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Canonical Transformation and its application

Canonical transformation → A Canonical transformation $(q, p, t) \rightarrow (Q, P, t)$ is canonical if it preserves the Hamiltonian form of equations of motion, although the explicit form of the Hamiltonian H may change to a new Hamiltonian K.

Canonical transformations are coordinate momentum mappings $(q, p) \rightarrow (Q, P)$ in analytical mechanics that preserve the form of Hamiltonian equations, ensuring $\dot{Q}_i = \frac{\partial K}{\partial P_i}$ and $\dot{P}_i = -\frac{\partial K}{\partial Q_i}$. The keep the ~~stur~~ structure of Hamiltonian machenics invariant, often using a generati function to simplify complex systems. While generally applicable to non relativistic system they are adapted in the special theory of relativity by using four(4) vactors to maintain Lorentz converiance.