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Effects of violation of the fundamental symmetries (P,T,Lorentz,CPT) and variation of the fundamental constants

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This abstract covers recent results on two different topics:

1. New results for variation of the fine structure constant alpha based on the quasar absorption spectra data indicate the variation of alpha in space. 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. There is an agreement between the results obtained using different telescopes and different redshifts.

The astrophysical results may be used to predict the variation effects in laboratory experiments. The variation effects are strongly enhanced in highly charged ions.

1. Measurements and calculations of parity (P) violation in atoms and ions provide tests of the Standard model and limits on new physics. Atomic and molecular experiments can also be used to detect nuclear anapole moment - magnetic multipole which violates fundamental symmetries: parity (P) and charge conjugation (C). These measurements will give us the strength of parity violating nuclear forces and may provide new test of the Standard model. Measurements of time-reversal (T) violating interactions and electric dipole moments (EDM) in atomic and molecular experiments present a possibility to search for physics beyond the Standard model.

Violation of the fundamental symmetries (P,T (EDM), Lorents) may also be produced by the primordial axion condensate created after Big Bang, and by other hypothetical cosmic fields. Limits on these fields may be obtained from current and new proposed experiments.

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