Department of Theoretical Physics

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Cancellation of infrared divergences in bino-like theories of dark matter at finite temperature

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Models incorporating moderately heavy dark matter (DM) typically need charged (scalar) fields to establish admissible relic densities. Since the DM freezes out at an early epoch, thermal corrections to the cross sections can be important. The Infra-Red (IR) finiteness of thermal field theories of charged fermions (fermionic QED) has been proven to all orders in perturbation theory. In this talk, after establishing the cancellation of IR divergences of charged scalar theories (scalar QED) at finite temperature at all orders in perturbation theory; I will describe the IR behaviour at finite temperatures, of a theory of dark matter interacting with charged scalars and fermions, which potentially contains both linear and sub-leading logarithmic divergences. I will show that the theory is IR-finite to all orders with the divergences cancelling when both absorption and emission of photons from and into the heat bath are taken into account. While 4-point scalar-photon interaction terms are known to be IR finite, we will show that their inclusion will lead to a neat factorisation and resummation. The result is generic and is applicable to a variety of models, independent of the specific form of the neutral-fermion-scalar interaction vertex.

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