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Constructing gravitational instantons

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Gavitational instantons are complete, Ricci-flat Riemannian manifolds (M,g) characterized by their asymptotic behaviour. We will cosnider asymptotically locally Euclidean (ALE) (a quotient of Euclidean space) with quartic volume growth, and asymptotically locally flat (ALF) spaces with cubic volume growth (e.g. a circle bundle over R³). Explicit examples can be constructed from known black hole metrics while others have no Lorentzian analogue. We will show that when reduced under toric symmetry, the Ricci flat equations are equivalent to a harmonic map. This can be used to construct a wide class of ALE and ALF examples.

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