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Title: Cosmological imprints of non-thermalized dark matter

Abstract: The nature of dark matter poses one of the most pressing questions in fundamental physics today. Thermal freeze-out of a weakly interacting massive particle (WIMP) has been the most widely studied framework for explaining the measured dark matter abundance in the Universe. However, this framework is put under severe pressure by experimental null-results at colliders, direct and indirect detection experiments. In this talk, we consider non-thermalized dark matter whose abundance may be set by freeze-in or superWIMP production instead. Interestingly, it imprints non-cold dark matter signatures on cosmological observables. We discuss constraints from Lyman-alpha forest observations for both cases, basing ourselves on a reinterpretation of the existing Lyman-alpha limits on thermal warm dark matter. Special emphasis is placed on the mixed scenario, where contributions from both freeze-in and superWIMP are similarly important. In this case, the imprint on cosmological observables can deviate significantly from thermal warm dark matter. For illustration, we apply the above generic limits to a colored t-channel mediator dark matter model, in which case contributions from both freeze-in through scatterings and decays, as well as superWIMP production can be important. We map out the entire cosmologically viable parameter space, cornered by bounds from Lyman-alpha observations, the LHC, and Big Bang Nucleosynthesis.