DAMOP14-2014-000938

Abstract for an Invited Paper
for the DAMOP14 Meeting of
the American Physical Society

Order of Magnitude Smaller Limit on the Electron's Electron Dipole Moment[1]

GERALD GABRIELSE[2], Harvard University

Proposed extensions to the Standard Model of particle physics typically predict that the electron would naturally have a small but potentially measurable electric dipole moment (EDM). The Standard Model, known to be incomplete, instead predicts that the electron EDM is much too small to measure. The ACME collaboration [1] used the enormous electric field that electrons experience within a ThO molecule, the unique structure of this molecule, and a cryogenic buffer gas beam of molecules to search for an electron EDM. The new search was sensitive enough to detect an EDM that is ten times smaller than the previously measured upper limit [2] – well within the range of predictions from various proposed extensions to the Standard Model. We did not detect such an EDM, however. Instead, we set a new upper limit on the electron EDM at a 90% confidence limit, $|d_e| < 8.7 \times 10^{-29}$, making use of the effective electric field calculated for ThO [3]. The new limit stringently constrains the parameters of proposed extensions to the Standard Model to values that predict an electron EDM smaller than the new limit. The TeV energy scale being probed is comparable to that being investigated at CERN's Large Hadron Collider (LHC).

[1] J. Baron, W. C. Campbell, D. DeMille, J. M. Doyle, G. Gabrielse, Y. V. Gurevich, P. W. Hess, N. R. Hutzler, E. Kirilov, I. Kozyryev, B. R. O'Leary, C. D. Panda, M. F. Parsons, B. Spaun, A. C. Vutha, and A. D. West, Science **343**, 269 (2014).
[2] J. J. Hudson, D. M. Kara, I. J. Smallman, B. E. Sauer, M. R. Tarbutt, and E. A. Hinds, Nature **473**, 493 (2011).
[3] L.V. Skripnikov, A.N. Petrov and A.V. Titov, J. Chem. Phys. **139**, 221103 (2013).

[1]Supported by the AMO program of the NSF
[2]On behalf of the ACME collaboration