

LECTURE SERIES

# Mathematical Science Literature

May 5, 2020

11:00am - *Virtually*



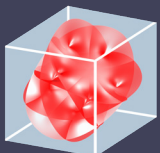
**Lydia Bieri**  
University of Michigan

## “Black Hole Formation”

Can black holes form through the focusing of gravitational waves? This was an outstanding question since the early days of general relativity. In his breakthrough result of 2008, Demetrios Christodoulou answered this question with “Yes!”

In order to investigate this result, we will delve deeper into the dynamical mathematical structures of the Einstein equations. Black holes are related to the presence of trapped surfaces in the spacetime manifold. Christodoulou proved that in the regime of pure general relativity and for arbitrarily dispersed initial data, trapped surfaces form through the focusing of gravitational waves provided the incoming energy is large

enough in a precisely defined way. The proof combines new ideas from geometric analysis and nonlinear partial differential equations as well as it introduces new methods to solve large data problems. These methods have many applications beyond general relativity. D. Christodoulou’s result was generalized in various directions by many authors. It launched mathematical activities going into multiple fields in mathematics and physics. In this talk, we will discuss the mathematical framework of the above question. Then we will outline the main ideas of Christodoulou’s result and its generalizations, show relations to other questions and give an overview of implications in other fields.



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