ADVANTAGE OF A DEUTERON EDM EXPERIMENT (A THEORIST POV)

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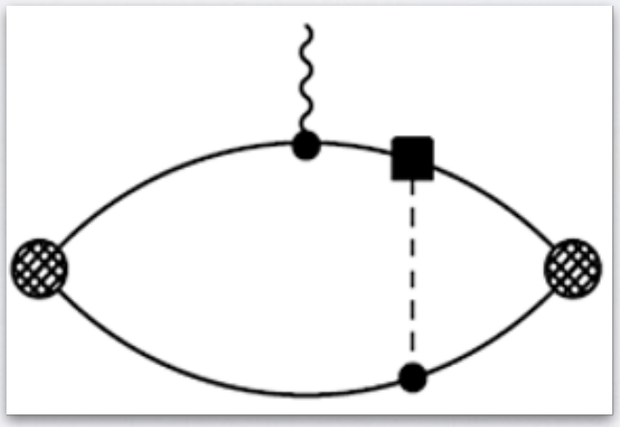
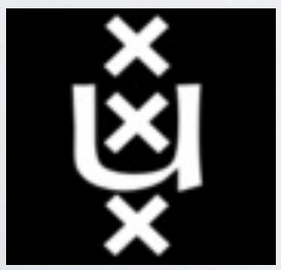
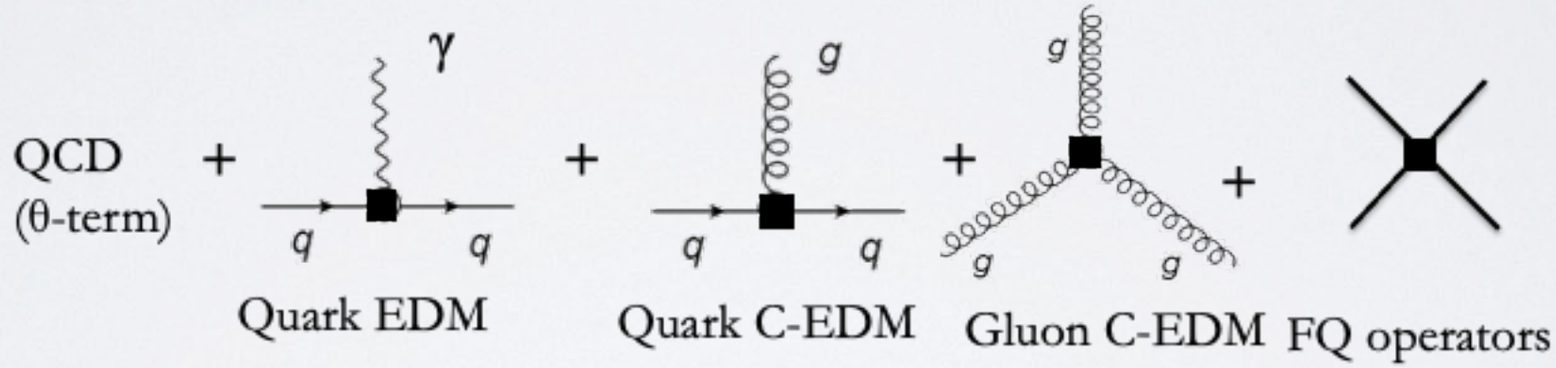




Preliminairies

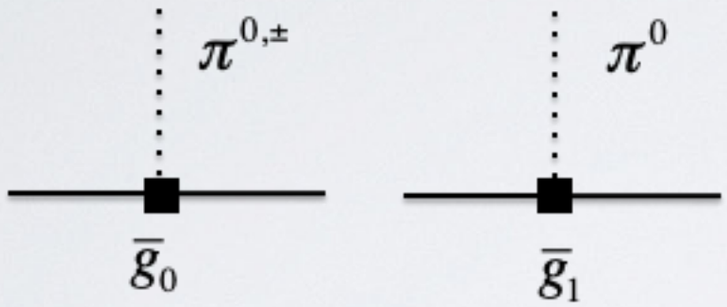
- EDMs are **low-energy observables**: not sensitive to high-energy details
- Effective description is useful to understand e.g. **deuteron v neutron v proton** EDM
- In Standard Model, only relevant source right now is **QCD theta term**
- **Beyond-the-SM models** can induce extra operators at **dimension-six**



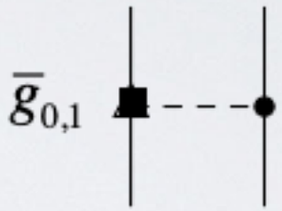
What would a deuteron experiment add to the neutron EDM program ?

The CP-odd nuclear force

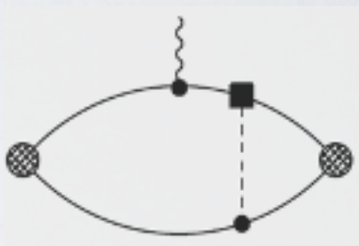
- CP-violation at quark-gluon level leads to hadronic CP-odd operators
- Largest couplings in principle are pion-nucleon CP-odd interactions



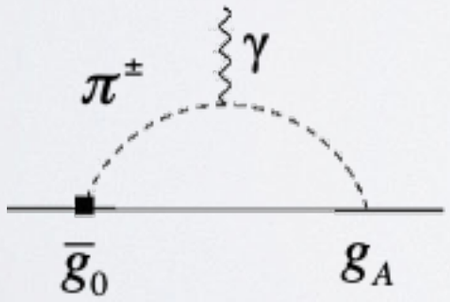
CP-odd nuclear force



Deuteron EDM = tree level



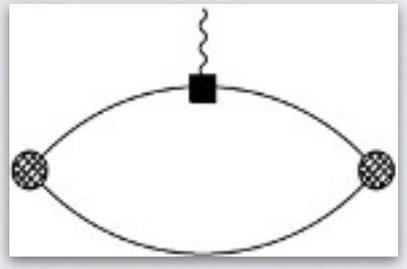
Neutron/Proton EDM at one-loop level

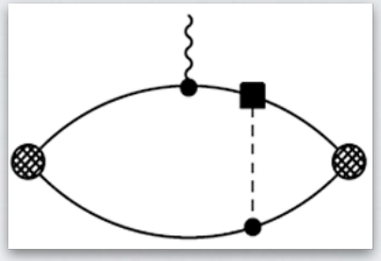


Loop suppression !

Loops are divergent: neutron/proton EDM not just function of pion-nucleon couplings. Lattice QCD needed for reliable calculations.

The deuteron EDM

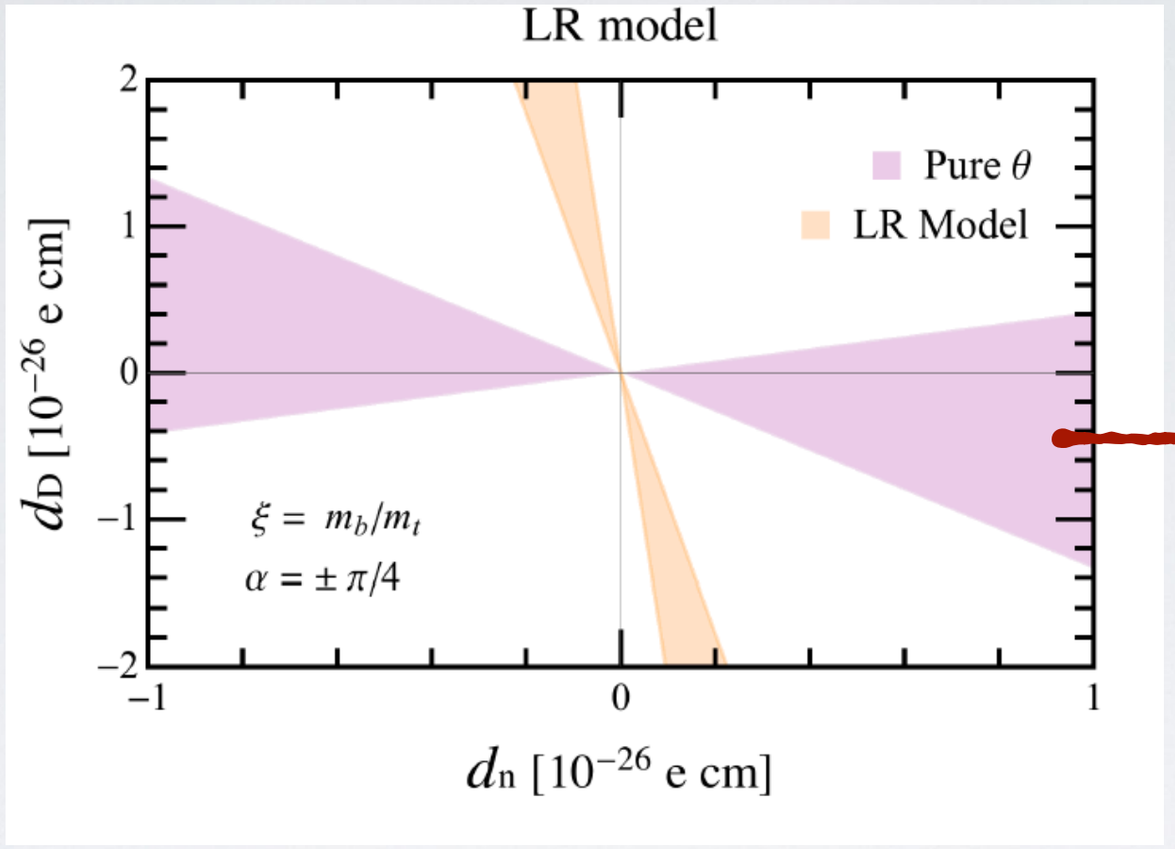




$$d_D = 0.9(d_n + d_p) + \left[(0.18 \pm 0.02)\,\bar{g}_1 + (0.0028 \pm 0.0003)\,\bar{g}_0\right] e\ fm$$

- EDMs of light nuclei can be calculated **accurately** (chiral EFT)
- **No Schiff Screening** (such as for Hg or Ra diamagnetic atoms)
- **Larger light nuclei** (e.g. 3He) more difficult due to CP-odd nucleon-nucleon forces in 1S0-3P0

Unraveling the CPV source



Bands from uncertainty in QCD matrix elements !

- Deuteron EDM very sensitive to **isospin-breaking CPV** sources !

	Theta term	Quark CEDMs	Four-quark operator	Quark EDM and Weinberg
$\left\lvert\frac{d_D - d_n - d_p}{d_n}\right\rvert$	0.5 ± 0.2	5 ± 3	20 ± 10	$\cong 0$

- **Very complementary to nucleon EDM program !**