Theoretical Aspects of Alkali-Radium Heteronuclear Diatomic Molecules for New Physics Searches

Timo Fleig[1]

[1] *Laboratoire de Chimie et Physique Quantique, I.R.S.A.M.C., Université Paul Sabatier, F-31062, Toulouse*

Presenting Author: timo.fleig@irsamc.ups-tlse.fr

Heteronuclear diatomic molecules built from a combination of radium and other laser-coolable atoms are studied in terms of their sensitivity to parity- and time-reversal ($\mathcal{P},\mathcal{T}$) violating physics [1] arising from flavor-diagonal charge-parity ($\mathcal{CP}$) violation [2]. Among these $\mathcal{P},\mathcal{T}$-odd effects are the electron-electric-dipole-moment effective electric field [3], the nucleon-electron scalar-pseudoscalar interaction [4] and the nuclear magnetic quadrupole moment interaction [5]. The largest $\mathcal{P},\mathcal{T}$-violating molecular interaction constants are obtained for the combination of radium and silver atoms and a mechanism for explaining this finding is proposed [6]. It is, furthermore, shown that atomic transition properties and dispersion coefficients relevant to creating these molecules *via* photoassociation in an ultracold environment [7] can be obtained reliably using relativistic many-body methods and Gaussian atomic basis sets, the latter of which are typically employed in purely molecular calculations.

References

[1] V. Cirigliano and M. J. Ramsey-Musolf and U. van Kolck, Prog. Part. Nuc. Phys. **71** 2 (2013)
[2] M. Raidal *et al.*, Eur. Phys. J. C **57** 13 (2008)
[3] V. V. Flambaum, Sov. J. Nuc. Phys. **24** 383 (1976)
[4] V. V. Flambaum and I. B. Khriplovich, Sov. Phys. JETP **62** 872 (1985)
[5] V. V. Flambaum, I. B. Khriplovich, and O. P. Sushkov, Sov. Phys. JETP **60** 873 (1984)
[6] T. F., in preparation (2021)
[7] T. F., O. Grasdijk and D. DeMille, in preparation (2021)