A search for the muon electric dipole moment

in the Fermilab Muon g-2 experiment

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1. Muon Electric Dipole Moment

The electric dipole moment (EDM), is given by:

 $\vec{d} = \eta \frac{e}{2mc} \vec{s}$ $d_{\mu} \sim 10^{-42}$ e cm (SM Prediction) [1] $d_{\mu} \sim 10^{-21} - 10^{-27} e cm$ (BSM Predictions)





2. Current Research Status

There are direct and indirect limits: Direct limit:

> $|d_{\mu}| \le 1.8 \times 10^{-19} \text{ e cm}$ Based on the BNL Muon g-2 experiment[3]

Indirect limits:

 $|d_{\mu}| \le 1.9 \times 10^{-20} \text{ e cm}$ Based on the d_{Hg} , d_{thO} EDM[4]



Contributing processes to a lepton EDM are at the 3-loop level in the Standard Model and in Beyond Standard Model Physics (e.g. Higgs Doublet) [2]



 $\left| d_{\mu} \right| = \frac{m_{\mu}}{m_{e}} \left| d_{e} \right| \le 2.3 \times 10^{-27} \text{ e cm}$

Assuming minimal flavor violation

Expected sensitivity at the Fermilab E989:

 $|d_{\mu}| < 10^{-19} \text{ e cm}$

4. Calorimeter Phase Method Analysis



The precession plane tilted when EDM existed





For EDM = 0, the phase vs vertical hit position is symmetric





 $N(t) = N_0 e^{-t/\tau} [1 + A\cos(\omega_a t + \varphi)]$ $\phi(y) = \phi_0 + E_{\phi}(y - y_0^{\phi}) + |G_{\phi}(y - y_0^{\phi})|$ (Muon decay) × (Oscillation due to precession) hase change

5. Run2 Preliminary Analysis



to the muon EDM

not related to EDM

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