Strong Cosmic Censorship and Cosmic No-Hair in spacetimes with symmetries

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Abstract

This thesis consists of three articles investigating the asymptotic behaviour of cosmological spacetimes with symmetries arising in Mathematical General Relativity.

In Paper A and B, we consider spacetimes with Bianchi symmetry and where the matter model is that of a perfect fluid. We investigate the behaviour of such spacetimes close to the initial singularity ('Big Bang'). In Paper A, we prove that the Strong Cosmic Censorship conjecture holds in non-exceptional Bianchi class B spacetimes. Using expansion-normalised variables, we further show detailed asymptotic estimates. In Paper B, we prove similar estimates in the case of stiff fluids.

In Paper C, we consider T2-symmetric spacetimes satisfying the Einstein equations for a non-linear scalar field. To given initial data, we show global existence and uniqueness of solutions to the corresponding differential equations for all future times. In the special case of a constant potential, a setting which is equivalent to a linear scalar field on a background with a positive cosmological constant, we investigate in detail the asymptotic behaviour towards the future. We prove that the Cosmic No-Hair conjecture holds for solutions satisfying an additional a priori estimate, an estimate which we show to hold in T3-Gowdy symmetry.

Keywords
Cosmic Censorship, Cosmic No-Hair, Big Bang, symmetry, Bianchi, T2-symmetry, Gowdy, general relativity, cosmology, late time, initial time, asymptotic behaviour, perfect fluid, scalar field, Einstein equations