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Entanglement conservation, $ER = EPR$, and a new classical area theorem for wormholes.  
(English)  
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Summary: We consider the question of entanglement conservation in the context of the ER=EPR correspondence equating quantum entanglement with wormholes. In quantum mechanics, the entanglement between a system and its complement is conserved under unitary operations that act independently on each; ER=EPR suggests that an analogous statement should hold for wormholes. We accordingly prove a new area theorem in general relativity: for a collection of dynamical wormholes and black holes in a spacetime satisfying the null curvature condition, the maximin area for a subset of the horizons (giving the largest area attained by the minimal cross section of the multi-wormhole throat separating the subset from its complement) is invariant under classical time evolution along the outermost apparent horizons. The evolution can be completely general, including horizon mergers and the addition of classical matter satisfying the null energy condition. This theorem is the gravitational dual of entanglement conservation and thus constitutes an explicit characterization of the ER=EPR duality in the classical limit.

MSC:
83C75 Space-time singularities, cosmic censorship, etc.  
83C57 Black holes

Keywords:  
classical theories of gravity; black holes; models of quantum gravity; gauge-gravity correspondence

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References: