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Novel mechanisms for the generation of EDMs in paramagnetic atoms and molecules via hadronic sources of CP violation

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Rapid advances in searches for the electron EDM have recently been achieved using paramagnetic molecules, with an improvement in sensitivity by more than 100-fold over the past decade alone **[1]**. In our recent paper **[2]**, we have identified novel mechanisms for the generation of EDMs in paramagnetic atoms and molecules via hadronic sources of CP violation. If the source of CP violation resides in the hadronic sector, then two-photon-exchange processes between electrons and the nucleus induce CP-odd semileptonic interactions, providing the dominant source of EDMs in paramagnetic systems instead of via the electron EDM. Unlike the nuclear Schiff moment mechanism in diamagnetic systems, the generation of a nucleon-number-enhanced CP-odd nuclear scalar polarisability can occur in all possible nuclei and is generally less sensitive to details of the underlying nuclear structure. Using the recent ACME EDM limit from paramagnetic ThO, we have derived bounds on the QCD theta term, proton EDM, isoscalar CP-odd pion-nucleon coupling, and colour EDMs of the light quarks.

References

[1] Andreev *et al.* (ACME Collaboration), Nature **562**, 355 (2018).
[2] Flambaum, Pospelov, Ritz and Stadnik, Physical Review D **102**, 035001 (2020).

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