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Probing new intra-atomic force with isotope shifts

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In the development of atomic clocks, some atomic transition frequencies are measured with remarkable precision. These measured spectra may include effects of a new force mediated by a weakly interacting boson. Such effects might be distilled out from possible violation of a linear relation in isotope shifts between two transitions, as known as King's linearity, with relatively suppressed theoretical uncertainties. We discuss the experimental sensitivity to a new force in the test of the linearity as well as the linearity violation owing to higher order effects within the Standard Model. The sensitivity to new physics is limited by such effects. We have found that for Yb^+, the higher order effect is in the reach of future experiments. The sensitivity to a heavy mediator is also discussed. It is analytically clarified that the sensitivity becomes weaker than that in the literature. Our numerical results of the sensitivity are compared with other weak force search experiments.

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