Opportunities and New Physics Implications for $(g-2)_{e,\mu}$

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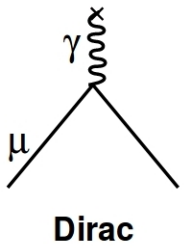
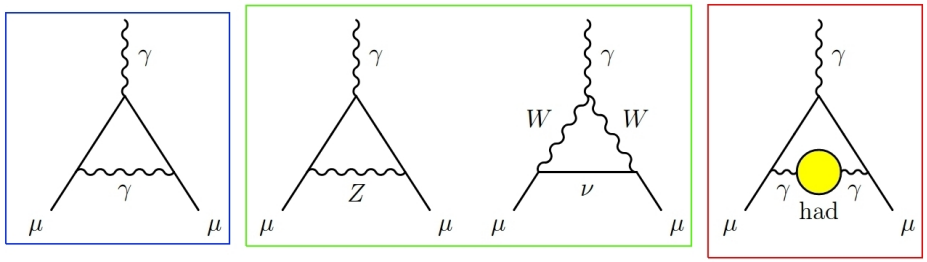
on behalf of the loi: SNOWMASS21-RF3 -RF5-EF8-EF0-TF8-TF0-070

The physics / basic idea of the LOI



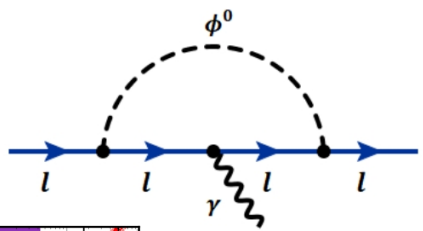


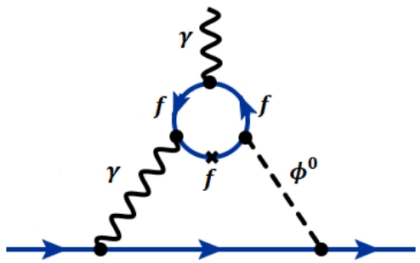
- Magnetic moment: $\vec{M} = g_\ell \frac{e}{2m_\ell} \vec{S}$
- Landé g-factor: $g_\ell = 2$
- Anomalous magnetic moment: $a_\ell = \frac{g_\mu - 2}{2}$
- $\Delta a_\mu = (2.74 \pm 0.73) \times 10^{-9}, \quad \Delta a_e = -(8.7 \pm 3.6) \times 10^{-13}$
- Strong evidence for NP:

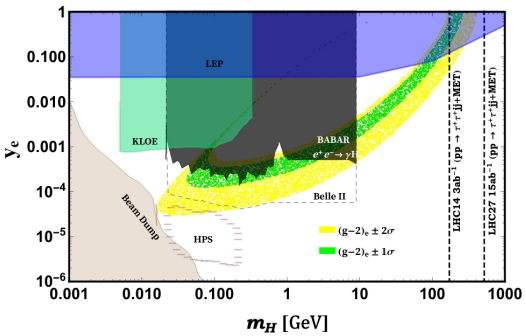
  (i) low scale: 2HDM

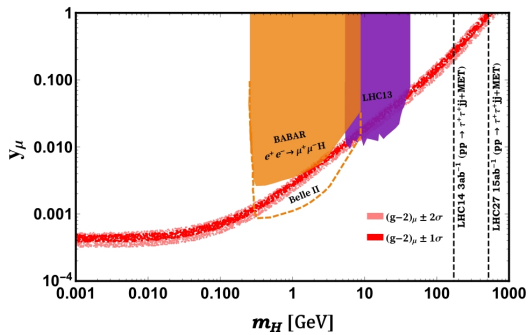
  Jana, Vishnu, Saad Phys.Rev.D 101 (2020) 11, 11503

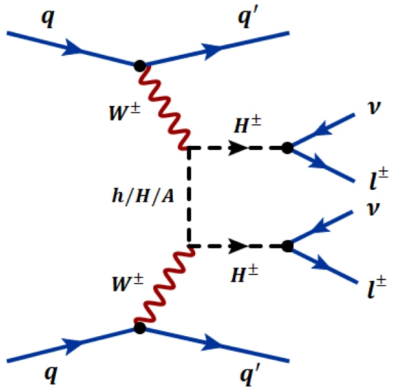
  (ii) heavy scale: SLQ, VLF











What is required for the LOI to succeed

- Most promising sector to hunt for NP.
- Need efforts from both from theory and experimental sides.
- Collaborative efforts need to continue to reduce theory errors to the same level as the experimental uncertainties (dispersive methods, lattice QCD, and effective field theories).
- Current and future experiments need to achieve more precision (E989 experiment at Fermilab; E34 experiment at J-PARC [2024]; experiment MUonE at CERN; Harvard group [α]).
- Complimentary experiments are required to identify the new physics: improved measurements at HPS (JLab), Babar (SLAC), Belle-II (super KEKB).
- If possible new experiments need to be designed to exploit its full potential (more thinking along this line is required).

What do you plan to do during Snowmass

- The authors of the LOI are considering to submit a contributed paper to Snowmass.
- We ask the broader community to participate in this study.
- We plan to work on different theories from phenomenological point of view (both low scale and heavy scale) trying to come up with alternative, complementary, and promising ways to probe NP from various types of experiments.

What do you hope to get out of Snowmass

- Interesting results are already there strongly pointing towards NP.
- Recognition that combined theory and experimental efforts along this direction are likely to discovery NP.
- Gain interest and strong endorsement from the particle physics community.
- Grow our collaboration.
- We propose to create a study group between theorists and experimentalists.
- Call for funding for our colleagues working in the related fields (phenomenologists, lattice QCD groups, related experiments in the USA and abroad).

THANK YOU

- Selected relevant papers (incomplete list)

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