

P149b Baryon-dark matter scattering and first star formation

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The recent detection of the sky-averaged 21-cm cosmological signal indicates a stronger absorption than the maximum allowed value based on the standard model. One explanation for the required colder primordial gas is the energy transfer between the baryon and dark matter fluids due to non-gravitational scattering. Here, we explore the thermal evolution of primordial gas, collapsing to form Population III (Pop III) stars, when this energy transfer is included. Performing a series of one-zone calculations, we find that the evolution results in stars more massive than in the standard model, provided that the dark matter is described by the best-fit parameters inferred from the 21-cm observation. On the other hand, a significant part of the dark matter parameter space can be excluded by the requirement to form massive Pop III stars sufficiently early in cosmic history. Otherwise, the radiation background needed to bring about the strong Wouthuysen-Field coupling at $z \sim 17$, inferred to explain the 21-cm absorption feature, could not be built up. Intriguingly, the independent constraint from the physics of first star formation at high densities points to a similarly narrow range in dark matter properties, compared to the conclusions from the 21-cm signal imprinted at low densities.