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Discovering a new well: Decaying dark matter with profile likelihoods

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A large number of studies, all using Bayesian parameter inference from Markov Chain Monte Carlo methods, have constrained the presence of a dark matter component decaying to invisible radiation. All such studies find a strong preference for either very long-lived or very short-lived dark matter.

In this talk, I will present our recent work, to appear on the arXiv in the coming weeks, in which we show that this preference is entirely driven by parameter volume effects. Using profile likelihoods, we instead find that the best-fitting parameters correspond to an intermediate regime where $\sim 3\%$ of cold dark matter decays around recombination, residing in a $\Delta\chi^2$ well of depth $\Delta\chi^2 \approx -6.2$ relative to ΛCDM with Planck and BAO data and $\Delta\chi^2 \approx -9.9$ with a Gaussian likelihood on the SH0ES H_0 measurement.

Ultimately, our results reveal that decaying dark matter is substantially more viable than previously assumed, and illustrate the importance of combined Bayesian/frequentist statistical methods for a fully nuanced analysis.

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