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Reconstructing the Primordial Power Spectrum With Planck

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Four years ago the Planck satellite was launched with the objective of furthering our understanding of the history and structure of the universe by making detailed measurements of the Cosmic Microwave Background. In March, the data and preliminary cosmological results from Planck were finally made public. The data collected by Planck is the most precise and comprehensive yet obtained, the full ramifications of which are still being studied. The current paradigm in cosmology is that approximately 10^-36 seconds after the big bang, our universe underwent a very brief and very rapid period of expansion, where the universe expanded from the size of an atom to the size of a galaxy in 10^-32 seconds. An important consequence of inflation is that it creates tiny inhomogeneities in the curvature of the universe, which then grow with the expansion of the universe into the CMB anisotropies that we observe today. While inflation has been very successful in explaining the general features of the CMB, there are several competing theories about how inflation could have occurred. Most theories of inflation predict that the spectrum of the initial curvature inhomogeneities created during the inflationary epoch should be a nearly scale-invariant, power-law function. Frequently, studies of CMB data assume a power-law spectrum, which means that potential features, which could signal new physics at work, are missed. In this presentation I will talk about how the Planck data were used to reconstruct the primordial power spectrum of curvature inhomogeneities, in a non-parametric manner. This method makes no assumptions about the form of the primordial power spectrum or how it was created. Such an approach allows us to determine if there are any statistically significant deviations from the traditionally assumed power-law form. We find the Planck data is mostly consistent with a power-law spectrum, but there is a large deviation at small scales that remains unexplained at this time.

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