Big Bang Cosmology

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The origin of matter and its early evolution occurred during the big bang epoch from the time between the first instants of cosmic expansion until and the photon scattering surface. Ideas about big bang cosmology have undergone rapid evolution in the past decade based upon various observational and theoretical developments. Several paradigm shifts have occurred. For example, topics such as vacuum energy, parallel universes, higher dimensional physics, which were considered speculation only a few years ago are now on the forefront of cosmology research. Even so, there remain only two means by which to probe the physics of the big bang epoch. One probe is the observed power spectrum of temperature fluctuations in the cosmic microwave background. This derives from a combination of physics from the first instants of cosmic inflation, and the physics of matter and radiation the surface of photon last scattering. The other probe is the observed ashes of primordial nucleosynthesis which occurred during the radiation dominated epoch from about 1 sec to $10^3$ sec into the big bang. This talk will summarize the current state of the art of these two cosmic probes and crucial role which each plays in motivating and constraining new cosmological paradigms. Among the topics discussed will be the limits which these probes place upon the nature of dark matter and dark energy, along with possible insights into physics beyond the standard model of particle physics.