2nd Dutch Mathematical Relativity Day

13 June 2024, Utrecht University

Abstracts

Cisco Gooding (University of Nottingham)

Title: *Relativistic analogues and quantum simulators*

Abstract: In 1981, Bill Unruh proposed a mathematical analogy between scalar field dynamics in a black hole spacetime and sound propagation in a transonic fluid flow. Almost half a century later, the field of analogue gravity has exploited this analogy in both classical and quantum systems, and extended the analogy from black holes to a wide class of other spacetime geometries, with an assortment of analogue systems such as surface waves in water, superfluids, Bose-Einstein condensates, and nonlinear optical systems. In this talk I will introduce the analogue metric used in such systems and describe milestones in the history of analogue gravity. Finally, I will outline ongoing research simulating relativistic quantum fields on analogue spacetimes.

Gustav Holzegel (University of Münster)

Title: *Dynamics and Holography in asymptotically anti-de Sitter spacetimes*

Abstract: tba

Sharmila Gunasekaran (Radboud University Nijmegen)

Title: *Quasi-Einstein manifolds and near-horizon geometries*

Abstract: A near horizon geometry is a notion associated with extreme black holes. Extreme black holes possess event horizons at zero temperature. These horizons are exclusively defined by a specific limiting procedure, defining what is called a near-horizon geometry or, more broadly, a quasi-Einstein equation which governs their properties. Solutions to the quasi-Einstein equation manifest as triples (M,g,X), where M represents a closed manifold (the horizon), g denotes a Riemannian metric, and X is a 1-form. The talk will be an overview of these concepts and some relevant results.

Grigalius Taujanskas (University of Cambridge)

Title: *On the scattering of finite energy Maxwell—Klein—Gordon fields*

Abstract: In 1989 John Baez attempted to construct a scattering theory for Yang—Mills fields using conformal techniques, however ran into the problem that at the time the global well-posedness for merely finite energy data had not been proven. He therefore treated data with more derivatives, and provided a construction of a scattering operator corresponding to a distinguished element of the conformal group, but did not show invertibility of the wave operators. In the mid 90s Klainerman and Machedon were the first to obtain a finite energy well-posedness result in Minkowski space in the Coulomb gauge for, in the first instance, Maxwell—Klein—Gordon fields, and then for the Yang—Mills equations. Their construction relied crucially on the celebrated null structure in the nonlinearities. however even this theorem is not enough to obtain what Baez initially set out for. In an upcoming paper with J.-P. Nicolas we prove the finite energy global well-posedness of Maxwell—Klein—Gordon fields on the Einstein cylinder. I will discuss how this leads to the existence of finite energy scattering states on Minkowski space, completing one half of Baez's goal, and mention the backward problem, which remains open.