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# Linear and non-linear wave equations on black hole backgrounds

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## Abstract

I will present recent results for linear and non-linear wave equations on black hole backgrounds. First I will discuss the characteristic gluing problem for the wave equation on general Lorentzian manifolds then present applications to extremal black holes including several non-decay and growth results. These instabilities results make the study of non-linear wave equations notoriously hard. I will then present a new physical space method for deriving very fast decay for general black holes (comparable to that of Price's law) and use this method to obtain several global well posedness results for non-linear wave equations on extremal black holes.

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