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The cosmological constant, dark matter, and supersymmetry from a fresh perspective

In this talk, three fundamental problems will be addressed within a unified picture [1-4]. The solution of the cosmological constant problem has two aspects: According to (10.3) of [1], spin 1/2 fermion fields and spin 0 boson fields give zero contribution to the conventional cosmological constant; and (10.8) of [1] (which is completely consistent with the Casimir effect) implies that the same is true for spin 1 gauge fields. In each case classical Einstein gravity is exactly regained for all fields except those in the vacuum (with a cutoff at high energy for quantized gravity). A new interpretation of scalar boson sectors has implications for both dark matter [2,3] and supersymmetry [4]: Calculations and estimates of the relevant cross-sections for a novel dark matter WIMP demonstrate that (i) it may be detectable within the next few years in Xe-based direct-detection experiments, (ii) it may be observable within about 15 years at the high-luminosity LHC, and (iii) it may already have been detected in the gamma rays observed by Fermi-LAT and antiprotons observed by AMS-02. The reinterpretation of scalar boson fields also implies a new phenomenology for sfermions, with reduced cross-sections and modified experimental signatures. There is then a unified picture which may explain why dark matter WIMPs and electroweak-scale sparticles have not yet been detected, but implies that they should still be within reach of near-term experiments.

[1] Roland E. Allen, arXiv:2302.10241 [hep-th].
[2] Reagan Thornberry et al., EPL [European Physics Letters] 134, 49001 (2021), arXiv:2104.11715 [hep-ph], and references therein.
[3] Bailey Tallman et al., Letters in High Energy Physics LHEP-342 (2023), arXiv:2210.15019 [hep-ph].
[4] Roland E. Allen, arXiv:2307.04255 [hep-ph].

Author: ALLEN, Roland

Presenter: ALLEN, Roland