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Atomic/nuclear clocks and precision spectroscopy measurements for dark matter and dark sector searches

Rapid developments of atomic clocks and other precision spectroscopy techniques are making possible phenomenologically interesting searches for bosonic dark matter and new force carriers. Furthermore, it is realistic to expect in the next decade many orders of magnitude improvements in the sensitivity of these experiments. To take full advantage of new opportunities presented by these advances will require experimental and theoretical engagements from both atomic and particle physics communities.

Several directions are being pursued to drastically improve the reach of the clock and other precision spectroscopy experiments for DM detection:
(i) significant improvement of the current clocks, that is expected to rapidly evolve in the next decade;
(ii) development of clock networks at the new level of precision;
(iii) development of new atomic clocks based on highly charged ions (HCI) that have much higher sensitivities to the variation of alpha;
(iv)development of a nuclear clock that is based on a nuclear rather than atomic transition;
(v) dedicated precision spectroscopy experiments sensitive to higher DM masses than clocks;
(vi) development and implementation of new clock-comparison schemes specifically designed to improves reach of oscillatory and transient dark matter searches;
and (vii)~development of molecular clocks
The experimental effort is strongly complimented by the development of high-precision atomic theory and particle physics model building.

Primary frontier topic

Cosmic Frontier

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