Warm Little Inflaton

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Inflation is one of the pillars of modern cosmology, postulating the existence of a new scalar field, a coherent collection of spin-0 particles, which was responsible for the exponential expansion of the Universe in its first tiny fractions of a second. Inflation explains not only the observed flatness and homogeneity of the Universe but also the small temperature anisotropies in the Cosmic Microwave Background (CMB), seeded by quantum fluctuations in the "inflaton" field.

The inflationary Universe is conventionally thought to have been extremely cold, due to the exponentially fast expansion, and to only later have reheated as a result of the inflaton's decay into ordinary matter and radiation. This decay could not, however, have left any observational imprint in the CMB, making it very hard to experimentally assess how the inflaton interacts with the known elementary particles.

In an alternative scenario, known as warm inflation, the inflaton field could have decayed during (rather than after) inflation, and slowly converted its energy into warm radiation. This could have prevented the Universe from supercooling during inflation and left a distinctive imprint in the CMB.

Despite its several attractive features, this idea has been regarded for nearly two decades as nearly impossible, since the inflaton's decay could have prevented inflation from occurring. In this Letter, we have confounded these expectations and constructed the first simple and compelling particle physics model of warm inflation, finding an excellent agreement with the latest observations of the CMB by ESA's Planck satellite. Our construction employed simple symmetry requirements, analogous to "Little Higgs" models of the recently discovered Higgs boson, to show that the early Universe may have always been in a warm state, thus opening up new avenues for research in early Universe cosmology.