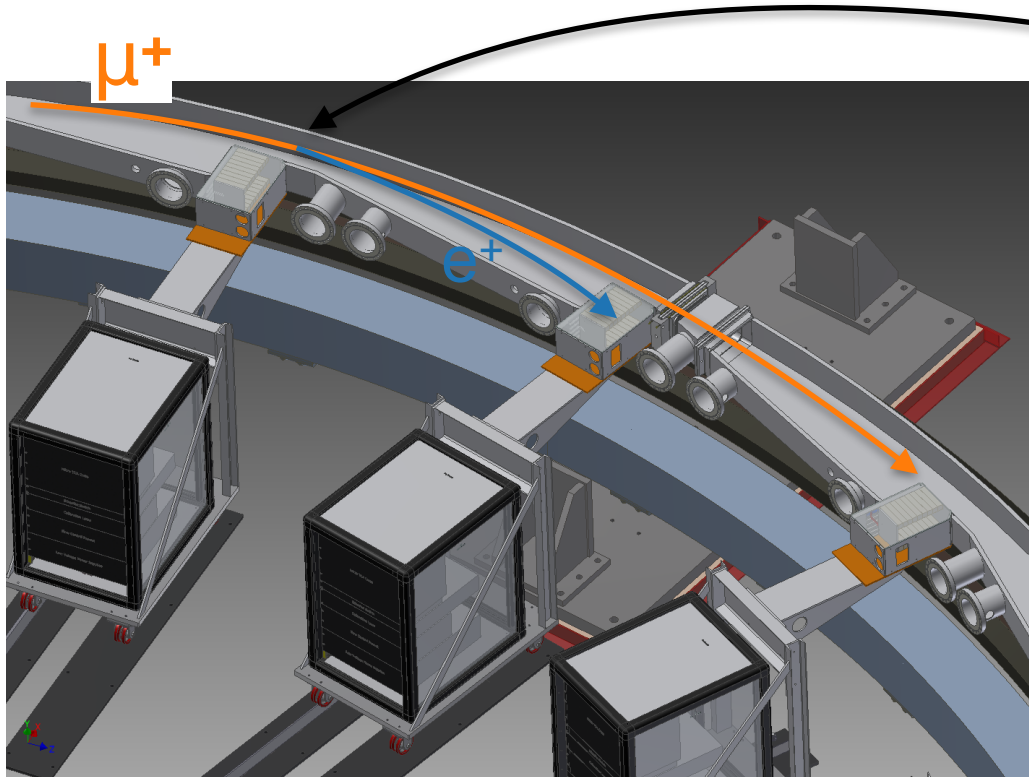
$$\vec{\omega}_a = -\frac{q}{m} \left(a_\mu \vec{B} - \left(a_\mu - \frac{1}{\gamma^2 - 1} \right) \frac{\vec{\beta} \times \vec{E}}{c} \right)$$

THE MEASUREMENT: CALORIMETERS (ω_a^{meas})

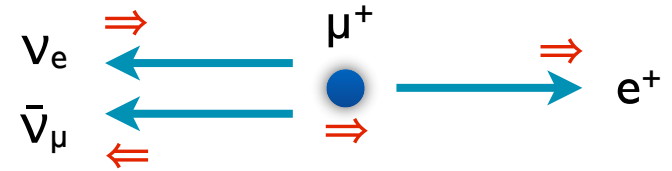


- 24 Calorimeters with 54 (9x6) Cherenkov PbF₂ crystals read out by SiPMs
 - arrival time (~100ps) & energy of e⁺ (~5% at 2GeV)
 - Laser system for gain response calibration throughout data taking (stability 10⁻³, rate difference 10⁴)

THE MEASUREMENTS: CALORIMETERS (ω_a^{meas})

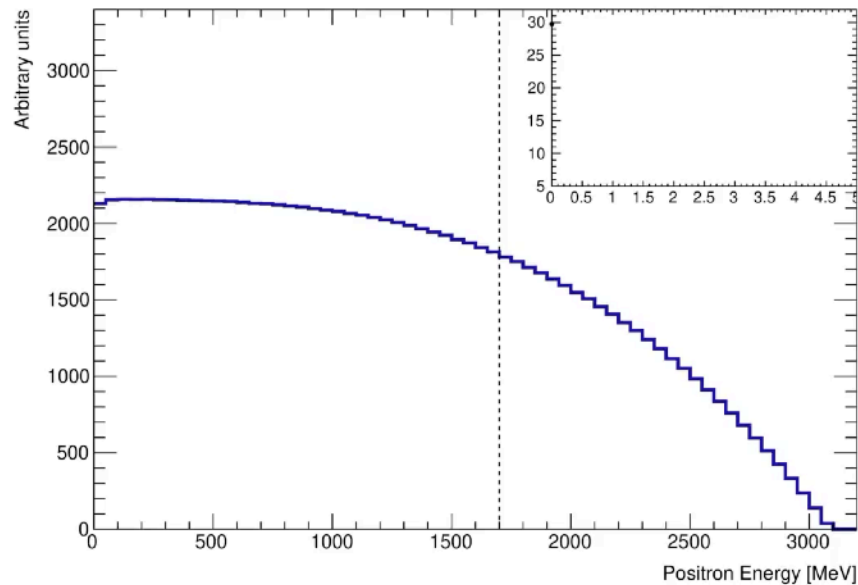
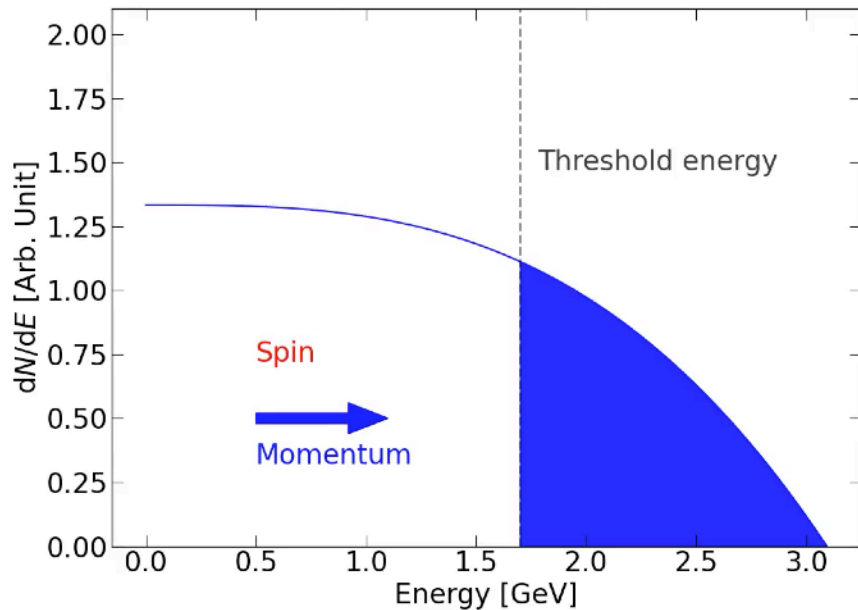


- Parity violating decay (Michel)
- Highest-energy e^+ emitted preferentially along muon spin



MEASUREMENTS: ω_a^{meas}

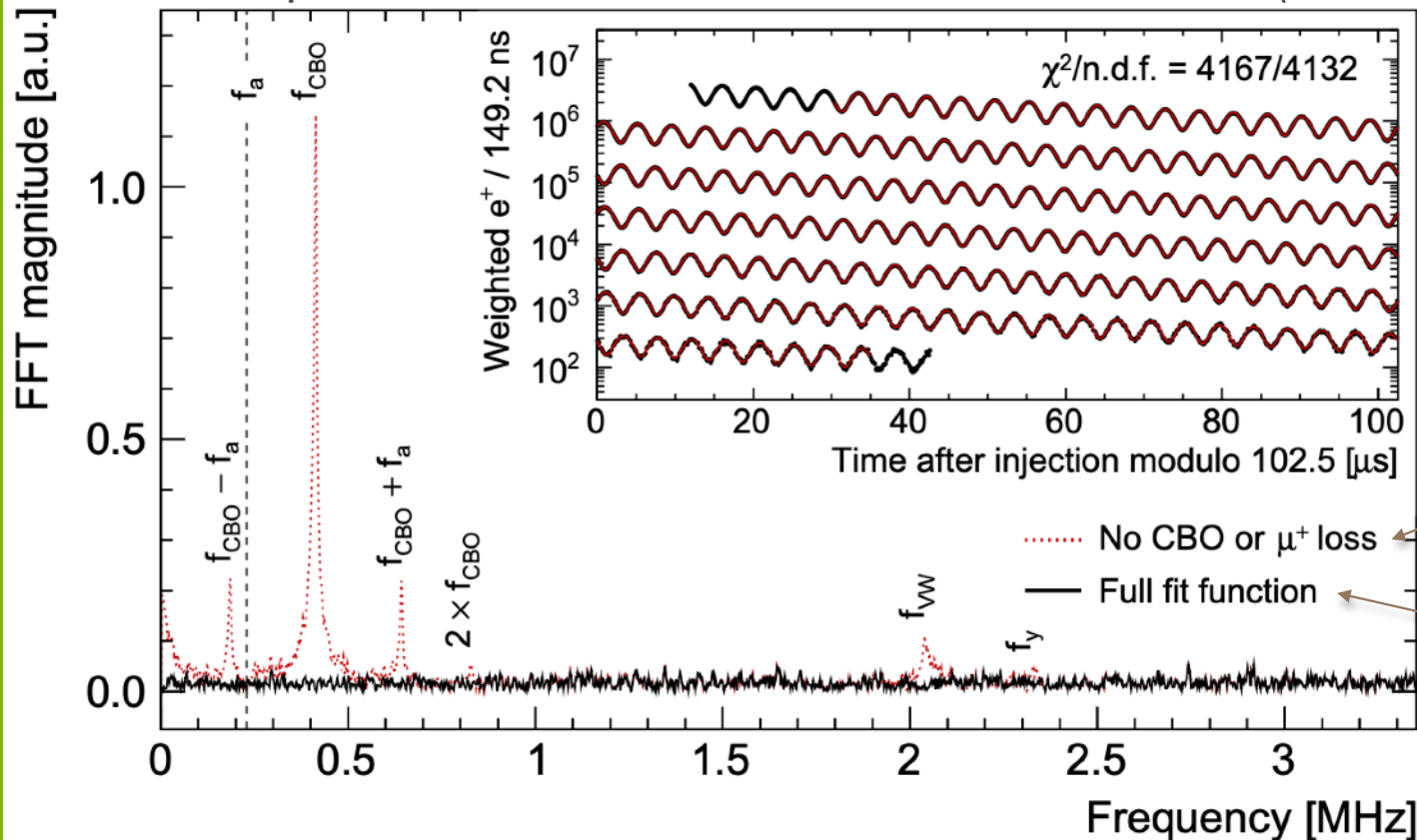
$$\frac{\omega_a}{\tilde{\omega}'_p} \approx \frac{f_{\text{clock}} \omega_a^{\text{meas}} (1 + C_e + C_p + C_{ml} + C_{pa})}{f_{\text{calib}} \langle \omega'_p(x, y, \phi) \times M(x, y, \phi) \rangle (1 + B_K + B_Q)}$$



MEASUREMENTS: ω_a^{meas}

Example from dataset 1d

$$\frac{\omega_a}{\tilde{\omega}'_p} \approx \frac{f_{\text{clock}} \omega_a^{\text{meas}} (1 + C_e + C_p + C_{ml} + C_{pa})}{f_{\text{calib}} \langle \omega'_p(x, y, \phi) \times M(x, y, \phi) \rangle (1 + B_K + B_Q)}$$



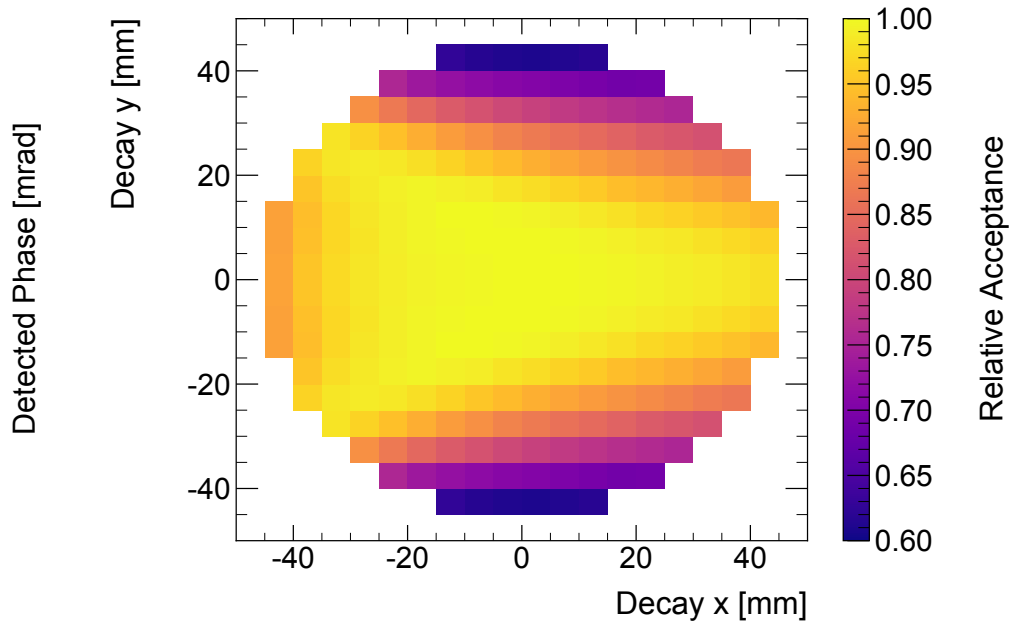
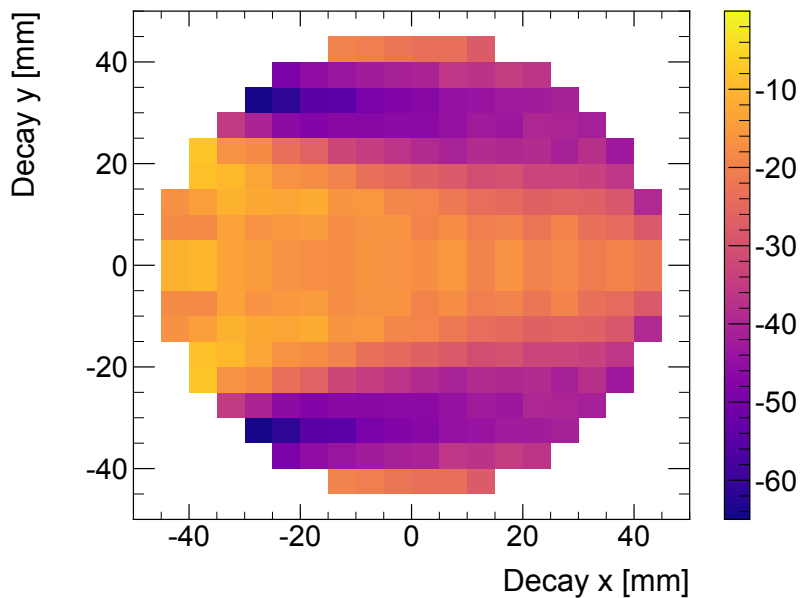
*CBO:
Coherent Betatron
Oscillation

MEASUREMENTS: ω_a^{meas}

$$N(t) = N_0 e^{-t/\gamma\tau_\mu} [1 + A \cos(\omega_a t + \phi_0)]$$

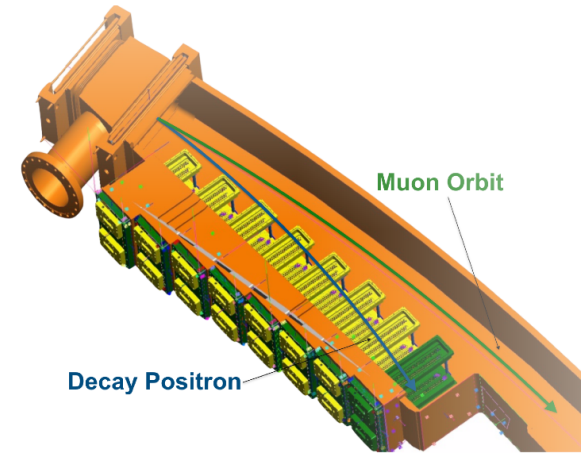
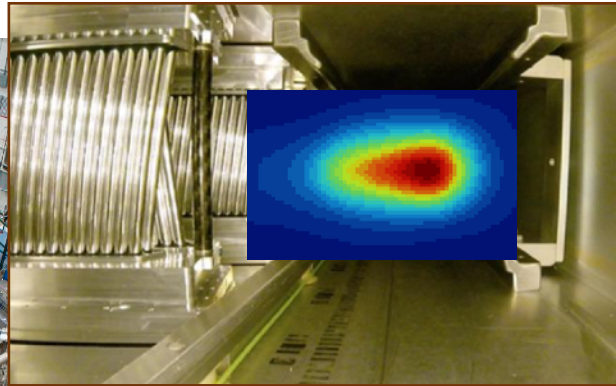
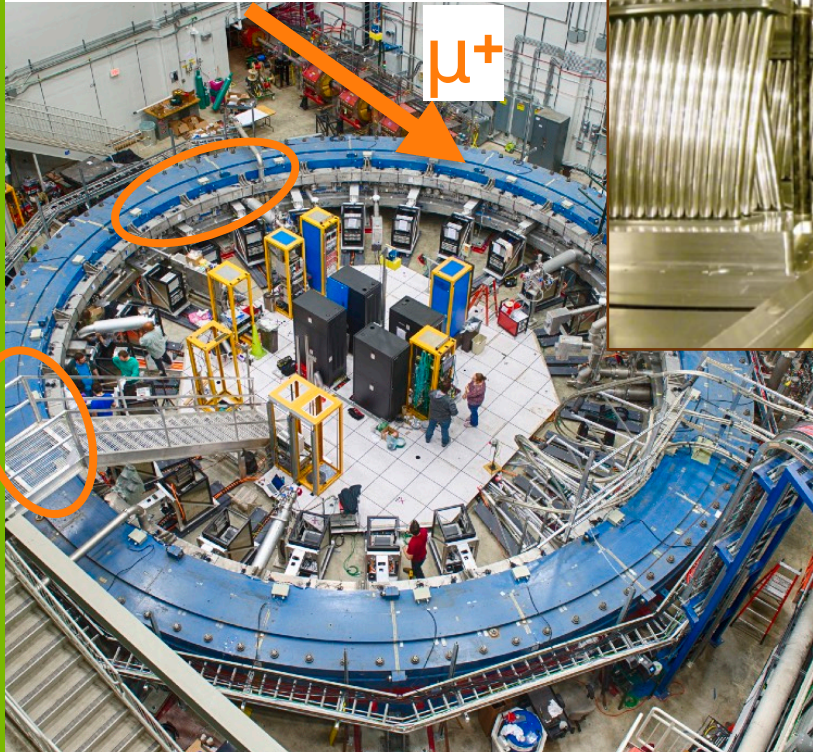
Early-to-late effects $\phi \rightarrow \phi(t) \rightarrow$ corrections needed

$$\frac{\omega_a}{\tilde{\omega}'_p} \approx \frac{f_{\text{clock}} \omega_a^{\text{meas}} (1 + C_e + C_p + C_{ml} + C_{pa})}{f_{\text{calib}} \langle \omega'_p(x, y, \phi) \times M(x, y, \phi) \rangle (1 + B_K + B_Q)}$$



TRACKERS: BEAM DYNAMICS

$$\frac{\omega_a}{\tilde{\omega}'_p} \approx \frac{f_{\text{clock}} \omega_a^{\text{meas}} (1 + C_e + C_p + C_{ml} + C_{pa})}{f_{\text{calib}} \langle \omega'_p(x, y, \phi) \times M(x, y, \phi) \rangle (1 + B_K + B_Q)}$$



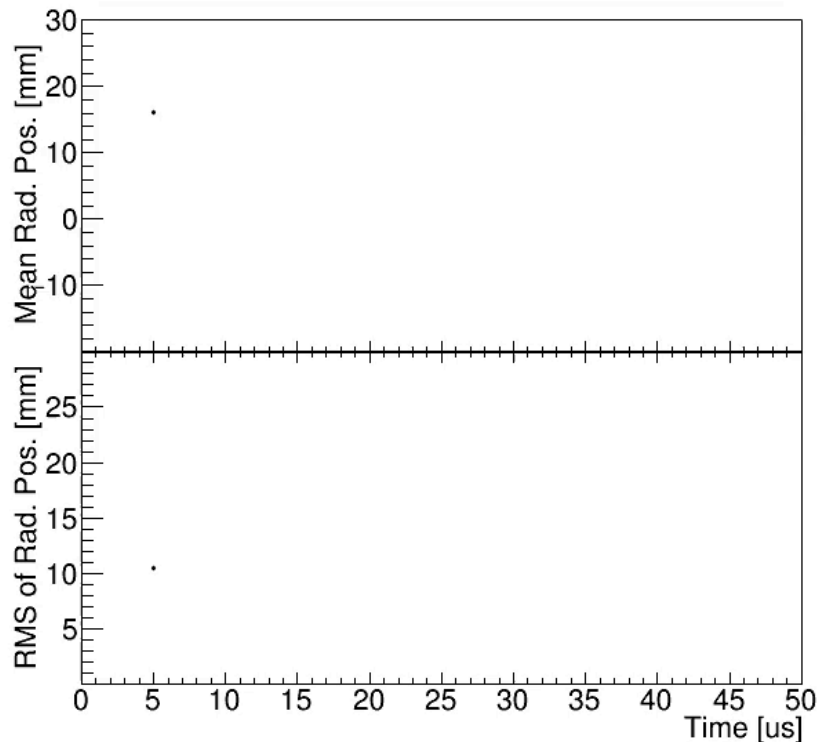
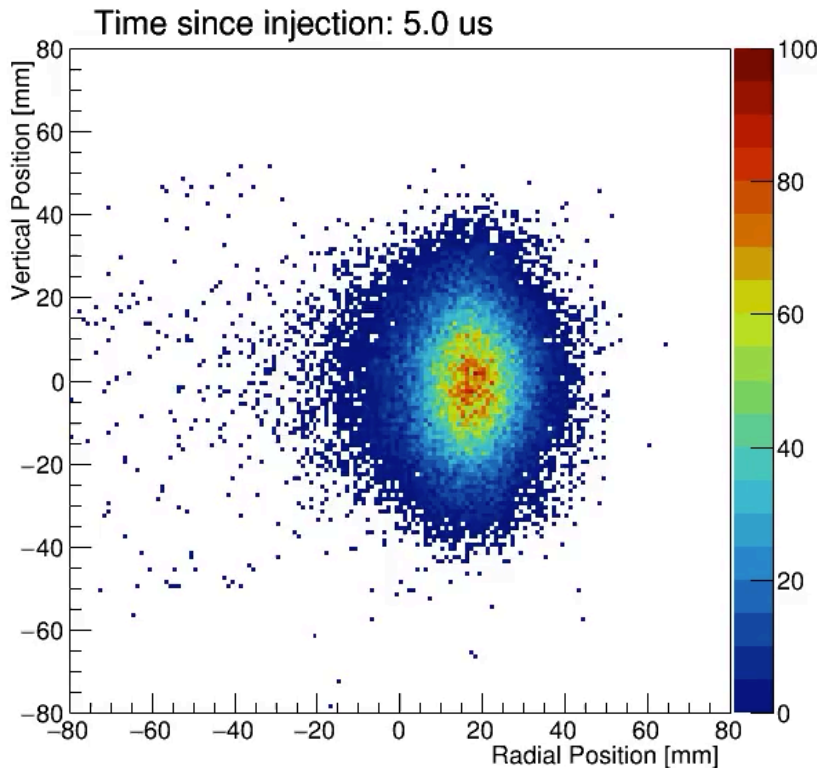
2 straw-tracker stations

(each 8 modules, 4 layers of 32 straws, 50:50 Ar:Ethane, res ~100um)

Muon distribution + field maps: $\tilde{\omega}'_p$
 Handle on beam dynamics

TRACKERS: BEAM DYNAMICS

$$\frac{\omega_a}{\tilde{\omega}'_p} \approx \frac{f_{\text{clock}} \omega_a^{\text{meas}} (1 + C_e + C_p + C_{ml} + C_{pa})}{f_{\text{calib}} \langle \omega'_p(x, y, \phi) \times M(x, y, \phi) \rangle (1 + B_K + B_Q)}$$

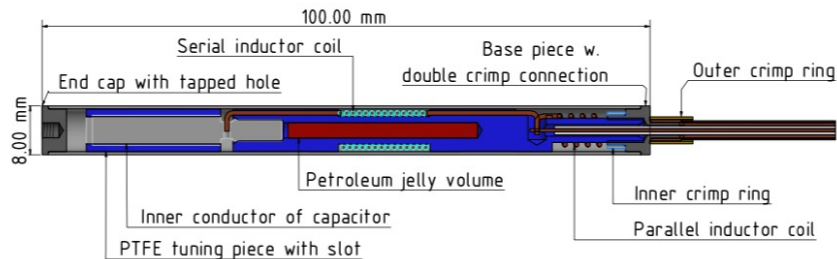


*CBO: Coherent Betatron Oscillation

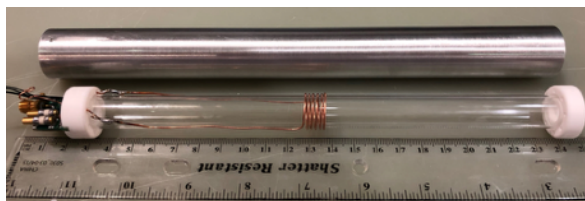
NUCLEAR MAGNETIC RESONANCE (NMR)

$$\hbar\omega'_p = 2\mu_p |B|$$

- Flip spins of a sample by delivering a $\pi/2$ -pulse
- measure Free Induced Decay (FID)

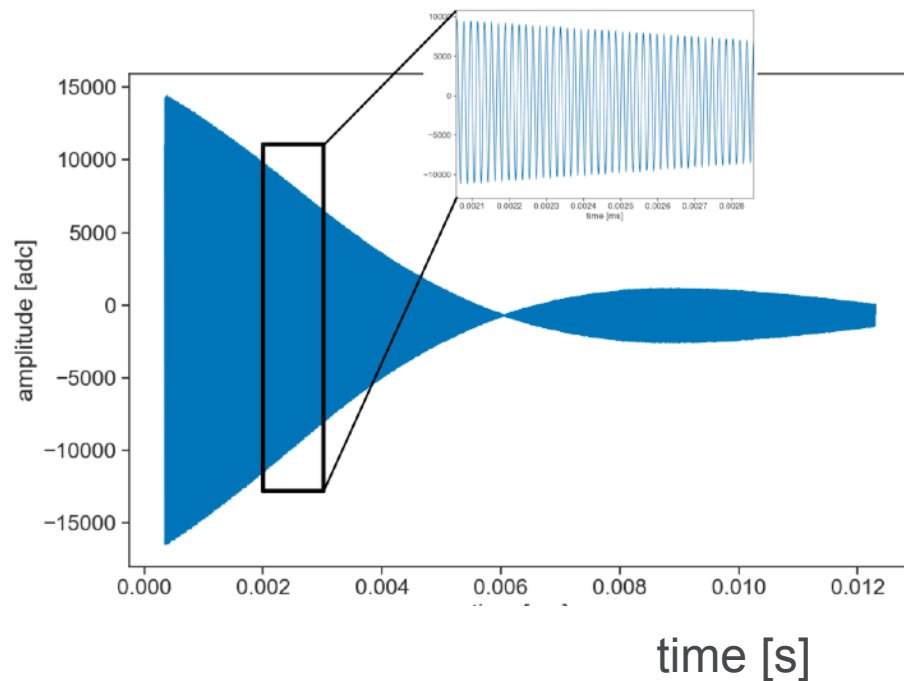


Petroleum Jelly probes



H₂O calibration probe (f_{calib})

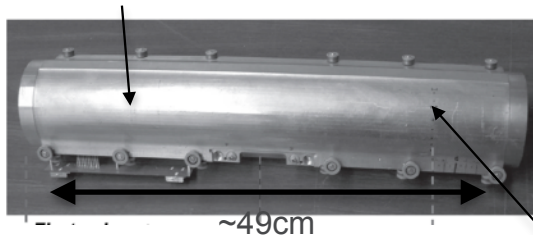
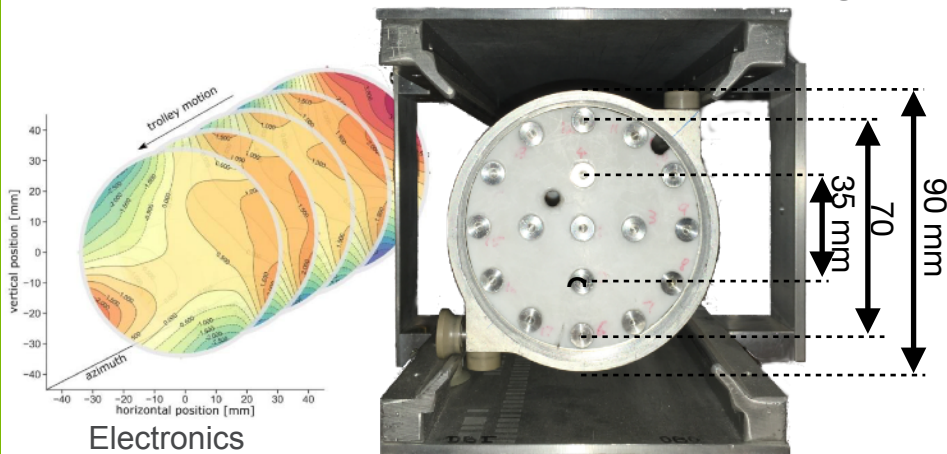
Free Induced Decay (FID)



THE FIELD MEASUREMENT

Trolley

- inside the storage region, ~3 days
- 17 probes, moves around the ring

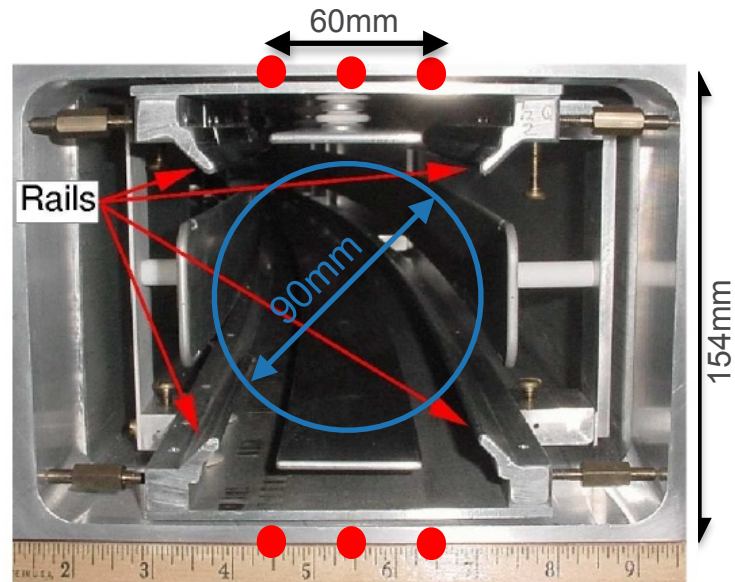


NMR probes

$$\frac{\omega_a}{\tilde{\omega}'_p} \approx \frac{f_{\text{clock}} \omega_a^{\text{meas}} (1 + C_e + C_p + C_{ml} + C_{pa})}{f_{\text{calib}} \langle \omega'_p(x, y, \phi) \times M(x, y, \phi) \rangle (1 + B_K + B_Q)}$$

378 Fixed Probes

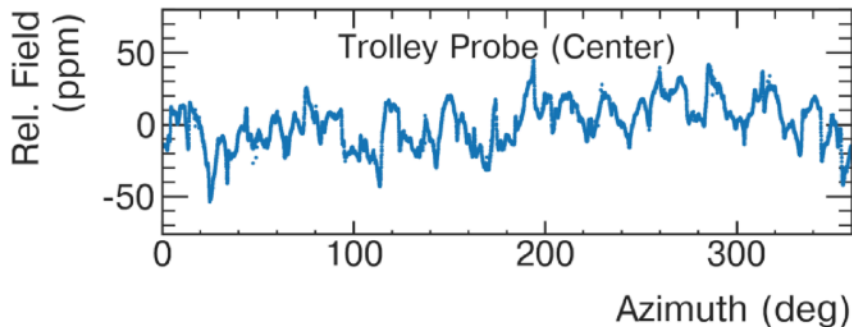
- Outside of the storage region
- 72 position, ~5deg apart



THE FIELD MEASUREMENT

Trolley (every ~3 days)

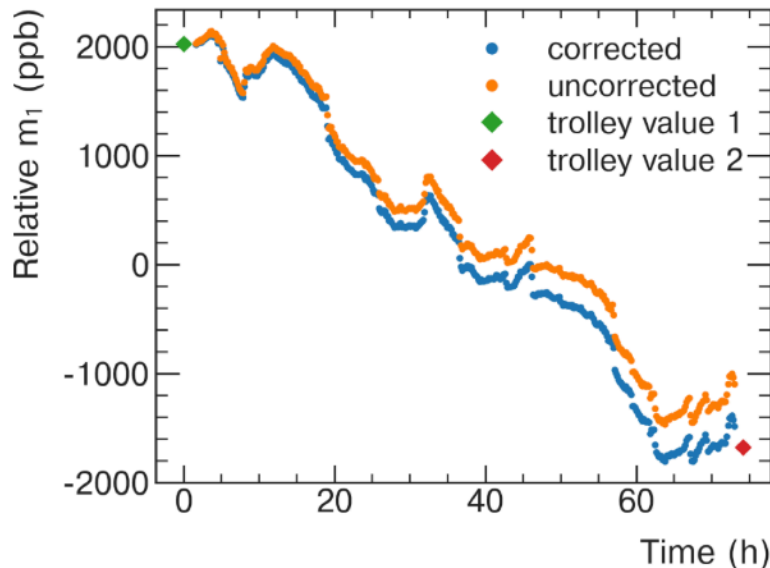
Field inside the muon storage volume



$$\frac{\omega_a}{\tilde{\omega}'_p} \approx \frac{f_{\text{clock}} \omega_a^{\text{meas}} (1 + C_e + C_p + C_{ml} + C_{pa})}{f_{\text{calib}} \langle \omega'_p(x, y, \phi) \times M(x, y, \phi) \rangle (1 + B_K + B_Q)}$$

378 Fixed Probes (from the outside)

Track the field between field maps

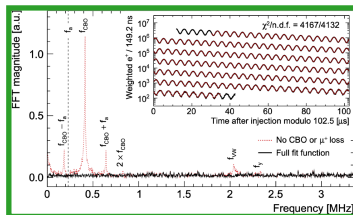


Uncertainty: random walk model
(Brownian bridge)



BACK TO THE MASTER FORMULA

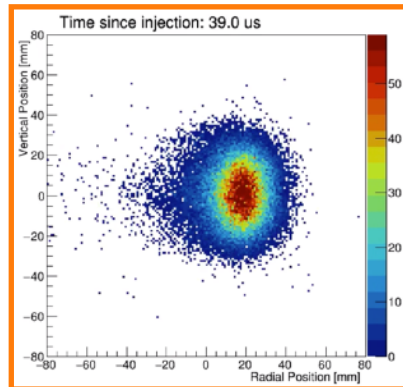
Matteo Sorbara
(WG 4)



precession

Alessandra Luca
(WG 3)

beam dynamics
corrections



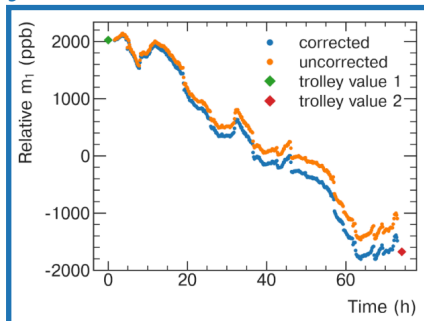
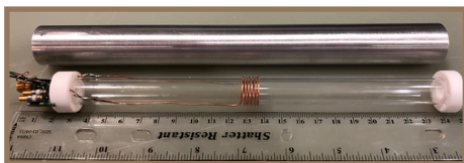
unblinding factor

$$\frac{\omega_a}{\tilde{\omega}'_p} \approx \frac{f_{\text{clock}} \omega_a^{\text{meas}} \left(1 + C_e + C_p + C_{ml} + C_{pa} \right)}{f_{\text{calib}} \left\langle \omega'_p(x, y, \phi) \times M(x, y, \phi) \right\rangle \left(1 + B_K + B_Q \right)}$$

magnetic field sampled
by the muon distribution

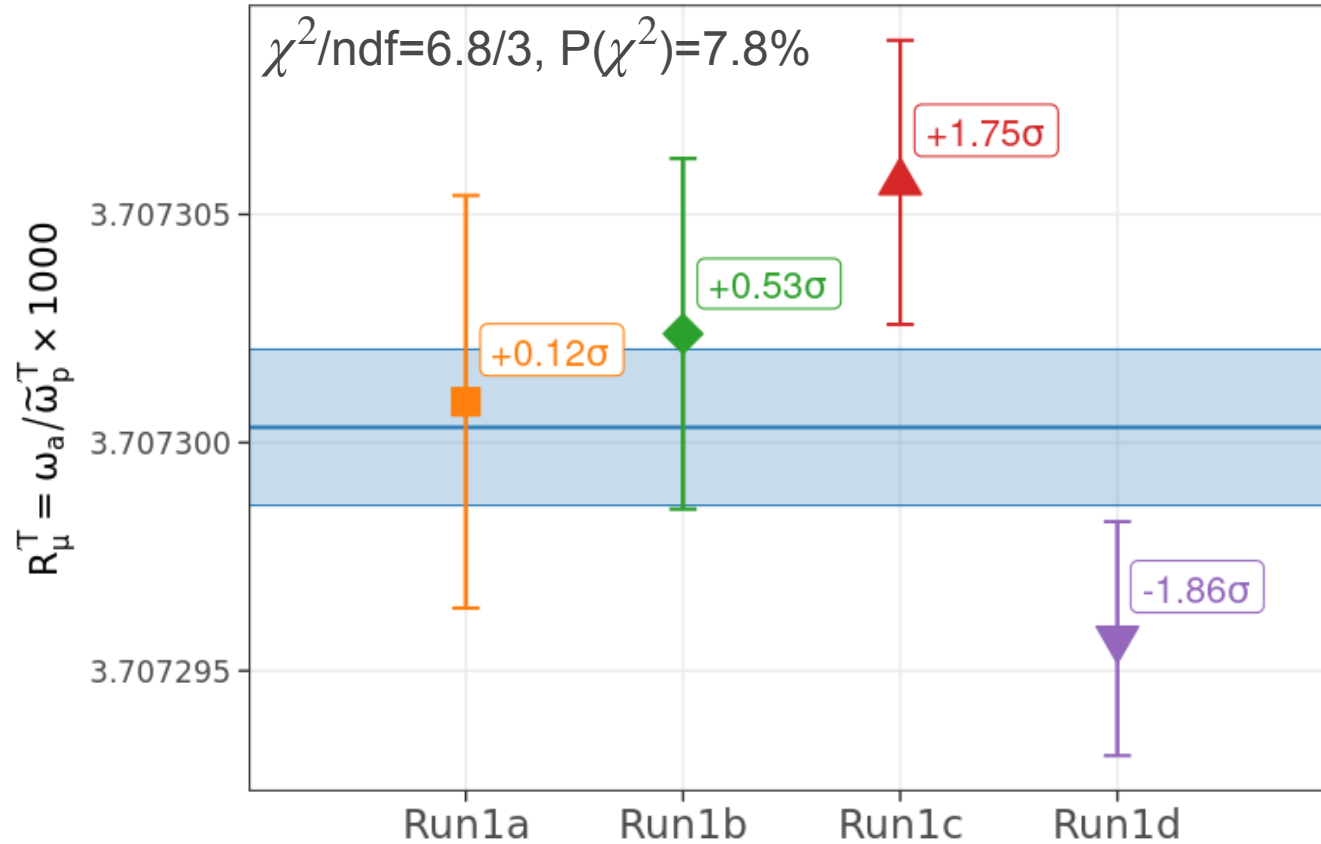
Magnetic transients
corrections

absolute field
calibration



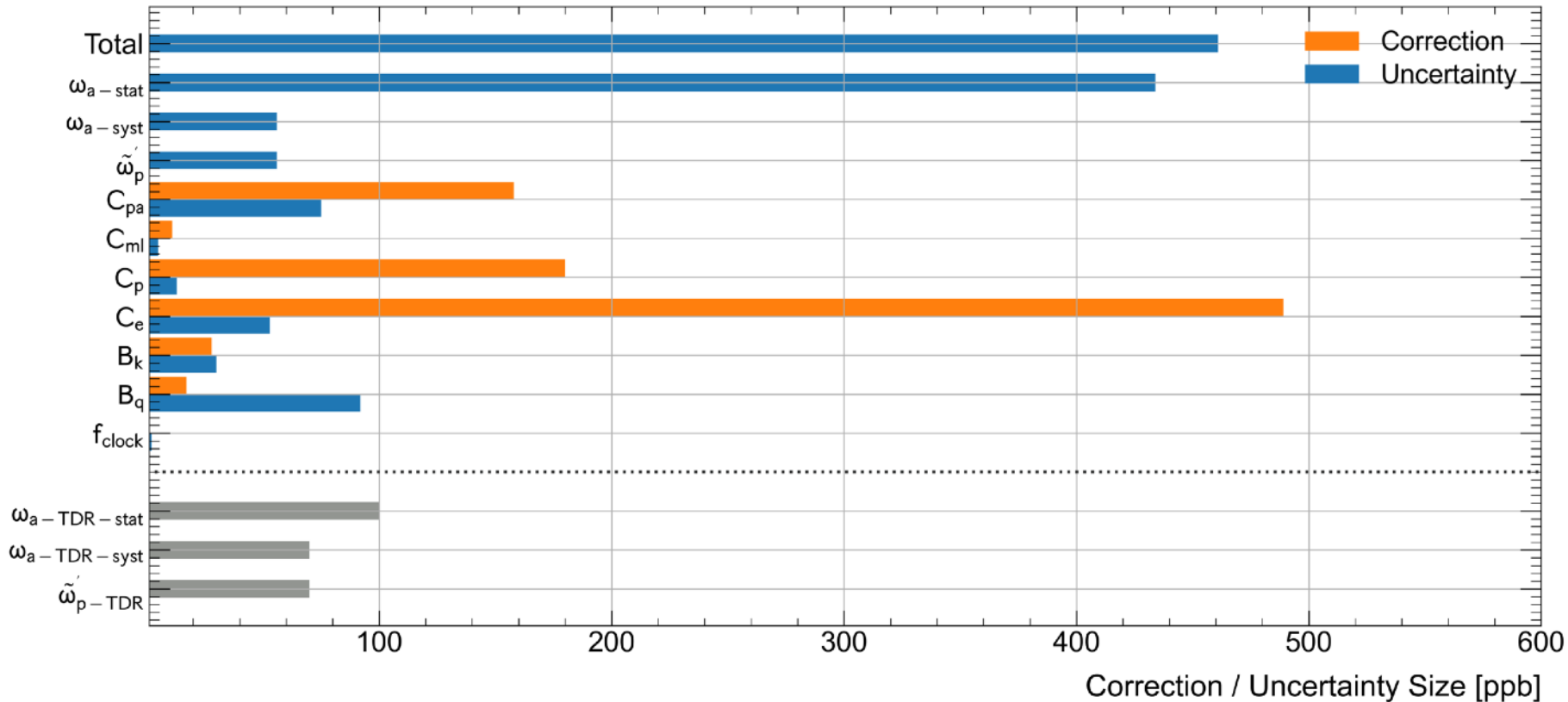
Alec Tewsley-Booth
(WG 4)

THE RUN-1 RESULT

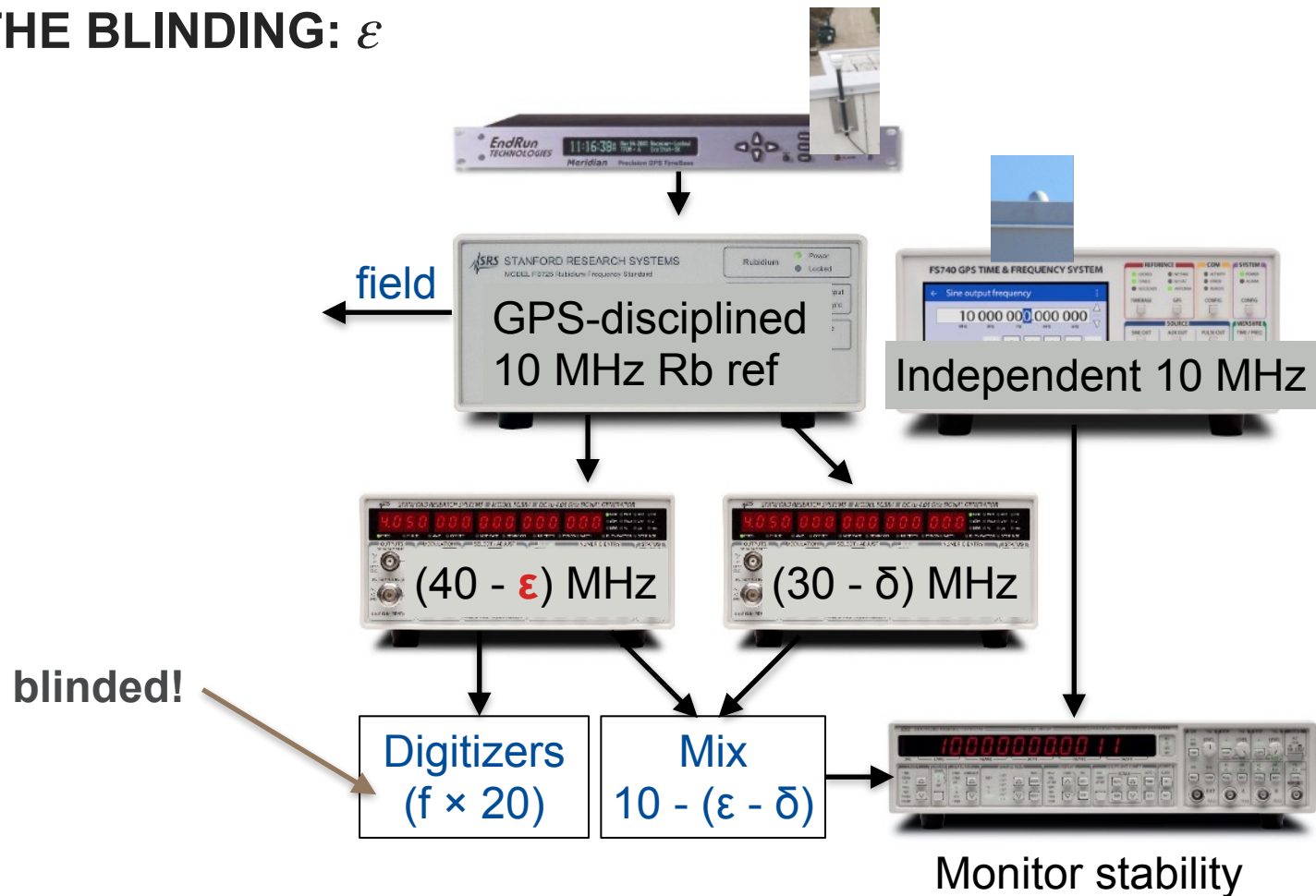


THE RUN-1 RESULT

$$\frac{\omega_a}{\tilde{\omega}'_p} \approx \frac{f_{\text{clock}} \omega_a^{\text{meas}} (1 + C_e + C_p + C_{ml} + C_{pa})}{f_{\text{calib}} \langle \omega'_p(x, y, \phi) \times M(x, y, \phi) \rangle (1 + B_K + B_Q)}$$



THE BLINDING: ϵ

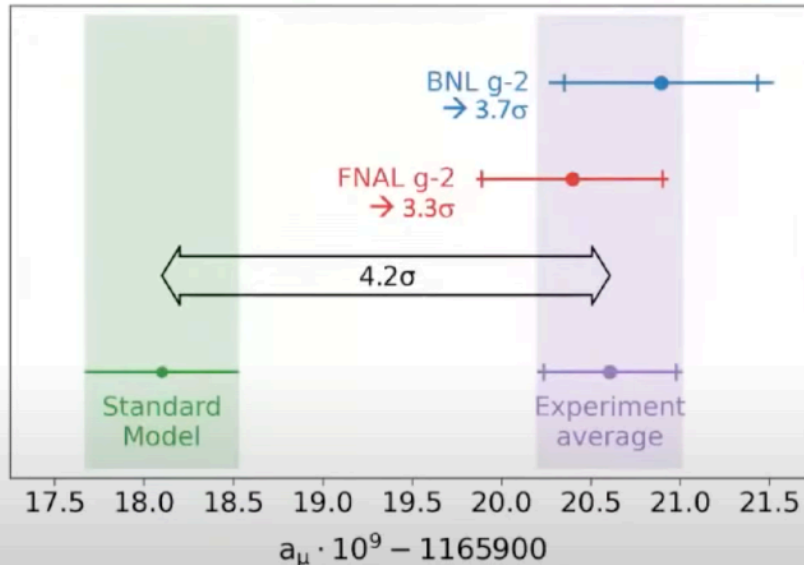


THE RUN-1 UNBLINDING

Comparison to SM prediction

$$a_{\mu}(\text{SM}) = 0.00116591810(43) \rightarrow 368 \text{ ppb}$$

Chris Polly



- Individual tension with SM

– BNL: 3.7σ

– FNAL: 3.3σ

$$a_{\mu}(\text{Exp}) - a_{\mu}(\text{SM}) = 0.00000000251(59) \rightarrow 4.2\sigma$$

is to compare it to the theory prediction.

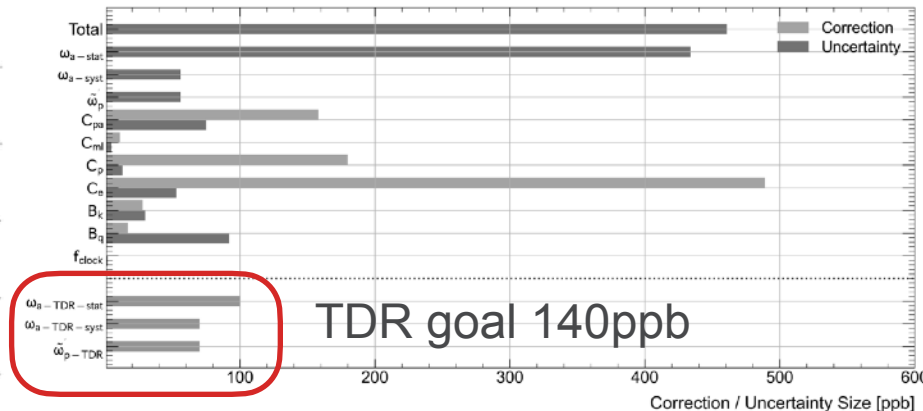
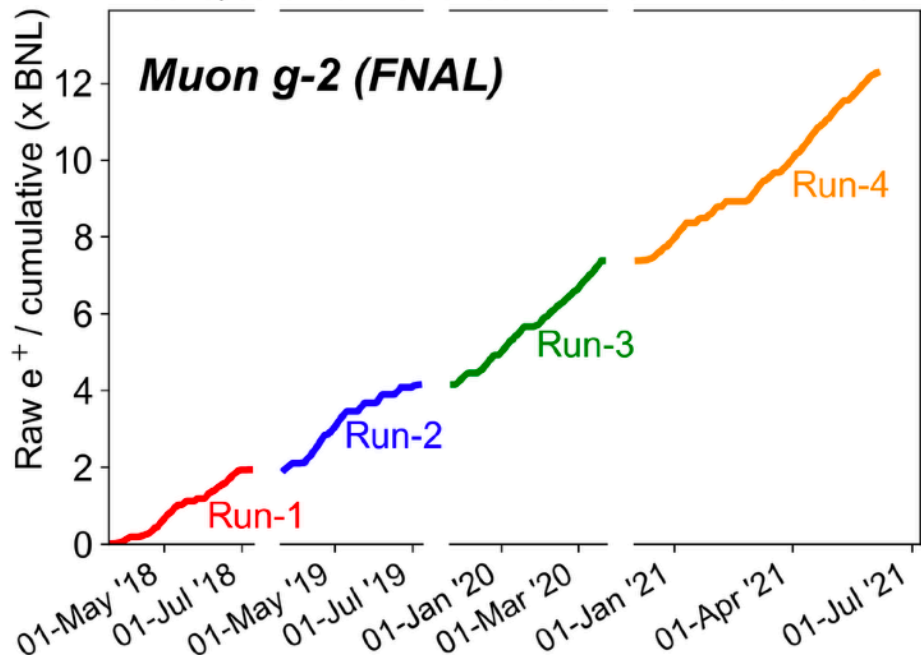
Fermilab

zoom

BEYOND RUN-1: WHATS NEXT

Run-1 publication: only ~6% of the full expected dataset

Last update: 2021-06-04 09:43 ; Total = 12.27 (xBNL)



We expect at least two more runs
Run 5 & 6

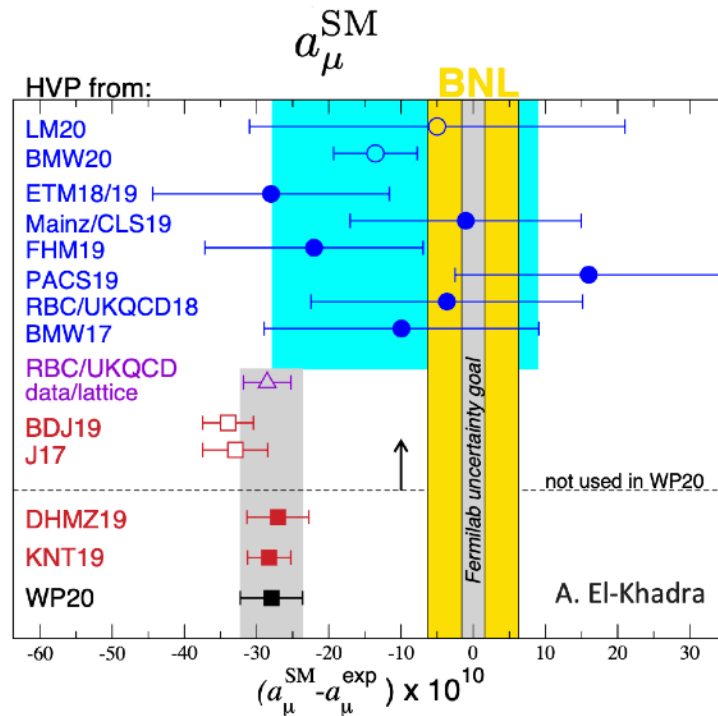
BEYOND RUN-1: VERY EXCITING TIMES

Much more data to come!

Also the theory side is very active!
New lattice results (and more expected) that will be scrutinized in the coming years.

Related: MUonE

Proposed experiment to measure a_{μ}^{HLO}



THE COLLABORATION

Run-1 unblinding ceremony



USA



- Boston
 - Cornell
 - Illinois
 - James Madison
 - Kentucky
 - Massachusetts
 - Michigan
 - Michigan State
 - Mississippi
- USA National Labs**
- North Central
 - Northern Illinois
 - Regis
 - Virginia
 - Washington
 - Argonne
 - Brookhaven
 - Fermilab



China

- Shanghai Jiao Tong



Germany

- Dresden
- Mainz



Russia

- Budker/Novosibirsk
- JINR Dubna



Italy

- Frascati
- Molise
- Naples
- Pisa
- Roma Tor Vergata
- Trieste
- Udine



United Kingdom

- Lancaster/Cockcroft
- Liverpool
- Manchester
- University College London



Korea

- CAPP/IBS
- KAIST



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