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Massive Gravity as a Quantum Gauge Theory

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ABSTRACT

We present a new point of view on the quantization of the massive gravitational field, namely we use exclusively the quantum framework of the second quantization. The Hilbert space of the many-gravitons system is a Fock space $F^+(H_{\text{graviton}})$ where the one-particle Hilbert space $H_{graviton}$ carries the direct sum of two unitary irreducible representations of the Poincaré group corresponding to two particles of mass $m > 0$ and spins 2 and 0, respectively. This Hilbert space is canonically isomorphic to a space of the type $Ker(Q)/Im(Q)$ where Q is a gauge charge defined in an extension of the Hilbert space Hgraviton generated by the gravitational field $h_{\mu\nu}$ and some ghosts fields $u_\mu, \tilde{u}_\mu$ (which are vector Fermi fields) and v_μ (which are vector Bose fields). Then we study the self interaction of massive gravity in the causal framework. We obtain a solution which goes smoothly to the zero-mass solution of linear quantum gravity up to a term depending on the bosonic ghost field. This solution depends on two real constants as it should be; these constants are related to the gravitational constant and the cosmological constant. In the second order of the perturbation theory we do not need a Higgs field, in sharp contrast to Yang-Mills theory.

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