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Linear local gauge-invariant observables on spacetimes of sub-maximal symmetry

The Killing operator $K_{ab}[v] = \nabla_a v_b + \nabla_b v_a$ is the generator of gauge symmetries (linearized diffeomorphisms) $h_{ab} \mapsto h_{ab} + K_{ab}[v]$ in linearized gravity. A linear local gauge-invariant observable is a differential operator $I[h]$ such that $I[K[v]] = 0$ for any gauge parameter field v_a. A set $\{I_i[h]\}$ of such observables is complete if the simultaneous conditions $I_i[h] = 0$ are sufficient to conclude that the argument is a pure gauge mode, $h_{ab} = K_{ab}[v]$. The explicit knowledge of a complete set of local gauge invariant observables has multiple applications from the points of view of both physics and geometry, whenever a precise separation of physical and gauge degrees of freedom is required. Surprisingly, until very recently, such complete sets have been known explicitly only on spacetimes of maximal symmetry (Minkowski or (anti-)de Sitter). I will discuss recent progress that has allowed an explicit construction of complete sets of local gauge invariant observables on backgrounds of sub-maximal symmetry, most notably on cosmological (FLRW) and black hole (Schwarzschild and Kerr) spacetimes.