Theory working group

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Mu2e-II Snowmass22 Workshop X

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UNIVERSITY of VIRGINIA

Theory working group

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Comments, questions, and members welcome!

Outline for white paper theory section

- General motivation for LFV

- Specific motivation for Mu2e upgrade

- Summary of DIO results

- Summary of new-physics isotope dependence and identification of good second target

- Motivation for $\mu \to e\, X$ & $\mu^- \to e^+$

General motivation for LFV

- Standard arguments:
  - neutrino oscillations motivate LFV
  - different models/operators give $\mu \to e\gamma$, $\mu \to 3e$, $\mu \to e$ con.
  - μLFV probes scales far above colliders
- Motivation by anomalies:
  - anomalies in $(g\text{-}2)_\mu$ and B-meson decays hint at special status of muons
  - models generically predict μLFV

Specific motivation for Mu2e-II

- **B-meson anomalies** hint at leptoquarks, which generically enhance μ → e conversion over μ → eγ, μ → 3e.

- Mu2e-II can fully **exclude** some models:
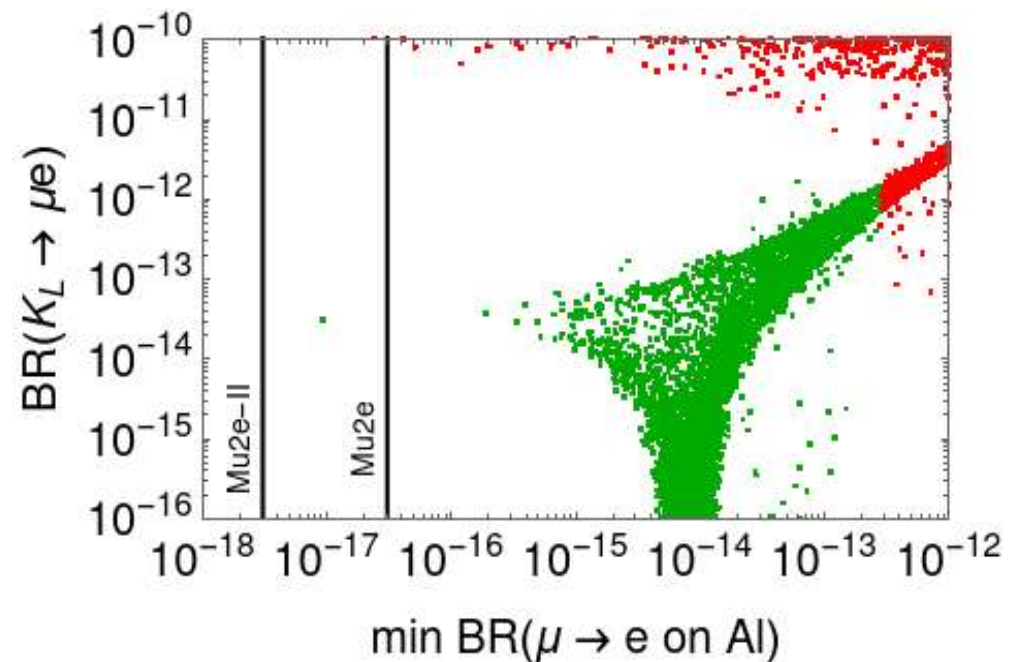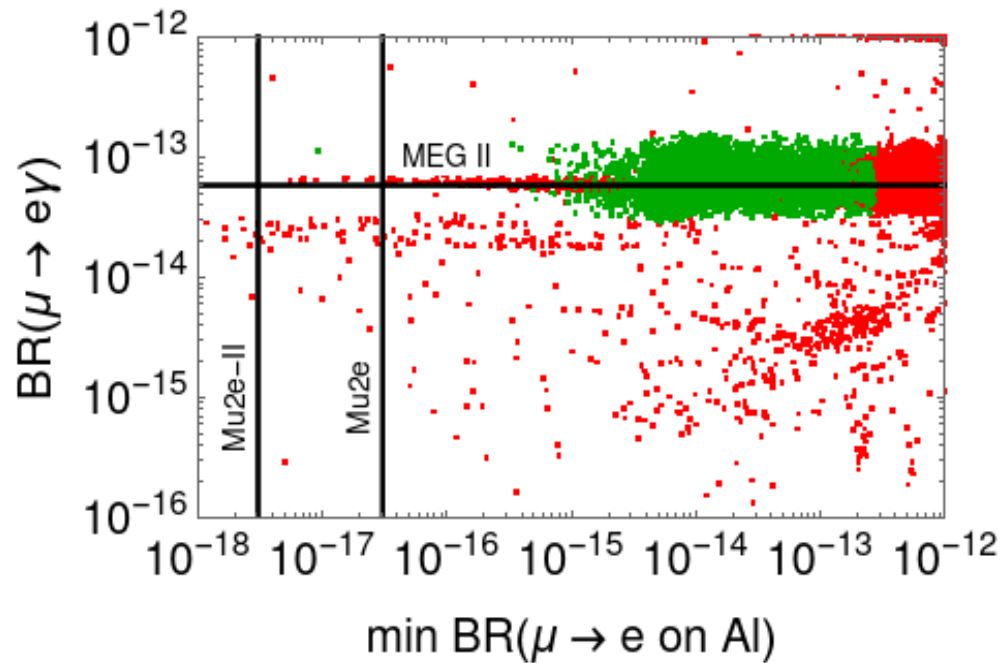
[Heeck & Teresi, 1808.07492]

Best-case motivation for Mu2e-II

- If LFV is observed in Mu2e/COMET/MEG-II/Mu3e:

  - Mu2e-II no-brainer, need as many observables as possible to pin down underlying operator/model.

  - LFV in Mu2e $\rightarrow$ precision study in Mu2e-II!

  - Mu2e-II's different target nuclei are invaluable source of data points.

 - Need to optimize the choice of targets to maximize use.

DIO results

- Summary of our work on µ decay in orbit:
  - Estimate of error due to charge distribution of nucleus.
  - Dependence of DIO background on target isotope.
 - Precise DIO spectrum for all isotopes near endpoint.
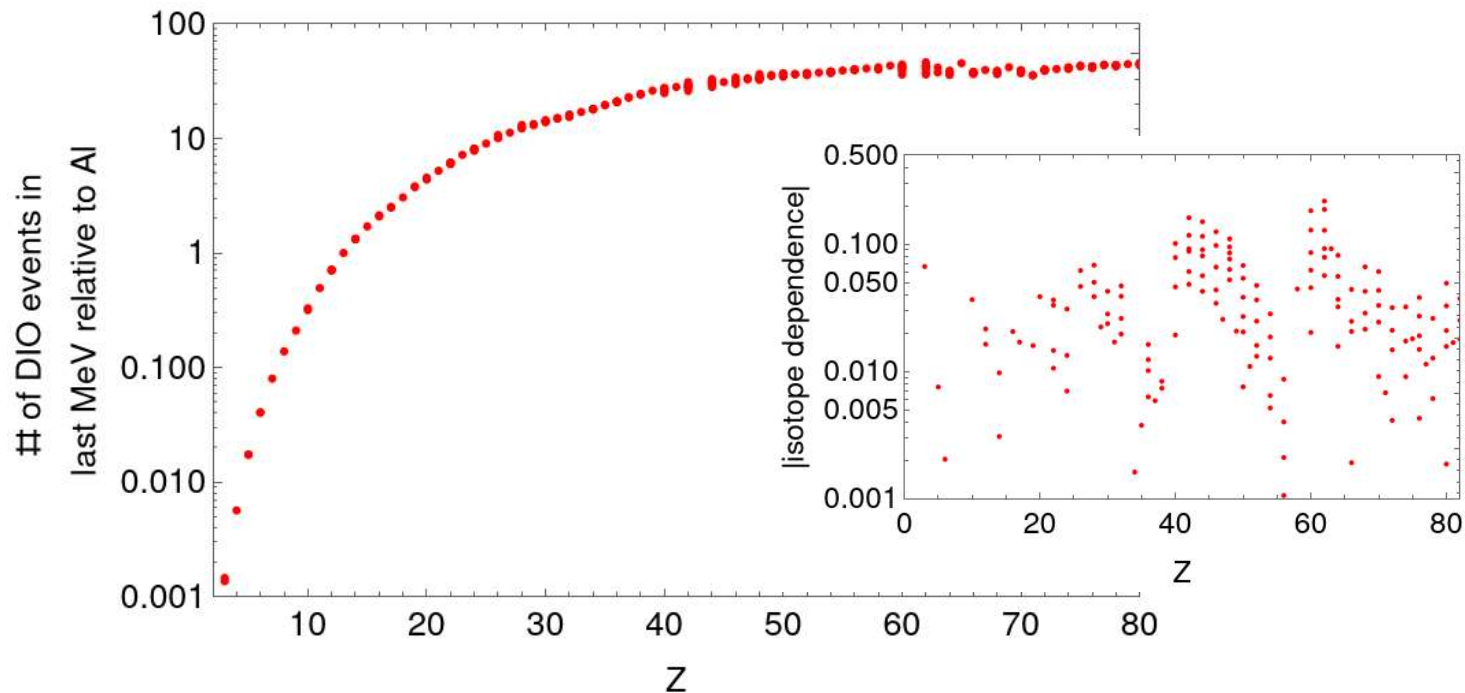
Isotope dependence of signal

- Summary of our work on μ→e conversion (to be done!):
  - improve Kitano et al's 20-year old results on overlap integrals and extend to all isotopes
  - apply Davidson et al's analysis to find target isotopes that are maximally complementary to aluminium
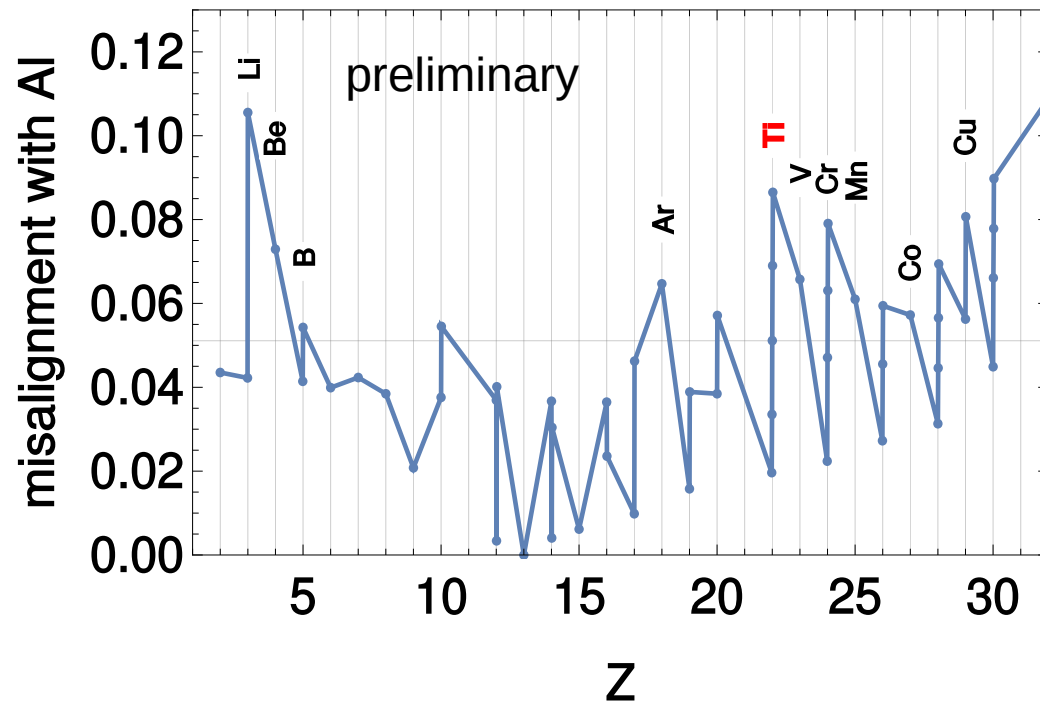
Extend Mu2e-II's physics reach

- Motivate μ→e X as a general process and its signature in Mu2e-II compared to other experiments.

- Motivate μ→e⁺.
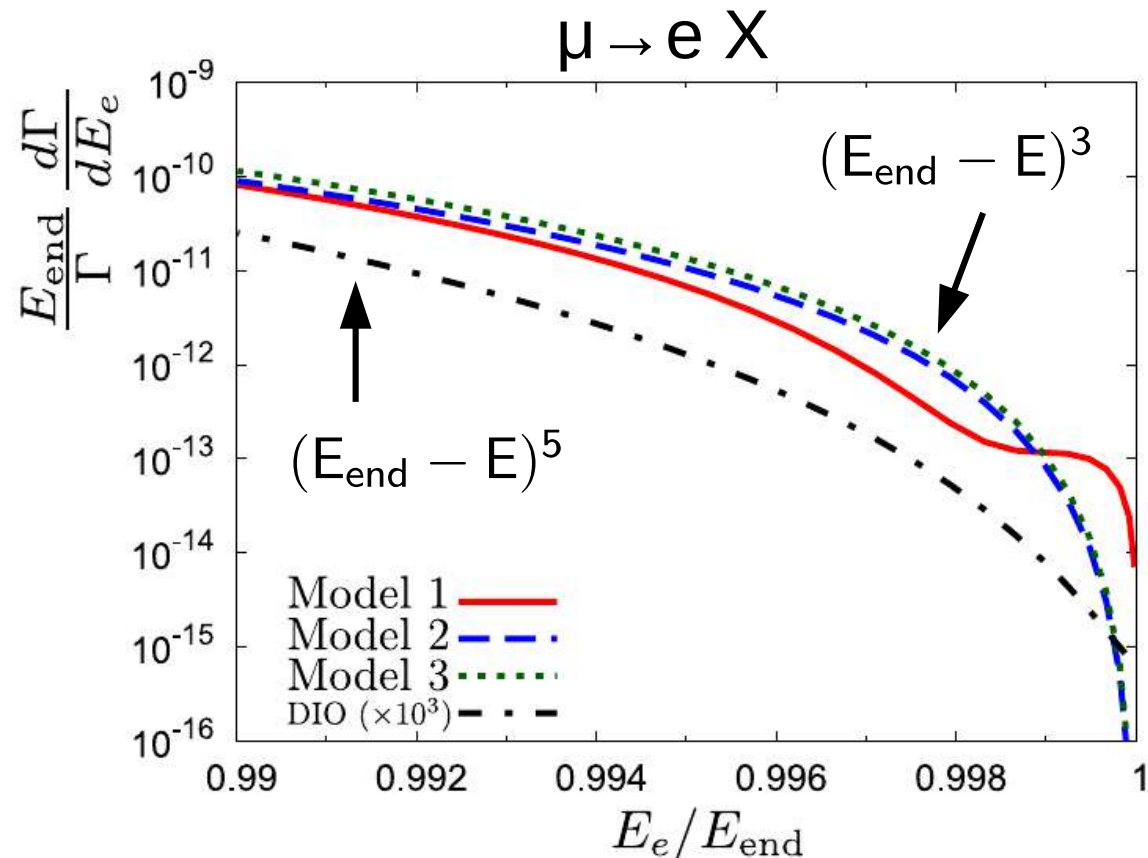
Summary

- General motivation for LFV

- Specific motivation for Mu2e upgrade

- Summary of DIO results

- Summary of new-physics isotope dependence and identification of good second target

- Motivation for for $\mu \to e\, X$ & $\mu \to e^+$

Can start writing soon, remaining analysis done asap.