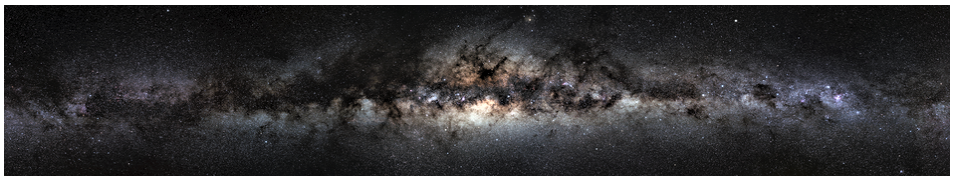

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Accurately Measuring Neutrinos, Massive Light Relics and Axions Using Cosmological Observables

Tuesday, 7 December 2021 08:20 (30 minutes)

Light relics are new degrees of freedom which decoupled from the Standard Model while relativistic. Nearly massless relics will both contribute to the radiation energy budget and, for relics with masses on the eV scale (meV-10 eV), will become non-relativistic before today, behaving as matter instead of radiation. Such relics leave an imprint in the large-scale structure of the universe as light relics have important streaming motions, as in the case of massive neutrinos. For massive neutrinos, in order to obtain unbiased estimates of the neutrino mass, the sensitivity of upcoming CMB and LSS surveys to two effects that can alter neutrino-mass measurements is explored. The first is the slight difference in the suppression of matter fluctuations that each neutrino-mass hierarchy generates at fixed total mass. The second is the growth-induced scale-dependent bias (GISDB) of haloes produced by massive neutrinos. Accounting for these effects, a forecast of how well current and upcoming cosmological surveys can probe generic light massive relics is discussed. This forecast considers minimal extensions to the Standard Model by both fermionic and bosonic relic degrees of freedom and predicts the significance at which relics with different masses and temperatures can be detected. In addition to thermal relics, Axion Like Particles (ALP) can imprint on the large-scale structure through their inability to cluster below scales set by their de Broglie wavelength. We discuss how the ALP mass and decay constant can be constrained by upcoming surveys, particularly through modeling effects on the halo bias.

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