



Department of
Theoretical Physics

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Comments on the double cone wormhole

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We revisit the double cone wormhole introduced by Saad, Shenker and Stanford (SSS), which was shown to reproduce the ramp in the spectral form factor. As a first approximation we can say that this solution computes $\text{Tr}[e^{-iKT}]$, a trace of the "evolution" operator that generates Schwarzschild time translations on the two sided wormhole geometry. This point of view leads to a simple way to compute the normalization factor of the wormhole. When we have bulk matter fields, SSS suggested using a modified evolution \tilde{K} which involves a slightly complex geometry, so that we are really computing $\text{Tr}[e^{-i\tilde{K}T}]$. We argue that, for general black holes, the spectrum of \tilde{K} is given by quasinormal mode frequencies. We explain that this reproduces various features that were previously predicted for the spectral form factor on hydrodynamics grounds. We also give a general algebraic construction of the modified boost in terms of operators constructed from half sided modular inclusions. For the special case of JT gravity, we work out the backreaction of matter on the geometry of the double cone and find that it deforms the geometry in an undesirable direction. We finally give some comments on the possible physical interpretation of \tilde{K} .