Theory working group

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Mu2e-II Snowmass22 Workshop VII

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Theory working group

- Julian Heeck (University of Virginia)
- Lorenzo Calibbi (Nankai University)
- Members:
  - Robert Szafron (**BNL**)
  - Yuichi Uesaka (Kyushu Sangyo University)
- Mailing list: mu2eii-theory@fnal.gov

Comments, questions, and members welcome!

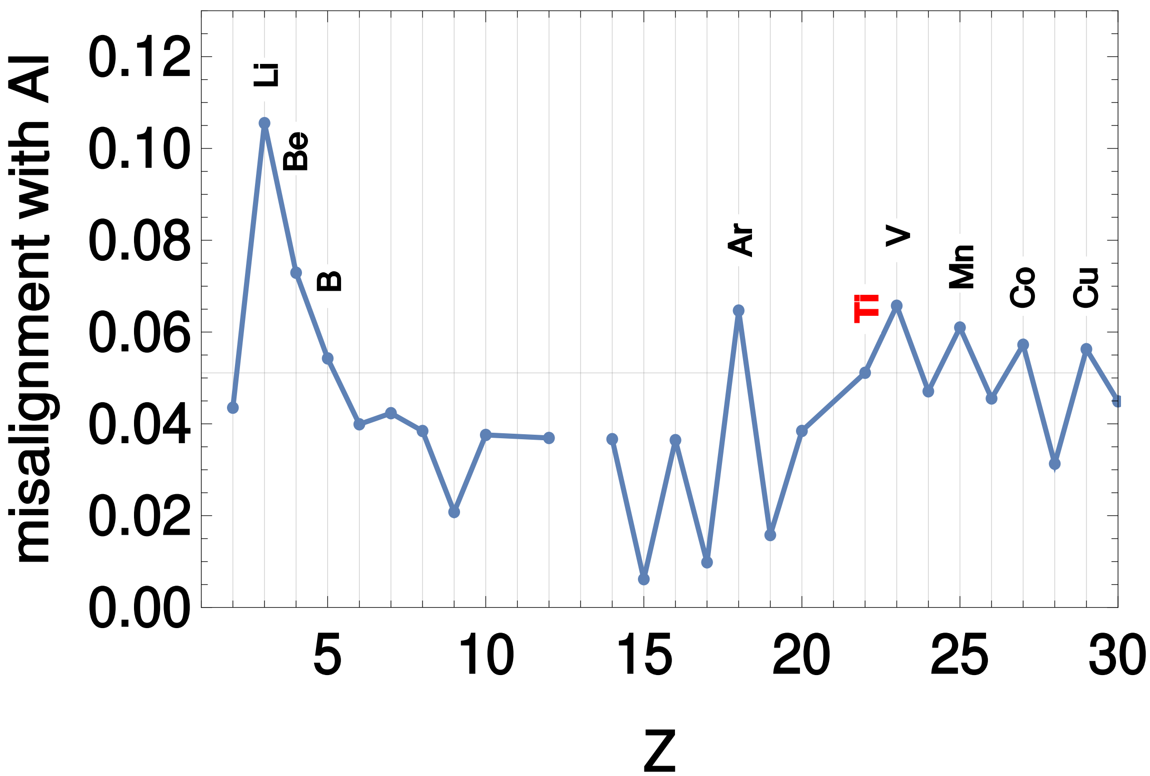
Current focus: targets

- "Good" (first) target?
  - Mostly experimental question.
  - Some targets are good for setting limits (many isotopes and spins).
  - Some targets are convenient in case of detection (single isotope, nuclear structure known).
- Good *second* target after Al?
  - Want complementarity, probe orthogonal operators.
  - High-Z targets ideal… [Kitano, Koike, Okada, hep-ph/0203110]
  - Low-Z for experimental reasons.

Complementarity of second target

$$\mathrm{BR}(\mu \to e) \propto |D C_{DL} + S^p C^p_{S,L} + V^p C^p_{V,R} + S^n C^n_{S,L} + V^n C^n_{V,R}|^2 + (L \leftrightarrow R)$$

- If you measure μ → e on Al you want a second target that is *sensitive* to Al's blind directions. [Davidson, Kuno, Yamanaka, 1810.01884]



Lithium-7 best among Z < 30 targets!

	τ_μ/ns	spin	NA	DIO
$^{7}_{3}\mathrm{Li}$	2187	3/2	92%	–
$^{9}_{4}\mathrm{Be}$	2168	3/2	100%	–
$^{51}_{23}\mathrm{V}$	280	7/2	99.8%	–
$^{55}_{25}\mathrm{Mn}$	230	5/2	100%	–
$^{48}_{22}\mathrm{Ti}$	329	0	74%	yes
$^{27}_{13}\mathrm{Al}$	865	5/2	100%	yes

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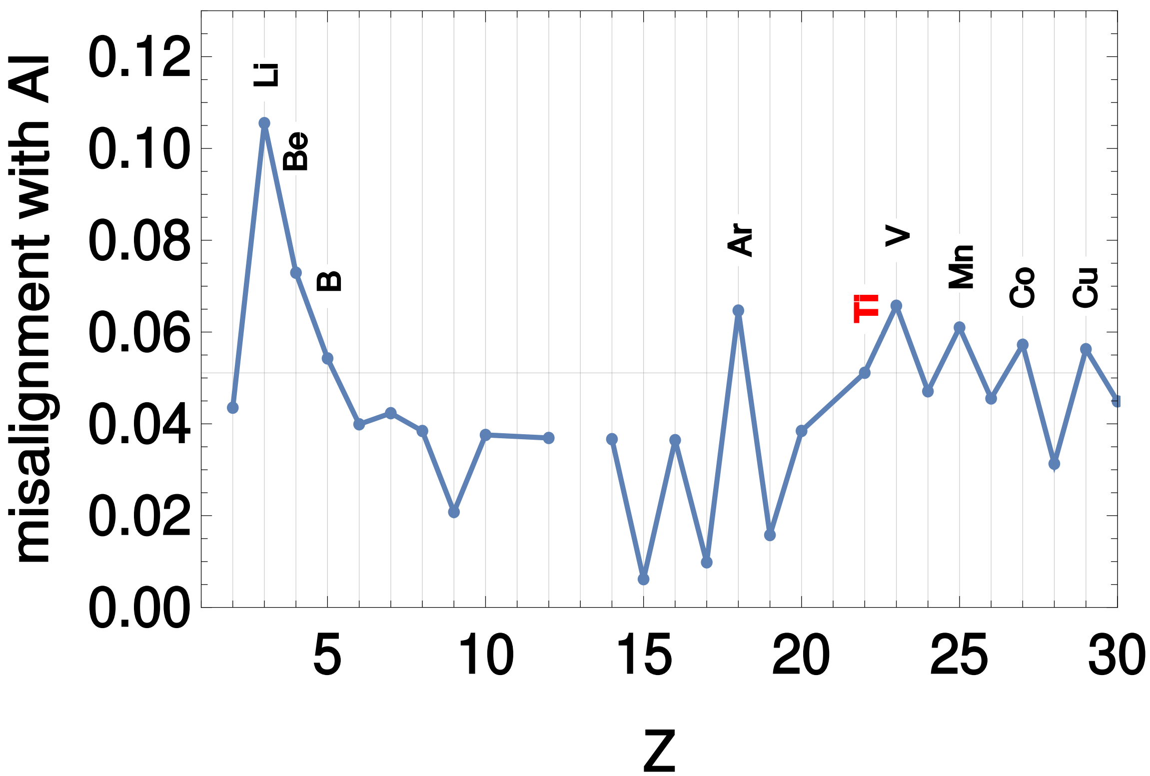

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DIO for V, Mn, etc.

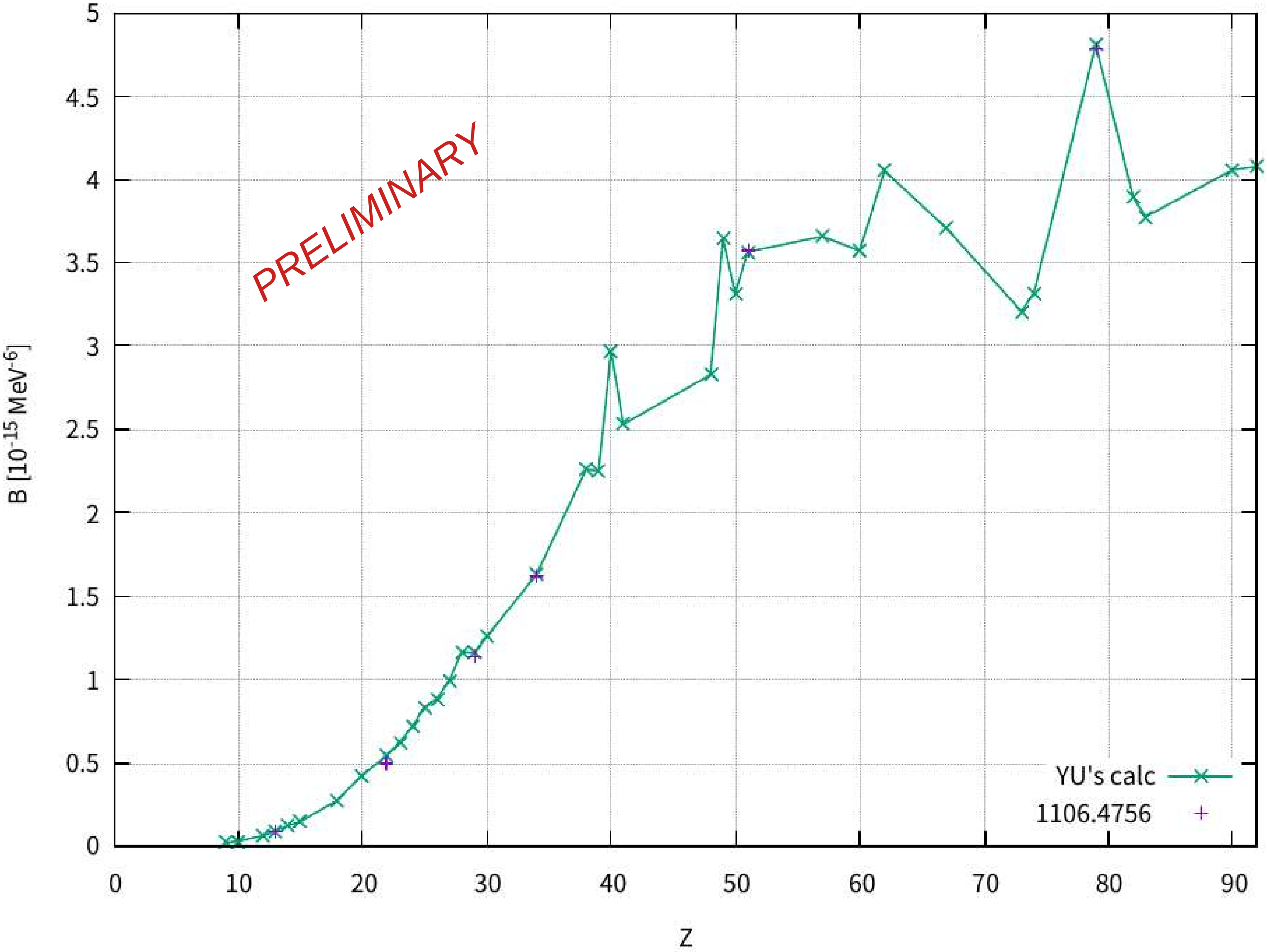
- Full calculation tedious, focus on endpoint:

$$\frac{1}{\Gamma_0}\frac{d\Gamma}{dE_e}\bigg|_{E_e\sim E_\mu-\frac{E_\mu^2}{2m_N}} \equiv B\left(E_\mu - E_e - \frac{E_e^2}{2m_N}\right)^5$$

[Czarnecki, Tormo, Marciano, 1106.4756]

- Coefficient B obtained by numerically solving Dirac equation for muon and electron in electric field of nucleus.
- Given by Czarnecki et al for Al, Ti, Cu, Se, Sb, Au.

We (Yuichi) are currently trying to reproduce results and extend to new nuclei.



- Percent-level agreement, except for Ti (~10%).
- Currently investigating difference.

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Thanks!