GR 2 Wurmlöcher und Zeitreisen

Zeit: Freitag 11:00–11:45 Raum: TU BH262

Hauptvortrag GR 2.1 Fr 11:00 TU BH262

Chronology Protection and Topological Censorship: Does physics allow wormholes and closed timelike curves? — •John Friedman[1] and Atsushi Higuchi[2] — [1]University of Wisconsin-Milwaukee, USA — [2]Department of Mathematics, University of York, UK

Vacuum solutions to the classical Einstein equations generically include black holes and white holes, wormholes (and a countably infinite set of 3-dimensional topological structures); closed timelike curves (particle paths that loop back in time), and time-nonorientable geometries. A path-integral formalism allows smooth topology change; and light-cone fluctuations lead to a microscopic foam of closed timelike curves, unless one a priori demands global causality. What then enforces the euclidean topology and strict causality of ordinary experience?

Work of the past fifteen years shows that, on scales large enough to ignore the quantum fluctuations of geometry, classical or semiclassical fields prevent exotic topological and causal structures. Positive energy forces topological structures to collapse in a light-crossing time. It also prevents the formation of closed timelike curves in local regions. At the boundary of a region of closed timelike curves, quantum fields become singular; and unitarity of interacting fields is lost.

Because these mechanisms do not rely on an ordinary Planck-scale topology and causal structure, they leave open the possibility of topology change and causality violation on the smallest scales.