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Isotope Shift Measurements of Ca+ in a Trapped Ion Quantum Computing Platform

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We present our preliminary findings regarding the measurement of the isotope shift in the $4s\,^2S_{1/2} \rightarrow 3d\,^2D_{5/2}$ transition within pairs of even isotopes of Ca^+. We perform the measurement by co-trapping the isotope pairs in a single well produced by a micro-fabricated segmented ion trap. Our method showcases a significant advancement in accuracy, enhancing the precision of the isotope shift measurement by two orders of magnitude compared to previous experiments. Furthermore, we address various systematic effects that gain importance within this elevated accuracy range.
The resulting precision of our measurements can serve not only as a reference point for evaluating theoretical isotope shift calculations but also paves the way for exploring New Physics: by combining our measurements with at least one isotope shift measurement of a different transition, new energy bounds for a potential 5th force between neutrons and electrons may be established. Additionally, our experiment underlines how the ongoing technical progress in trapped ion quantum computing contributes to the domain of precision measurements.

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