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On the topology of higher dimensional black holes

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Hawking's theorem on the topology of black holes asserts that cross sections of the event horizon in 4-dimensional asymptotically flat stationary black hole spacetimes obeying the dominant energy condition are topologically 2-spheres. This conclusion extends to outer apparent horizons in spacetimes that are not necessarily stationary. Inspired by recent developments in the study of higher dimensional black holes, Rick Schoen and I have obtained a natural generalization of Hawking's results to higher dimensions by showing that cross sections of the event horizon (in the stationary case) and outer apparent horizons (in the general case) are of positive Yamabe type, i.e., admit metrics of positive scalar curvature. This implies many well-known restrictions on the topology, and is consistent with recent examples of five dimensional stationary black hole spacetimes with horizon topology $S^2 \times S^1$. In this talk we shall describe this joint work with Schoen, as well as more recent developments which address certain borderline cases arising in this work.