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Evolution of the Metallicity of the Universe

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Abstract The primordial compositions of the first stars reflect that of the Universe as it emerged from the cosmological Big Bang: hydrogen, deuterium, ^{3}He, ^{4}He, and ^{7}Li. Within galaxies, stars and supernovae play the dominant roles in synthesizing the elements from carbon through uranium, and in returning heavy-element-enriched matter to the interstellar gas from which new stars are formed. This abundance history is written in the compositions of stars in our Galaxy (and other galaxies). Observational studies, both with HST and with large aperture ground-based telescopes, are now providing increasing amounts of information concerning both the compositions of stars in our Galaxy and nearby galaxies and the spectroscopic and photometric properties of gas clouds at high red shifts. We review the nuclear processes that participate in heavy element synthesis, identify the astrophysical sites (stars and supernovae) with which they are associated, and note particularly the (production) timescales on which this enrichment is expected to occur. We then demonstrate how observations of distinctive abundance patterns in older stellar populations can be used to trace and to constrain the star formation and nucleosynthesis histories of galaxies and the Universe.