“We Are Quantum Fluctuations: The Cosmic Microwave Background and the Quest for the Origin of All Structure in the Universe”

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Thirty years ago inflation was a highly speculative idea about the origin of the hot big bang, born from the application of modern ideas about particles and fields to questions about the early evolution of the universe. Today, having met with considerable empirical success, it is our leading theory for the origin of the density fluctuations that grow over time to be all the structure we see in the universe today. In a talk designed to be accessible to all first year physics graduate students, I will explain some of the beautiful physics at work during inflation, and then in the plasma that used to fill all space when the universe was very hot. I will demonstrate how the predictions of inflation are being verified by observations of the cosmic microwave background, including the most recent polarization results from the Planck satellite. These empirical successes motivate us to search for the siblings of these density fluctuations, the inflationary gravitational waves, via their signature in the polarization of the CMB. Their discovery would open up an observational window on quantum gravitational effects, extremely early times, and extremely high energies. I will present the most recent upper limits on the amplitude of these gravitational waves (derived from Planck data and data from the BICEP2 and Keck telescopes at the South Pole) and briefly describe the continuing hunt.

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wine and cheese following the colloquium