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Abstract for an Invited Paper
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**Laboratory Cosmology**[1]

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Atomic and molecular physics during the early Universe has become a topic of major significance over the last decade. This is due to the recent revolution in our understanding of the cosmological evolution of the Universe. Recent observational, theoretical, and computational advances in cosmology have shifted our understanding of the early Universe from qualitative to quantitative. Concurrent with this shift has been a deeper realization of the cosmological importance of atomic and molecular processes. For example, studies of primordial galaxy and first star formation require accurate models of the hydrogen chemistry during this epoch. As another example, interpreting observations of heavy elements in the high-redshift intergalactic medium (IGM) can be used to constrain the chemical evolution of the early Universe and the formation of the stars which produced these elements. But to do this requires a reliable understanding of the underlying atomic and molecular processes which determine the ionization balance in the IGM. Surprisingly, an accurate understanding is often lacking of the atomic and molecular physics needed to advance these and other cosmological studies. Many of the cosmologically important atomic and molecular processes occur in energy regimes which can be theoretical, computationally, and experimentally challenging or even inaccessible. Here I will report on a series of recent laboratory measurements, theoretical calculations, and modeling studies which we have carried out in order to improve our knowledge of atomic and molecular physics under cosmological conditions and to thereby increase our understanding of the early Universe.

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