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Quadratic curvature theory with a non-ghost massive spin-2 particle in Riemann-Cartan geometry

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Although quadratic curvature terms are well-motivated by leading quantum corrections to gravity and can be responsible for inflation, they generally lead to a massive spin-2 ghost. In this talk, instead of Riemannian geometry, we study quadratic curvature theories in four-dimensional Riemann-Cartan geometry where the torsion tensor does not vanish and can carry new degrees of freedom. Including all possible terms up to mass dimension four, we find a ghost-free quadratic curvature theory under some conditions where higher derivatives of the graviton perturbation are degenerate via curvature-torsion derivative couplings at least around the Minkowski background. The ghost-free theory has a massive spin-2 particle and a massive spin-0 particle in addition to the massless graviton. In the limit of the infinite mass of the torsion, these particles coincide with the well-known massive spin-2 ghost and massive spin-0 particle of the quadratic curvature theory in the metric formalism, while these can be non-ghost particles in a finite mass of the torsion.

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