

# **On Kerr Black Hole Formation and a New Approach Toward Penrose Inequality**

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## **ABSTRACT.**

Black hole formation is a central question in mathematical general relativity, involving nonlinear wave equations, geometric analysis, and mathematical physics. In this talk I will present a recent joint work with Taoran He. For the 3+1 dimensional Einstein vacuum equations, we extend Christodoulou's celebrated trapped surface formation theorem to a black hole formation result. Without time-symmetric assumption, we further introduce a new approach and prove the spacetime Penrose inequality in perturbative regimes of sub-extremal Kerr black holes.