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Are Analytic Compact Cauchy Horizons Necessarily Killing Horizons?

A project Jim and I have revisited several times over the years involves the question of whether compact Cauchy horizons admitted by analytic vacuum spacetimes are always Killing horizons. In our earliest work on this subject we showed that this was the case (even for electro-vacuum spacetimes) provided that the null geodesic generators of the horizon were all closed curves. While it may seem that this (closure) hypothesis is highly restrictive geometrically our expectation was rather the opposite—namely that analytic, compact Cauchy horizons with *non-closed* generators would necessarily admit *additional* Killing vectors fields and thus comprise a much *smaller* set than those with closed generators (which need only admit the actual, horizon generating Killing field).

In this talk I will review recent progress on settling this issue. Some open questions remain but these mostly involve dealing with special cases that are believed to be either spatially homogeneous (the so-called ‘ergodic’ case conjectured to correspond purely to quotients of flat-Kazner spacetime) or even vacuous (the hypothetical ‘degenerate’ case having generators with infinite affine length). For non-ergodic and non-degenerate spacetimes the basic question is essentially settled in the vacuum case and the arguments can almost surely be extended to cover electro-vacuum spacetimes as well.