COLLOQUIUM

The Unexpected Universe: Measurements of Cosmological Parameters

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November 4, 2015
4:00 p.m.

Over the past few decades, cosmologists have for the first time identified the major constituents of the universe. Surprisingly, the universe hardly resembles what we thought only a few decades ago. The universe is filled with dark matter that is not visible and energy that permeates all of space, causing its expansion to speed up with time. Accurate distances remain central to a number of fundamental problems in astrophysics and cosmology. They are critical for measurements of the acceleration of the universe using supernovae. A more accurate measurement of the Hubble constant is critical for providing independent constraints on dark energy, the geometry, and matter density of the universe. The increased precision of cosmic microwave background fluctuations (most recently with the Planck satellite) make these direct comparisons even more critical, given the physical degeneracies amongst different cosmological parameters, and the apparent tension with the direct measurements of the Hubble constant. There has been fundamental progress over the last couple of decades in measuring extragalactic distances. The upcoming decade promises robust distances and a measurement of the Hubble constant to a few percent accuracy. New giant telescopes planned for the next decade are likely to reveal more surprises.

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