SPEAKER:

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TITLE:

Anisotropic Dynamical Horizons Arising in Gravitational Collapse

ABSTRACT:

Black holes are predicted by Einstein's theory of general relativity, and now we have ample observational evidence for their existence. However theoretically there are many unanswered questions about how black holes come into being and about the structures of their inner spacetime singularities. In this talk, we will present several results in these directions. First, in a joint work with Qing Han, with tools from scale-critical hyperbolic method and non-perturbative elliptic techniques, with anisotropic characteristic initial data we prove that: in the process of gravitational collapse, a smooth and spacelike apparent horizon (dynamical horizon) emerges from general (both isotropic and anisotropic) initial data. This result extends the 2008 Christodoulou's monumental work and it connects to black hole thermodynamics along the apparent horizon. Second, in joint works with Dejan Gajic and Ruixiang Zhang, for the spherically symmetric Einstein-scalar field system, we derive precise blow-up rates for various geometric quantities along the inner spacelike singularities. These rates obey polynomial blow-up upper bounds; and when it is close to timelike infinity, these rates are not limited to discrete finite choices and they are related to the Price's law along the event horizon. This indicates a new blow-up phenomenon, driven by a PDE mechanism, rather than an ODE mechanism.