

Stability of marginally outer trapped surfaces and existence of marginally outer trapped tubes

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Abstract

The present work extends our short communication L. Andersson, M. Mars and W. Simon, *Local existence of dynamical and trapping horizons*, Phys. Rev. Lett. **95** (2005), 111102. For smooth marginally outer trapped surfaces (MOTS) in a smooth spacetime, we define stability with respect to variations along arbitrary vectors v normal to the MOTS. After giving some introductory material about linear non-self-adjoint elliptic operators, we introduce the stability operator L_v and we characterize stable MOTS in terms of sign conditions on the principal eigenvalue of L_v . The main result shows that given a strictly stable MOTS $\mathcal{S}_0 \subset \Sigma_0$ in a spacetime with a reference foliation Σ_t , there is an open marginally outer trapped tube (MOTT), adapted to the reference foliation, which contains \mathcal{S}_0 . We give conditions under which the MOTT can be completed. Finally, we show that under standard energy conditions on the spacetime, the MOTT must be either locally achronal, spacelike or null.