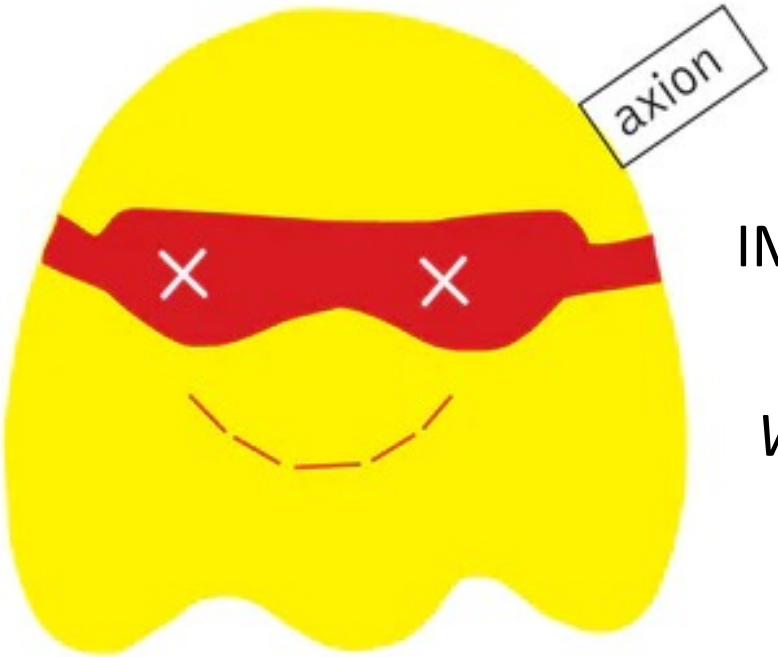
A Leptonic ALP



Joachim Weiss

IMPRS Workshop Ringberg, 23.11.2023

arXiv:2310.05827

With Giovanni Armando, Paolo Panci, Robert Ziegler

MAX-PLANCK-INSTITUT
FÜR PHYSIK

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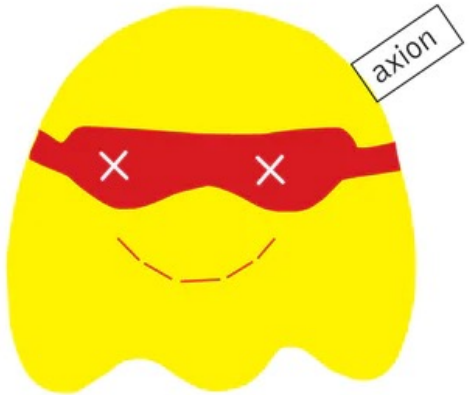
A Leptonic ALP

(Axion-like Particle)



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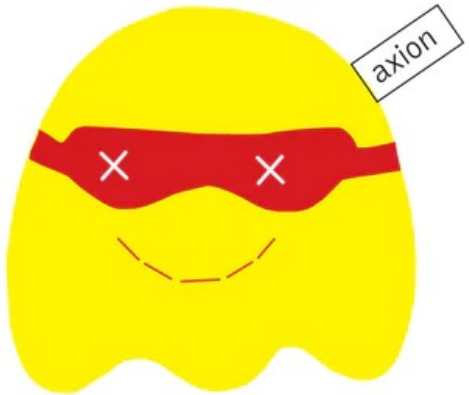
(1) ALP coupling to electrons

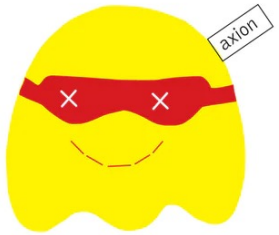
(2) ALP coupling to muons

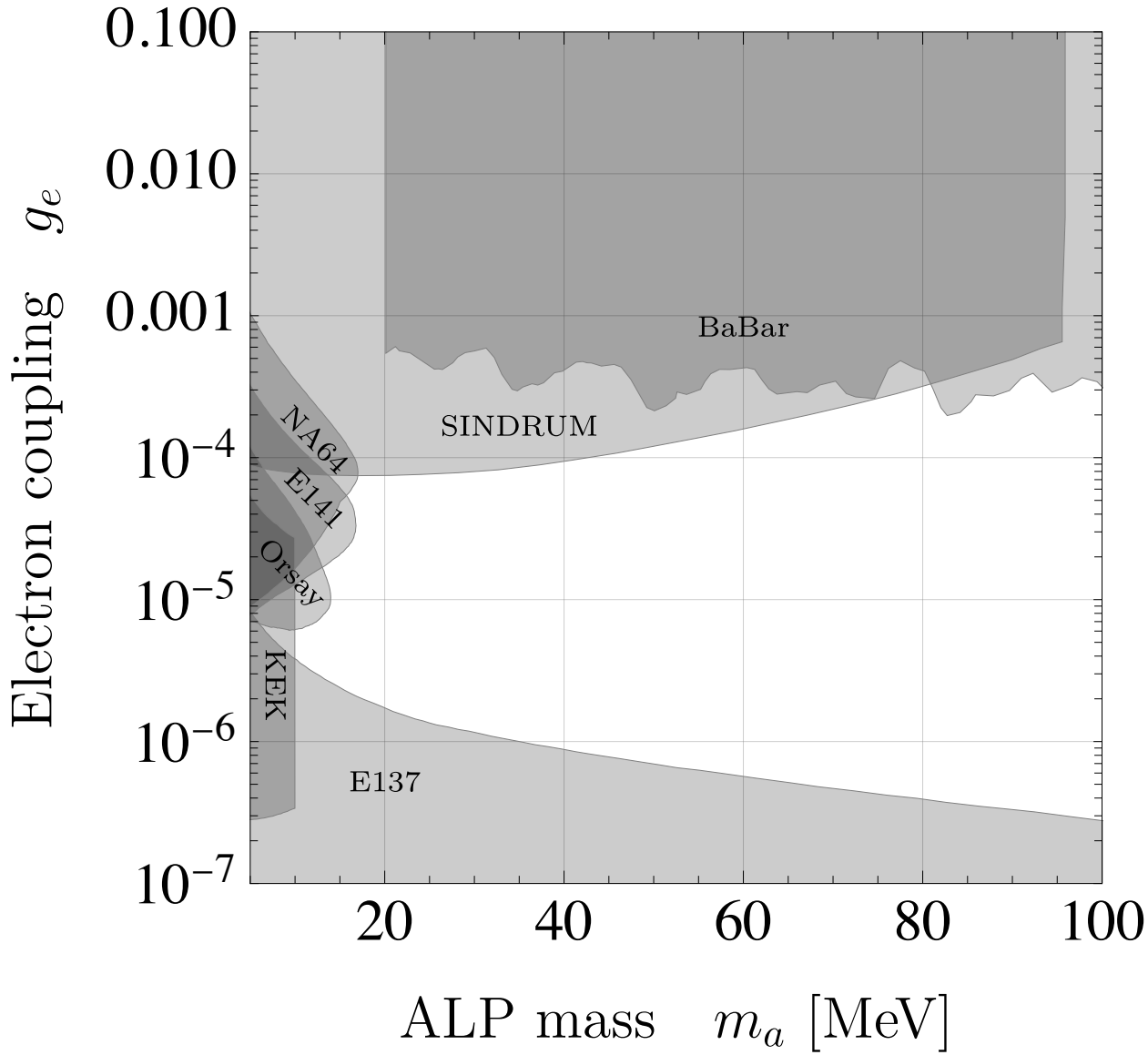
(3) ALP coupling to tau leptons



① ALP coupling to electrons

- $\mathcal{L} = -iag_e\bar{e}\,\gamma_5 e$
- Pseudoscalar





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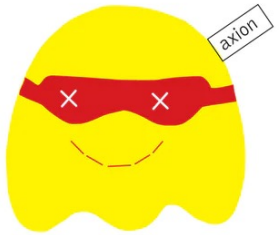
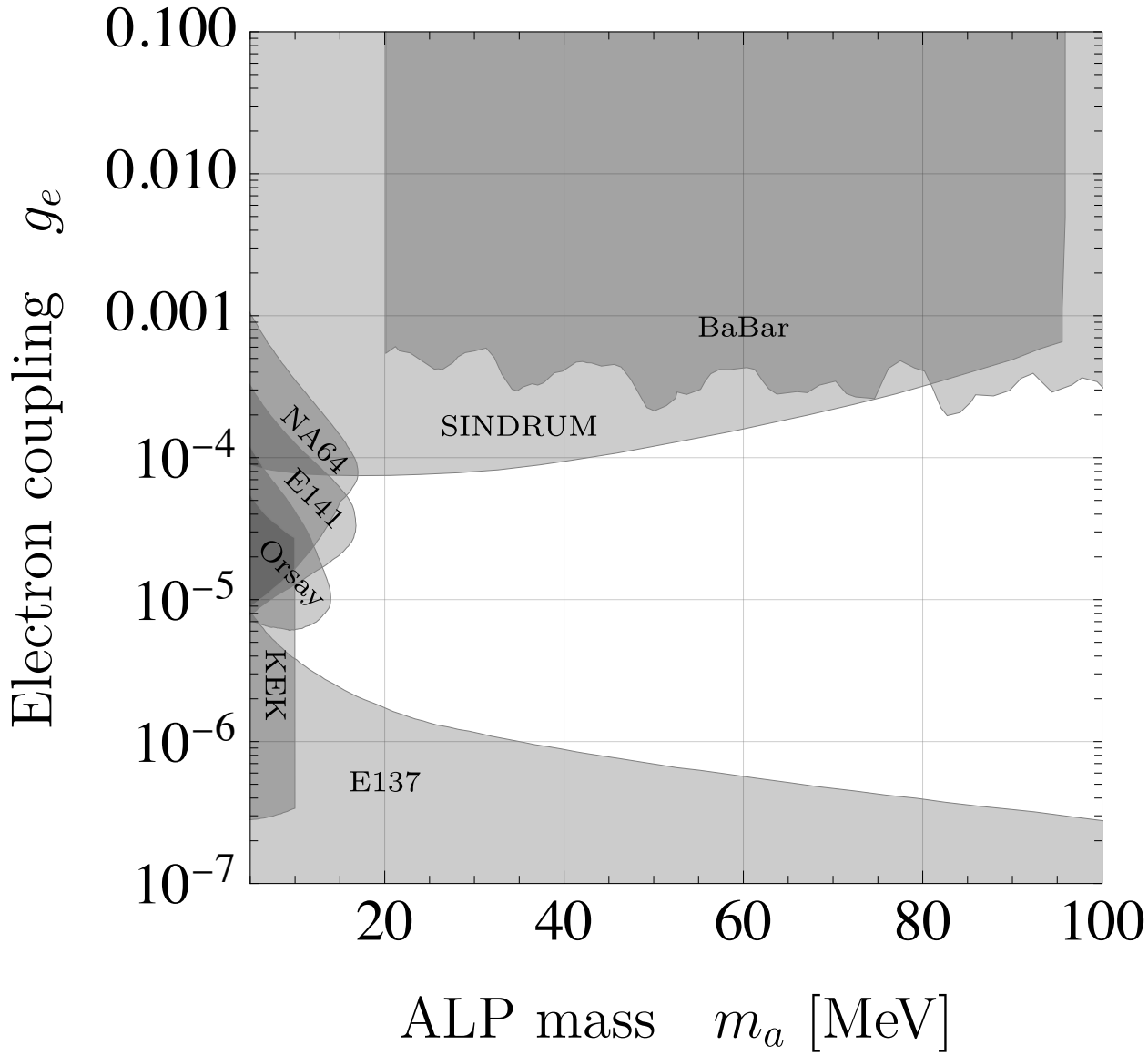
- ALP mass $m_a > 2m_e$

  → ALP is „visible“

  → $a \to e^+e^-$





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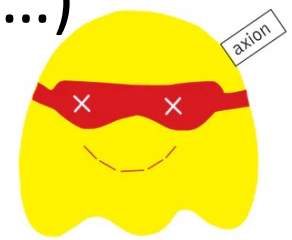
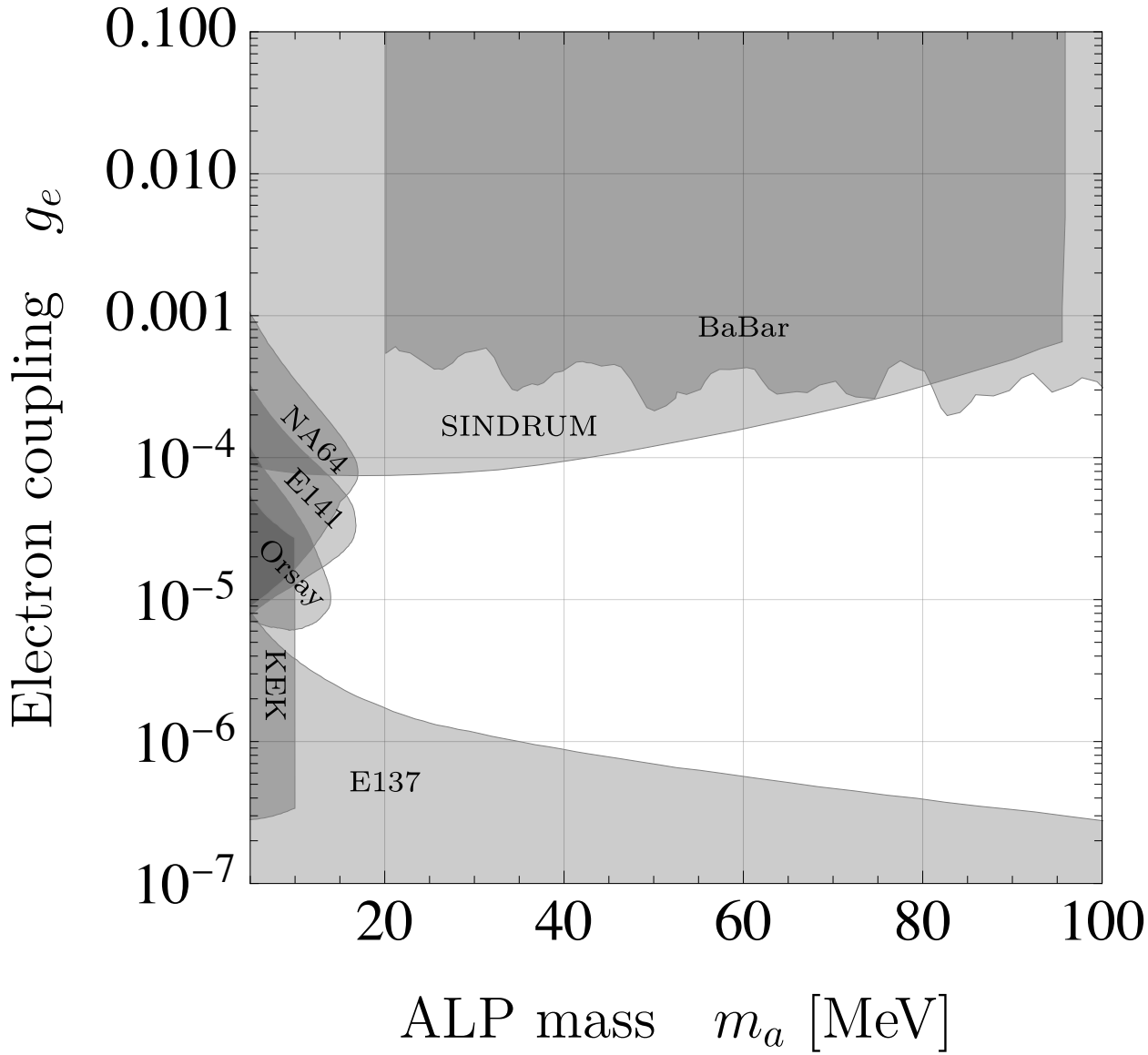
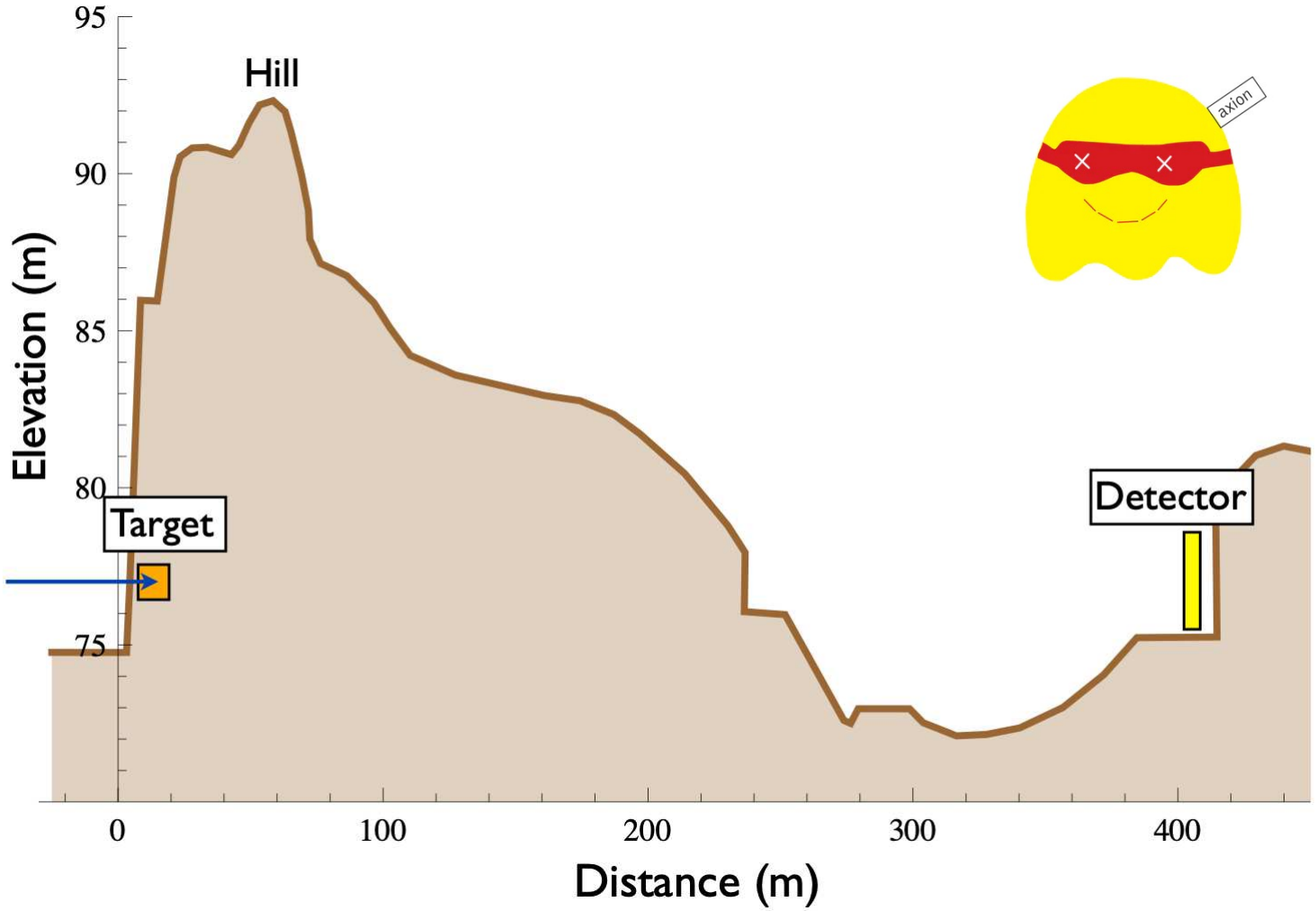
- Beam dump experiments (NA64, …)
- Piondecay (SINDRUM,…)





Beam Dump: E137



arxiv:1406.2698

② ALP coupling to muons

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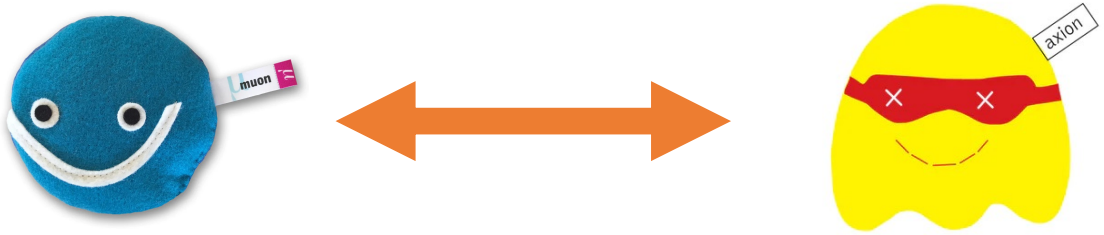

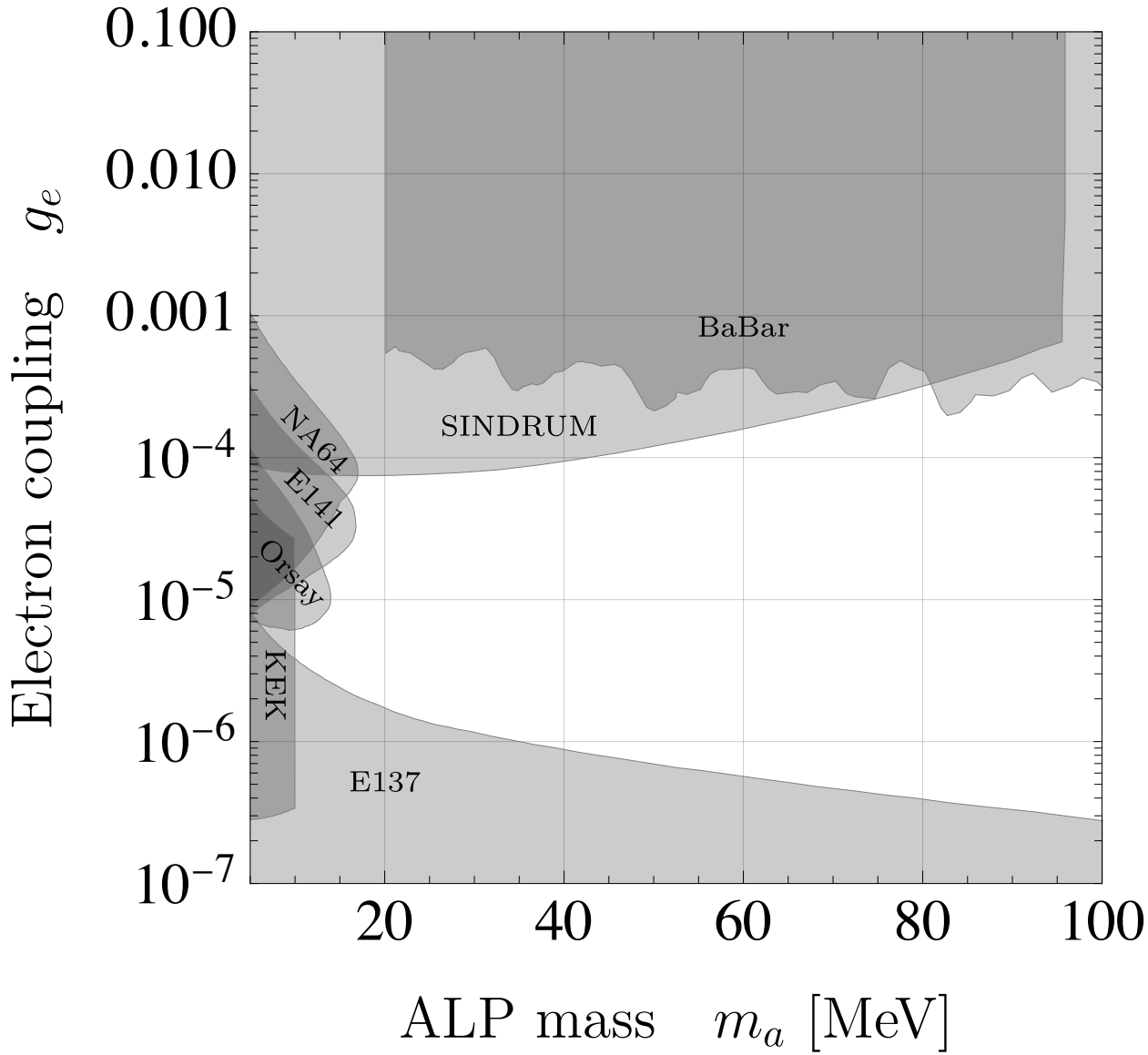

② Adressing $(g-2)$

- $\mathcal{L} = -iag_{\mu}\bar{\mu}\,\gamma_5\mu$
- Tension

  Experiment vs. Theory

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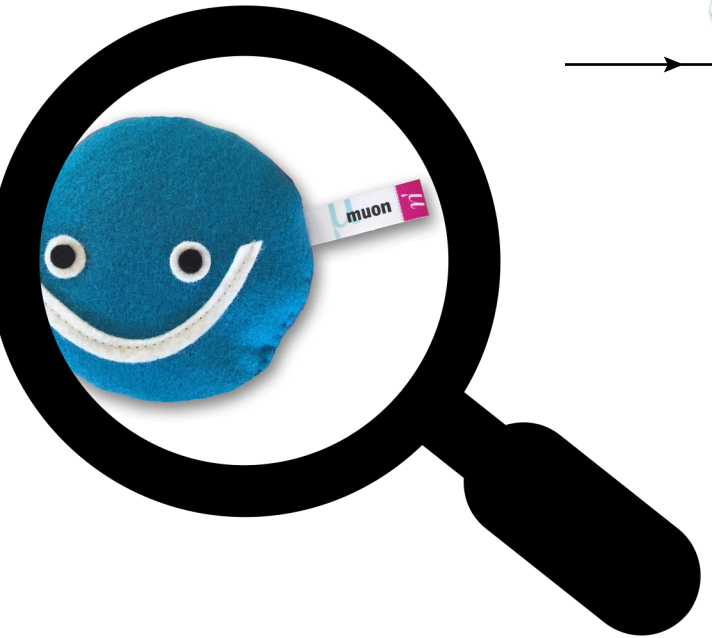

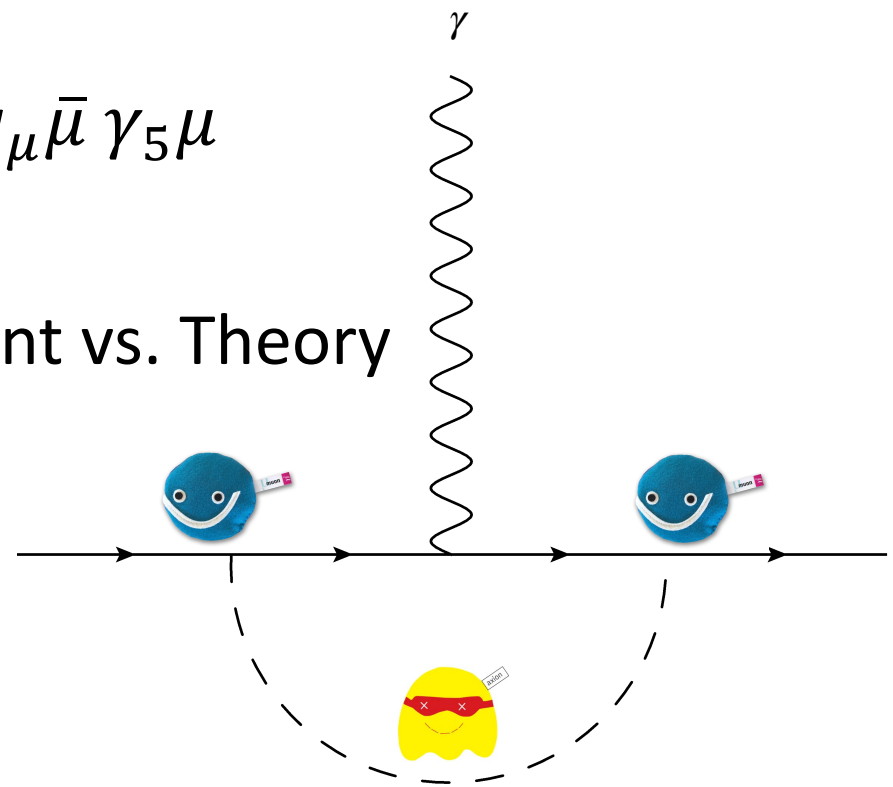

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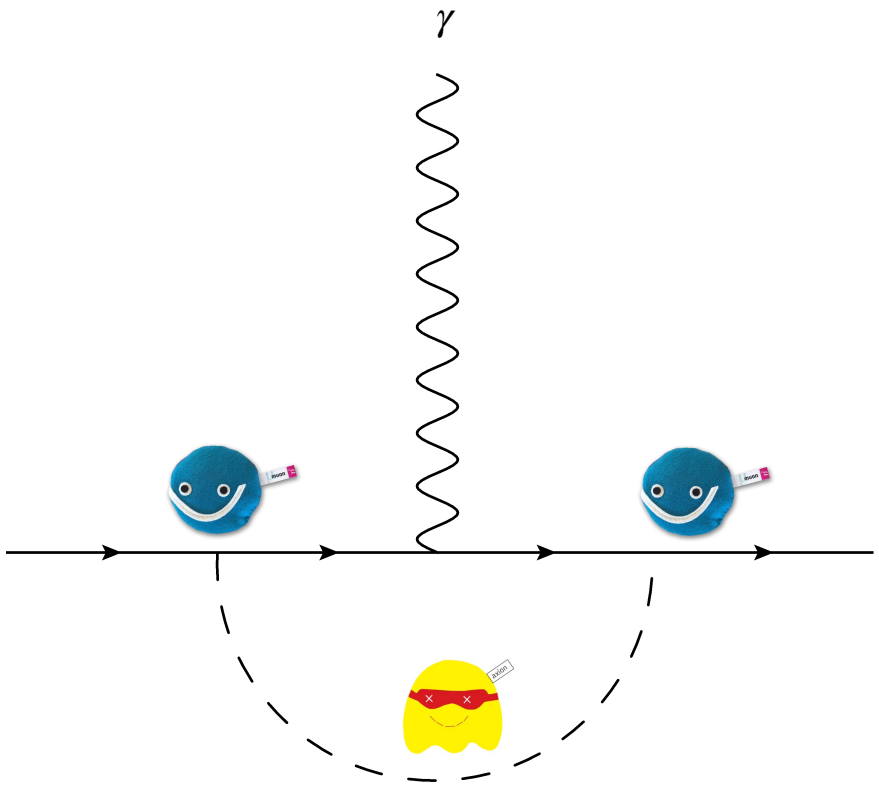

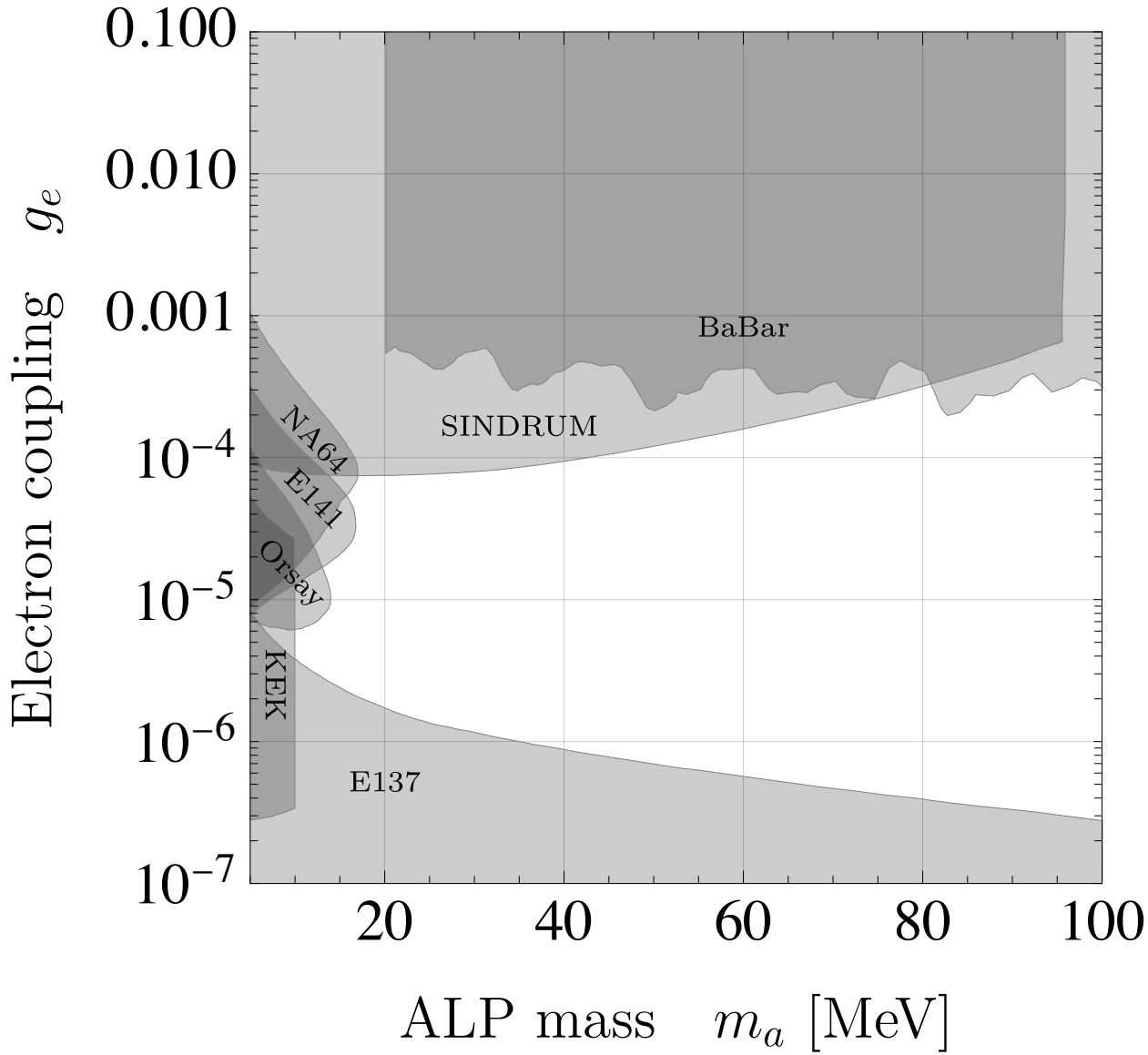

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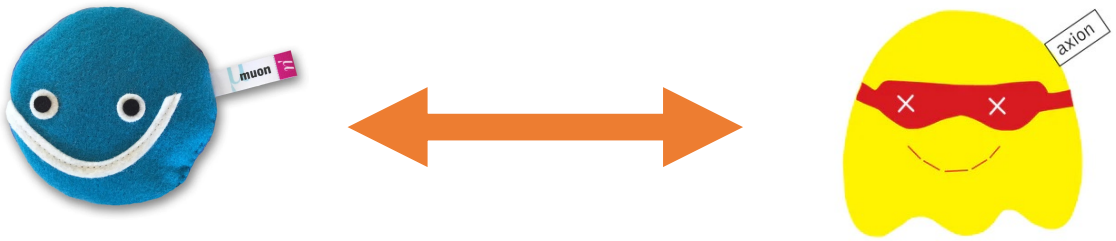
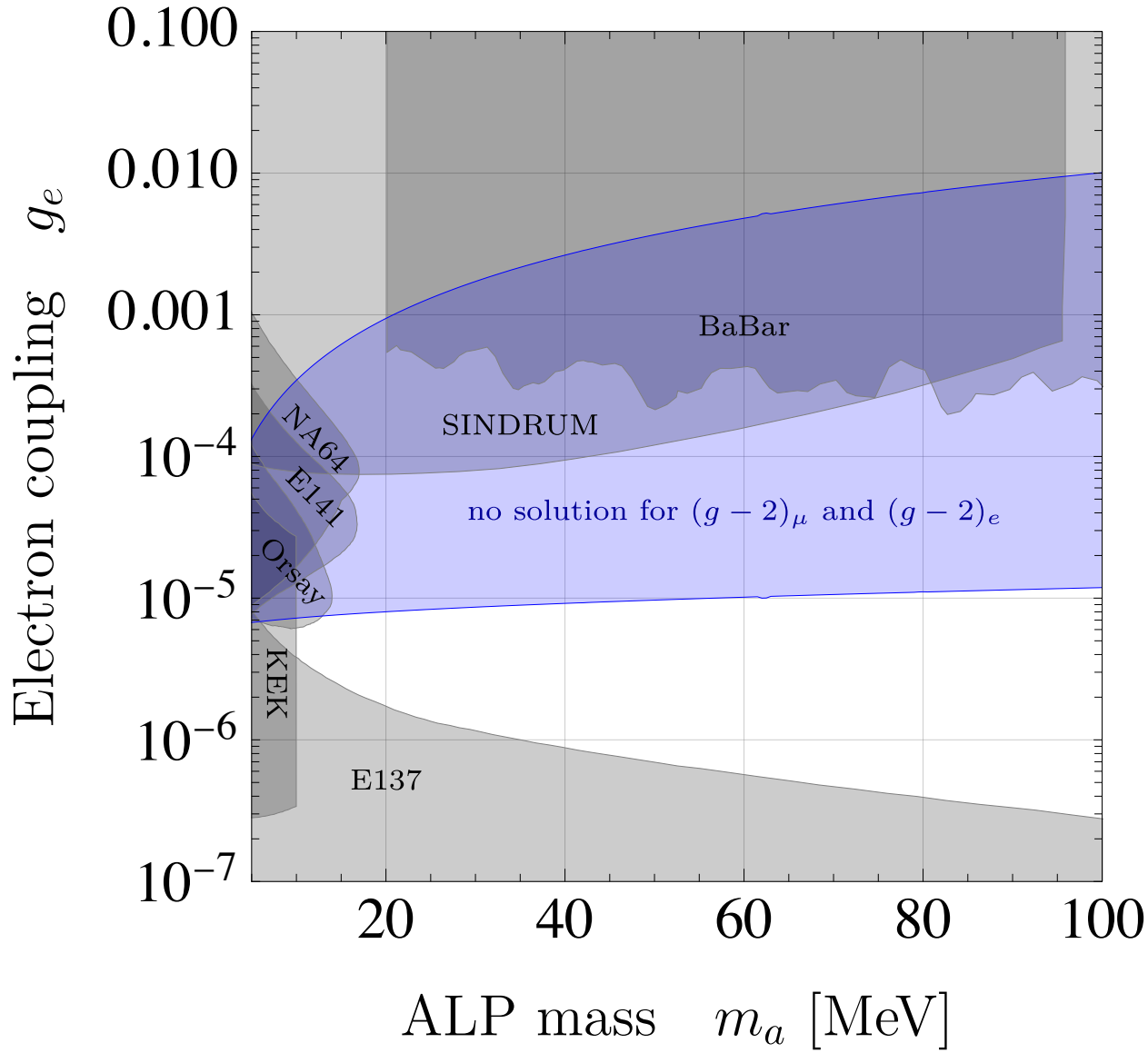
  $(g-2)$ only doable for some g_e





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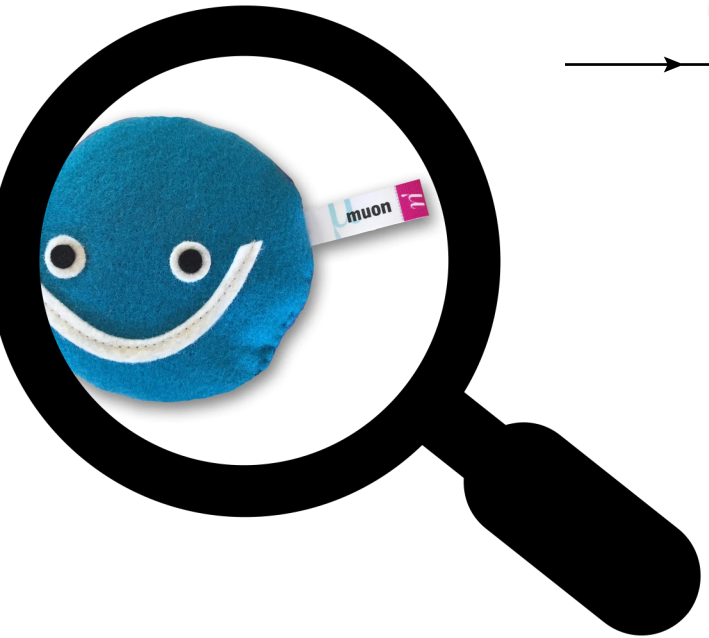

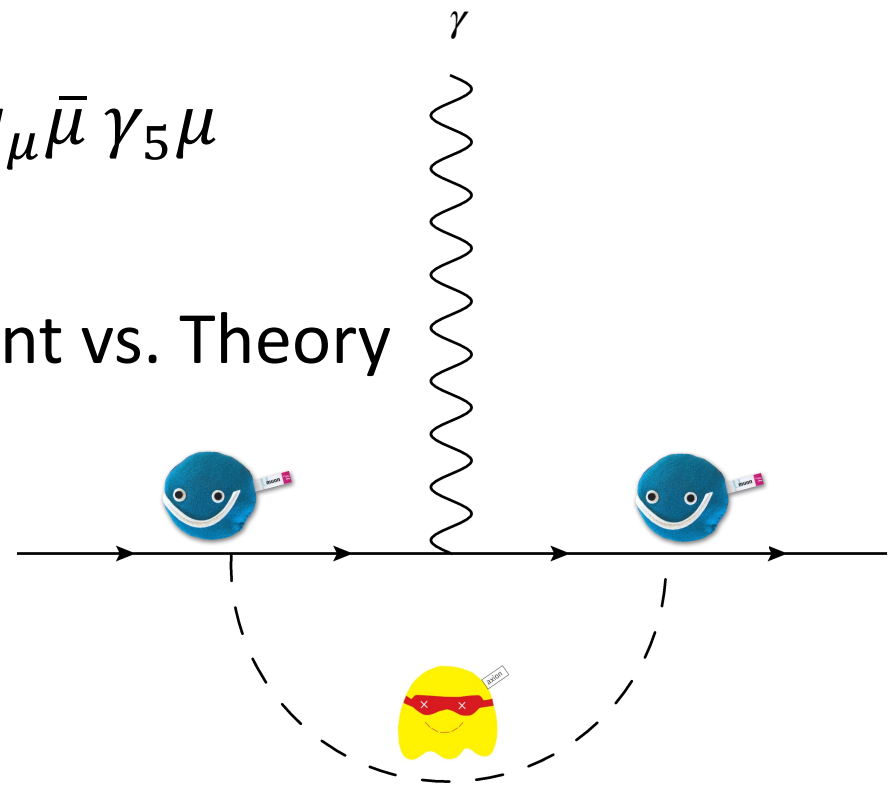

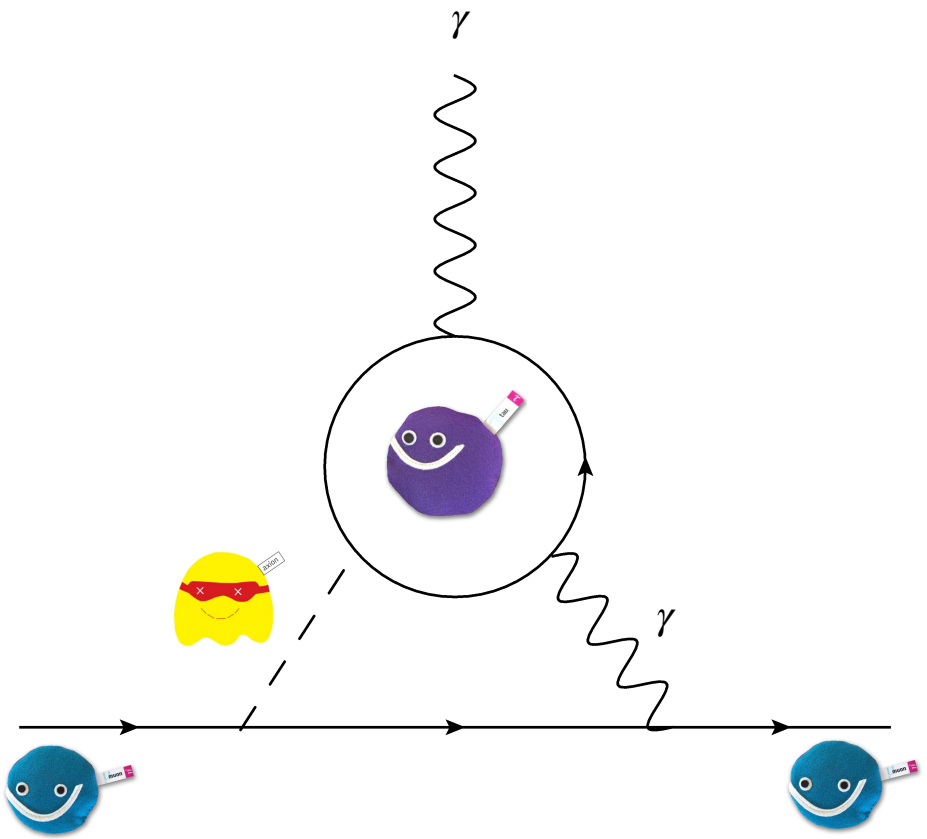

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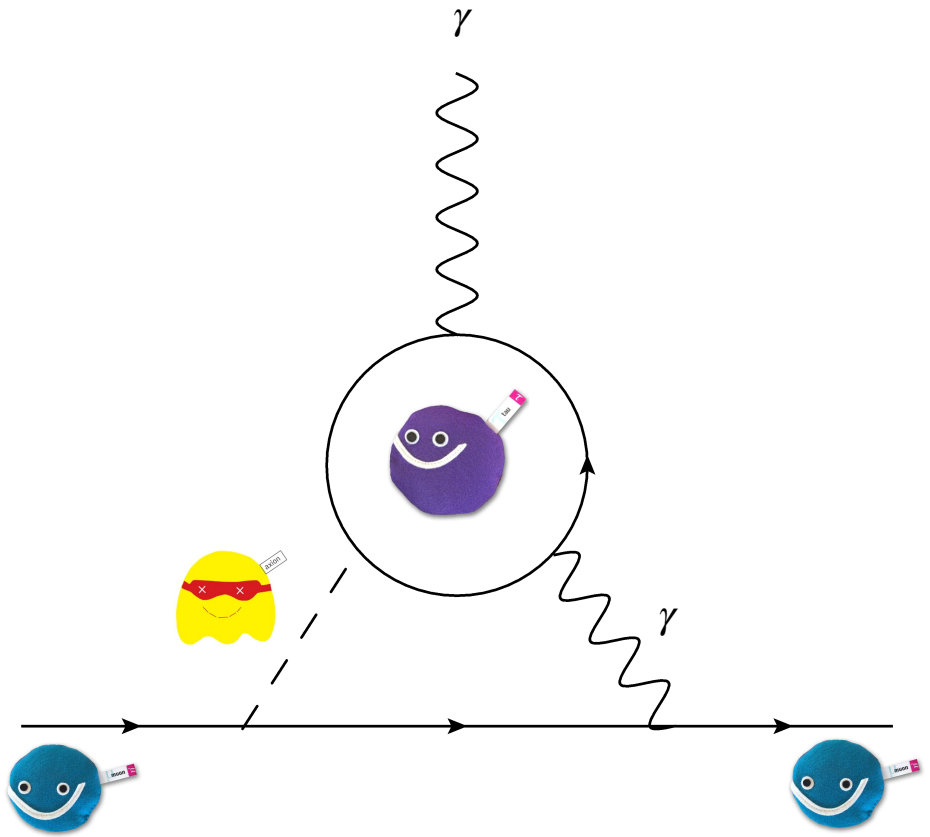

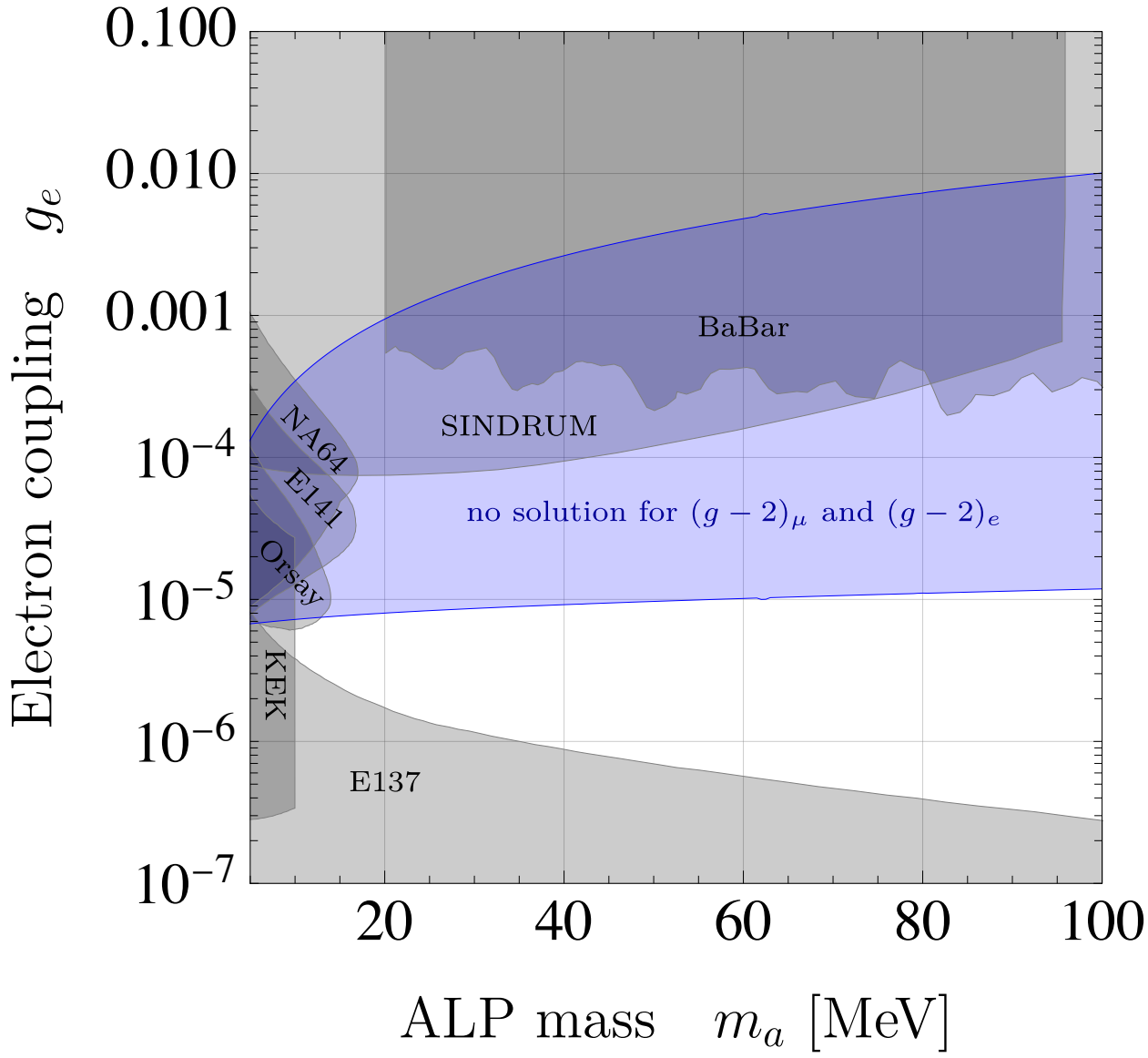

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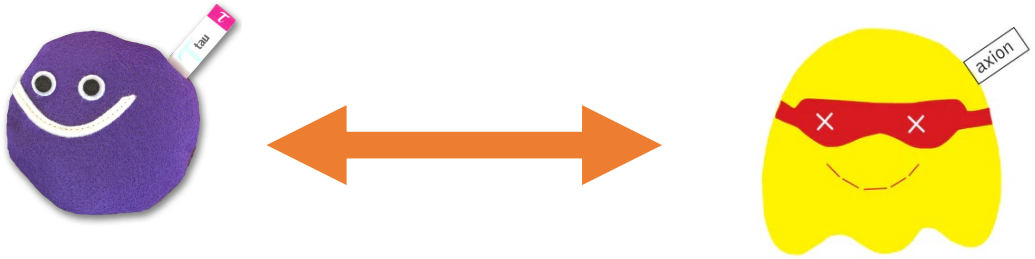
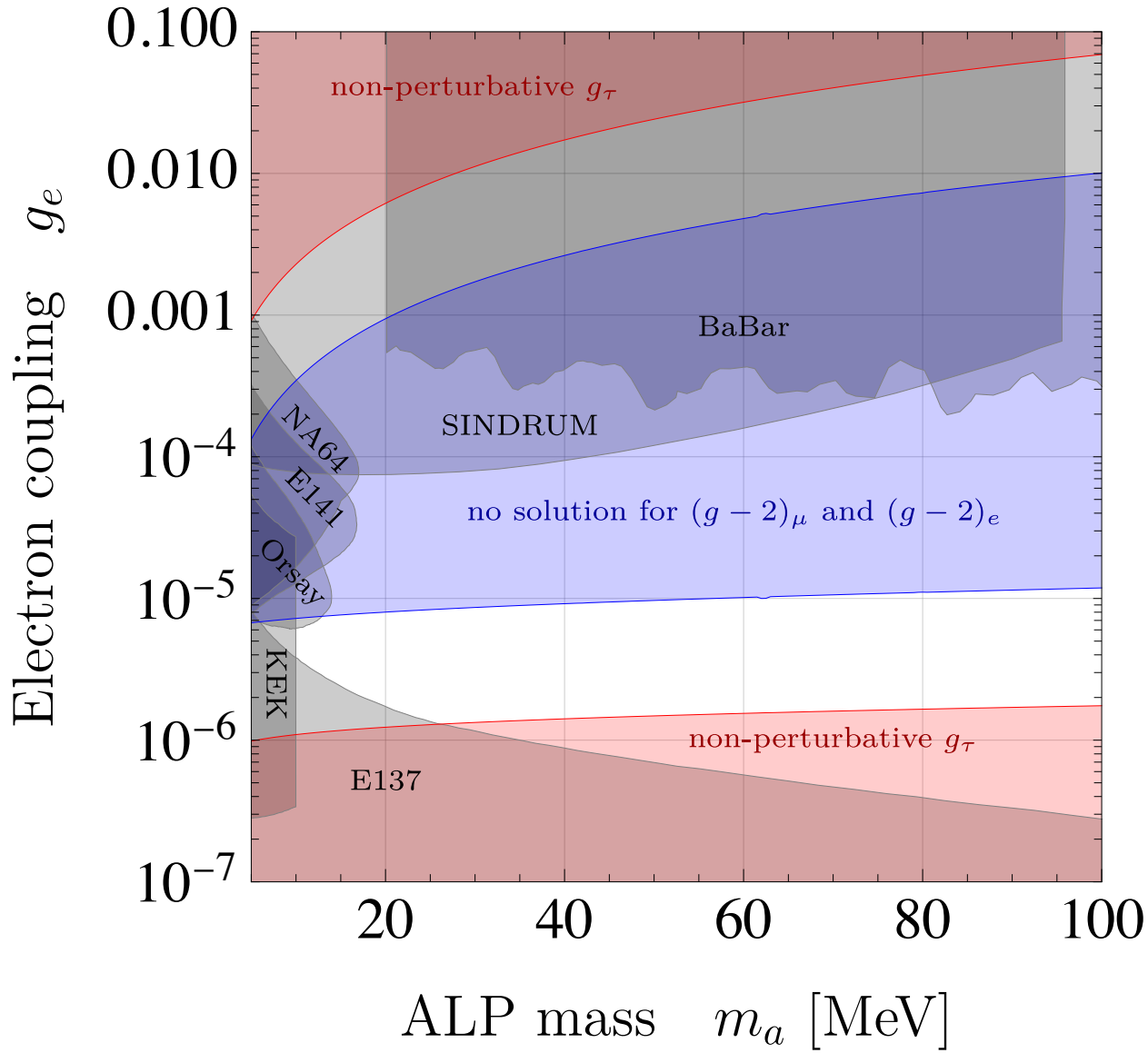
  $(g-2)$ only doable for some g_e
- Red:

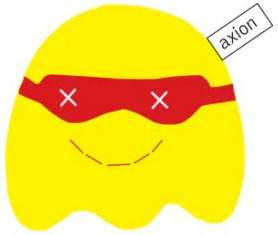
  Required g_τ too large

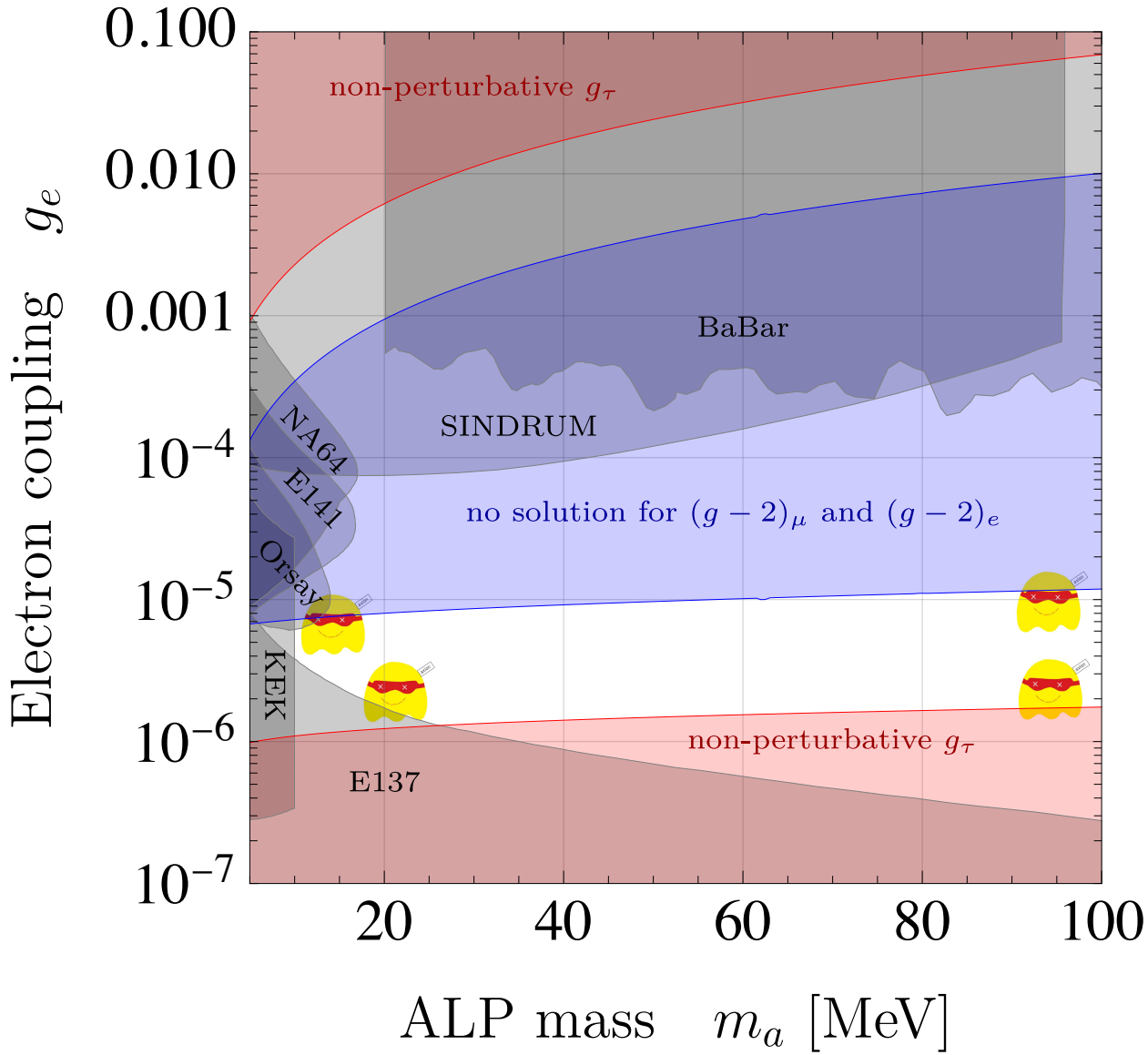




Summary

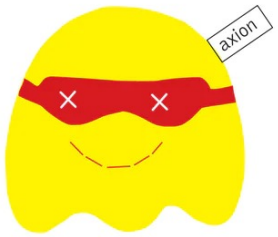
- 4 viable benchmark ALP models
- Visible ALP ($a \to e^+e^-$)
- Purely leptonic
- Address $(g-2)$

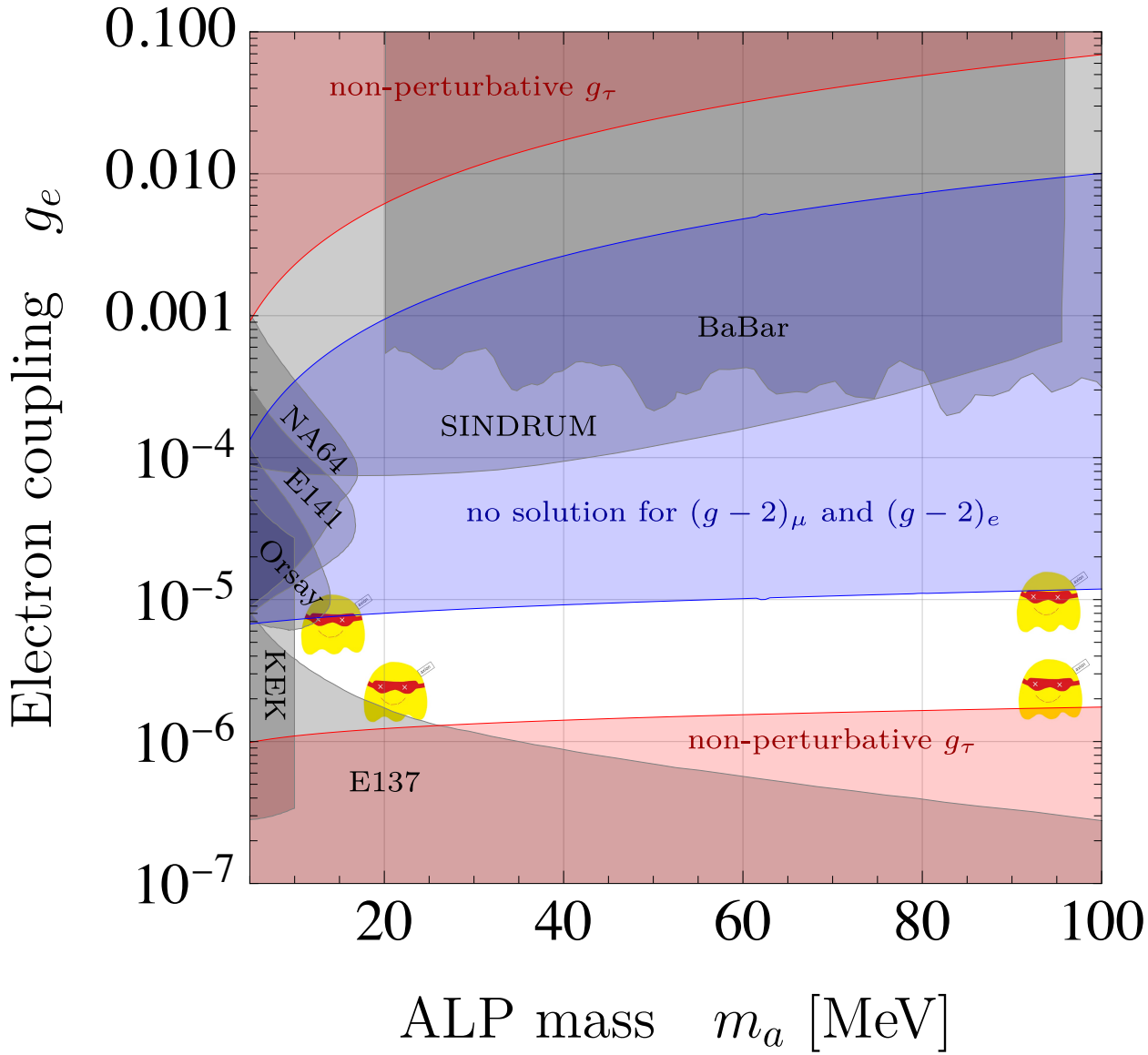




Outlook

- 2 viable benchmark ALP models
- Visible ALP ($a \to e^+e^-$)
- Purely leptonic
- Address $(g-2)$
- Dark Matter portal





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THANKS

Bibliography

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- arXiv:1406.2698
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