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Warp Drives, Black Holes, and Wormholes

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As was shown by Ellis in gr-qc/0411096, one can establish a correspondence between the Schwarzschild metric and a warp drive-type metric, making it possible to consider a warp drive in a black hole background. We elaborate upon this result and demonstrate that the black hole's gravitational field can alleviate the violations of energy conditions, reducing the amount of negative energy required to sustain a warp bubble. Besides, we demonstrate that the black hole horizon is effectively absent for the observers inside the bubble, making it possible for them to send a light signal from the inside to the outside.

We also generalize the Ellis scheme to the case of Morris-Thorne wormholes and prove that Alcubierre warp drives cannot traverse humanly traversable wormholes and can only pass through those that either have a horizon or violate the flare-out condition. However, this "no-go" theorem does not apply to another class of warp drive solutions, the spherically symmetric warp drives, that are not localized in space, and have the form of spherical waves.

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