UNIVERSITY OF LIVERPOOL
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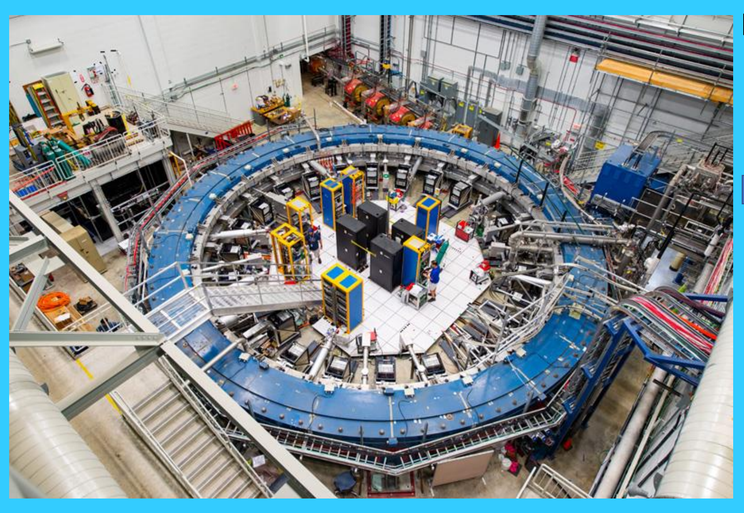
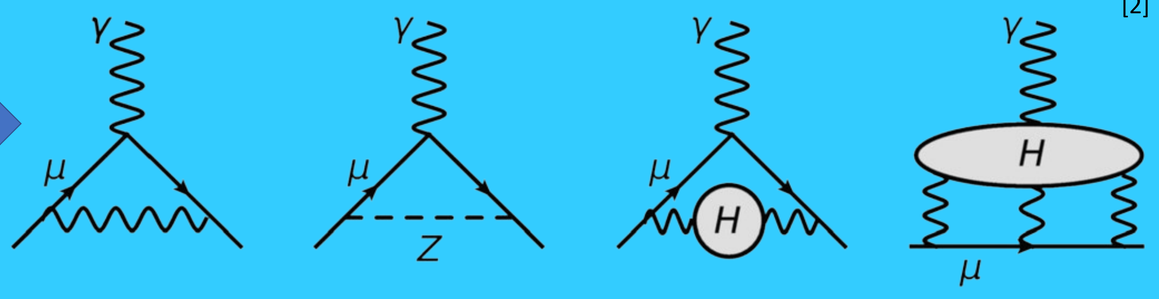
g-2 experiment


[1]

g-2 is a storage ring experiment to measure the muon anomaly, $a_\mu = \frac{g-2}{2}$.



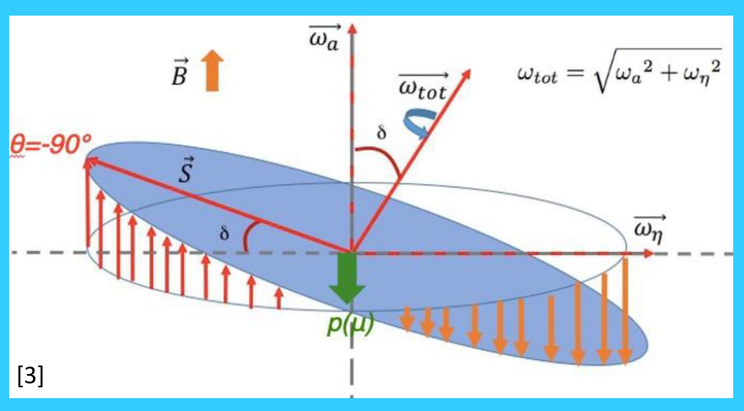
[2]

g-2 investigates the behaviour of the muons in a B-field. The g-factor relates the magnetic dipole moment (MDM) of a particle to its spin. η is analogous to the g-factor – it relates the electric dipole moment (EDM) of a particle to its spin.

MDM $\vec{\mu} = g\frac{e}{2m}\vec{s}$ EDM $\vec{d} = \eta\frac{e}{2m}\vec{s}$

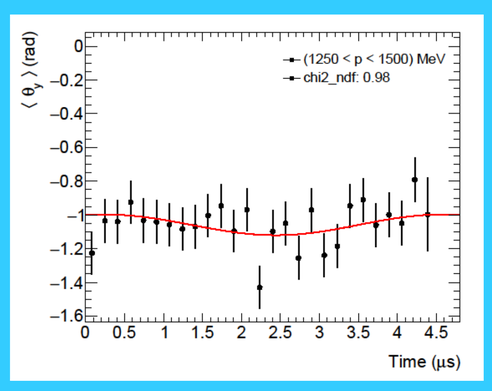
The g-2 experiment measures the muon MDM and is sensitive to a muon EDM below the current experimental limit. A muon EDM is forbidden in the Standard Model.

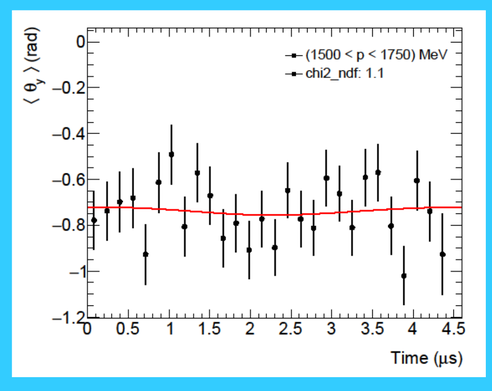
Muon EDM in the g-2 experiment

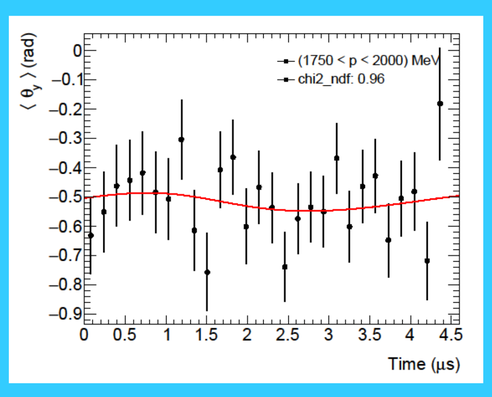


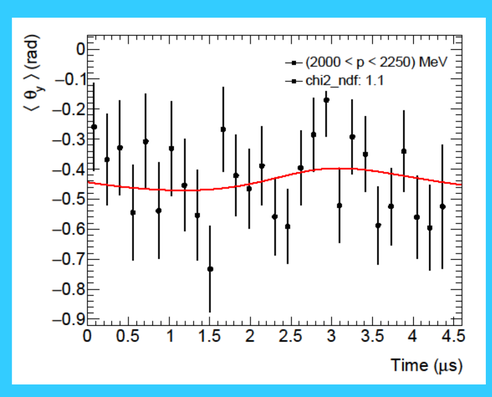
[3]

If present, a muon EDM causes the precession plane to tilt towards the centre of the storage ring.









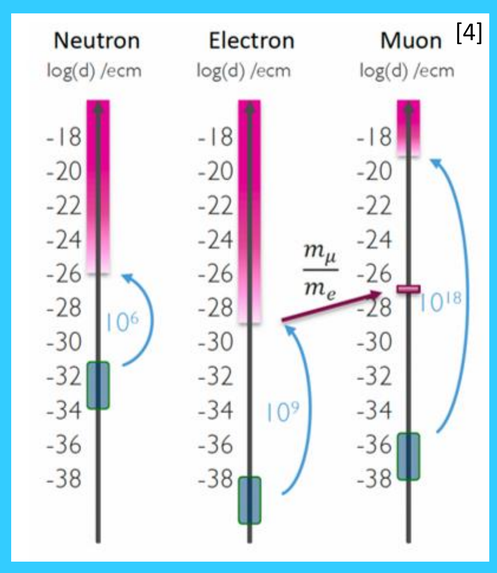
The resulting oscillation in the average vertical angle of the positrons is dependent on positron momentum and it has an amplitude proportional to the EDM signal.

We can use a modified sinusoidal fit function to calculate the amplitude and therefore the EDM.

Muon EDM

Brookhaven measurement of the muon EDM limit in 2002: $d_\mu < 1.8 \times 10^{-19} e.cm$ [4]

g-2 expects to set a muon EDM limit of: $d_\mu < 1.0 \times 10^{-20} e.cm$

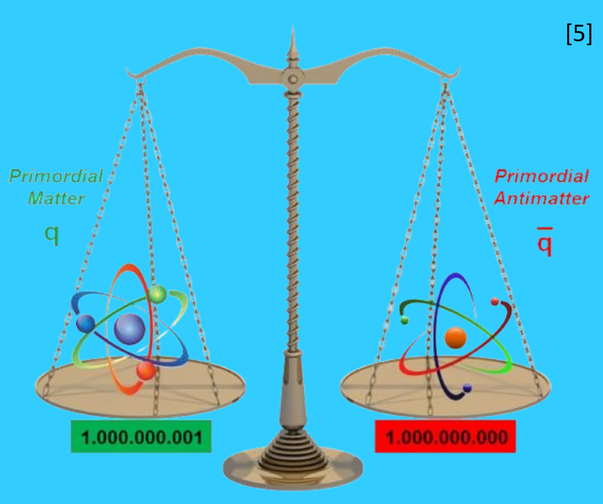


[4]

CP violation

Particle EDMs are suppressed in the Standard Model and are a source of CP violation.

New CP sources can help explain the matter-antimatter asymmetry in the Universe.



[5]

References:
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[3] Vossebeld, J. (2023). *The Muon programme g-2, EDM and lepton flavour violation* [online] Available at: https://indico.cern.ch/event/1261135/contributions/5299368/attachments/2623788/4537212/IOP%202023%20J%20Vossebeld%20v3.pdf
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