

Stress-Energy-Momentum Tensors

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January 20, 2006

Abstract

We present a new method of constructing a stress-energy-momentum tensor for a classical field theory based on covariance considerations and Noether theory. The stress-energy-momentum tensor \mathcal{T}_ν^μ that we construct is defined using the (multi)momentum map associated to the spacetime diffeomorphism group. The tensor \mathcal{T}_ν^μ is uniquely determined as well as gauge-covariant, and depends only upon the divergence equivalence class of the Lagrangian. It satisfies a generalized version of the classical Belinfante–Rosenfeld formula, and hence naturally incorporates both the canonical stress-energy-momentum tensor and the correction terms that are necessary to make the latter well behaved. Furthermore, in the presence of a metric on spacetime, our \mathcal{T}_ν^μ coincides with the Hilbert tensor and hence is automatically symmetric.