



清华大学高等研究院

Institute for Advanced Study, Tsinghua University

Astrophysics Seminar

- Title:** Generalised uncertainty relations from superpositions of geometries
- Speaker:** Dr. Matthew James Lake
(*Sun Yat-Sen University*)
- Time:** 3:00pm, Friday, April 12, 2019
- Venue:** Conference Hall 322, Science Building, Tsinghua University

Abstract

Phenomenological approaches to quantum gravity implement a minimum resolvable length-scale but do not link it to an underlying formalism describing geometric superpositions. Here, we introduce an intuitive approach in which points in the classical spatial background are delocalised, or "smeared", giving rise to an entangled superposition of geometries. The model uses additional degrees of freedom to parameterise the superposed classical backgrounds. Our formalism contains both minimum length and minimum momentum resolutions and we naturally identify the former with the Planck length. In addition, we argue that the minimum momentum is determined by the de Sitter scale, and may be identified with the effects of dark energy in the form of a cosmological constant. Within the new formalism, we obtain both the Generalised Uncertainty Principle (GUP) and Extended Uncertainty Principle (EUP), which may be combined to give an uncertainty relation that is symmetric in position and momentum. Crucially, our approach does not imply a significant modification of the position-momentum commutator, which remains proportional to the identity matrix. It therefore yields generalised uncertainty relations without violating the Equivalence Principle, in contradistinction to existing models based on nonlinear dispersion relations. Implications for cosmology and the black hole uncertainty principle correspondence are briefly discussed, and prospects for future work on the smeared-space model are outlined.