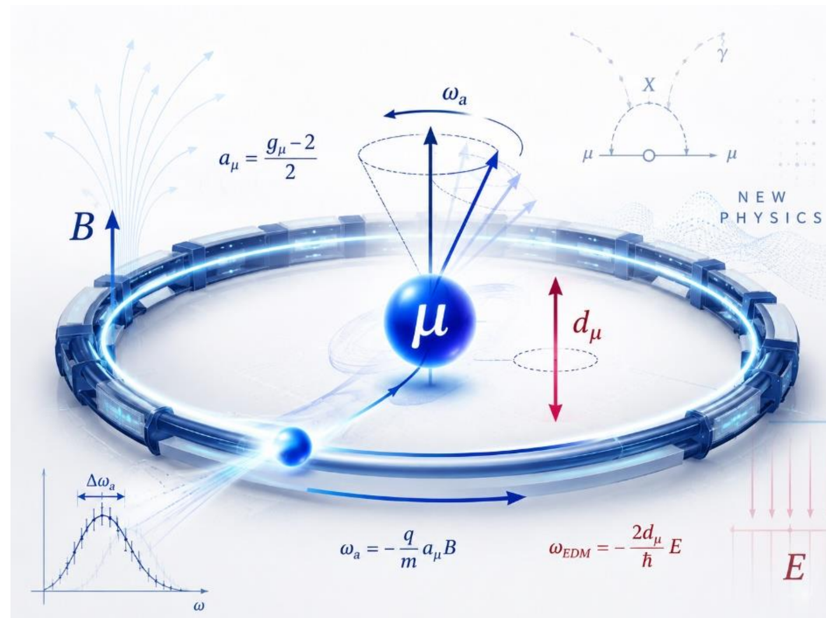
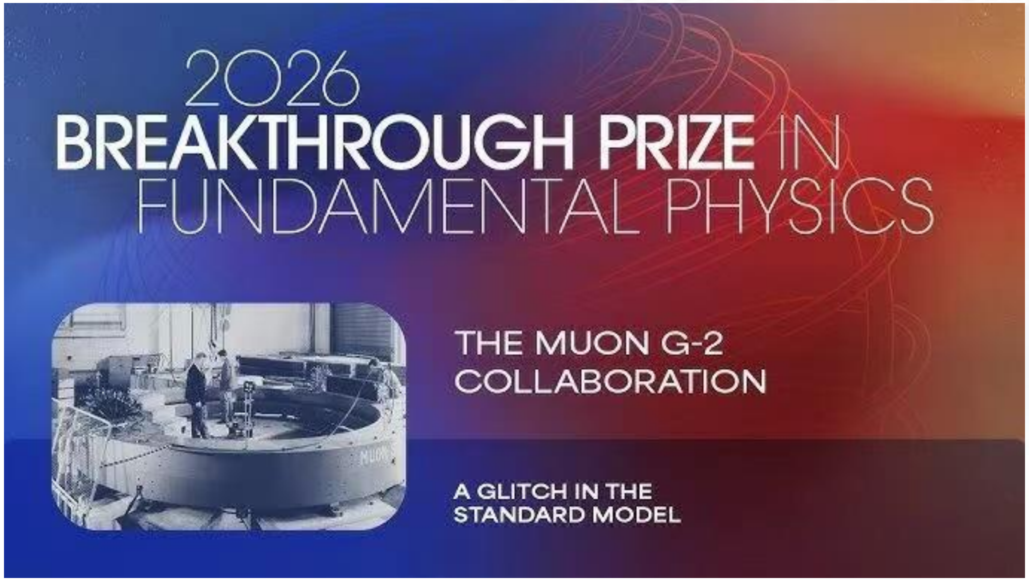
Muon g-2 and EDM: Precision Probes of New Physics



Liang Li
Shanghai Jiao Tong University

Breakthrough Prize in Fundamental Physics



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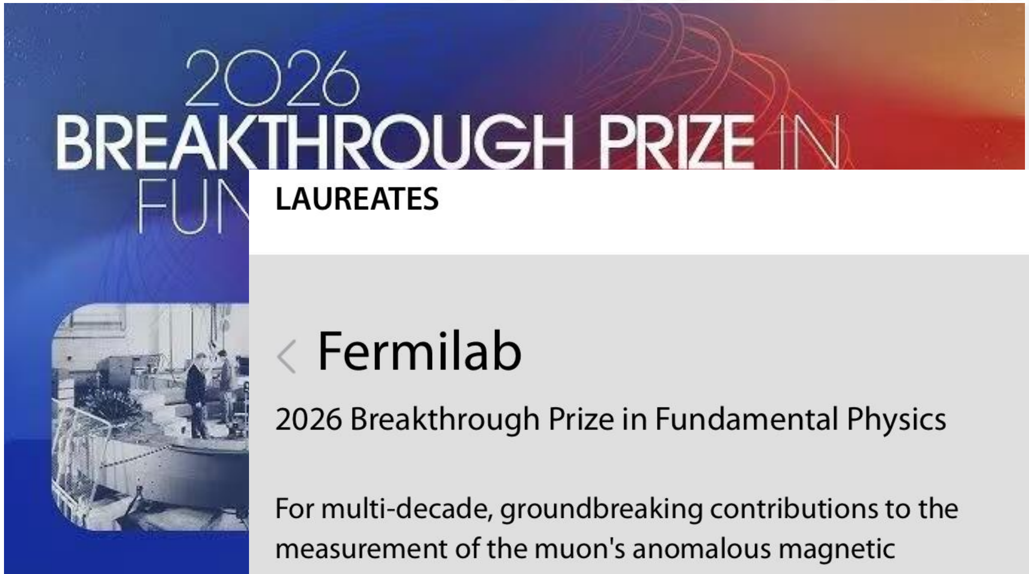


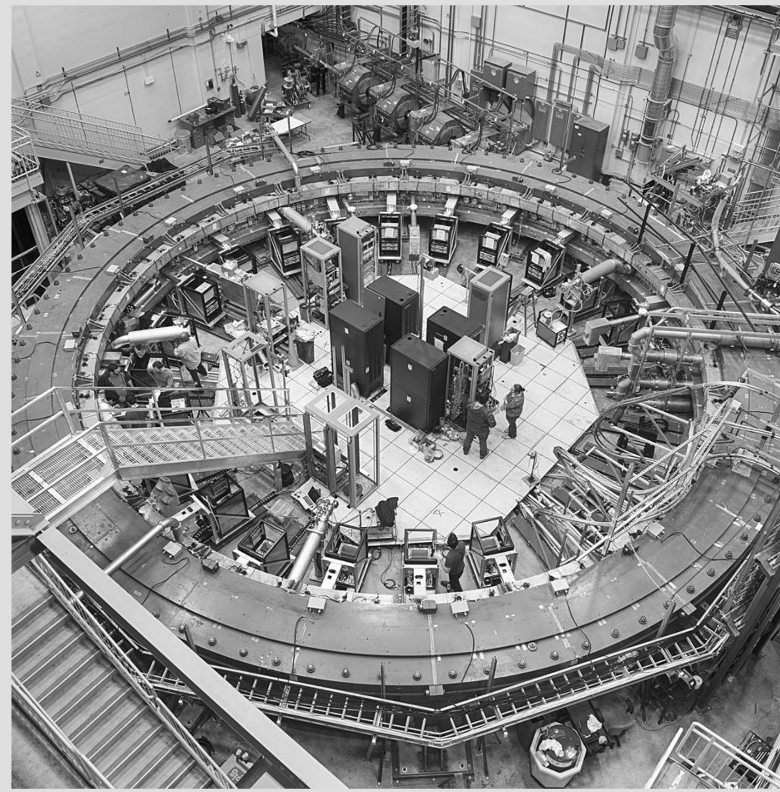
LAUREATES

Fermilab

2026 Breakthrough Prize in Fundamental Physics

For multi-decade, groundbreaking contributions to the measurement of the muon's anomalous magnetic moment, pushing the boundaries of experimental precision and igniting a new era in the quest for physics beyond the Standard Model.

The prizewinners are the living co-authors of the publications that reported the results from the measurement campaigns at CERN, BNL, and Fermilab. The names are listed below.



Breakthrough Prize in Fundamental Physics

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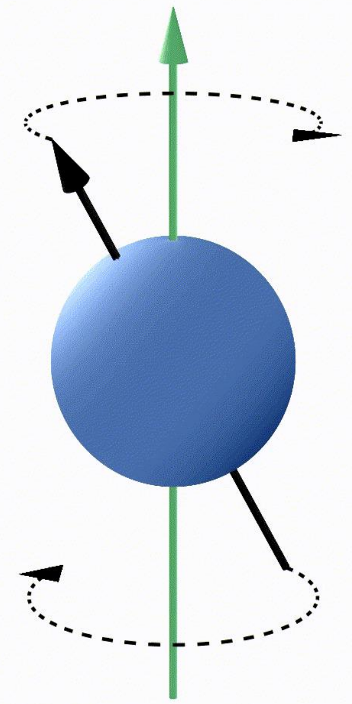
$3M prize shared by 370 collaborators world wide
SJTU Muon g-2 team: 14 laureates

What is Muon g-2?

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



In the quantum world, particles have spin

- **Fermions have half integer spins, bosons have integer spins**
- **Muon's magnetic moment is closely related to spin and internal structure**
- **Muon's intrinsic magnet interacts with external magnetic field: precess!**
  - **Muon's precession frequency can be influenced by (virtual) particles**
  - **Anomalous magnetic moment can be measured and calculated**

Discrepancy between experiment and theory leads to new physics

$$a_\mu^{SM} = a_\mu^{QED} + a_\mu^{had} + a_\mu^{EW} + \boldsymbol{a_\mu^{NP}}?$$

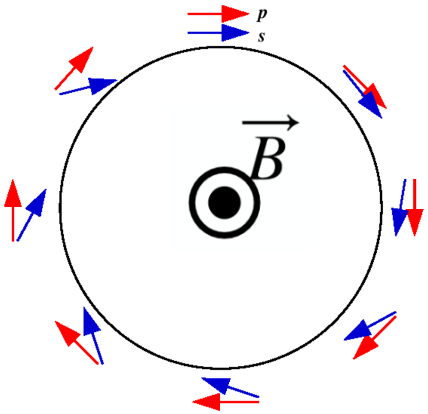
- **New particles, fifth force, or new structure?**

Experimental Principle

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

ω_a : g–2 term

ω_η : EDM term



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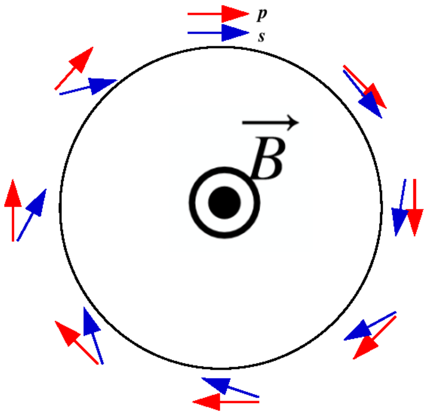
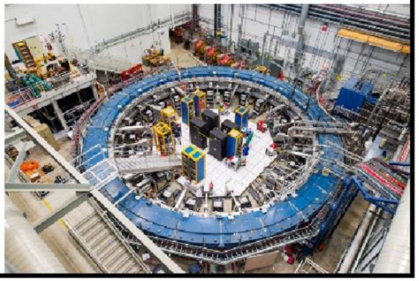


Approach1 : $a_\mu - \frac{1}{\gamma^2 - 1} \approx 0$

$$\vec{\omega} = -\frac{e}{m_\mu}\left[a_\mu \vec{B} + \frac{\eta}{2}\left(\vec{\beta}\times\vec{B} + \frac{\vec{E}}{c}\right)\right]$$

- Adopted at BNL/FNAL
- Electric field is used for beam focusing (Strong beam focusing)



Approach2 : $\vec{E} = 0$

$$\vec{\omega} = -\frac{e}{m_\mu}\left[a_\mu \vec{B} + \frac{\eta}{2}\vec{\beta}\times\vec{B}\right]$$

- Adopted at J-PARC
- Magnetic field is used for beam focusing (Weak beam focusing)
- EDM term is orthogonal to g-2 term

Muon g-2 Experimental Measurement

Frequency measurements can be done in very high precision

Muon g-2 Experimental Measurement

Frequency measurements can be done in very high precision

- **Measure frequency ratio and extract from several measurements**

$$a_\mu \sim \frac{\omega_a}{<B>} = \frac{g_e}{2}\frac{\omega_a}{\varpi_p}\frac{m_\mu}{m_e}\frac{\mu_p}{\mu_e}$$

  - **ω_p is proton Larmor precession frequency in water sample ($\omega_p \sim |B|$)**
  - **ϖ_p is the weighted magnetic field folded with muon distribution**
  - **All other values from Committee on Data for Science and Technology (CODATA), uncertainty < 25 ppb**
    - **E.g. muon-to-electron mass ratio by muonium hyperfine structure experiment**

Muon g-2 Experimental Measurement

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    - **E.g. muon-to-electron mass ratio by muonium hyperfine structure experiment**
- **Final measurements done in three steps**
  - **Inject muons into a ring with uniform magnetic field**
  - **Measure muon frequency difference ω_a**
  - **Measure proton precession frequency ω_p and muon distribution**
  - **Blind analyses: measurements and correction factors done *independently* before final answer**

Milestones for Muon g-2 Experiment

2008 — Proposal

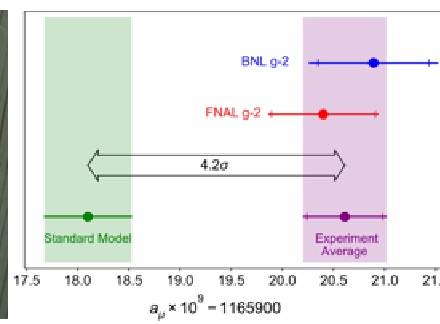
The New (g − 2) Experiment:
A Proposal to Measure the Muon Anomalous
Magnetic Moment to ±0.14 ppm Precision

2012 — Muon g-2 Critical Decision-0

2013 — The Big Move

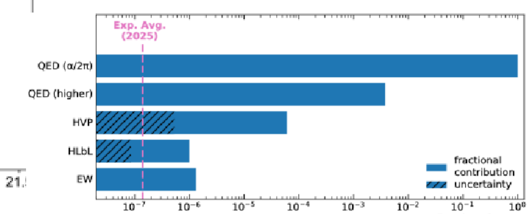
2017 — 1st Muon Beam

2021 — First Run1 Result

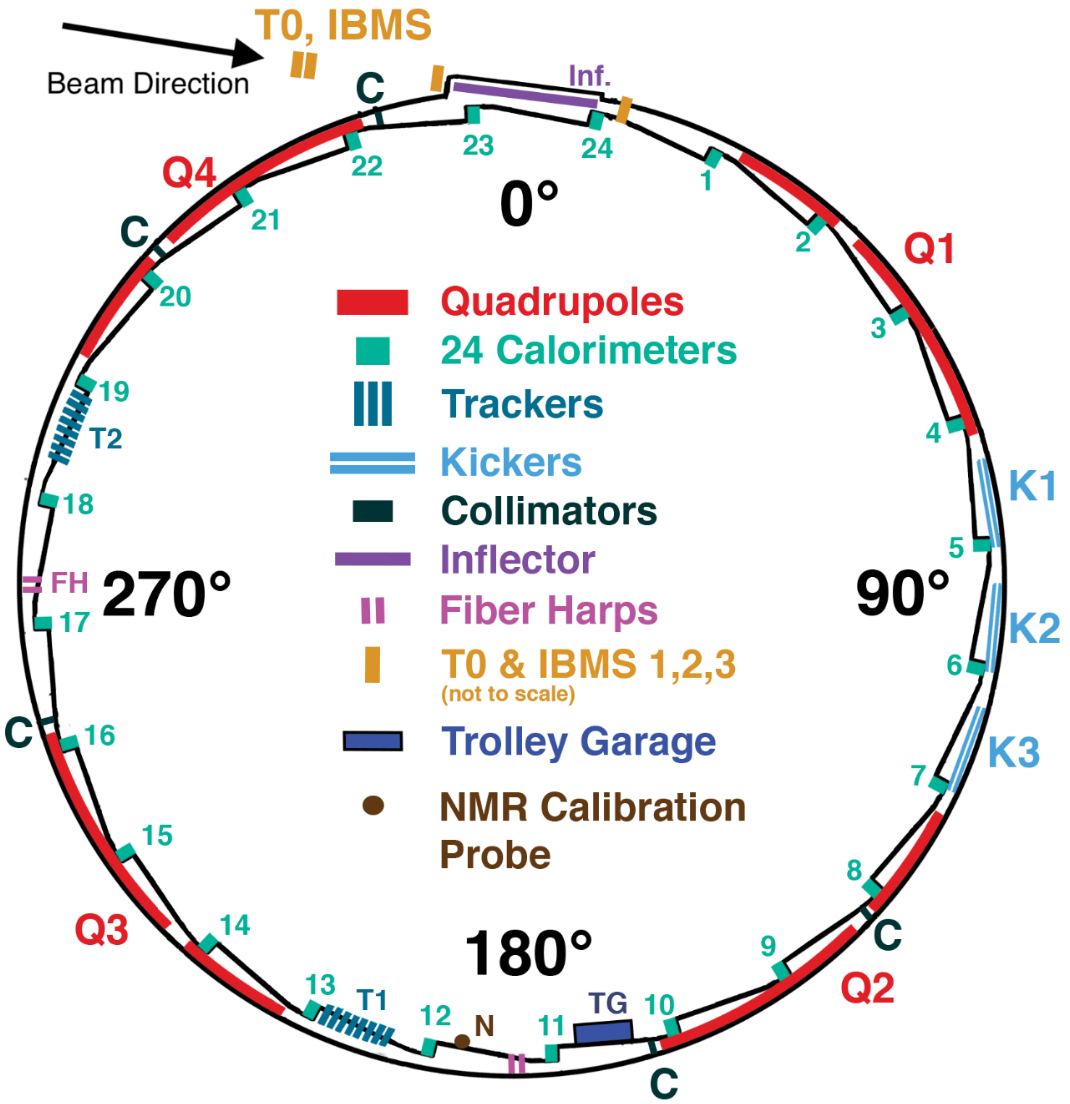


2023 — End of Data Taking, Second Run2/3 Result

2025 — Final Run1-6 Result



Fermilab Muon g-2 Detector System



- 15 meter wide dipole superconducting magnet
- Inflector, kickers, quadrupoles, collimators for beam insertion
- 386 NMR probes
- Moving trolley with 17 probes
- 24 calorimeters
- Laser calibration system
- 2 tracker stations
- Auxiliary detectors: T0, IBMs, Fiber harps

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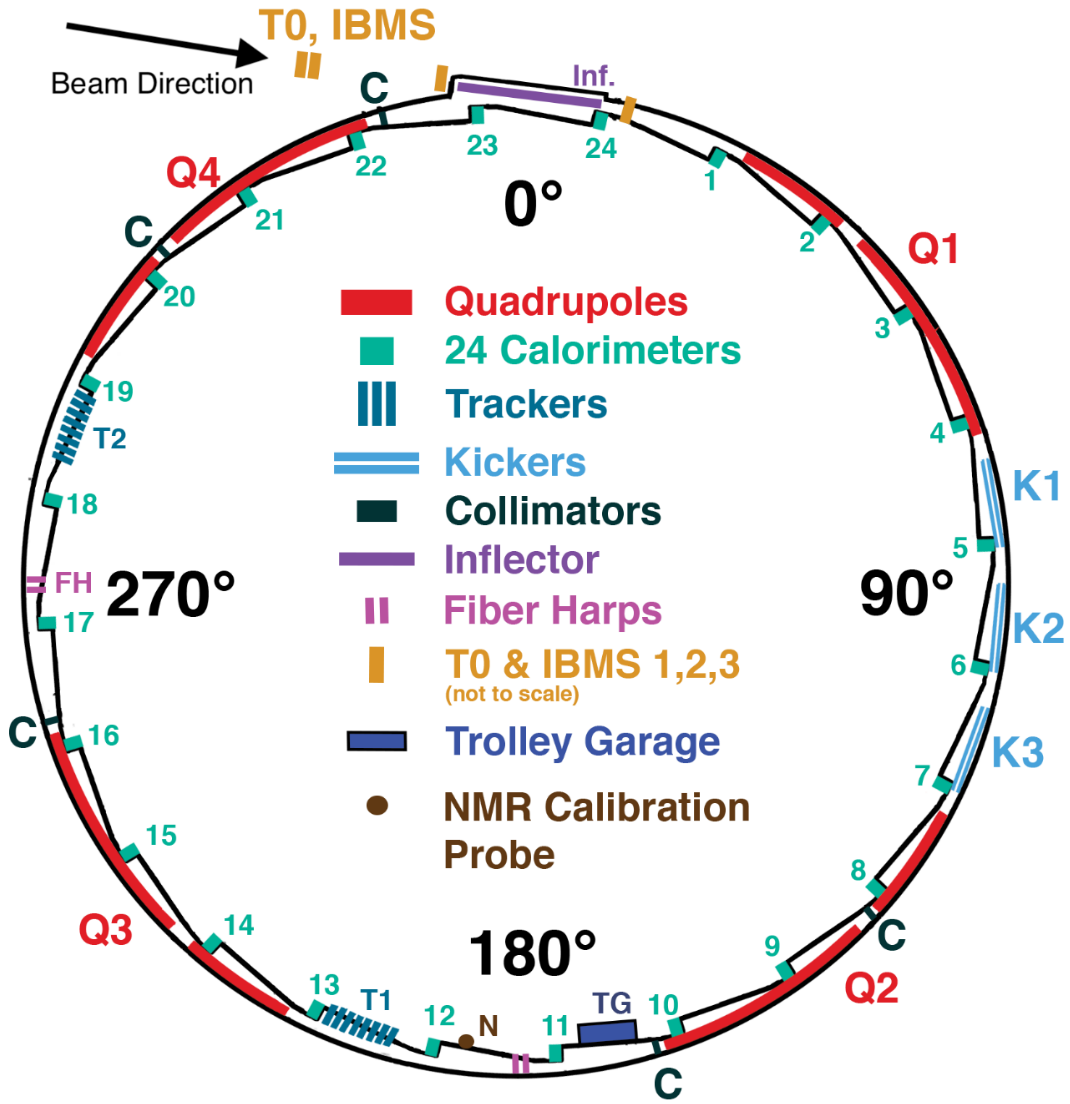

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MiniSciFi added in Run6
QuadRF added in Run5

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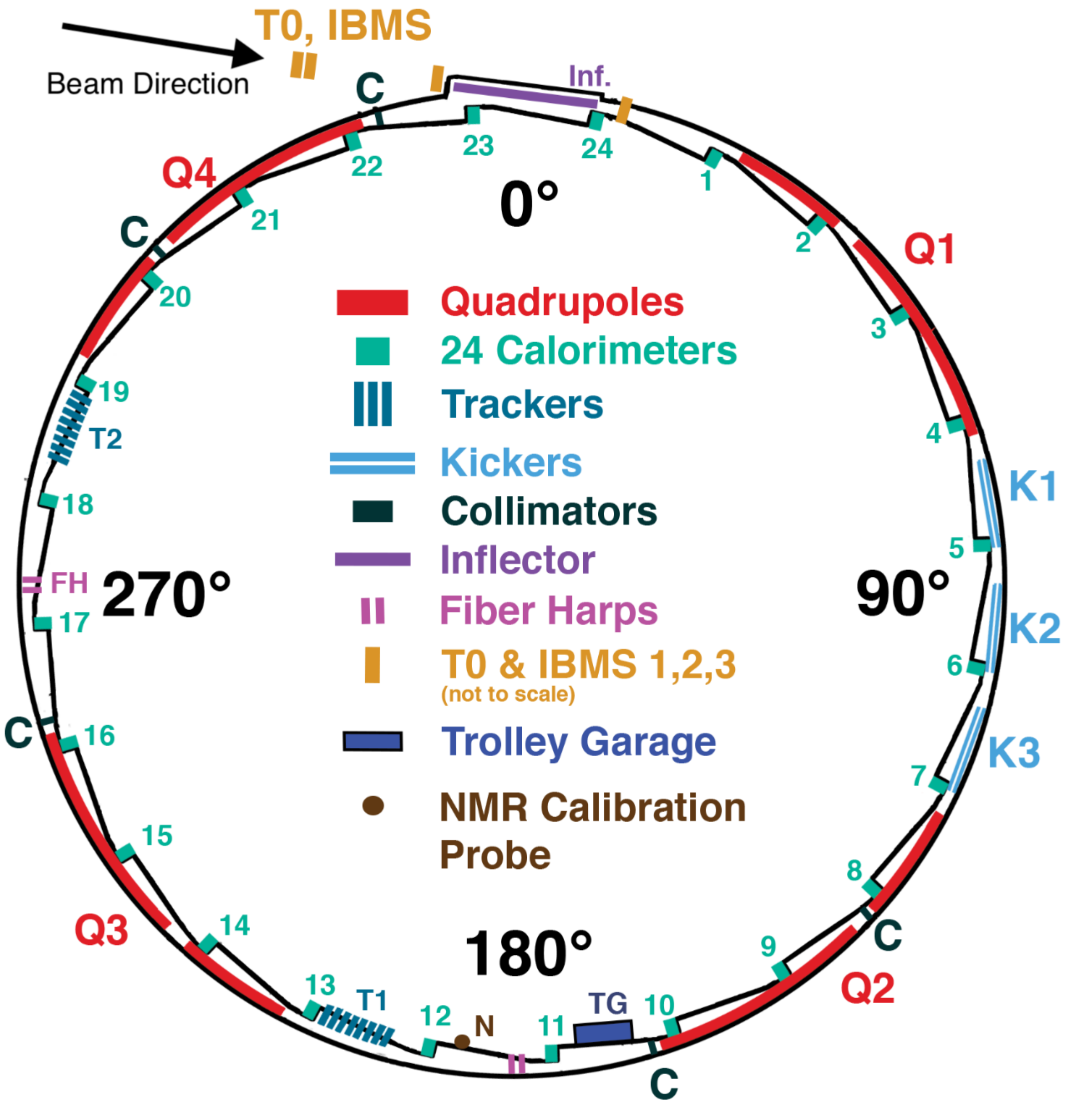

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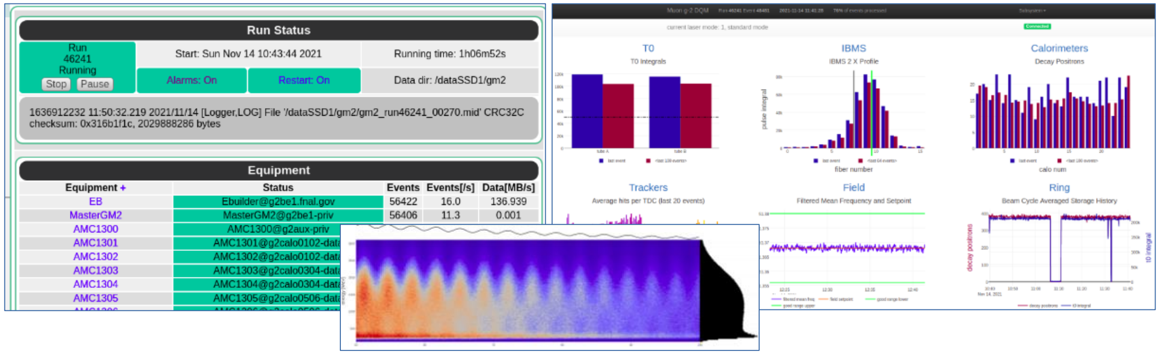
9 PB of Raw Data!

Data Flow

Raw data → Online

Online

Fraction of data
Instantaneous plots
DAQ and DQM



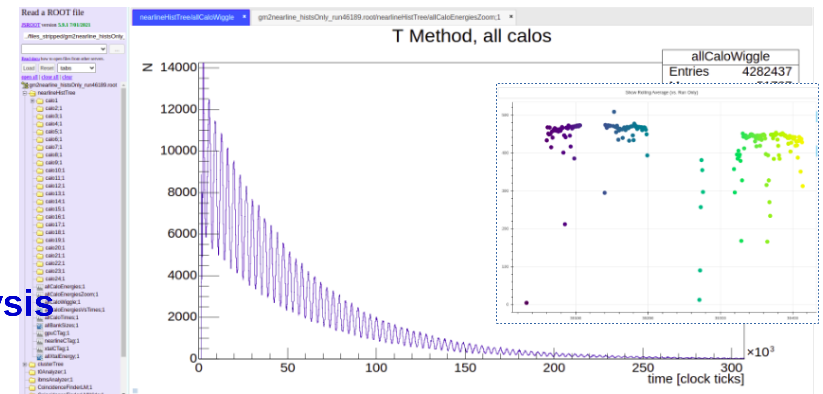
MIDAS

plotly

Raw data → Nearline

Nearline

Full data analyzed and plotted
Standard calibration
Useful for quick physics analysis
Results in ~ 30 min



ROOT Data Analysis Framework

bokeh

Raw data → Offline

Offline

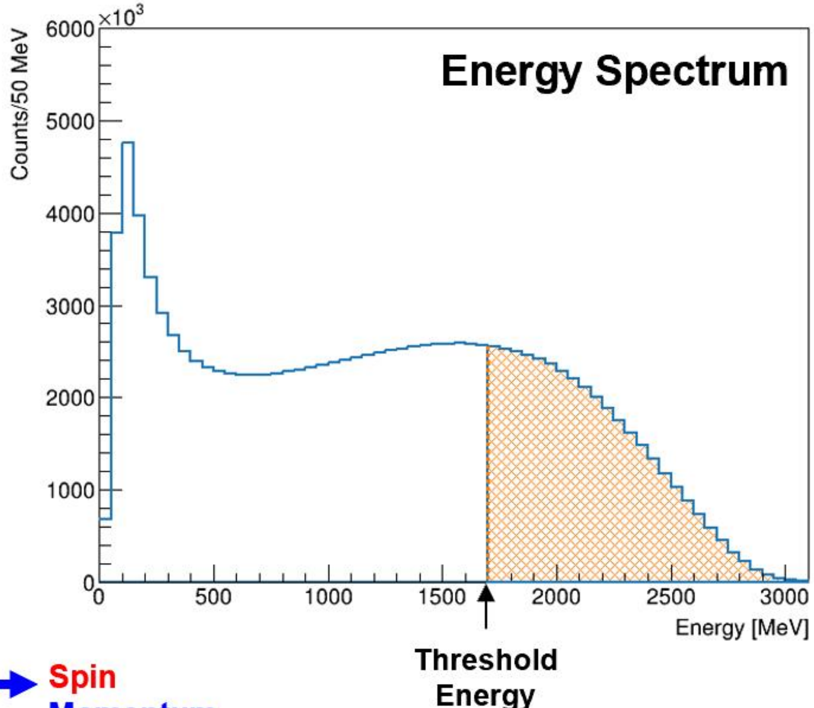
Pre-production → Calibration → Full-production → DQC

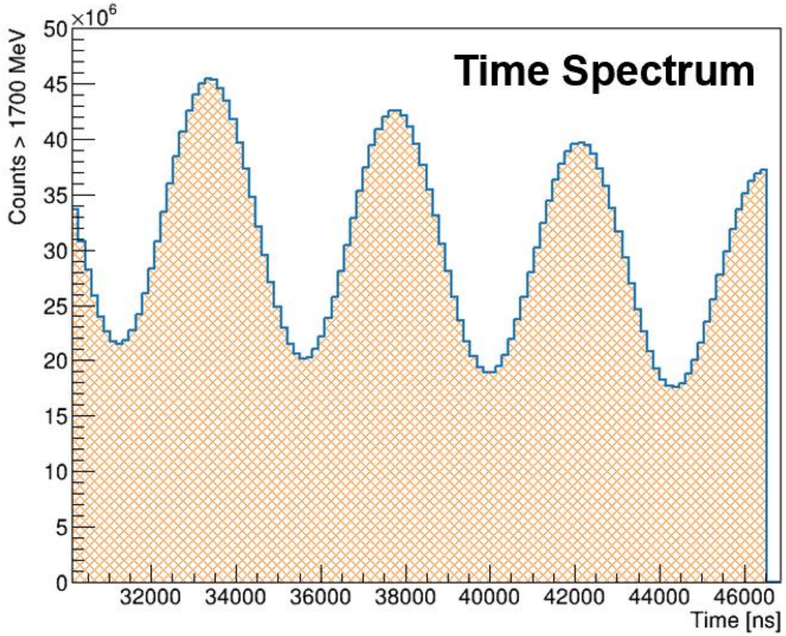
- Complete and fully calibrated reconstruction
- Involves pre- and full- productions
- Multiple reconstruction techniques
- Version-controlled, produced with POMS on grid
- Full results with DQC in ~ 1 year

art

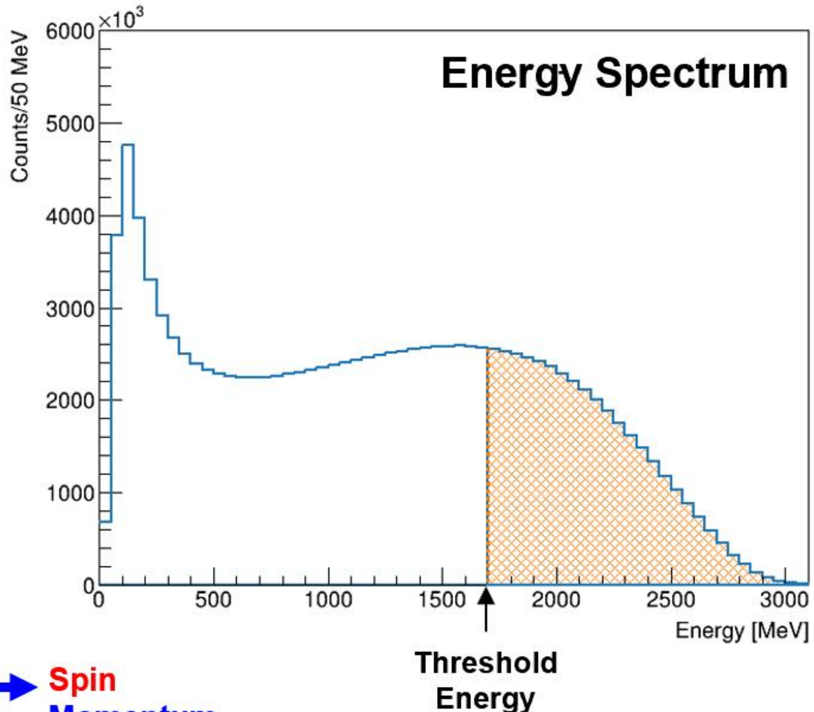
Production Operations Management System

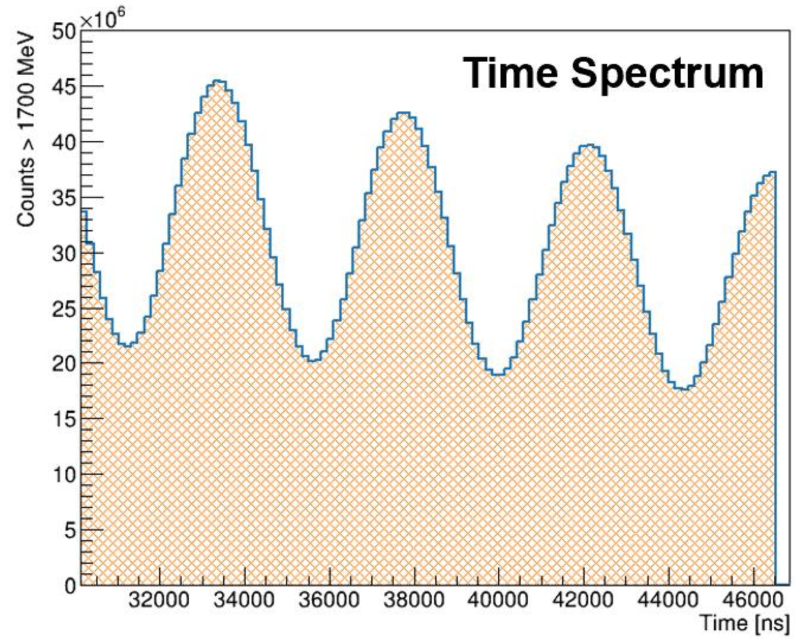
ω_a Measurement





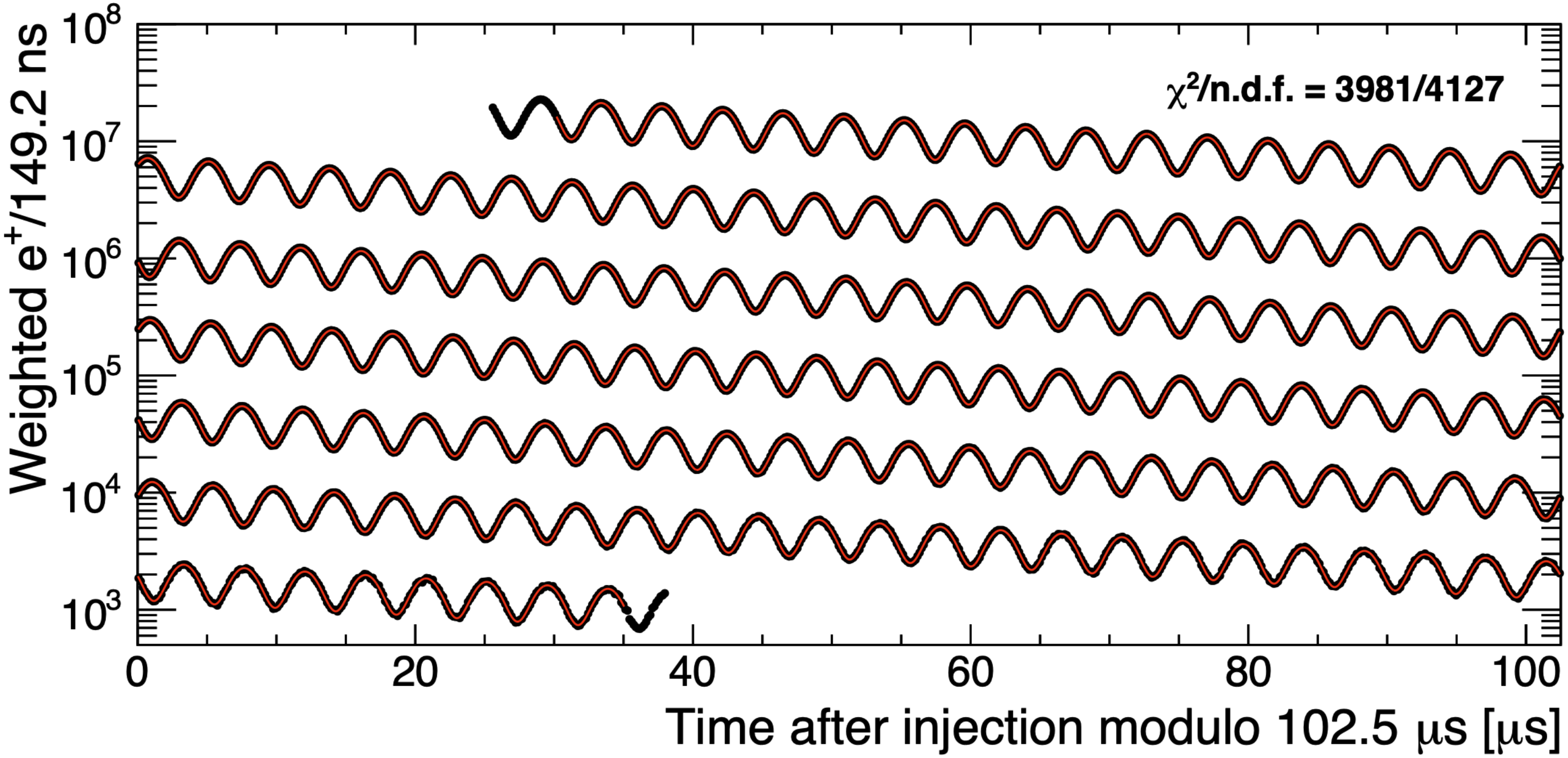
ω_a Measurement





- Energetic e+ oscillates as μ+ spin direction aligns or anti-aligns with momentum direction
- Count e+ hitting calorimeters above threshold (or weight the hits)
- Extract the oscillation frequency ω_a via fitting time spectrum

ω_a Measurement



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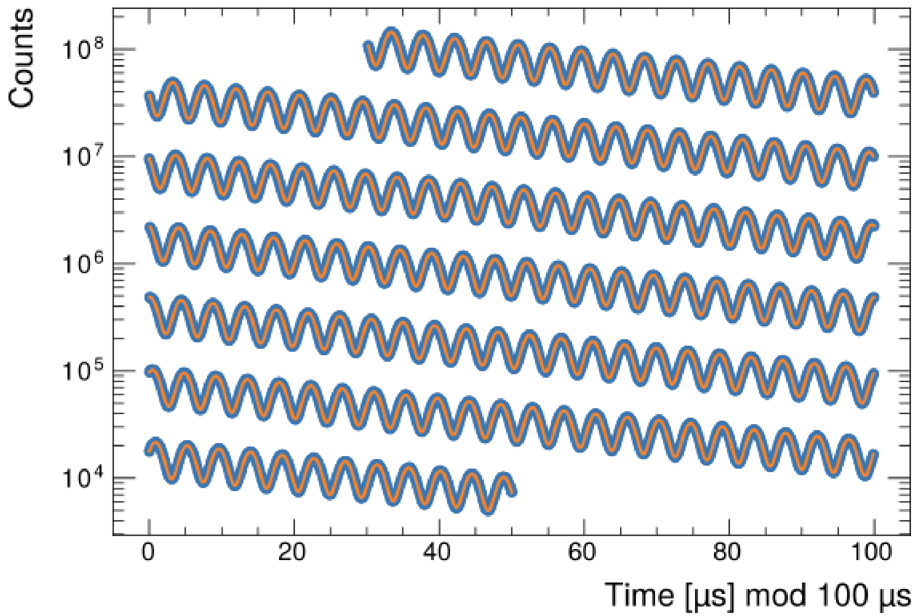
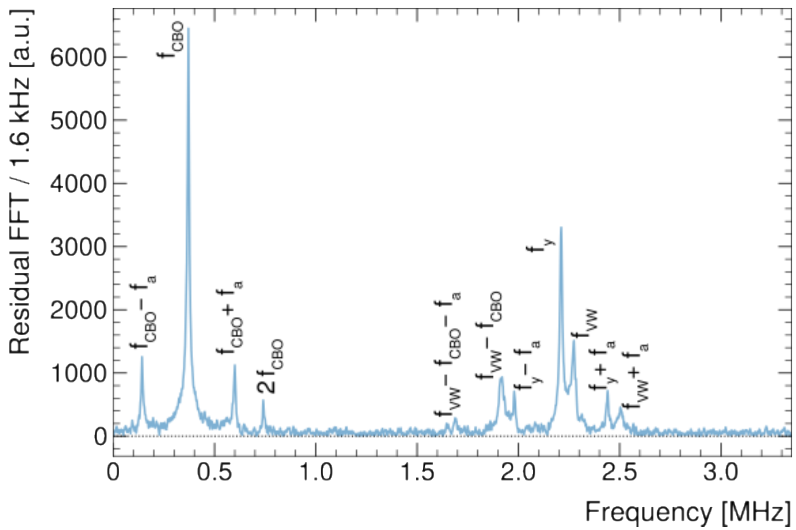
ω_a Measurement

Simplest fit model captures exponential decay & g-2 oscillation

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





Larger statistics reveal even more prominent frequency components.

ω_a Measurement

Simplest fit model captures exponential decay & g-2 oscillation

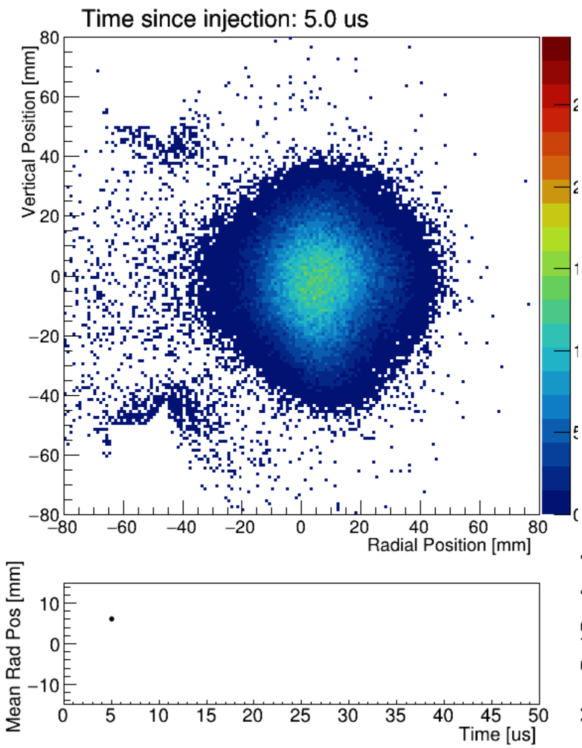
$$N(t) = N_0\, e^{-t/\tau}\,[1 + A\cos(\omega_a t\, - \phi_0)]$$

Must account for beam oscillations, muons losses, and detector effects

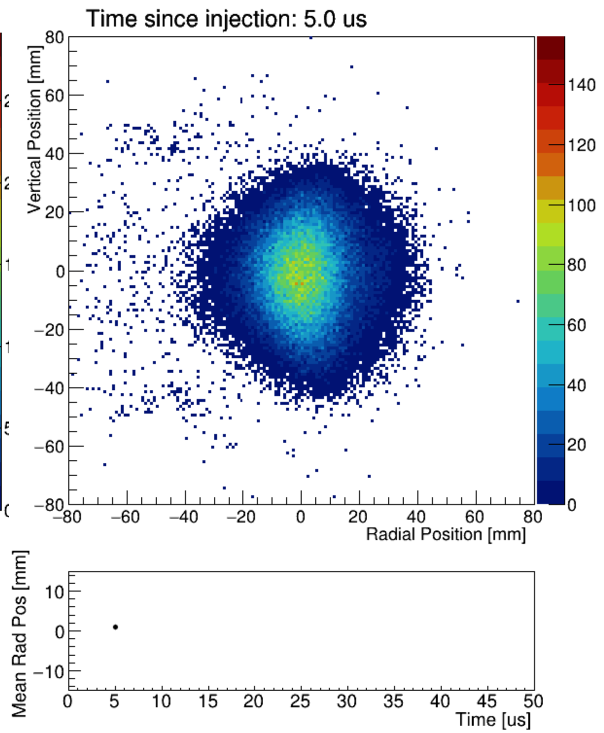
- **Final fit functions include 40+ additional parameters to model these effects!**

Beam dynamics modeling: CBO

- **If not accounted for: ~800 ppb without the additional RF**
- **If not accounted for: ~80 ppb with the additional RF**



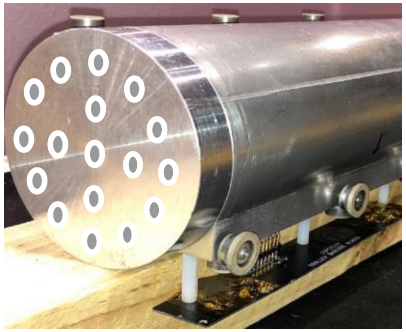
No Additional RF on ESQ



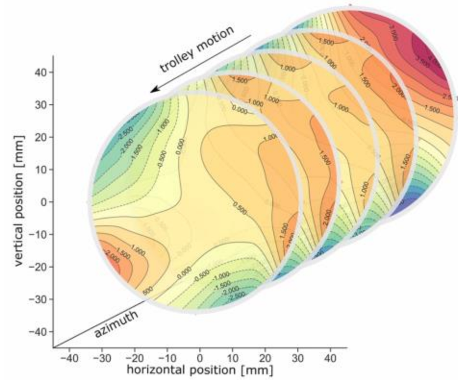
Additional RF on ESQ

ω_p Measurement

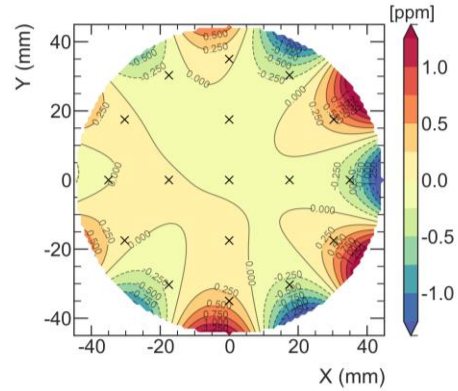
- **In-vacuum NMR trolley maps field every few days**



17 petroleum jelly NMR probes

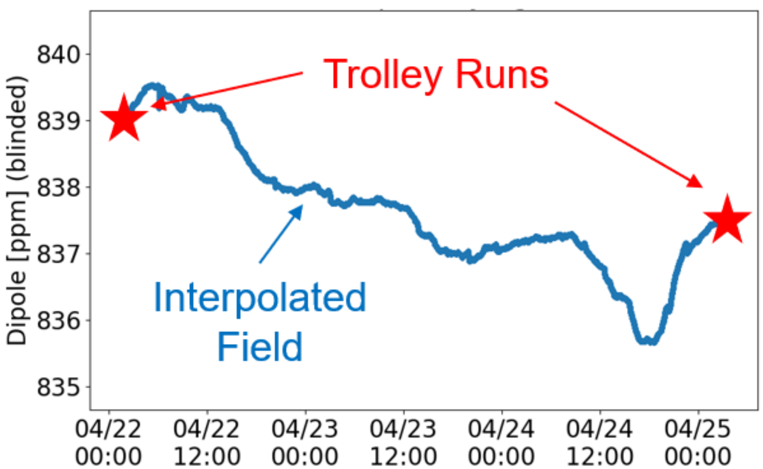


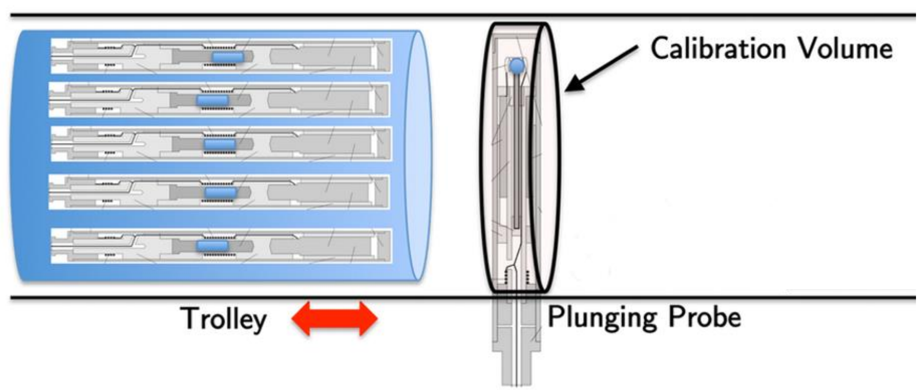
2D field maps (~8000 points)



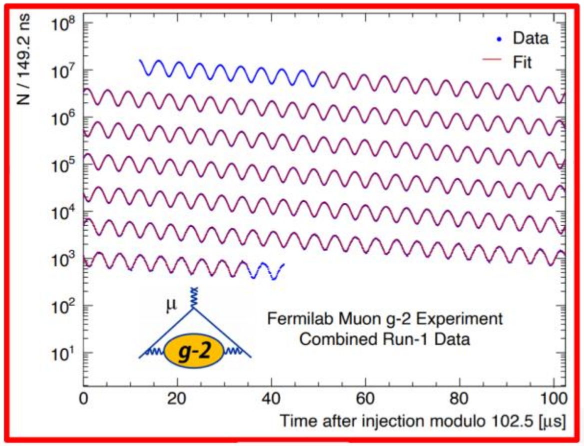
Azimuthally-Averaged Variation < 1 ppm

- **378 fixed probes monitor field during muon storage at 72 locations**
- **Cross-calibrate using a cylindrical plunging H_2O probe**

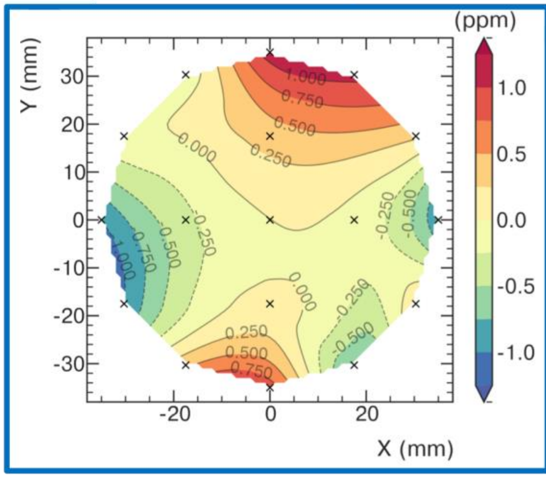




Full Measurement with Corrections



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



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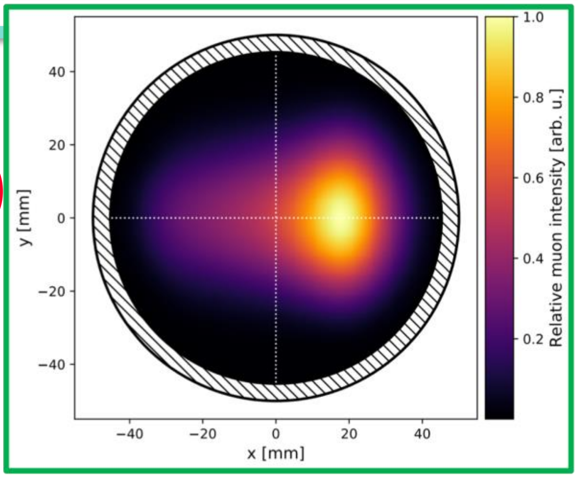

Full Measurement with Corrections

$$\frac{\omega_a}{\omega_p} = \frac{\omega_a^m}{\omega_p^m} \frac{1 + C_e + C_p + C_{pa} + C_{dd} + C_{ml}}{1 + B_k + B_q}$$

Measured Values

Full Measurement with Corrections

E-field & Up/Down motion: Spin precesses slower than in basic equation

$$\frac{\omega_a}{\omega_p} = \frac{\omega_a^m}{\omega_p^m} \frac{1 + C_e + C_p + C_{pa} + C_{dd} + C_{ml}}{1 + B_k + B_q}$$

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Full Measurement with Corrections

E-field & Up/Down motion: Spin precesses slower than in basic equation

Phase changes over each fill: Phase-Acceptance, Differential Decay, Muon Losses

$$\frac{\omega_a}{\omega_p} = \frac{\omega_a^m}{\omega_p^m} \frac{1 + C_e + C_p + C_{pa} + C_{dd} + C_{ml}}{1 + B_k + B_q}$$

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Measured Values

Transient Magnetic Fields: Quad Vibrations, Kicker Eddy Current

Full Measurement with Corrections

E-field & Up/Down motion: Spin precesses slower than in basic equation

Phase changes over each fill: Phase-Acceptance, Differential Decay, Muon Losses

$$\frac{\omega_a}{\omega_p} = \frac{\omega_a^m}{\omega_p^m} \frac{1 + C_e + C_p + C_{pa} + C_{dd} + C_{ml}}{1 + B_k + B_q}$$

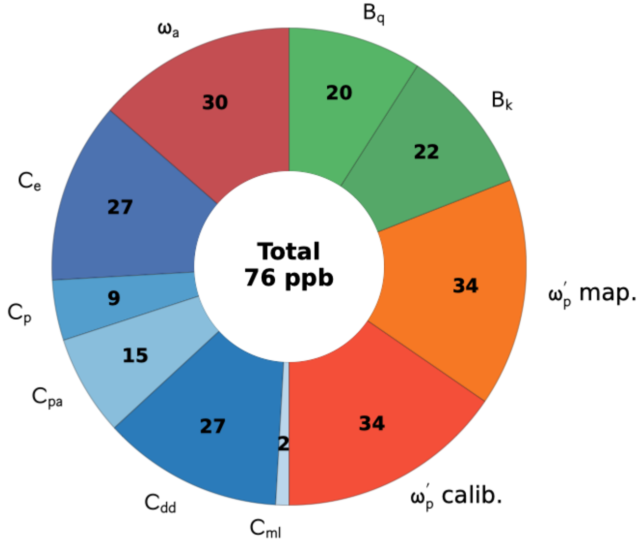
Measured Values

Transient Magnetic Fields: Quad Vibrations, Kicker Eddy Current

- Total correction 572 ppb, dominated by E-field & Pitch
  - ~350 ppb & 170 ppb, other ω_a correction ~ 30ppb
  - B_k ~ 30 ppb, B_q ~ 20 ppb

Total Uncertainties

Quantity	Correction (ppb)	Uncertainty (ppb)
ω_a^m (statistical)	$\cdots$	114
ω_a^m (systematic)	$\cdots$	30
C_e	347	27
C_p	175	9
C_{pa}	-33	15
C_{dd}	26	27
C_{ml}	0	2
$\langle \omega_p' \times M \rangle$	$\cdots$	48
B_k	-37	22
B_q	-21	20
μ_p'/μ_B	$\cdots$	4
m_μ/m_e	$\cdots$	22
Total systematic for $\mathcal{R}_\mu'$	$\cdots$	76
Total for a_μ	572	139



TDR goal : 100 ppb ✓

- **Evenly distributed**
- **No dominant source**
- **Further improving would require reducing in many categories**

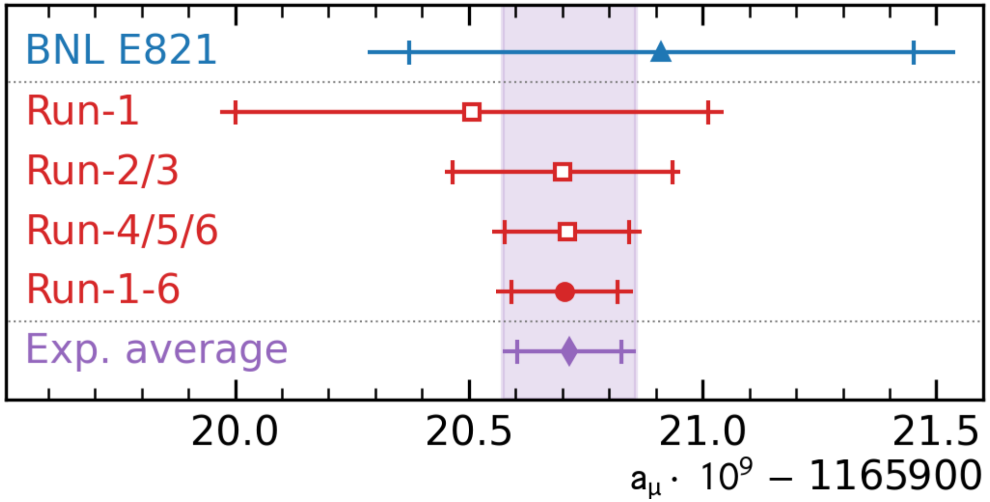
Total Uncertainties

$\frac{\omega_a}{\tilde{\omega}'_p}$	Stat. Uncertainty (ppb)	Syst. Uncertainty (ppb)	Total Uncertainty (ppb)
Run-1	434	159*	462
Run-2/3	201	78*	216
Run-4/5/6	114	76	137
Run-1-6	**98**	**78**	**125**
	TDR goal 100 ppb ✓	TDR goal: 100 ppb ✓	TDR goal: 140 ppb ✓

*corrected

A good example of precision measurements that actually exceeds the TDR design goal!

Final Results



$$\boldsymbol{a_\mu}\textbf{(Run−1−6)} = \mathbf{0.001165920710(162)}$$

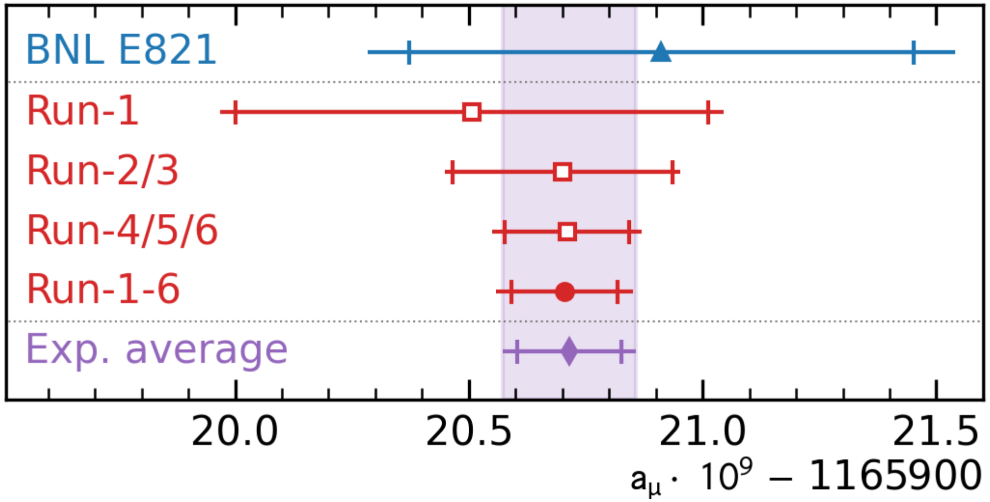
Total uncertainty: 127 ppb

$$\boldsymbol{a_\mu}\textbf{(Exp. Average)} = \mathbf{0.001165920705(148)}$$

Total uncertainty: 124 ppb

Final Results

- **Excellent agreement** with Run-1/2/3 and BNL E821
- Uncertainty reduced by 1.8 times over Run-1/2/3
- Combined Run-1-6 reduces the uncertainty by a factor of 4.3 (compared to BNL E821)
- **New world average** reduces the uncertainty by a factor of 4.4 (compared to BNL E821)



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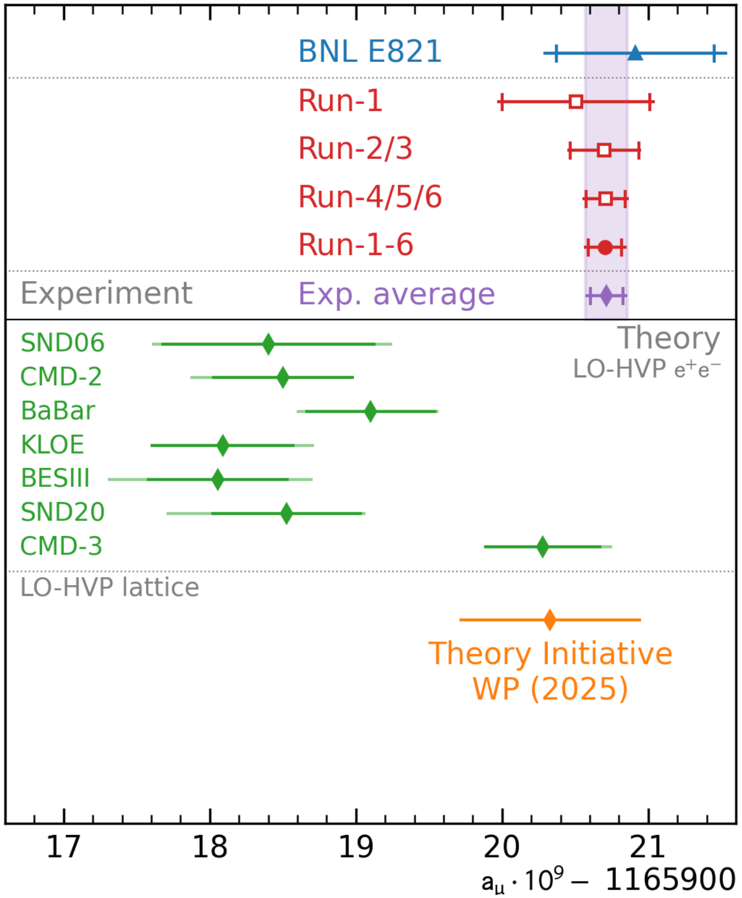
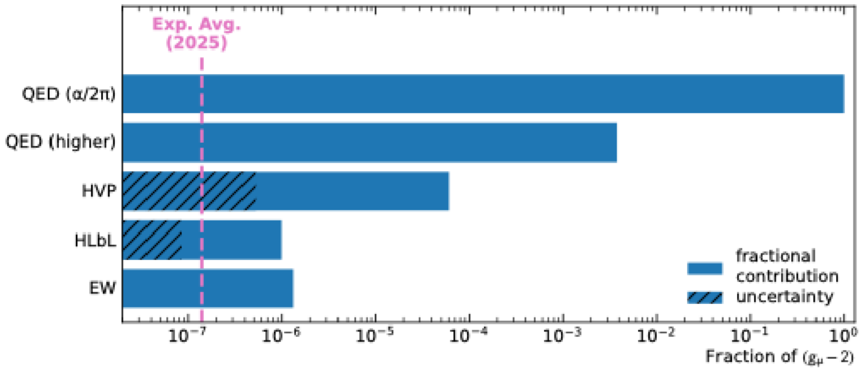


a_μ(Run−1−6) $= 0.001165920710(162)$

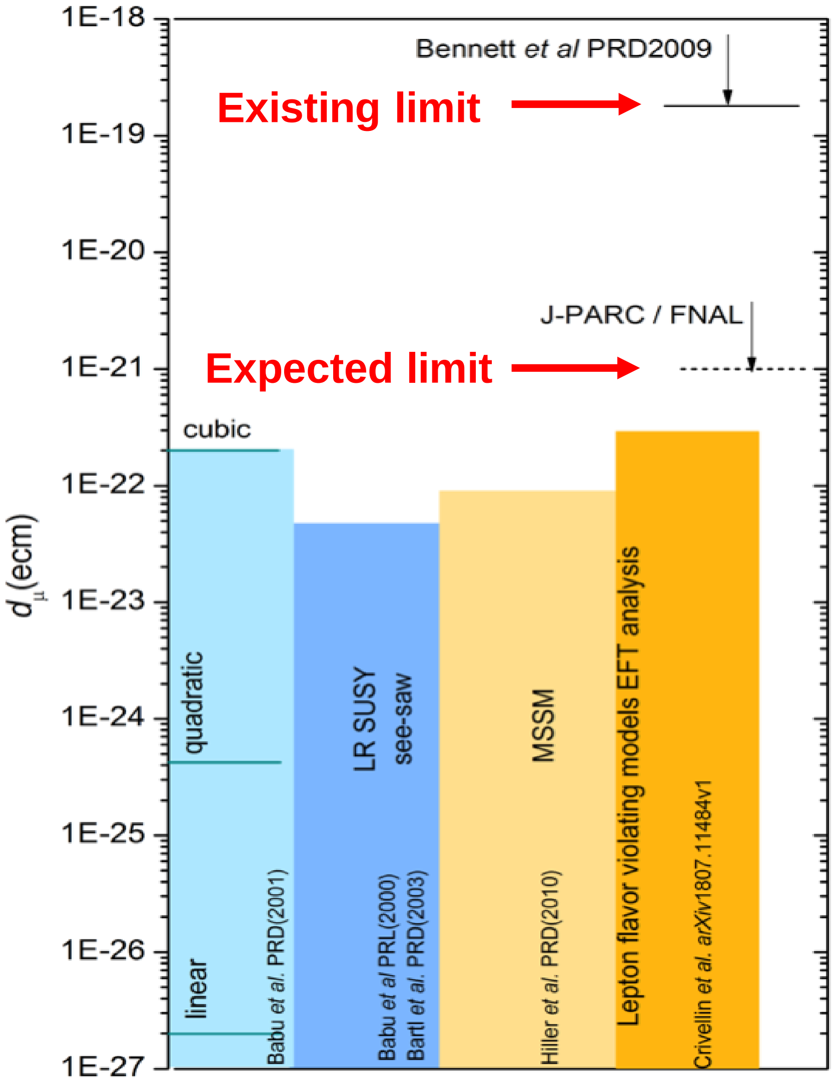
- **Most precise determination of a_μ for many years to come**
- **0.12 ppm measurement tests all Standard Model contributions**



- **Benchmark for models with new particles or forces**

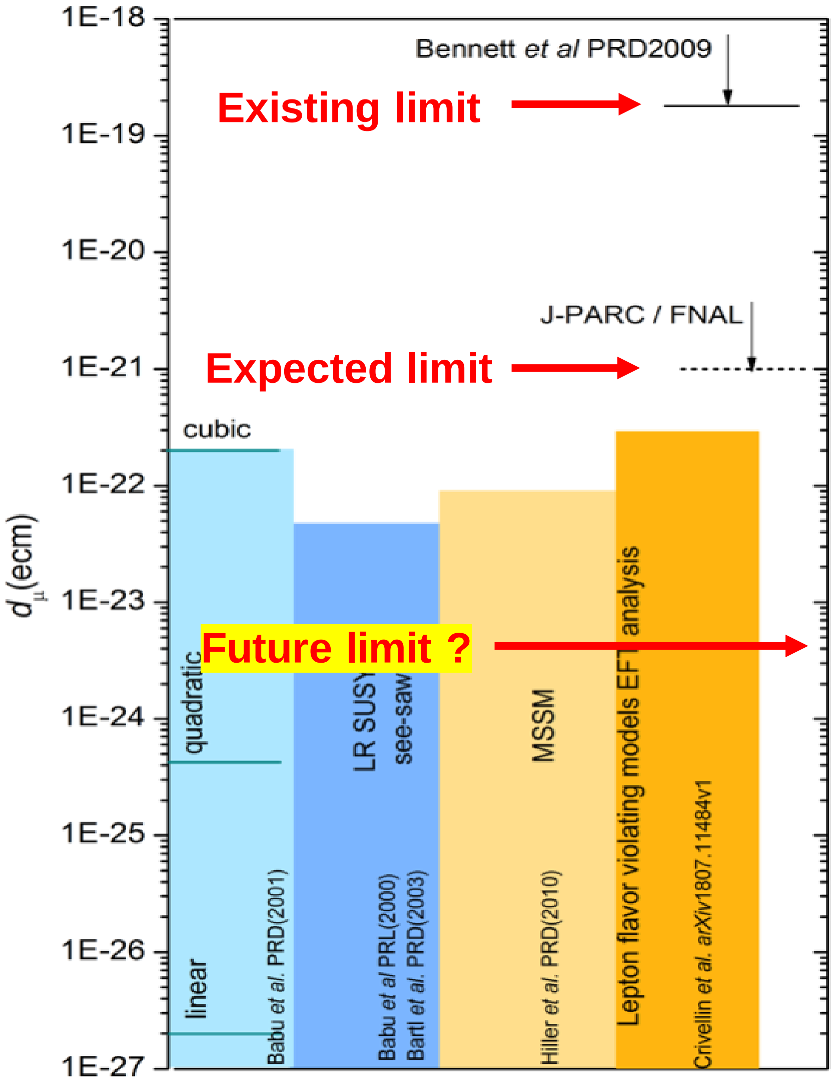
- **WP 2025: LQCD LO HVP brings the SM prediction in agreement with experiment**
- **Unresolved puzzle: disagreement between dispersive e^+e^- method and LQCD HVP**
- **Interesting contrast: ~1% agreement between LQCD LO HVP and e^+e^- results in tau and electron g-2!**

Muon Electric Dipole Moment (EDM)



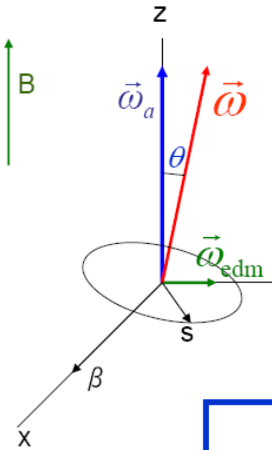
- SM prediction for muon EDM is almost 0: $d_\mu < 10^{-38}$ e·cm
- Unambiguous new physics signal
- Muon is the best option
  - Direct measurement
  - Free of nuclear / molecular effects
- Note that $d_e \sim 10^{-29}$ e·cm
  - Current best result $d_\mu \sim 10^{-19}$ e·cm
  - 10-10^2 improvement expected

Muon Electric Dipole Moment (EDM)



- **SM prediction for muon EDM is almost 0: $d_\mu < 10^{-38}$ e·cm**
- **Unambiguous new physics signal**
- **Muon is the best option**
  - **Direct measurement**
  - **Free of nuclear / molecular effects**
- **Note that $d_e \sim 10^{-29}$ e·cm**
  - **Current best result $d_\mu \sim 10^{-19}$ e·cm**
  - **10-10^2 improvement expected**
- **Big discovery potential**

Muon EDM Searches



$$\vec{\omega} = \frac{e}{m}\left\{a\vec{B} + \frac{\eta}{2}\left(\vec{\beta}\times\vec{B}\right)\right\}$$

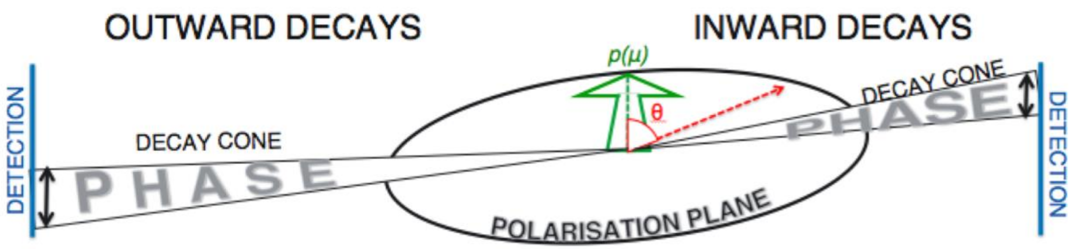
$$\vec{\omega} = \vec{\omega}_a + \vec{\omega}_{\text{edm}}$$

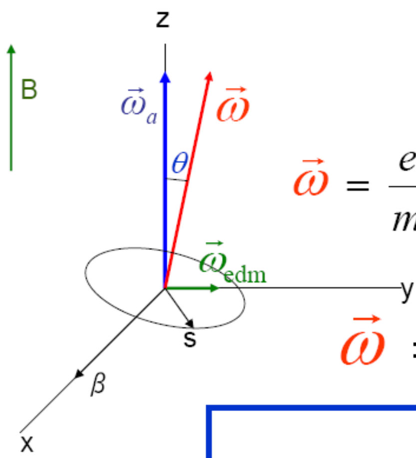
$$\tan\theta = \frac{\omega_{edm}}{\omega_a}$$

Muon EDM Searches

Calorimeter-based

- Phase asymmetry and vertical position oscillation
- Systematically limited

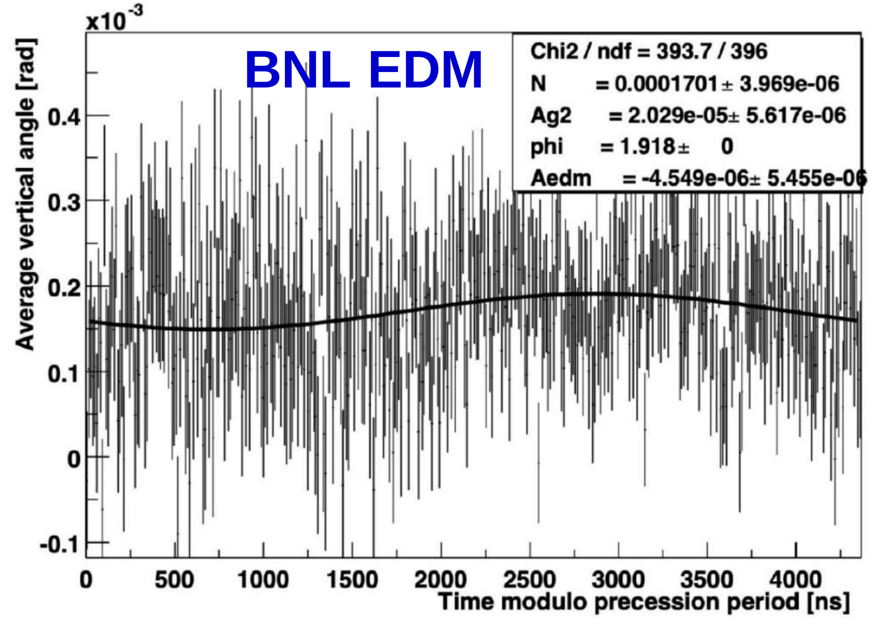




$$\vec{\omega} = \frac{e}{m}\left\{a\vec{B} + \frac{\eta}{2}\left(\vec{\beta}\times\vec{B}\right)\right\}$$

$$\vec{\omega} = \vec{\omega}_a + \vec{\omega}_{\text{edm}}$$

$$\tan\theta = \frac{\omega_{edm}}{\omega_a}$$

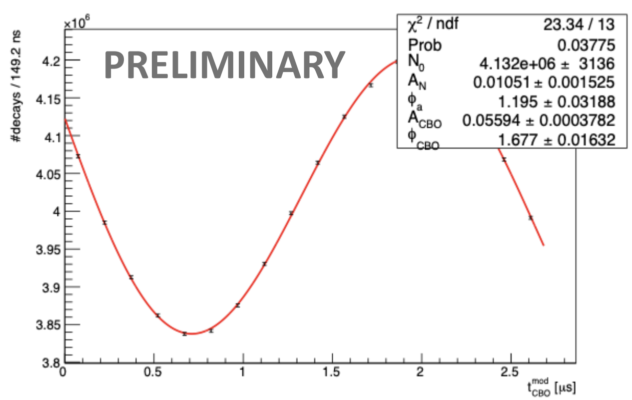


Tracker-based

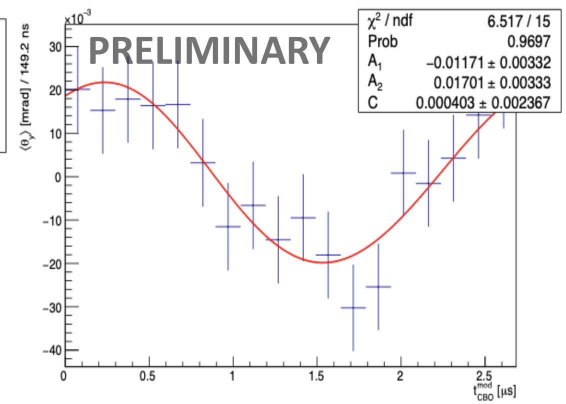
- Vertical angle oscillation measurement
- Statistically limited at BNL

Muon EDM Searches

- **Blind analysis with large fake signal**
- **Fit the ω_a oscillation**
- **Fit the average vertical angle oscillation**



(a) $750 \leq p < 1000$ MeV

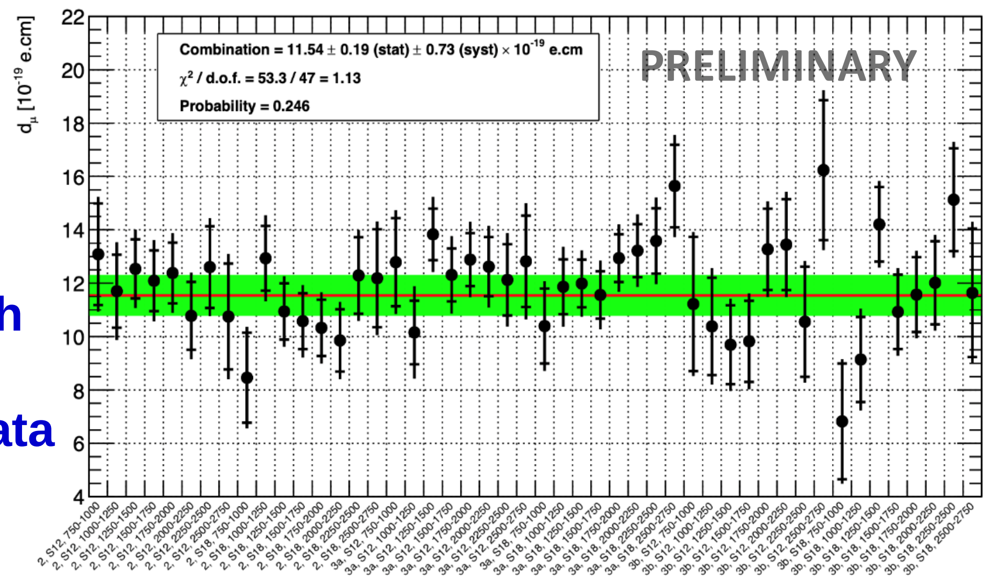


(a) $750 \leq p < 1000$ MeV

EDM Signal

$$\langle\theta_y\rangle(t) = \frac{A_{g-2}\cos(\omega_a t + \phi_a) + A_{\mathrm{EDM}}\sin(\omega_a t + \phi_a)}{(1 + A_N\cos(\omega_a t + \phi_a^p))\,(1 + A_{\mathrm{CBO}}\cos(\omega_{\mathrm{CBO}} t + \phi_{\mathrm{CBO}}))} + C$$

Fixed Term



- **Assuming central value at 0 after unblinding → limit of** 9.2×10^{-20} e · cm
- **2x improvement compared to BNL with Run-2/3 data**
- $\sim 10^{-21}$ e · cm **reachable with Run1-6 data**

Canton-μ Proposal: Muon g-2 at HIAF

arXiv > hep-ex > arXiv:2512.11486

Sear
Help

High Energy Physics – Experiment

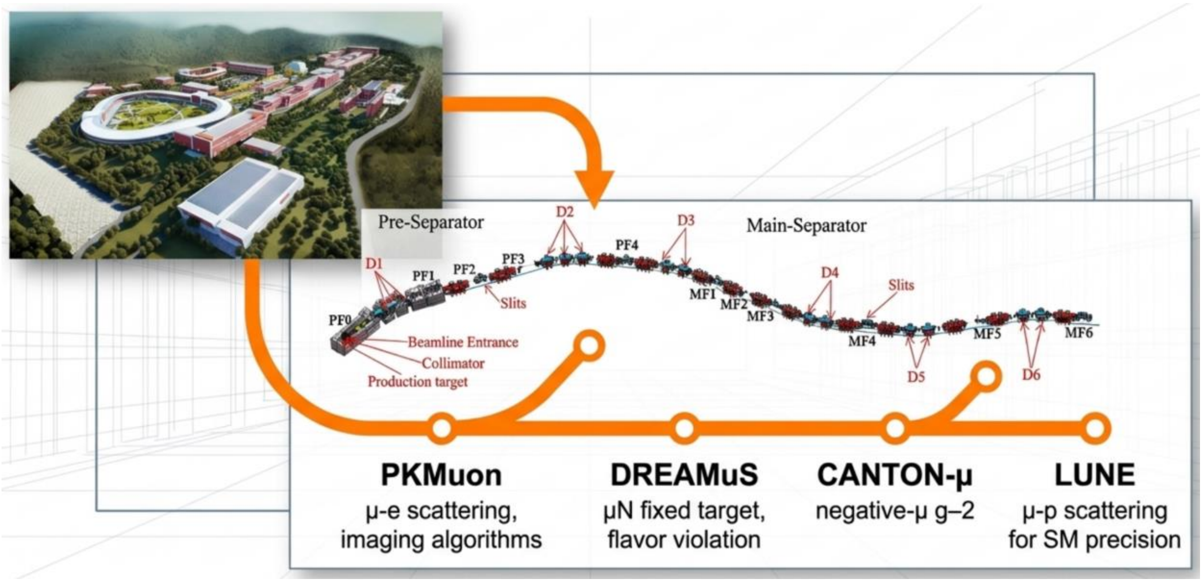
[Submitted on 12 Dec 2025]

CANTON-μ Proposal: A Next-Generation Muon $g-2$ Measurement at Sub-0.1 ppm Precision

Ce Zhang, Yu Xu, On Kim, Bingzhi Li, Guodong Shen, Liangwen Chen, Fedor Ignatov, Liang Li, Qiang Li, Xueheng Zhang, Zhiyu Sun

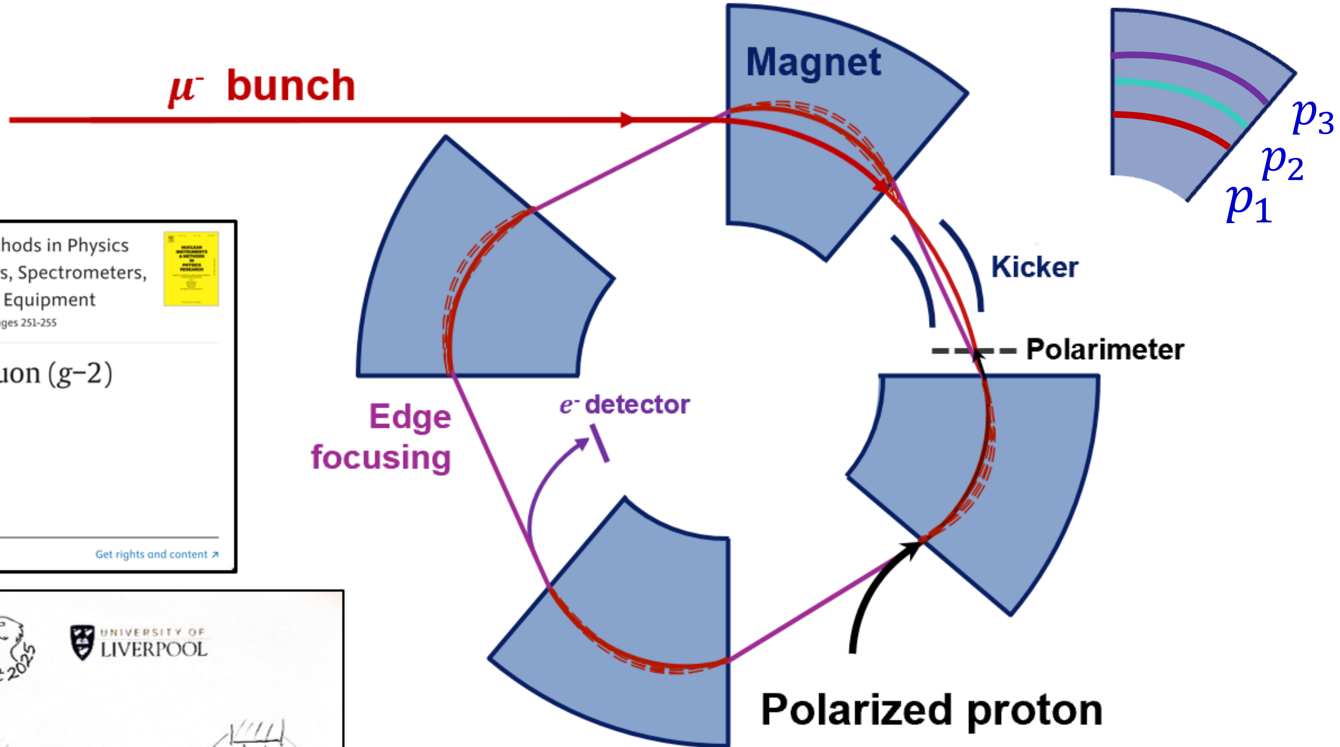
We propose a next-generation precision measurement of the muon anomalous magnetic moment $(g-2)$ at the High Intensity Heavy-Ion Accelerator Facility (HIAF) in Huizhou, China. The project, named CANTON-μ (Coherent Anomalous magNetic momenT ObservatioN with muon), describes novel experimental approaches based on HIAF's unique capability to produce intense pulsed muon beams at the GeV scale, particularly for negative-muon polarity. These approaches incorporate innovative focusing concepts such as the sector-magnet and weak-focusing ring designs, complemented by advanced magnetic-field calibration methods including a polarized-proton co-magnetometer. This independent measurement with distinct systematics is designed to achieve a precision of 0.1 ppm in Phase 1, matching the latest Fermilab result for μ^+, and 0.05 ppm in Phase 2 with the HIAF upgrade. Such precision will provide an exceptionally sensitive test of the Standard Model and a powerful probe of New Physics and CPT symmetry.

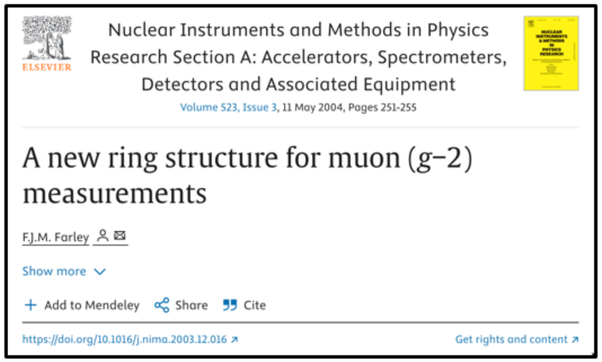
Comments: 25 pages, 7 figures
Subjects: **High Energy Physics – Experiment (hep-ex)**
Cite as: arXiv:2512.11486 **[hep-ex]**
(or arXiv:2512.11486v1 **[hep-ex]** for this version)
https://doi.org/10.48550/arXiv.2512.11486



Canton-μ Proposal: Muon g-2 at HIAF

HFRS (HIRIBL)





Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment

Volume 523, Issue 3, 11 May 2004, Pages 251-255

A new ring structure for muon (g−2) measurements

F.J.M. Farley

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https://doi.org/10.1016/j.nima.2003.12.016

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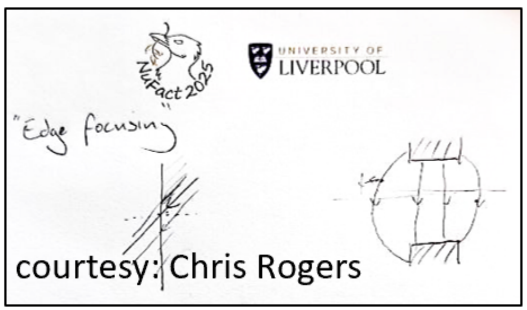


- Segmented sector magnet structure with fringe fields to focus the muons, no need for additional E field focusing.
- No restriction on magic muon momentum. Polarized protons experience the same magnetic field as muons for a direct calibration of the magnetic field.

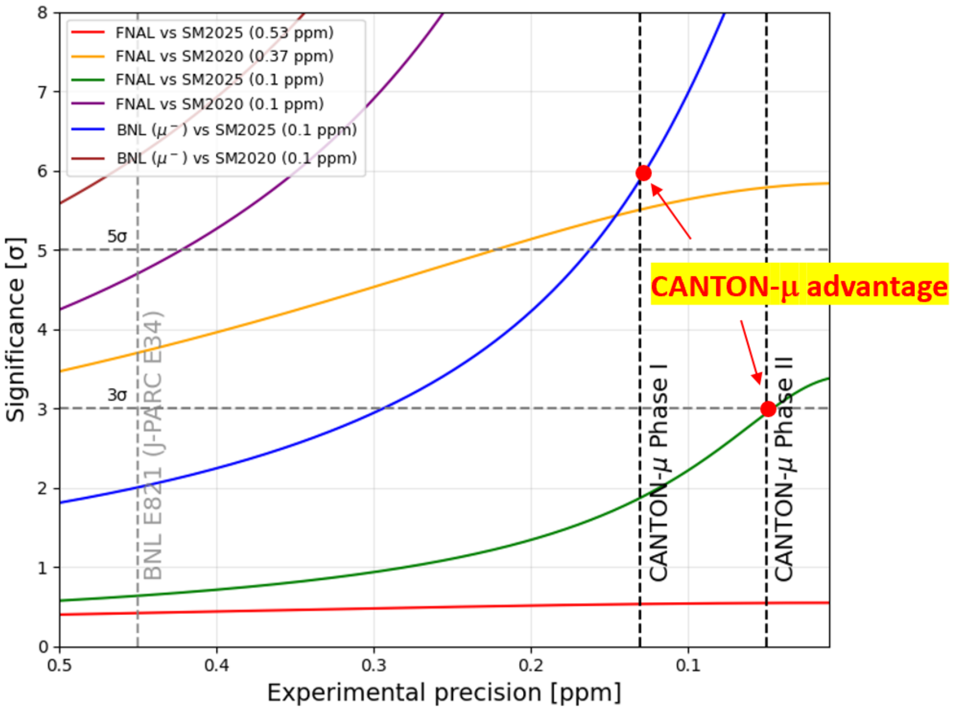
Canton-μ Proposal: Muon g-2 at HIAF

Muon g-2 theory and experiment comparison continues:

$$\Delta a_\mu^{\mathrm{Exp-WP2020}} = 26.2(4.5) \times 10^{-10},$$

$$\Delta a_\mu^{\mathrm{Exp-WP2025}} = 3.8(6.3) \times 10^{-10}$$

Canton-μ Phase-1 goal: 0.12ppm (FNAL precision)
Canton-μ Phase-2 goal: 0.05ppm



- **Canton-μ Phase-1 reaches 5σ in case of BNL central (μ^-) vs. WP2025**
- **Canton-μ Phase-2 reaches 3σ in case of FNAL central (μ^+) vs. WP2025**

Conclusion and Outlook

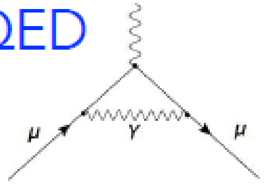
- ✓ **Breakthrough Prize for 3 generations of Muon g-2 exp.**
  - ✓ **FNAL gives most precise measurement at 0.12ppm**
- ✓ **Puzzles remain to be solved and many new potentials**
  - ✓ **Tension between different methods to evaluate HVP contribution**
  - ✓ **Muon EDM ($O(10^{-21})$ $e \cdot cm$) , CPT/LV and Dark Matter searches**
- ✓ **J-PARC Muon g-2/EDM to take data in ca. 2030: 1.5×10^{-21} $e \cdot cm$ EDM**
- ✓ **PSI MuEDM Phase I to take data from 2027: 3×10^{-21} $e \cdot cm$ EDM**
- ✓ **Canton-μ Proposal: μ^{-} 0.05 ppm precision potential**
- ✓ **More exciting results from Muon g-2 and EDM sector underway!**

Backup

Muon g-2 Theory Prediction

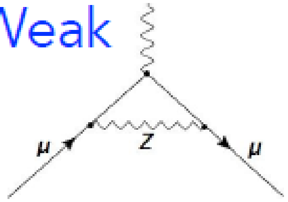
$$a_\mu = a_\mu(\mathrm{QED}) + a_\mu(\mathrm{Weak}) + a_\mu(\mathrm{Hadronic})$$

QED



$+\ldots$ $116\,584\,718.9\,(1) \times 10^{-11}$ 0.001 ppm

Weak

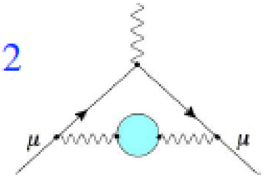


$+\ldots$ $153.6\,(1.0) \times 10^{-11}$ 0.01 ppm

Hadronic… **Muon g-2 Theory Initiative: Phys. Rept. 887 (2020) 1-166 (WP2020)**

…Vacuum Polarization (HVP)

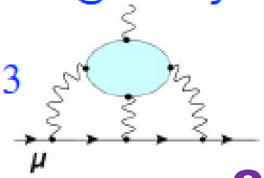
α^2



$+\ldots$ $6845\,(40) \times 10^{-11}$ 0.37 ppm [0.6%]

…Light-by-Light (HLbL)

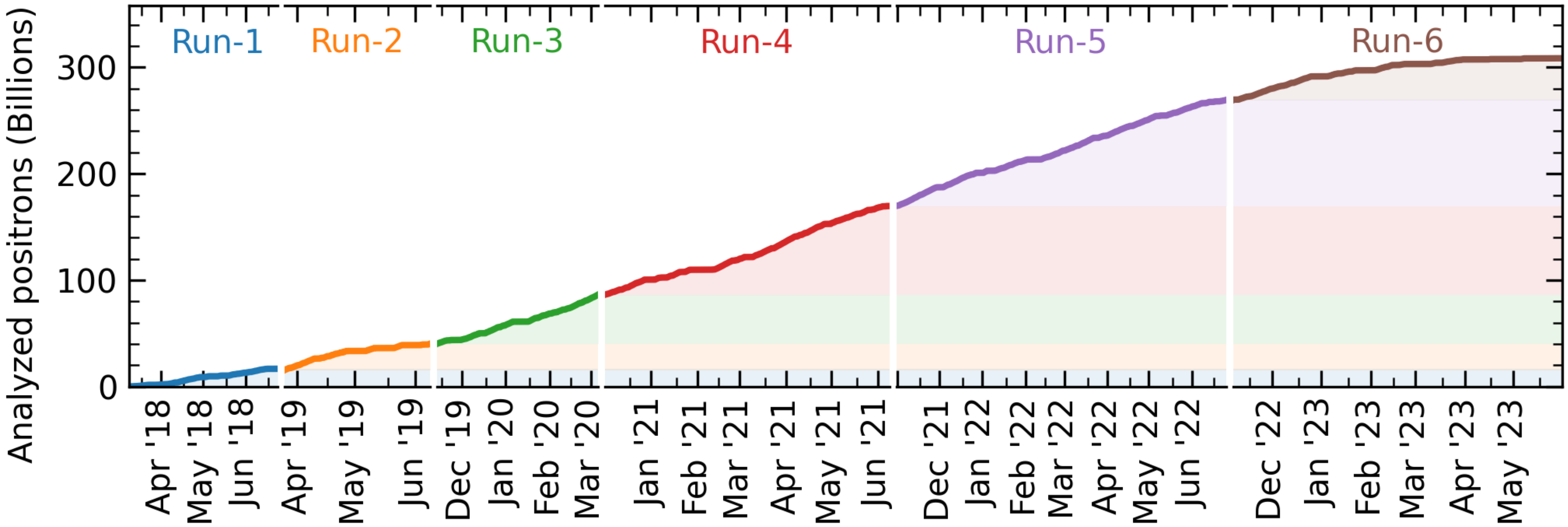
α^3



$+\ldots$ $92\,(18) \times 10^{-11}$ 0.15 ppm [20%]

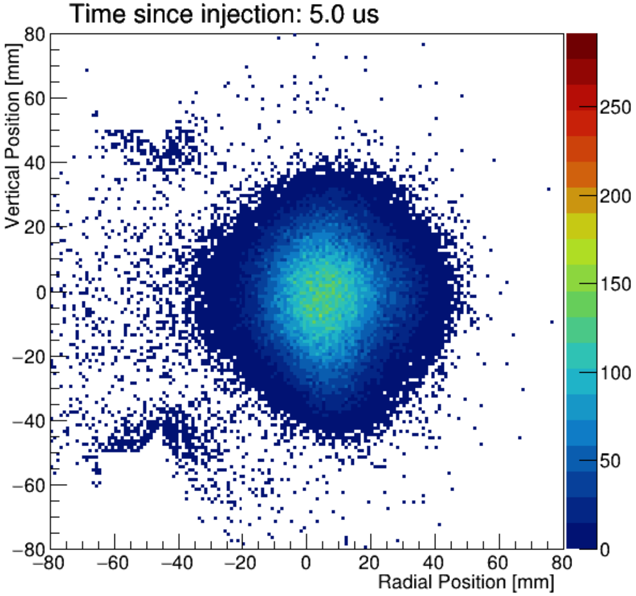
a_μ(SM) = 0.00 116 591 810(43) [370 ppb]

Data Collection

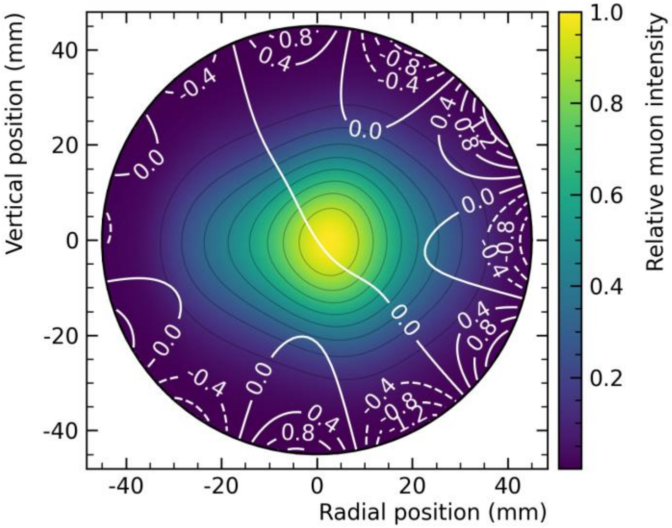


- ✓ **Apr. 2021: Run-1 Result (2018 data) Stat. 434ppb**
- ✓ **Aug. 2023: Run-2/3 Result (2019-20 data) Stat. 201ppb**
- ✓ **Jun. 2025: Run-4/5/6 Result (2021-23 data) Stat. 114ppb**
- ✓ **Run-2/3 ~ 4 times larger than Run-1**
- ✓ **Run-4/5/6 ~ 4 times larger than Run-2/3**

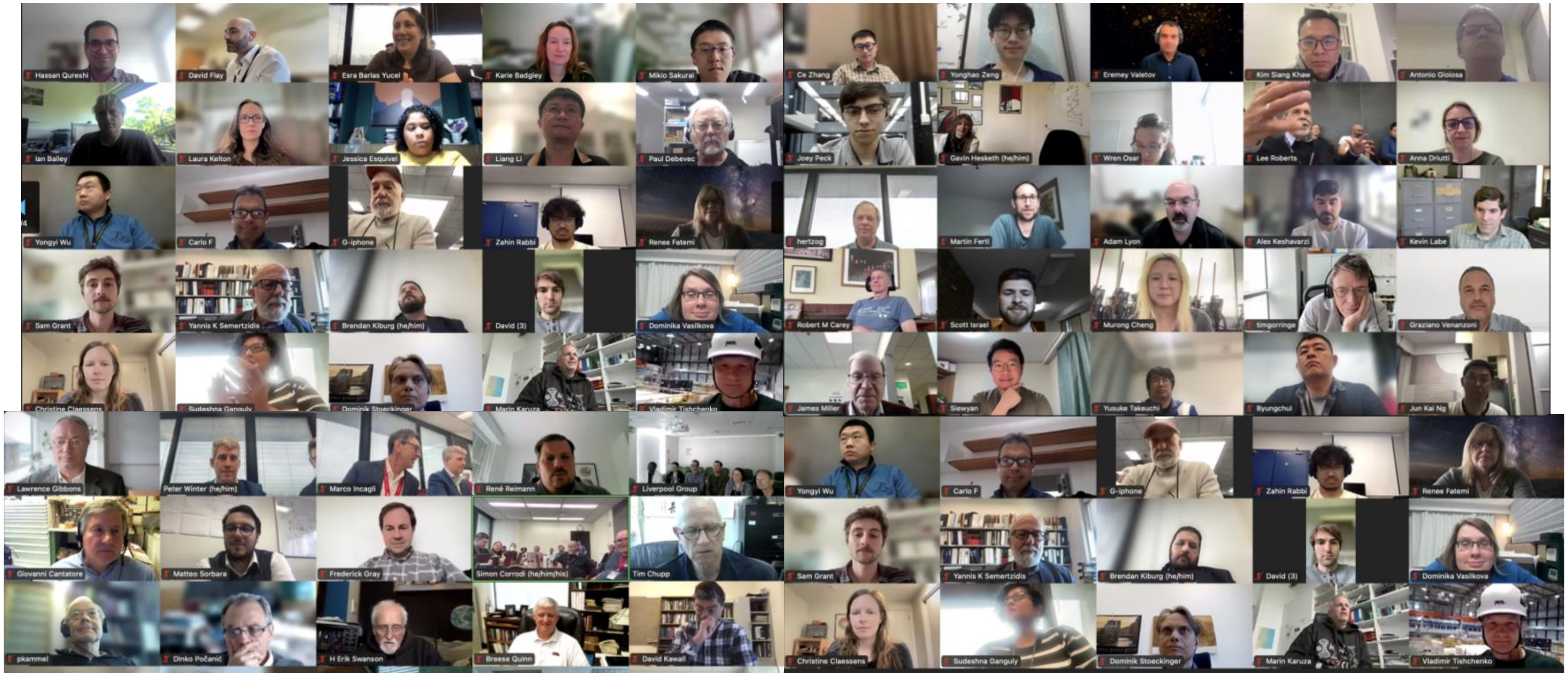
Muon Distribution Measurement



- Trackers can measure beam oscillations directly
  - Beam-dynamics corrections
  - Tuning simulations
  - Optimizing experiment running conditions
- Use muon distribution to weight field maps by where the muons live



Unblinding Ceremony



The Muon g-2 Collaboration:

176 collaborators, 34 institutes, 7 countries

Particle-, Nuclear-, Atomic-, Optical-, Accelerator-, and Theoretical- Physicists and Engineers

Improving Systematic Uncertainties

Identified an Intensity-Dependent Gain Sag

- with a magnitude below our stability design goal (10^{-4})
- however, phase-shifted oscillation at ω_a leads to larger sensitivity than orig. estimated
- Resolved puzzle of residual slow terms in ω_a-fits
- Run-2/3: +47 ppb $\pm$ 24 ppb
  (Run-1: +50 ppb $\pm$ 29 ppb)

Improved spatial-model of Kicker-Transients

- Additional, dedicated measurement after muon storage periods
- similar cross-checks for transient fields from ESQ (B_Q), confirmed used model
- Run-2/3: +19 ppb $\pm$ 23 ppb
  *on a_μ, correction on B_k has opposite sign

Identified and corrected a sign error

- in one (of three) contribution to the Differential Decay Correction ($C_{dd}^{beamline}$)
- Run-2/3: magnitude of $C_{dd}^{beamline}$: 12 ppb to 20 ppb
- Run-2/3: +32 ppb $\pm$17 ppb
  *uncertainty due to method not sign error

Simulation efforts allowed for many cross-checks and gain new insights

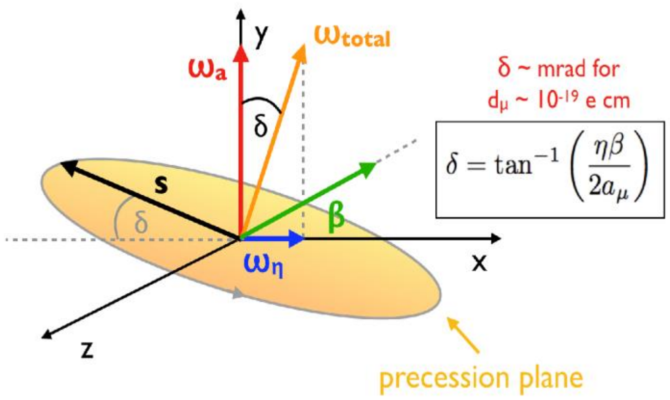
Use Run-4/5/6 knowledge for Run-1/2/3:

Run-2/3 central value: +89 ppb
Run-2/3 uncertainty: from 70 ppb to 78 ppb

BSM searches (EDM, CPT/LV, DM)

Muon Electric Dipole Moment (EDM)

- Spin precession plane is tilted in the presence of the EDM
- Run-2/3 analysis to be announced soon!
- BNL limit: $1.8 \times 10^{-19}\, e \cdot cm \rightarrow$ FNAL Projected limit: $\sim \mathcal{O}(10^{-20}\, e \cdot \mathrm{cm})$

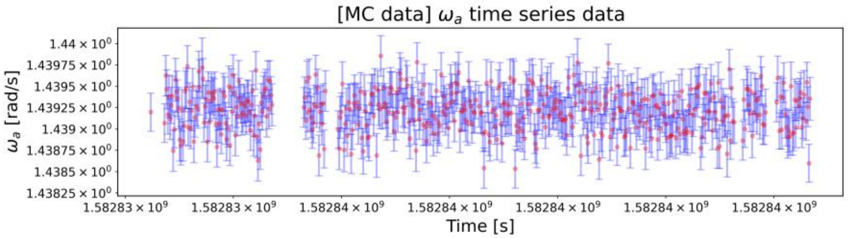


CPT and Lorentz Invariance Violation

- ω_a modulated at sidereal motion freq.
- Run-2/3 analysis in review
- BNL limit: 1.4×10^{-24} GeV $\rightarrow$ FNAL Projected limit: $\mathcal{O}(10^{-25})$ GeV

Ultralight Muonic Dark Matter (scalar)

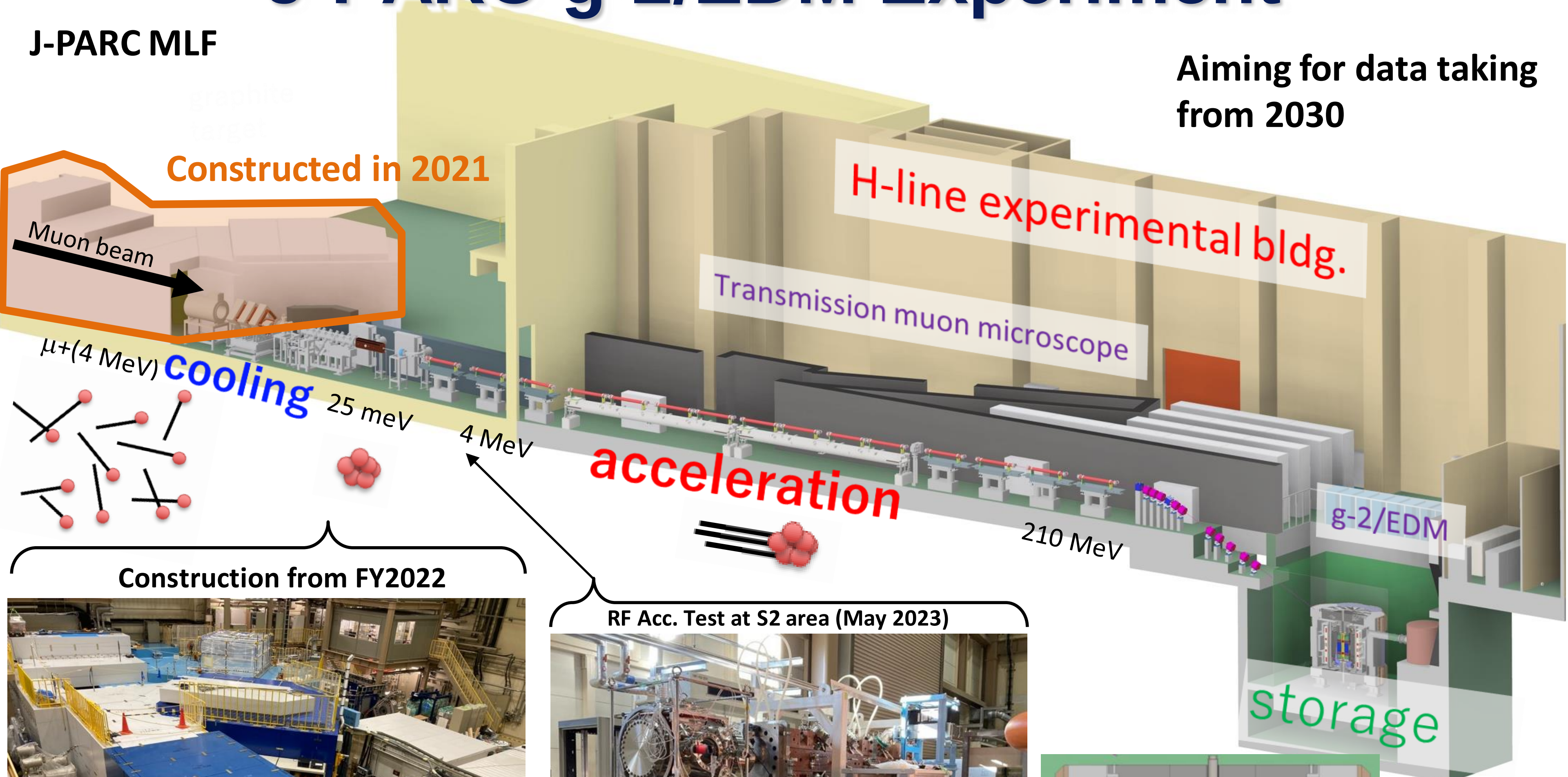
- ω_a modulated at the DM Compton frequency: $\omega_{DM} = c^2 m_{DM}/\hbar$
- Run-2/3 analysis in progress



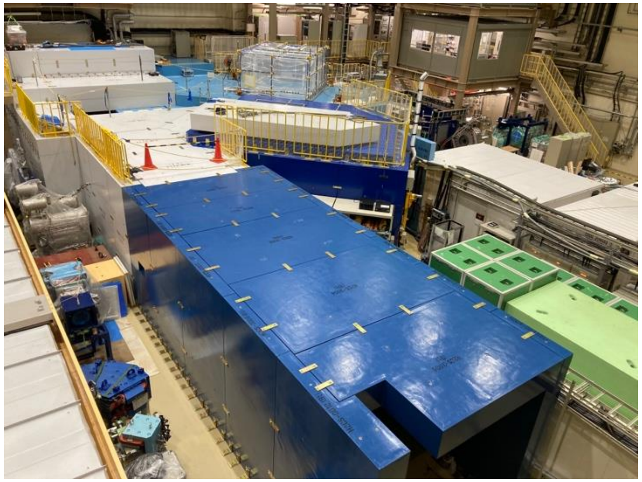
J-PARC g-2/EDM Experiment

J-PARC MLF

Aiming for data taking from 2030

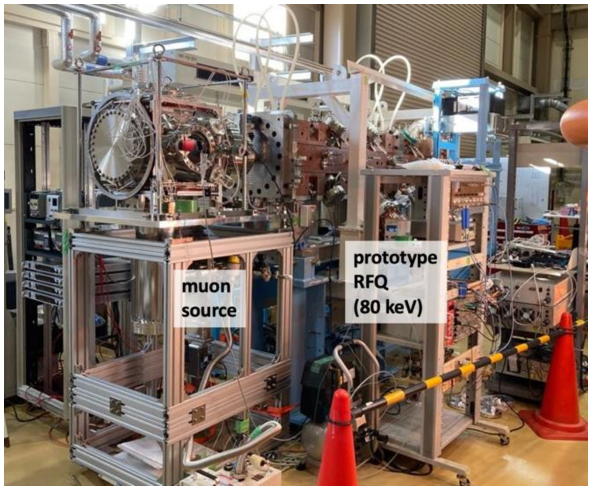


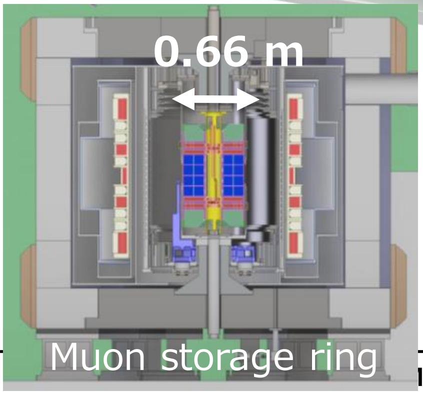
Construction from FY2022



Shields, area control (2022)

RF Acc. Test at S2 area (May 2023)

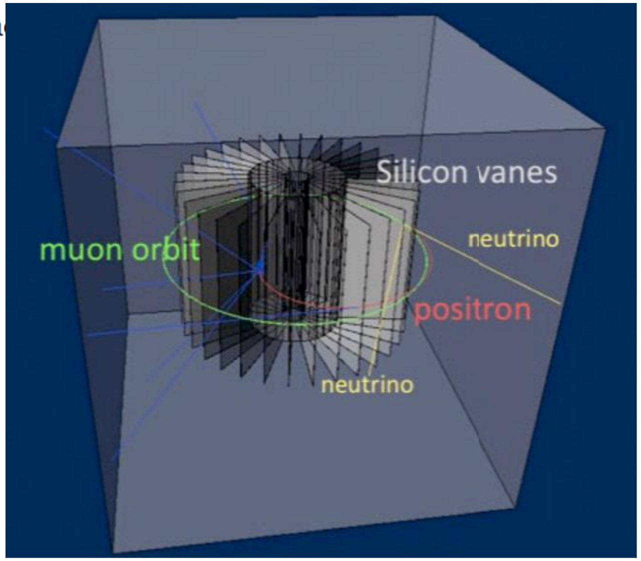




J-PARC g-2/EDM Expectation

Comparison of various parameters for the Fermilab and J-PARC $(g-2)$ Experim

Parameter	Fermilab E989	J-PARC E24
Statistical goal	100 ppb	400 ppb
Magnetic field	1.45 T	3.0 T
Radius	711 cm	33.3 cm
Cyclotron period	149.1 ns	7.4 ns
Precession frequency, ω_a	1.43 MHz	2.96 MHz
Lifetime, $\gamma\tau_\mu$	64.4 μs	6.6 μs
Typical asymmetry, A	0.4	0.4
Beam polarization	0.97	0.50
Events in final fit	1.8×10^{11}	8.1×10^{11}



Subsystem	Efficiency
Surface muon transportation	16%
Thermal muon generation	0.19%
Thermal muon transportation	72%
Acceleration	71%
Injection	78%
Energy window	12%
Detector acceptance	100%
Reconstruction	90%
Total	0.0013%

Aim to have comparable precision with FNAL Run-1 result

- **Assuming 1 year operation**
- **Statistical uncertainty dominated**
  - $\delta\omega_a$ = 0.45 ppm, $\delta\omega_{a\_sys}$ = 0.07 ppm
  - δEDM = $1.5\cdot10^{-21}$e$\cdot$cm

What makes them so different?

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

g-2 E=0 EDM

- “Ultra-cold” muon source: low P_T muons
  - Not constrained to run at the “magic momentum”
  - Smaller magnet, Compact design
  - Low emittance beam, Intrinsically more uniform
- Challenges
  - Produce, accelerate and inject cold muons into storage ring
  - Overall low muon efficiency