

BOOK SUGGESTIONS:

DATE: 8/25/25

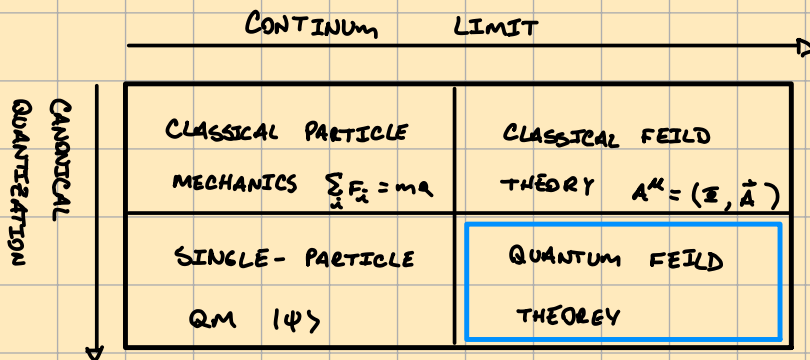
COLEMAN QFT , STERMAN QFT

QFT REQUIRES QUITE A BIT OF MATH NOTABLY

COMPLEX VARIABLES / ANALYSIS $\Rightarrow$ CAUCHY INTEGRAL / WICK THEOREM

GROUP THEORY $\Rightarrow$ LIE GROUPS / CONTINUOUS GROUPS

THE VIEW FROM 30000 FT , AN OVERVIEW :



* QFT IS THE COMBINATION OF QUANTUM MECHANICS AND SPECIAL RELATIVITY

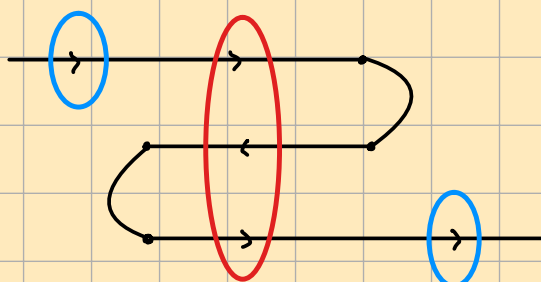
SINGLE PARTICLE QUANTUM MECHANICS IS GOVERNED BY THE SCHRÖDINGER EQUATION

$$\frac{\hbar^2}{2m} \nabla^2 \psi(x,t) + V(x,t) \psi(x,t) = i\hbar \frac{\partial}{\partial t} \psi(x,t) \quad (\text{SPIN ZERO NONRELATIVISTIC})$$

$|\psi\rangle$ LIVES IN A HILBERT SPACE

WHEN INTRODUCING SPECIAL RELATIVITY TO QUANTUM MECHANICS , QFT GAINS

$\pm$ ENERGY SOLUTIONS TO THE FIELD EQUATIONS $\Rightarrow$ INTRODUCTION OF ANTI PARTICLES



1 PARTICLE

2 PARTICLES , 1 ANTI PARTICLE

1 PARTICLE

IN QFT WE NEED A COLLECTION OF HILBERT SPACES AS FOLLOWS:

VACUUM = 0-PARTICLE HILBERT SPACE
1-PARTICLE HILBERT SPACE
2-PARTICLE HILBERT SPACE
3-PARTICLE HILBERT SPACE
⋮

THESE HILBERT SPACES
FORM A FOCK SPACE.

REVIEW OF SPECIAL RELATIVITY (SR) AND
SINGLE PARTICLE QUANTUM MECHANICS (QM)

WE ARE INTERESTED IN HOW DIFFERENT TRANSFORMATIONS AFFECT THE FOCK SPACE
NOTABLY HOW ROTATIONS, BOOSTS, AND TRANSLATIONS, ARE APPLIED.

LORENTZ GROUP / LORENTZ TRANSFORMATIONS

MEMBERS OF A LARGER GROUP THE POINCARÉ GROUP

THESE TRANSFORMATIONS CAN BE THOUGHT OF AS HOW THE POSITION AND
MOMENTUM FOUR-VECTORS CHANGE:

$$\left. \begin{aligned} x^{\mu'} &= \Lambda^{\mu'}_{\nu} x^{\nu} + a^{\mu'} \\ p^{\mu'} &= \Lambda^{\mu'}_{\nu} p^{\nu} + b^{\mu'} \end{aligned} \right\} \begin{aligned} x^{\mu'}, p^{\mu'} &\text{ ARE THE POSITION AND MOMENTUM} \\ \Lambda^{\mu'}_{\nu} &\text{ ARE THE LORENTZ TRANSFORMATIONS} \\ a^{\mu'}, b^{\mu'} &\text{ ARE THE TRANSLATIONS} \end{aligned}$$

⇒ HOW THESE FOUR VECTORS AFFECT THE FOCK SPACE OR THE SUMMED OVER
HILBERT SPACES $|\psi\rangle$ IS WHAT WE ARE INTERESTED IN.