Cosmic Inflation and Primordial Gravitational Waves

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BICEP2 is a radio telescope located at the South Pole. On March 17, 2014, the BICEP2 collaboration announced the indirect detection of primordial gravitational waves by measuring the polarization of the cosmic microwave background (CMB). The world's press reported that the *inflation theory*, the Big Bang paradigm for the origin of the Universe, has been confirmed by this discovery. The inflation theory predicts the exponential expansion of tiny quantum space-time, which turned the Universe into a fire ball with tremendous heat created when the rapid expansion stopped, and the production of density fluctuations, which later grew into galaxies or groups of galaxies, as a result of tremendous expansion of quantum fluctuations in the exponential expansion era, and so on. NASA's CMB satellites, COBE and WMAP, unveiled the picture of the Universe only 380,000 years after its birth, and found the density fluctuations predicted by the inflation theory; this result supported the inflation theory. On the other hand, quantum fluctuations not only produce matter-energy density fluctuations, but they also produce space-time fluctuations, i.e., gravitational waves, at the same time. These gravitational waves produce a twisting pattern of the CMB polarization, called the B-mode. If it is really observed, the inflation theory will be further strengthened. However, the effect of interstellar dust in our Galaxy could produce a similar pattern, and criticisms have been raised that the BICEP2 estimation of this effect is underestimated. In October this year, ESA's CMB satellite Planck will announce the results of polarization measurements. Also, a number of groups including POLARBEAR, in which Hazumi from KEK and collaborators are working, are measuring the CMB polarization at the South Pole, the Atacama Desert in Chile, and other such locations. We are looking forward to seeing the results from these measurements.