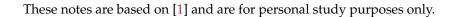
# **Notes on Quantum Field Theory**

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#### **Abstract**



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### 1 Classical Field Theory

Quantum field theory is just quantum mechanics with an infinite number of oscillators

#### 1.1 Hamiltonians and Lagrangians

A classical field theory is just a mechanical system with a continuous set of degrees of freedom. Field theories can be defined in terms of either a Hamiltonian or a Lagrangian, which we often write as integrals over all space of Hamiltonian or Lagrangian densities:

$$H = \int d^3x \mathcal{H}, \quad L = \int d^3x \mathcal{L}.$$
 (1)

Formally, the *Hamiltonian* (density) is a functional of fields and their conjugate momenta  $\mathcal{H}[\phi, \pi]$ . The *Lagrangian* (density) is the Legendre transform of the Hamiltonian (density). Formally, it is defined as

$$\mathcal{L}[\phi, \dot{\phi}] = \pi[\phi, \dot{\phi}]\dot{\phi} - \mathcal{H}[\phi, \pi[\phi\dot{\phi}]],\tag{2}$$

where  $\dot{\phi} = \partial_t \phi$  and  $\pi[\phi, \dot{\phi}]$  is implicitly defined by  $\partial \mathcal{H}[\phi, \pi]/\partial \pi = \dot{\phi}$ . The inverse transform is

$$\mathcal{H}[\phi, \pi] = \pi \dot{\phi}[\phi, \pi] - \mathcal{L}[\phi, \dot{\phi}[\phi, \pi]],\tag{3}$$

where  $\dot{\phi}[\phi, \pi]$  is implicitly defined by  $\partial \mathcal{L}[\phi, \dot{\phi}]/\partial \dot{\phi} = \pi$ .

## References

[1] L. Ciambelli, From Asymptotic Symmetries to the Corner Proposal, PoS Modave2022 (2023) 002 [2212.13644].