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## Classical and Quantum Mechanics of Non-holonomic Constraints

Modern classical and quantum physics is based on Hamilton's variational action principle. Holonomic constraints, constraints that depend on coordinates alone, can be incorporated into a modified Hamilton's variational action principle through the use of Lagrange multipliers. Non-holonomic constraints, those that depend on coordinates and velocity, such as rolling without slipping, have for 180 years eluded a variational action formulation. We present first results on incorporating non-holonomic constraints into a variational action principle and discuss the implications for classical and quantum mechanics.

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