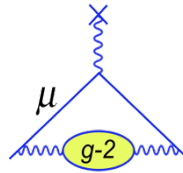
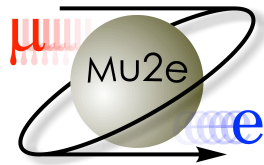


More Muons: Mu2e, g-2 and MUonE

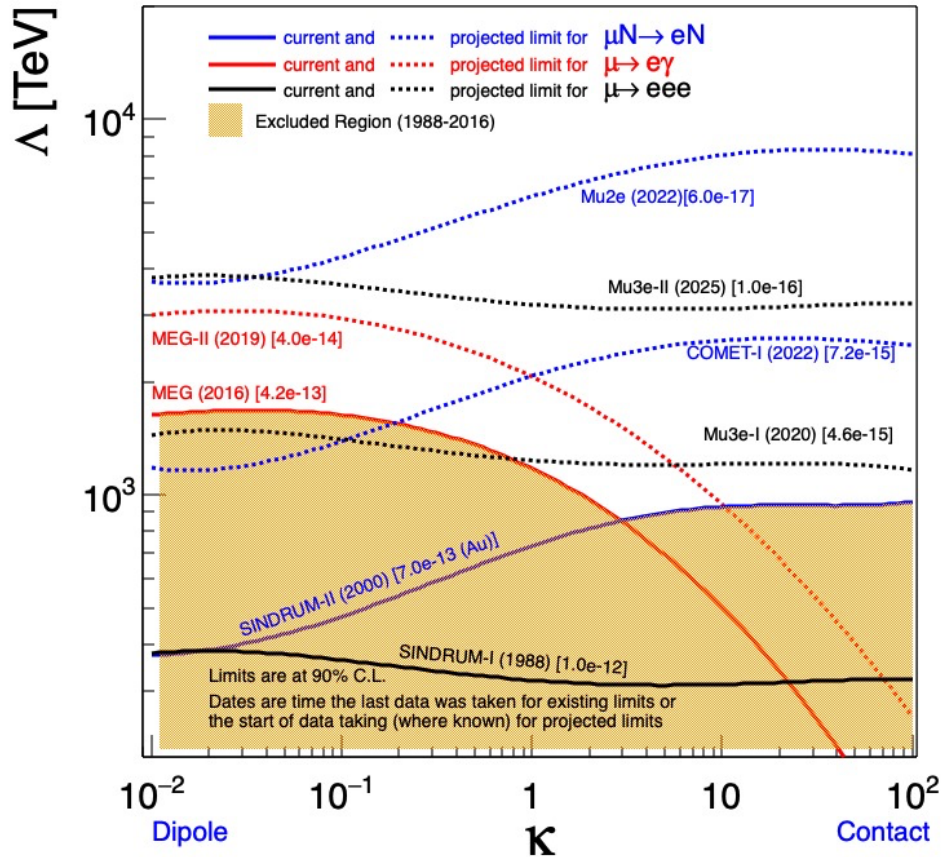
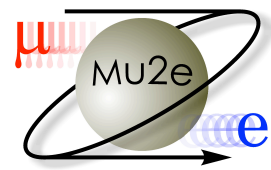


Joe Price



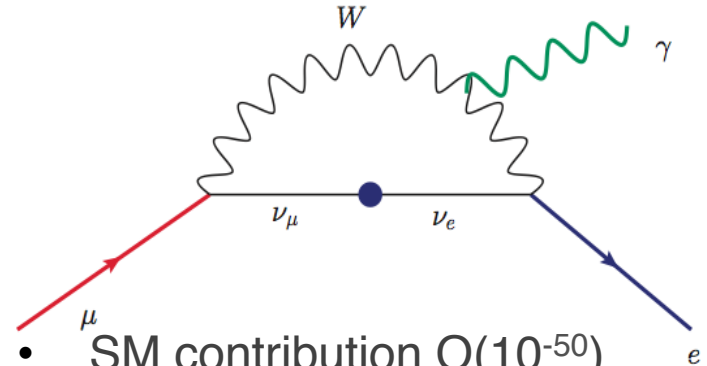
UNIVERSITY OF
LIVERPOOL

Mu2e: CLFV

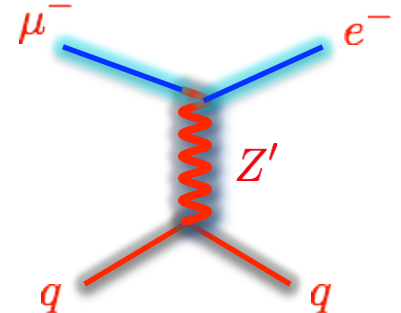
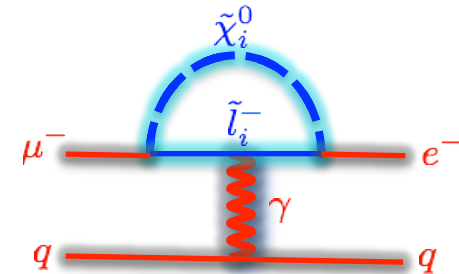
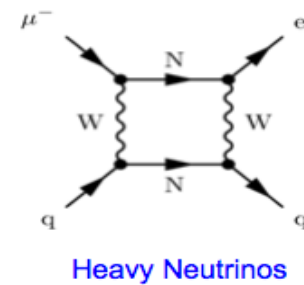
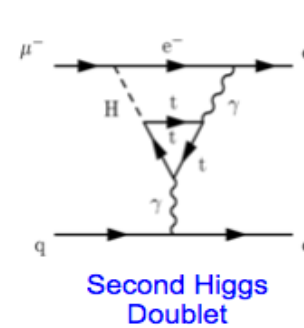


Updated from A. de Gouvea, P. Vogel, arXiv:1303.4097

Mu2e sensitive to new physics via loops and contact interactions



- SM contribution $O(10^{-50})$
- Any signal is a sign of new physics

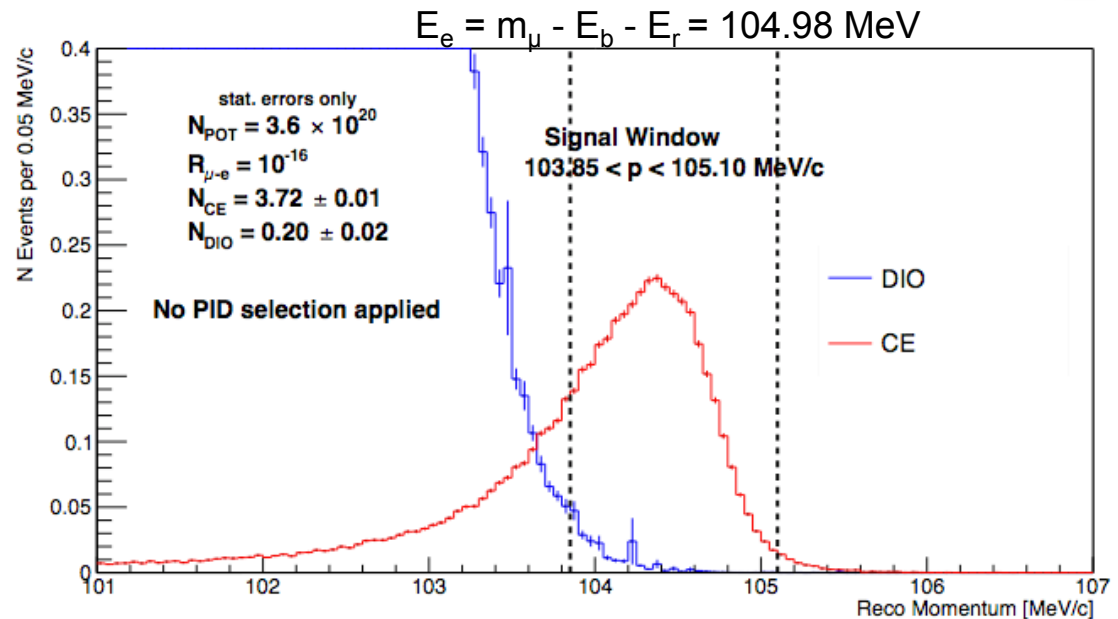
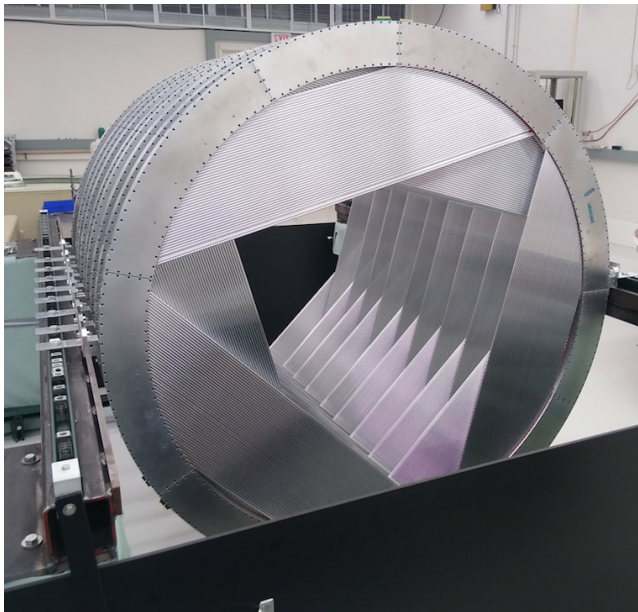
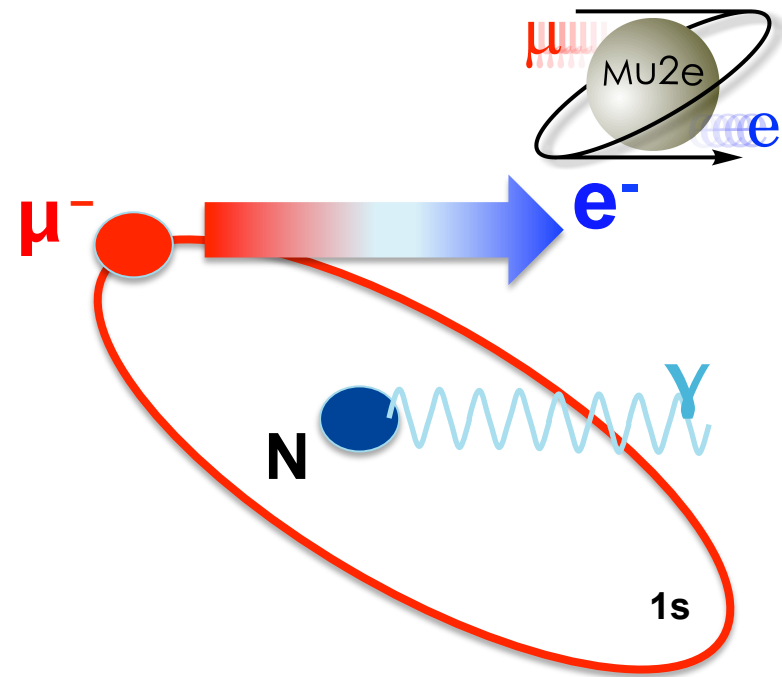


Mu2e: Measurement Principle

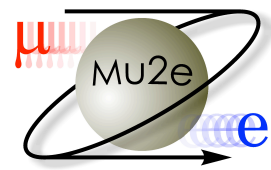
- Neutrinoless conversion of μ^- to e^- produces mono-energetic e^- signal

$$R_{\mu \rightarrow e} = \frac{\mu^- + A(Z, N) \rightarrow e^- + A(Z, N)}{\mu^- + A(Z, N) \rightarrow \nu_\mu + A(Z - 1, N) + \gamma}$$

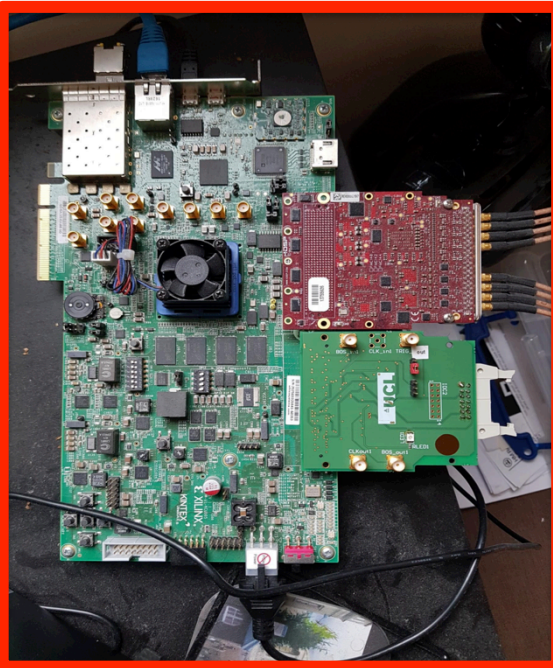
- Normalisation measured by STM
- Backgrounds from decay in orbit



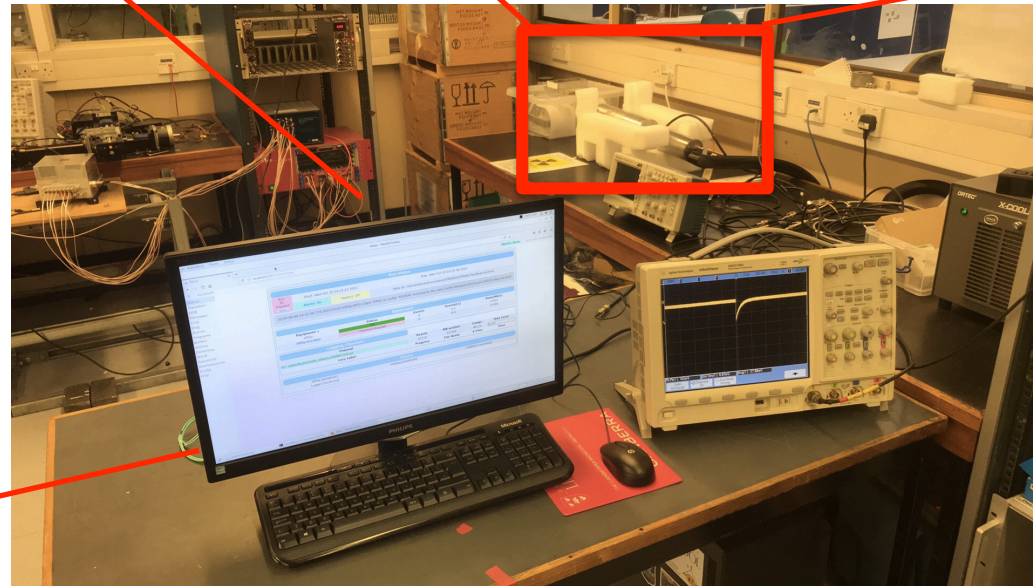
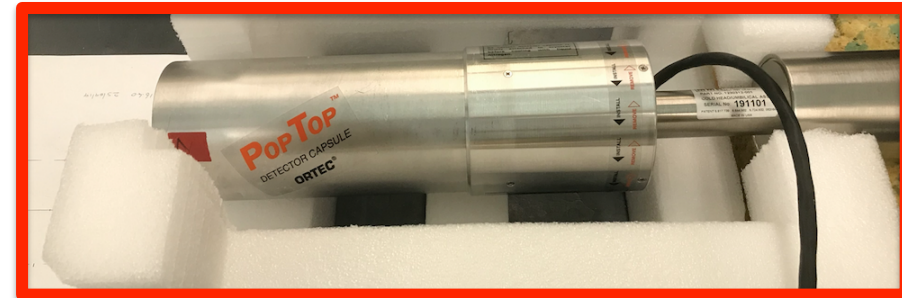
Mu2e: STM at Liverpool



ADC / FPGA / Clock



HPGe

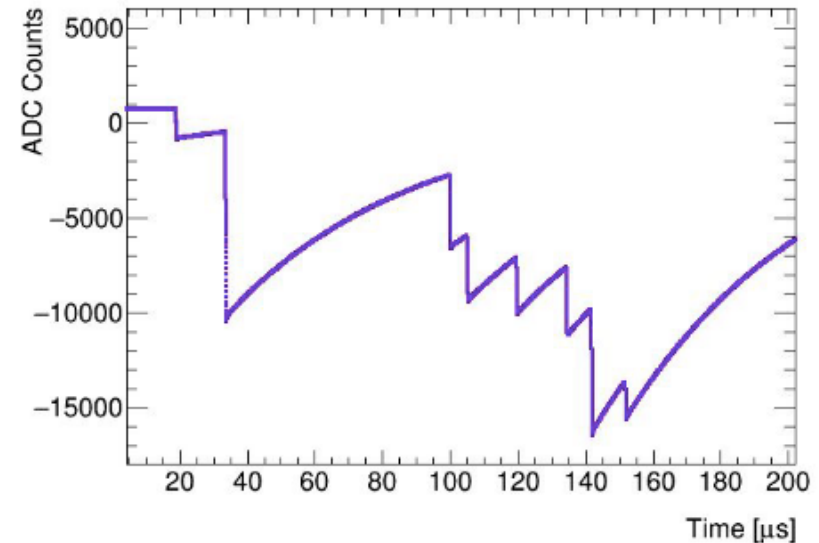
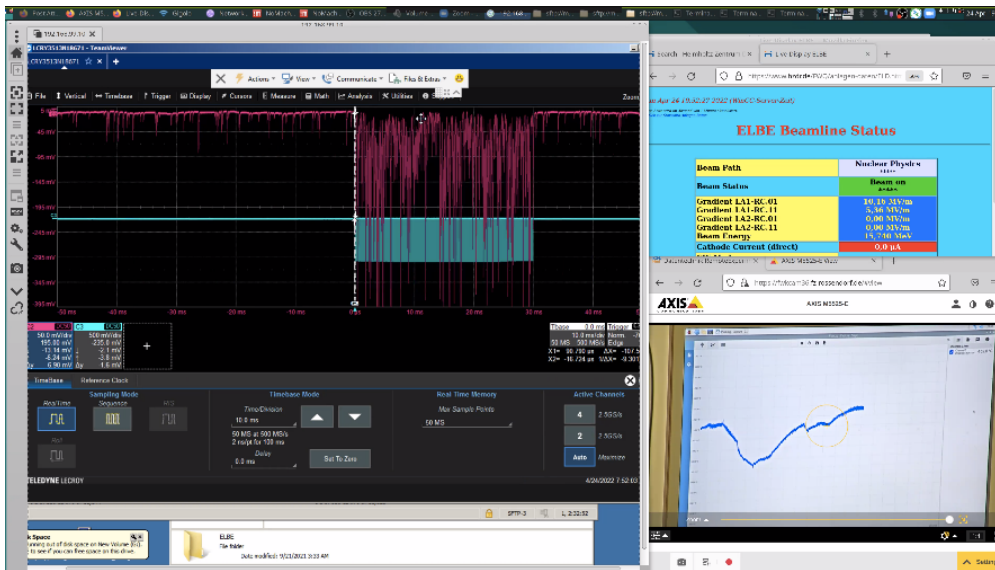
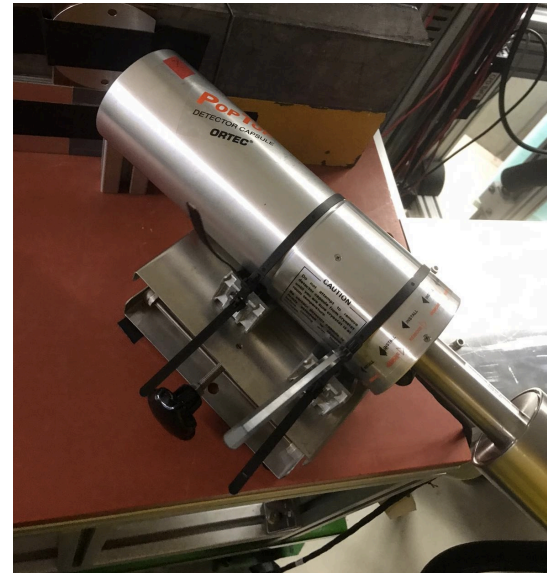
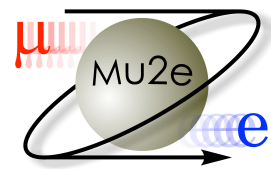


DAQ Setup at Liverpool

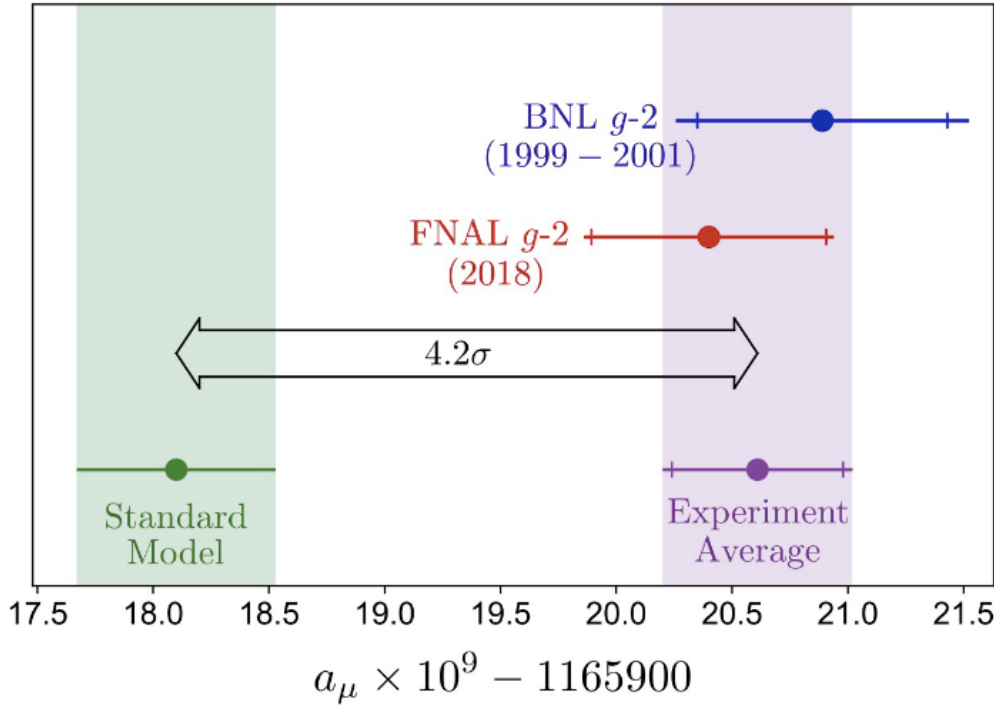
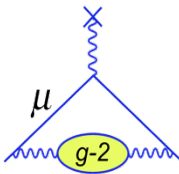
- Shipped first HPGe detector to FNAL in September 2021!

Mu2e: ELBE test beam

- Took the other to HZDR for a test beam in April 2022
- DAQ integration and high rate tests
- Ready for shipment to FNAL



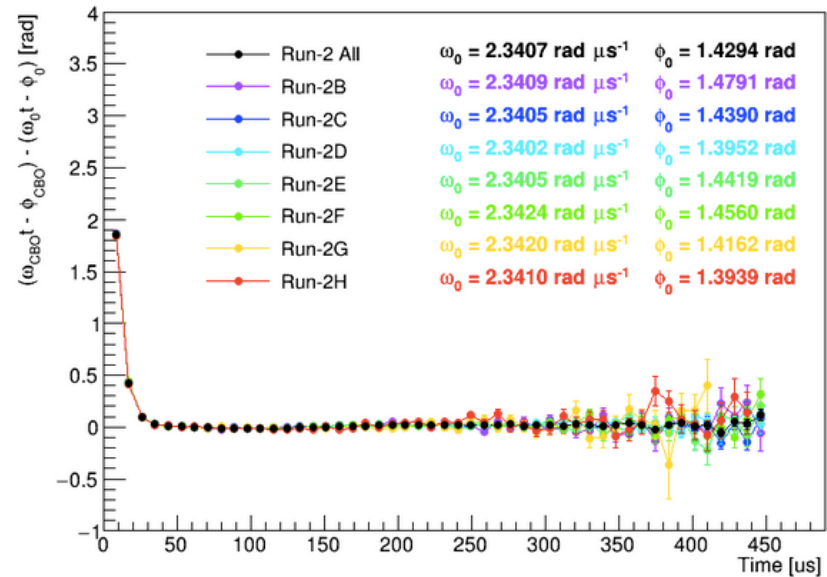
Muon g-2



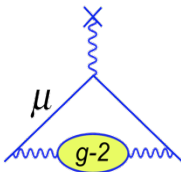
$$a_\mu(\text{FNAL}) = 116\,592\,040(54) \times 10^{-11} \quad (0.46 \text{ ppm})$$

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

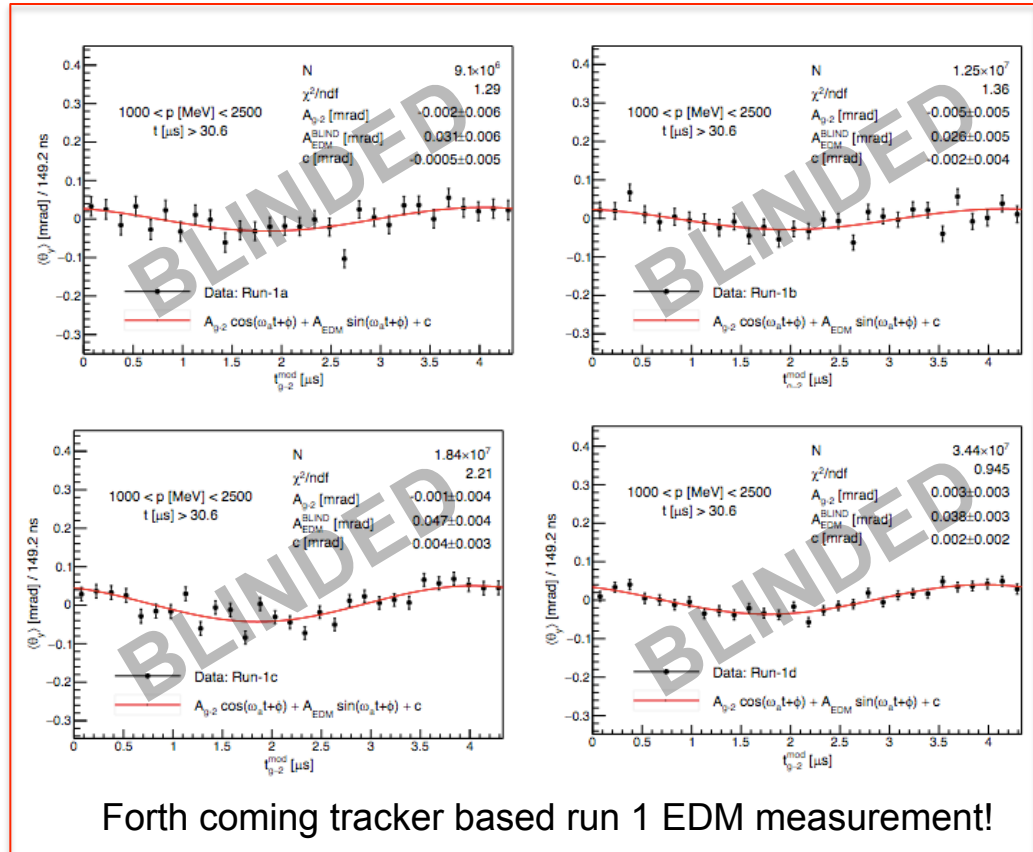
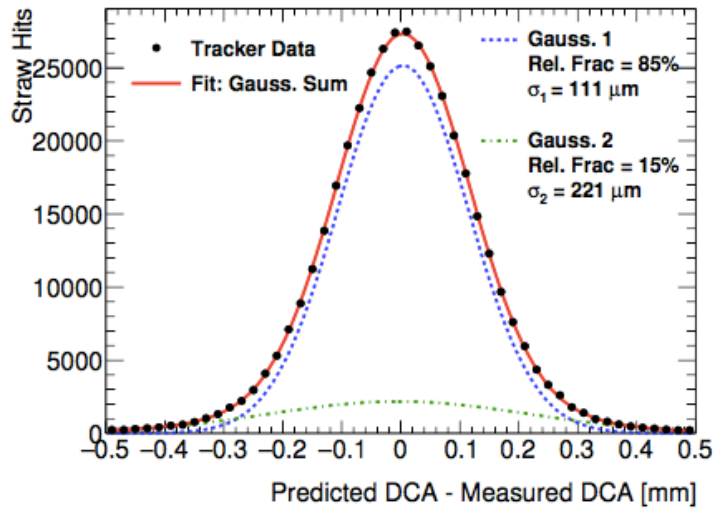
- 1 year on since publication!
- Improved stability of beam for future runs
- Continue to take μ^+ runs until this summer...



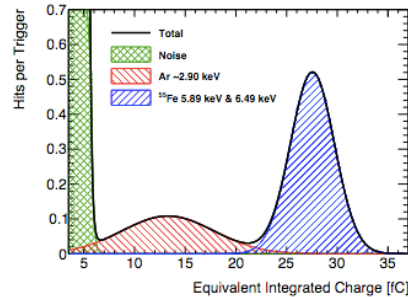
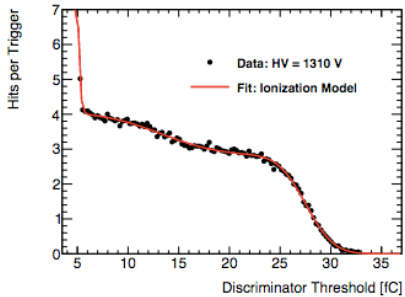
Muon g-2: Trackers



- Trackers still going strong (although warranty is now void)
- Published tracking paper: B.T.King *et al* 2022 JINST 17 P02035

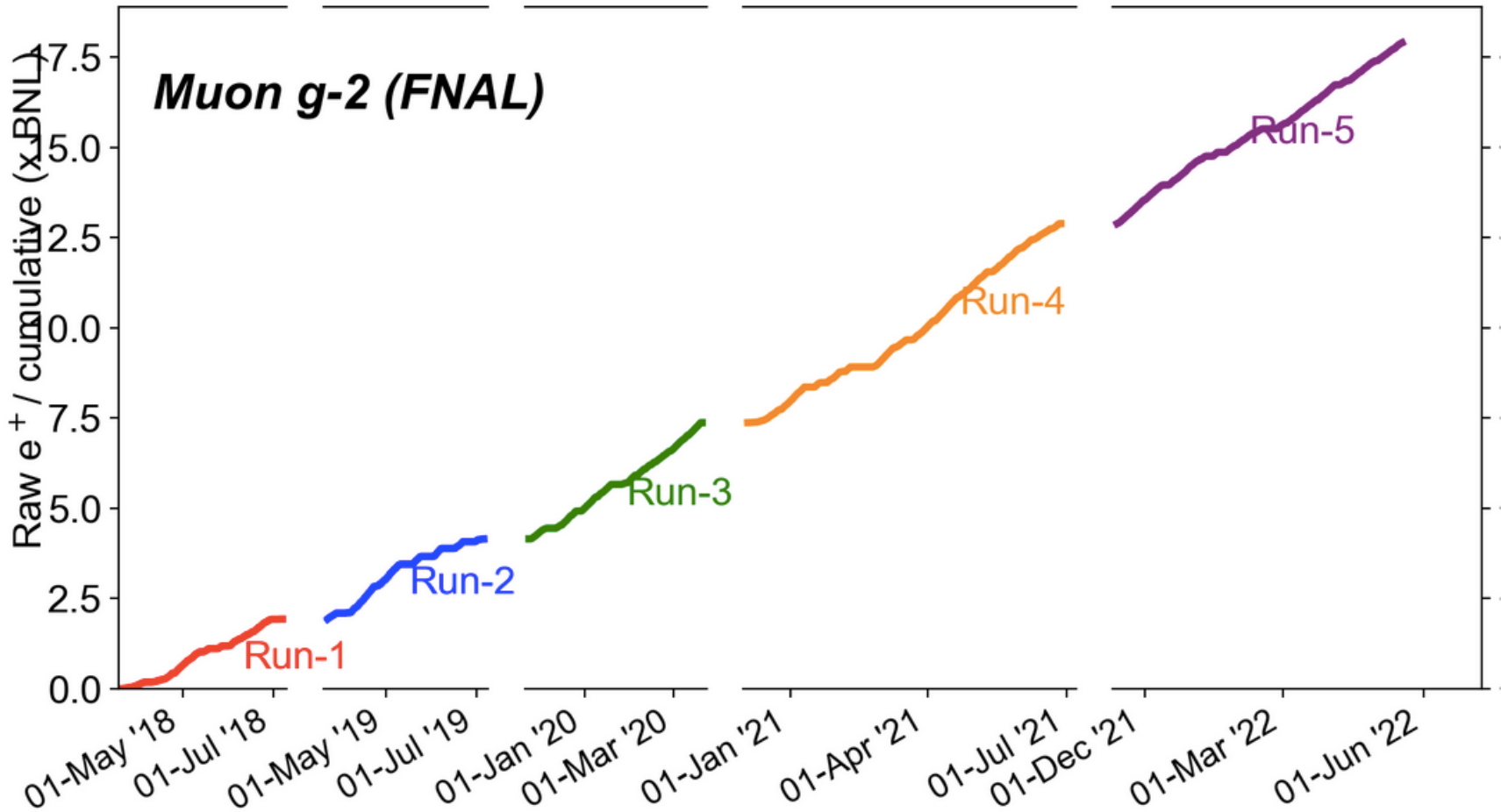
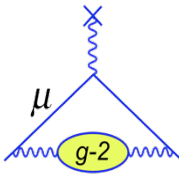


Forth coming tracker based run 1 EDM measurement!



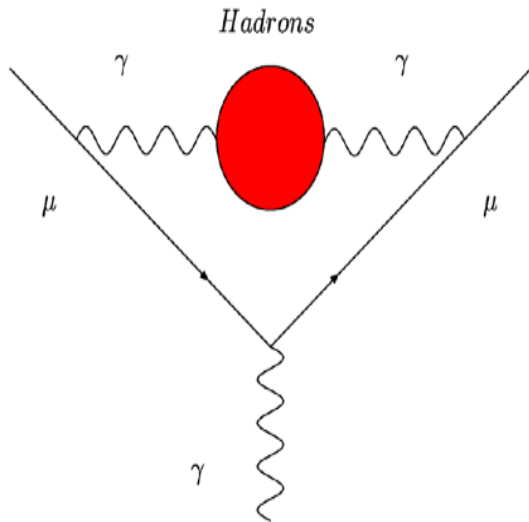
Muon g-2: Dataset

Last update: 2022-05-18 14:22 ; Total = 17.90 (xBNL)

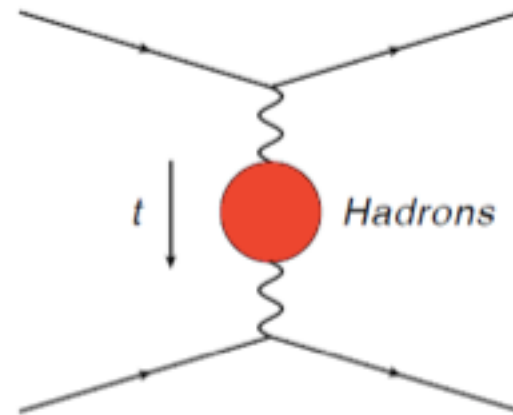


Trackers set to play a crucial role in the forthcoming run 2+3 paper
...as well as final publication!

- How do we confirm significance of $g-2$ result?
- Remember corrections are due to higher order processes
- Compute from timelike formula or Lattice Gauge

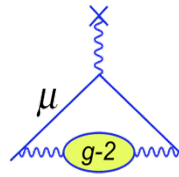
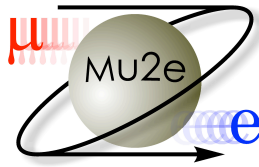


OR

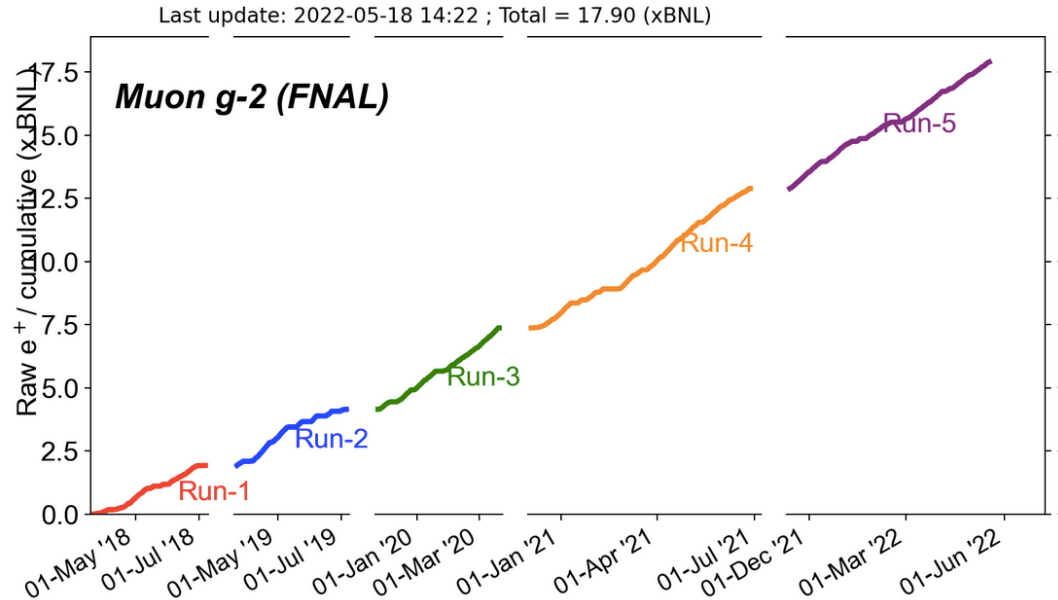


- Compute from timelike formula
- or Lattice Gauge
- Or look at scattering of muon off electron in spacelike region

Conclusions



- Mu2e STM tests completing at Liverpool
- Ship final detector to FNAL this year
- New data for g-2 taken
- New result on Run 2+3 for end of year
- Thanks to David Tarazona!



MUonE

- Exciting follow on from g-2
- Independent measurement of the hadronic corrections to either e+e- data or lattice
- Idea “small” high-tech experiment
- High physics importance

Backups...



What could Liverpool possible contribute

Discussions beginning

Ideas:

Micron precision mechanics with composites

Modules

Metrology

New Spectrometer (dp/p of about 0.1% at 100 GeV)

Summary

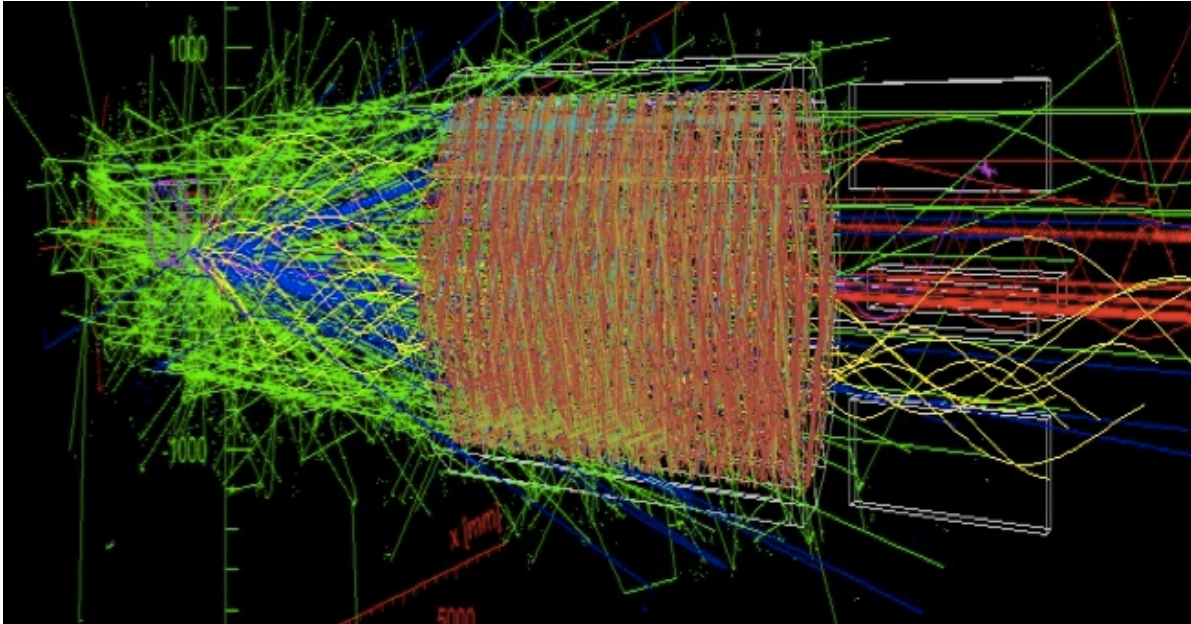
Exciting follow on from g-2

Independent measurement of the hadronic corrections to either e+e- data or lattice

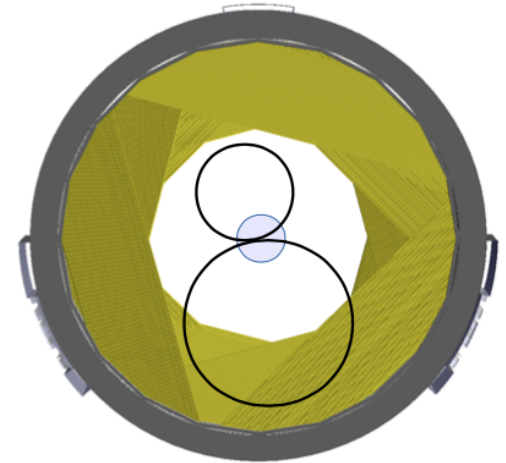
Idea “small” high-tech experiment

High physics importance

Mu2e -> Mu2e-II

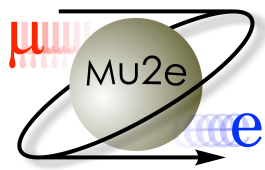


occupancy of the Mu2e tracker. 10 × higher for Mu2e II



Mu2e has 10^{10} muons per second on target
Upgraded experiment increase sensitivity by factor of 10
Thinner straws ($\sim 8\mu\text{m}$)
Tracking challenge - FPGAs potential
Potential STM upgrade required

Mu2e: ELBE test beam



Upon Arrival...



Exit...



...via neustadt

