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Differential curvature invariants as detectors of horizon and ergosurface radii for accelerating, rotating and charged black holes in (anti-)de Sitter background.

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In this work we compute novel analytical expressions for differential curvature invariants for accelerating Kerr-Newman black holes in (anti-)de Sitter spacetime. We explore and prove that some of the calculated frame agnostic scalar polynomial invariants (SPIs), can be used on the detection of horizon and ergosurfaces of this important class of black holes. Using the Bianchi identities we calculate in closed-form in the Newman-Penrose tetrad formalism, the Page-Shoom curvature invariant as well as some relevant Cartan invariants. The differential invariants which are norms associated with the gradients of the first two Weyl invariants, are explored in detail. Although both locally single out the horizons, their global behaviour is also intriguing. Both reflect the background angular momentum and electric charge as the volume of space allowing a timelike gradient decreases with increasing spin and charge.

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