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Enhanced Effects of Dark Matter

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Low-mass boson dark matter particles produced after Big Bang form classical field and/or topological defects. In contrast to traditional dark matter searches, effects produced by interaction of an ordinary matter with this field and defects may be first power in the underlying interaction strength rather than the second power or higher (which appears in a traditional search for the dark matter).This may give an enormous advantage since the dark matter interaction constant is extremely small.
Interaction between the density of the dark matter particles and ordinary matter produces both 'slow' cosmological evolution and oscillating variations of the fundamental constants including the fine structure constant alpha and particle masses. Atomic Dy, Rb and Cs spectroscopy measurements and the primordial helium abundance data allowed us to improve on existing constraints on the quadratic interactions of the scalar dark matter with the photon, electron, quarks and Higgs boson by up to 15 orders of magnitude. Limits on the linear and quadratic interactions of the dark matter with W and Z bosons have been obtained for the first time [1,2].
In addition to traditional methods to search for the variation of the fundamental constants (atomic clocks, quasar spectra, Big Bang Nucleosynthesis, etc) we discuss variations in phase shifts produced in laser/maser interferometers (such as giant LIGO, Virgo, GEO600 and TAMA300, and the table-top silicon cavity and sapphire interferometers) [3,4]. Corresponding measurements which have significantly improved limits on the topological defect dark matter have been performed in [5].
Dark matter may produce changes in pulsar rotational frequencies (which may have been observed already in pulsar glitches), non-gravitational lensing of cosmic radiation and the time-delay of pulsar signals [6].
Other effects of dark matter and dark energy include apparent violation of the fundamental symmetries: oscillating or transient atomic electric dipole moments, precession of electron and nuclear spins about the direction of Earth's motion through an axion dark matter (the axion wind effect), and axion-mediated spin-gravity couplings [7-9], violation of Lorentz symmetry and Einstein equivalence principle [10]. Recent measurements by nEDM collaboration [11] improved the limits on interaction of the low-mass axion with gluons and nucleons up to 3 orders of magnitude.
Recently we investigated possibilities to detect linear effects in the axion interaction constants using interference between axion and photon atomic capture amplitudes [12] and coherent axion-photon transformations in the forward scattering on atoms [13].
Effects of scalar field produced by massive bodies on atomic transition frequencies have been experimentally investigated in [14]. Improved limits on the axions and low mass Z'- bosons have been derived from the measurements of atomic and molecular electric dipole moments [15] and parity violating effects [16].
We explore a possibility to explain the DAMA collaboration claim of dark matter detection by the dark matter scattering on electrons. We have shown that the electron relativistic effects increase the ionization differential cross section up to 3 orders of magnitude [17,18]. Recent results of ZENON collaboration [19] based on our calculations contradict to DAMA results.
We investigated possible effect of finite photon mass due to magnetic interaction in plazma on galaxy rotation curve [20]. Slowly varying vector potential A of a low-mass photon field provides negative pressure P=-E/3 in the electromagnetic stress tensor (E is the magnetic field energy density), imitates gravitational pull and may provide observed distribution of the rotational velocities in the Galaxy (without dark matter!).
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Summary

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