Ostrogradsky Quantum Field Theory

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Abstract

We recognize n-order prime of Schrödinger wavefunction $\overset{(n)}{\psi}$, $(n = 0,1,2,3,...)$ as basic variables describing Field densities in Ostrogradsky transformation. We further formulate Ostrogradsky Quantum Field Theory deducing interrelationships and connections between classical Ostrogradsky method and this Quantum one.

Keywords: Ostrogradsky transformation; Field Schrödinger wavefunction.

In 1850, Ostrogradsky recognized n-order primes of generalized coordinates $\overset{(n)}{q}_a$, $(n = 0,1,2,3,...)$ as basic and independent dynamical properties. A pure Ostrogradsky transformation is given by

$$f := f(\overset{(n)}{q}_a, t) \qquad n = 0,1,2,3,...$$

further formalism of physics under Ostrogradsky transformation is later deduced. Lagrangian and Hamiltonian under Ostrogradsky transformation are given

$$\begin{aligned} L &:= L(\overset{(n)}{q}_a, t) \\ H &:= H(\overset{(n)}{q}_a, \overset{(n)}{p}_a, t) \end{aligned} \qquad n = 0,1,2,3,...$$

which apparently describe dynamical properties. Here $\overset{(n)}{p}_a$ is n-order prime of canonical variable p_a.

We deduce the similar methods for Quantum field theory. The densities in Quantum field theories are described in Ostrogradsky method by n-order prime of field wavefunction

$\overset{(n)}{\psi}$. We propose an *Ostrogradsky field transformation* as pure and initial deduction. Ostrogradsky field transformation for a field density is given by

$$\mathcal{F} := \mathcal{F}(\overset{(n)}{\psi}, t) \qquad\qquad n = 0,1,2,3,...$$

which satisfy the density formalism

$$f(\overset{(n)}{q}_a, t) = \int \mathcal{F}(\overset{(n)}{\psi}, t)\, dt$$

Moreover, we adopt above deduction as a fundamental postulated field transformation, *Ostrogradsky field transformation* as basic postulate for the formulation of Ostrogradsky field theory. Lagrangian and Hamiltonian densities are given under Ostrogradsky field transformation by

$$\begin{aligned} L(\overset{(n)}{q}_a, t) &= \int \mathcal{L}(\overset{(n)}{\psi}, t)\, dt \\ H(\overset{(n)}{q}_a\ \overset{(n)}{p}_a, t) &= \int \mathcal{H}(\overset{(n)}{\psi}, \overset{(n)}{\pi}, t)\, dt \end{aligned} \qquad\qquad n = 0,1,2,3,...$$

here $\mathcal{L}(\overset{(n)}{\psi}, t)$ and $\mathcal{H}(\overset{(n)}{\psi}, \overset{(n)}{\pi}, t)$ are Lagrangian and Hamiltonian field densities under Ostrogradsky quantum field transformation. Here $\overset{(n)}{\pi}$ is n-order canonical field prime under Ostrogradsky transformation, $n = 0,1,2,3,...$

References

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