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Light Elements on Fire: Nuclear Information for Big Bang Studies[1]

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Within the last decade, our notions of the cosmos have been radically altered by precision observations of the light from distant Type Ia supernovae and, separately, the power spectrum of the cosmic microwave afterglow of the Big Bang. These show that the expansion of the universe is actually accelerating, and that the Universe is overwhelmingly composed of a mysterious dark energy (75%) and dark matter (21%), with only 4% of the total being baryonic "normal") matter. Determining the amount and characteristics of dark matter, dark energy, and normal matter is one of the most compelling problems in astrophysics today. A complementary and independent approach to determine the baryonic matter density is to compare the predictions of the abundances of "primordial" light elements (H, He, Li) formed three minutes after the Big Bang with observations of these elements in the interstellar medium and on the surface of very old stars. "Big Bang Nucleosynthesis" (BBN) calculations require, as input, thermonuclear reaction rates at the high temperatures characteristic of the early universe. BBN estimates of the ^{2}H, ^{4}He, and ^{7}Li abundances imply a baryonic density that, respectively, agrees, marginally agrees, and disagrees with the density from other approaches. This discordance, and the current status of nuclear physics information for BBN studies, will be reviewed, and reactions needing additional measurements will be discussed.

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