VIOLATION OF FUNDAMENTAL SYMMETRIES AND VARIATION OF FUNDAMENTAL CONSTANTS IN ATOMIC PHENOMENA

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Recently great progress has been made in experiments on violation of fundamental symmetries in atoms, including the discovery of the nuclear anapole moment (an electromagnetic multipole which violates parity) and the measurement of the electron-nucleon weak interaction with 0.35% accuracy by Boulder group and greatly improved limits on the atomic and electron electric dipole moments by Seattle and Berkely groups. The interpretation of these results gives us reliable information about parity and time-reversal violating interactions and provides a vital window on new physics beyond the Standard Model. I explain the origin of P and T-violating effects in atoms, describe current status of the theory and present conclusions for "new physics" which follow from the recent calculations and measurements.

Theories unifying gravity with other interactions suggest temporal and spatial variation of the fundamental "constants" in expanding Universe. The spatial variation can explain fine tuning of the fundamental constants which allows humans (and any life) to appear. We appeared in the area of the Universe where the values of the fundamental constants are consistent with our existence. I present a review of recent works devoted to the variation of the fine structure constant alpha, strong interaction and fundamental masses. There are some hints for the variation in quasar absorption spectra, Big Bang nucleosynthesis, and Oklo natural nuclear reactor data. A very promising method to search for the variation of the fundamental constants consists in comparison of different atomic clocks. Huge enhancement of the variation effects happens in transition between accidentally degenerate atomic, molecular and nuclear energy levels.

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