JOINT TUFTS/MIT COSMOLOGY SEMINAR

Testing Quantum Mechanics and Bell's Inequality with Observations of Causally Disconnected Cosmological Events

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I will discuss a thought experiment which would leverage cosmology to test quantum mechanics using astronomical observations. Specifically, we aim to close the "settings-independence" loophole in experimental tests of Bell's inequality by choosing the detector settings (e.g. polarizer orientations) using real-time observations of causally disconnected cosmic sources. This would help close one of the most important remaining Bell test loopholes whereby a local hidden variable theory could mimic the quantum predictions if the experimental settings choices shared even a small correlation due to unknown local causal influences prior to the experiment. The talk will focus on the theoretical cosmology constraints needed to choose optimal sources for such an experiment, describing general conditions for pairs of cosmic events with arbitrary redshifts and angular separations to have shared causal pasts in Friedman-Lemaitre-Robertson-Walker universes with arbitrary curvature, including flat, dark energy dominated, accelerating universes like our own. While causally disjoint patches of the cosmic microwave background radiation at redshift $z \sim 1090$ could be used to set the detectors, $z > 3.65$ quasars observed at optical wavelengths are arguably the optimal candidate source pairs using present technology that meet the condition of having no shared causal past since the end of any period of inflation, 13.82 Gyr ago. Results are illustrated for our universe with causal structure animations to help visualize the intersections of past light cones for arbitrary event pairs.

Tuesday, November 19, 2013, 2:45 pm
Cosman Seminar Room
Center for Theoretical Physics
Building 6C, Room 6C-442
Massachusetts Institute of Technology

Refreshments at 2:30 in the same room