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Status and progress of the NL-eEDM experiment

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Status and progress of the NL-eEDM experiment
Jelmer Levenga, on behalf of the NL-eEDM collaboration

Within the Standard Model fundamental particles are predicted to have a permanent electric dipole moment (EDM). An EDM is a CP-violating signature which is small within the standard model, but can be greatly enhanced in Beyond the Standard Model (BSM) physics. EDM experiments are therefore powerful tools in constraining BSM models. The NL-eEDM experiment aims to be a competitive determination of the electron EDM (eEDM) with measurements on a spin 1 system, barium monofluoride molecules $^{138}Ba^{19}F$ [1]. The experiment uses a spin precession technique within the electronic and rovibrational ground state of the molecule, the $X^2\Sigma$ state. Using short optical pulses, within this state a superposition is be created in the angular momentum $F = 1$ state, eg: $|\psi> = \frac{1}{\sqrt{2}}(|1,-1> + |1,1>)$. This superposition then evolves in time in well-controlled electric and magnetic fields resulting in an interference signal, which can also be read out with an optical pulse. The shape and behavior of the signal as a function of these parameters is theoretically well understood, allowing for a characterization of systematic effects without the need for additional auxiliary measurements [2]. Our experiment is uniquely powerful in its ability to provide measurements and data on the state of the experimental parameters such as the intensity and detuning of the pulses and strength of applied fields during operations, which are captured in the interference spectrum. Our setup has been moved to a new lab which provided an opportunity to perform upgrades to improve its sensitivity and diagnostic capabilities. We will discuss these upgrades and the future of the experiment.

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[2] A. Boeschoten, V. R. Marshall, A. Borschevsky, S. Hoekstra, T. B. Meijknecht, A. Touwen, J. W. F. van Hofslot, H. L. Bethlem, K. Jungmann, M. C. Mooij, W. Ubachs, R. G. E. Timmermans, L. Willmann. "Spin-Precession Method for Sensitive Electric Dipole Moment Searches."Phys. Rev. A 110, (2024): L010801. https://doi.org/10.1103/PhysRevA.110.L010801

Author: LEVENGA, Jelmer (University of Groningen, Nikhef)

Presenter: LEVENGA, Jelmer (University of Groningen, Nikhef)

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