

Constraints on exotic interactions from scalar spin-spin coupling in tritium deuteride (DT)

Lei Cong^{1,2,3}, **Derek F. Jackson Kimball**⁴, **Mikhail G. Kozlov** , **Dmitry Budker**^{1,2,3,5, +}

¹Helmholtz Institute Mainz, 55099 Mainz, Germany

²GSI Helmholtzzentrum für Schwerionenforschung GmbH, 64291 Darmstadt, Germany

³Johannes Gutenberg University, Mainz 55128, Germany

⁴Department of Physics, California State University – East Bay, Hayward, California 94542-3084, USA

⁵Department of Physics, University of California at Berkeley, Berkeley, California 94720-7300, USA

+ corresponding author's email: budker@uni-mainz.de;

A comparison of theoretical and experimental values of the scalar spin-spin interaction (J -coupling) in tritium deuteride molecules yield constraints for nucleon-nucleon exotic interactions of the dimensionless coupling strengths $g_V g_V$, $g_A g_A$ and $g_p g_p$, corresponding to the exchange of a vector, axial-vector, and pseudoscalar (axionlike) boson. The couplings between proton (p) and nucleon (N), denoted by $g_V^p g_V^N$, $g_p^p g_p^N$ are constrained to be less than 1.4×10^{-6} and 2.7×10^{-6} , respectively, for boson masses around 5 keV. The coupling constant $g_A^p g_A^N$ is constrained to be less than 1.0×10^{-18} for boson masses ≤ 100 eV. It is noteworthy that this study represents the first instance in which constraints on $g_V g_V$ have been established through the analysis of the potential term $V_2 + V_3$ for both tritium deuteride and hydrogen deuteride molecules.

References

- [1] L. Cong, D. F. Jackson Kimball, M. G. Kozlov, D. Budker. Constraints on exotic interactions from scalar spin-spin coupling in tritium deuteride (DT), arXiv:2408.15442 (2024).